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# Seventy-Five Years (1940-2015) of Lehigh University's Chemistry Department

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# Seventy-Five Years

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# Department

# Preface

The 75-years 1940 to 2015 have been exciting ones for the Department of Chemistry; new buildings, new programs, energetic young faculty, enhanced research image, and a far broader coverage of Chemistry than our ancestors ever presumed. Five chairs guided the department through its first 75-years but it took 11 chairs (with two of them serving twice) to manage the second 75-years. As one of the Lehigh founding departments in 1865 our first 75-years have already been covered. The reader is directed to a history written by Robert D. Billinger, *A History of the Department of Chemistry and Chemical Engineering of Lehigh University*, Bethlehem, Pennsylvania (1866-1941) which is available in original in the Lehigh Archives and as an on-line document. This sesquicentennial volume is also available in hardcopy with original illustrations in the archives or on-line.

Reminiscences from graduate and undergraduate students have been collected and these are included within the text and as supplemental remarks in the Appendix. Since an e-copy of this document shall be maintained on-line by the Lehigh Archives, graduates may continue to submit reminiscences which will be added to the e-copy.

Almost all the chemistry faculty played a role in writing this material but the following committee assembled the story.

Ned D. Heindel (Cmt Chair)

Jack A. Alhadeff

Gregory Ferguson

Natalie M. Foster

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Charles S. Kraihanzel (deceased)

Joseph Merkel

James E. Roberts,

James E. Sturm

Daniel Zeroka

December 2015

# Milestones

**In the Beginning: a Degree, a Program, a Building:** Seventy-five years – the period of this report -- is a long time in the history of a Department of Chemistry. It's almost half the time that academic units called Departments of Chemistry have actually existed in the United States. But in fact our Department's history really does begin when chemistry departments were new entities a century-and-a-half ago. Charles Mayer Wetherill, our chair for six-years at the creation, William Henry Chandler, our chair for 35 years in our infancy, and Harry Maas Ullmann, our chair for 24 years in our first growth surge, presided over far less change in their stints in office than the later shorter-term chairs who have managed the department in the last seven-and-half decades. Chandler never changed the one undergraduate degree (the A.C. for Analytical Chemist) which the department granted from the day of its founding under Wetherill and he made only minor changes in its curriculum. Assaying was what chemists did in the mid-19$^{th}$ century and Chandler saw that Lehigh's chemistry program reflected that truth.

Chandler did briefly experiment with graduate education, starting (1891) and then terminating (1896) the PhD program. He did not have to worry about acquiring major instrumentation, recruiting graduate students, or raising external research funding. The few graduate assistants working towards an M.S. were Lehigh undergraduates staying on. Chandler's faculty was small; only two regular faculty (including Chandler himself) till 1893 and five at the time of his death in 1906. Chandler did use MS candidates and senior undergraduates as teaching assistants.

In truth, Chandler achieved one big thing and he did it very well. He convinced the trustees to build a first-class award-winning chemistry laboratory building, planned a number of unique architectural features to be included in it, and supervised every step of its construction to completion in 1885. The building included a Museum of Chemistry which – as one of the first in America – was Chandler's pride and joy. The trustees appropriately named the building Chandler Laboratory and later Chandler-Ullmann after his successor chair made many additions to the facility. Chandler gave his department a home which lasted a century as a laboratory and 90-years as the department's headquarters. Chandler Lab was Chandler's biggest contribution and maybe that was enough for his chairmanship. He came, he served, he passed but all before the modern age of Chemistry.

Harry Maas Ullmann and his period of chair service are somewhat better comparators for the progressive Chemistry Department of 2015. He presided over a faculty of 16 in the professorial ranks and five in the lecturer and graduate assistant category. Ullmann did manage considerably more change than Chandler. He, too, persuaded the trustees to expand the building but more than that, he had created the need for that expansion. In the last two declining years of Chandler's reign (1904-05), young Ullmann with the encouragement and blessing of Lehigh's new chemist-president (Thomas M. Drown, formerly from MIT), converted the A.C. to a B.S., created a new core course in physical chemistry and designed -- with Drown's personal involvement – a completely new undergraduate major in chemical engineering. The dying

Chandler played virtually no role in these changes but fortunately his replacement chairman, William Bush Schober (1906-1914), strongly supported them.

**War Brings External Money and Demand for Graduates:** Ullmann followed Schober in the leadership role with the biggest element of change being the cumulative effect of World War 1 on the University. Naturally Ullmann supported and promoted the B.S.-chemistry and the B.S.-chemical engineering track because these were his degrees created barely a decade ago. In addition, the First World War stimulated the explosive growth of the chemical industry in America and with it a new culture where large companies looked to universities to provide them with well-trained workers. Dyestuffs, cement, pharmaceuticals, paints, fibers, fertilizers, explosives, and distilled fuels were just some of the many companies needing a relationship with universities to insure a supply of much-needed chemists, chemical engineers, and academic innovations that could become tomorrow's products. Suddenly, Lehigh had graduate fellowships, summer internships, and research contracts to professors from Dupont, Columbian Carbon, Hunt-Rankin Leather, National Lead, New Jersey Zinc, Portland Cement, Bethlehem Steel, Socony-Vacuum, Raybestos-Manhattan, Hershey Chocolate, Rohm and Haas, Archer-Daniels-Midland, Devoe-Reynolds, R. K. Laros Silk Mills, National Oil Products, Goodrich Rubber, Corn Products Refining, and many other companies. Substantial external support rained on the department and the department responded in two ways.

Ullmann began planning for the return of the PhD degree by hiring highly credentialized young faculty to be mentor-leaders in the program; the PhD was officially re-opened in 1937. In addition a number of industrially-supported research centers were created such as Coatings/Paints and Varnishes, Confectionary, Leather, and Iron and Steel to provide bridges between Lehigh's chemistry and the needs of the corporate underwriters. Examples of inventions by Lehigh chemistry faculty that rewarded the faith of their sponsors were: an instrument to measure trapped hydrogen in steel, a rapid hydration and softening broth for goat hide, a spreadable epoxy paint, an emulsifier which greatly increased shelf life of chocolate candy, an automatic titration unit which signaled the end-point with an electronic ray sensor, a long-lasting patent leather, a synthetic fiber-based paint brush, a cyclic anhydride additive which shortened the drying time of oil-based paints, a vacuum tube relay switch, and tobacco-softening additives which make possible virtually unbreakable cigars. Throughout Ullmann's chairmanship the Department came to be known to industry as the "go-to" place for practical solutions to real world problems.

**The Doctorate Reborn, Women Admitted for Graduate Work:** In the period covered by this 75-Year History (1940-2015), the Department entered World War II with a research philosophy honed by Ullmann and Neville. The plan was to build a reborn doctoral program in which the support for most students flowed through corporately-oriented Centers and was tightly linked to specific sets of companies supporting those centers. Two PhDs graduated in 1939 – first fruits of the restarted doctoral track --- but then the war virtually shut down the pipeline of available young men and stymied the proposed up-tick in the graduate program. The university responded in a unique way. The all-male Lehigh decided to admit women to the doctoral program to take up the slack. Four or five women became graduate students in the period 1941-1945. Most

stopped at the M.S. and did not go on to the PhD but Mary Elizabeth Hertzog Perry (1922-2007) did not stop.

Mary was one of the first non-Lehigh B.S. grads to enroll in the department's graduate program. She had completed her B.S. in chemistry at Russell Sage College and with her husband, Bill, stationed in Bethlehem and employed by Bethlehem Steel, Mary began graduate study under the department's plan to permit women students. She took the Analytical Chemistry path, received stipend support from the Leather Research Institute and wrote a doctoral dissertation on *The Use of Organic Reagents for the Determination of Trace Impurities.* Her post-Lehigh career was as an analytical chemist for J. T. Baker Chemical and as a faculty member at Muhlenberg and Cedar Crest Colleges. She rose to full professor and Department Chair at the latter. Interviewed late in life about her Lehigh experience, Mary was highly complementary of the faculty and the other students who recognized her as a trail-blazer. She remarked, "I worked as hard as the men day-in-and-day-out but I may have disappointed the all-male faculty by not showing up at commencement to receive my diploma. My son chose to arrive on graduation day and I spent my time laboring in the hospital delivery room."

**The Center/Institute Model Funds Graduate Research:** Mary Perry may have been the first female PhD graduate but the mechanism of support for her doctorate – the Center/Institute model – had flourished for 15 years before her time. In fact, over three decades, the Center model was to grow, thrive, bring in money, and support graduate students just as Ullmann and Neville had hoped it would. Leather, Chocolate-Confectionary, Iron & Steel, and Paint & Varnish were the early Centers but in the post WW II period the department was to see many of its faculty involved in and even directing new interdisciplinary research units such as the National Printing Ink Research Institute, the Marine and Environmental Studies Center, the Emulsion Polymers Institute, the Center for Surface and Coatings Research, the Corrosion Sciences Laboratory, the Institute for Pathobiology, the Center for Health Sciences, the Energy Research Center, the Center for Molecular Biology and Biotechnology, the Materials Research Center, and a few other shorter-lived enterprises.

Before the federal government created the multiple grant programs sponsored by the alphabet agencies – NSF, NIH, NASA, USDA, DOD, DOE, etc. – industry was the only source for chemistry graduate student support and each Center/Institute was created to capture those corporate dollars. In Ullmann's early years faculty would make private research sponsorship deals with companies but this arrangement morphed into centers and institutes. Theis, Long, Myers and Neville took leadership roles. In the 1927 to 1940 period the company money went directly to running and staffing the center laboratories – through a liaison system similar to what still exists today -- and the university did not claim indirect costs or intellectual property (IP) rights. Valuable patents on drying promoters for oil-based paints, synthetic polymer bristles, irradiation accelerated hardening of patent leather, and easily-applied epoxys were carried out at Lehigh and assigned to corporate sponsors with little or no share in the IP for Lehigh. Rarely was the university's slice even 1/3$^{rd}$ , often it was 1/6$^{th}$, and in one case (an invention from the lab of a future Lehigh President, Harvey A. Neville, see U.S.Patent 2,426,896) it was zero. Archer-Daniels-Midlands, Devoe & Reynolds, National Lead, and Goodrich were just some of

the companies who brought inventions to market from Lehigh chemistry research. U.S. Patents 2,426,896, 1,818,073 and 2,059,259 show this generous-to-industry trend by Lehigh chemistry professors working at Lehigh for corporate sponsors.

**Government Grants Wound and Kill Lehigh's Original Industrially-Supported Centers:** But times were changing. World War II showed professors and administrators that the federal government was willing to plow big bucks into universities. NIH grants and, in the post-Sputnik era NASA and NSF grants, provided universities coffers with much-needed overhead (indirect costs) dollars for making available the facilities in which their faculty did nationally-valued research. Initially it wasn't hard for faculty to capture that governmental money and soon industrially-supported research with low (or no) indirect cost allowance to the central university began to look unattractive. Harvey Neville, one of the strongest supporters of centers up through and into his Presidency (1961-64), closed his own chocolate-confectionary operation and worked with Chairman Amstutz to encourage the departure of the Leather and Paints & Varnishes centers. Even Zettlemoyer's much vaunted industrially-supported National Printing Ink Institute – which proved untouchable to the changes sought by Chairman Amstutz -- barely survived his death before it, too, closed its doors forever. New centers and institutes would arise in the future but for this next generation the goal was to make Lehigh look more attractive by creating high visibility interdisciplinary centers aimed at bringing in more narrow-topic federal grants with much less concern for garnering the diminishing corporate support.

Liaison programs, the financial keystone of centers and a few departments, had existed at Lehigh since before the 1950s. If a Center had a liaison account at Lehigh it could solicit industrial "gift" monies, deposit those "gifts," and spend those funds without any administrative charge by the University. In theory this influx of company money was not supposed to be used for specific problem-solving industrial work for any given firm but instead was intended to underwrite generic, fundamental, cutting-edge science. In truth, these liaison programs brought industrial dollars to Lehigh centers without any overhead assessment. In fact, many centers served the specific needs of corporate sponsors (see patent citations mentioned above) and depended entirely for their own existence on the income derived from those industries.

In 1989 (see attached letter dated 18 June 1991) Lehigh imposed a 10% "administrative charge" on new liaison monies and in 1991 it extended that charge to all accounts – whether old or new. Within a decade the charge was raised to 12%. The university's assessment against these accounts coincided with a growing trend by chemistry firms – for a host of other reasons – to shrink their investment in liaison support to universities. Centers and institutes soon found themselves more-and-more dependent on federal and state grant monies. More Centers and Institutes died but others lingered on as shells of what existed in their glory days as industrial funding decreased and the percentage of that funding able to be retained by the unit decreased too.

Lehigh University

Roy C. Herrenkohl
Vice Provost for Research and
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June 18, 1991

***MEMORANDUM***

TO: Administrators of Liaison Activities
Center/Institute Directors
Department Chairs, Other Faculty

FROM: Roy C. Herrenkohl Roy Herrenkohl

SUBJECT: Liaison Activities - Administration Charge

The President's Council decided during the last budget process that the University was no longer able to continue to support all of the costs associated with liaison type activities. Therefore, to offset some of the actual costs incurred, and to be able to continue to support University-wide research and scholarship, a 10% administrative charge on all liaison type activities will be charged as of July 1, 1991.

To deal with this issue on a fair, consistent, University-wide basis, all liaison type activities residing in centers/institutes or academic departments, whether supported by memberships/project agreements or gifts, will bear this charge.

Since July 1, 1989, all new liaison and departmental projects have been assessed a university project administration charge of 10% at the time that the revenues were received from the sponsor. Beginning July 1, 1991, there will be three changes in this policy. First, the 10% charge will now apply to all new and continuing liaison type activity, ***without exceptions***, including memberships and gifts. Second, the charge will be made to accounts as expenditures/transfers to non-liaison accounts occur, rather than when the revenue is received; and third, graduate tuition will be excluded from this administrative charge.

The university has promoted liaison activity for close to 30 years. These programs, residing in centers, institutes and departments, are designed to provide for a wide range of interactions across a broad spectrum of interests primarily with the private sector. Lehigh's successful liaison programs include many important areas such as materials, energy, polymers, process modeling and control, innovation management studies, and manufacturing systems engineering. Annual membership fees vary depending on the anticipated level of interaction. Membership is usually on a continuing basis, reviewed and renewed annually, with new projects coming on stream and completed as needed.

The university recognizes the value of liaison activity to the faculty and the importance of the income generated for the sponsoring department or research center/ institute in supporting graduate students and faculty. At the same time, this activity incurs real costs to the university, such as laboratory and space use, use of administrative resources, and the use of library facilities, etc. In order to recover some of these costs, the university will assess the administrative charge on all membership/project and agreement expenditures with the exception of graduate tuition.

All liaison projects which have come on stream since July 1, 1989 have had a 10% administration charge collected up front by the university as revenues were received from the sponsor. As of July 1, 1991, both projects and subscriptions/memberships will be charged on expenditures/transfers as they occur. In order that no project accounts already assessed under the old system will be charged twice, current project accounts with unspent balances will receive a credit as of July 1, 1991, of 10% of funds not yet spent. All accounts can then be charged uniformly as expenditures occur.

In order to ensure that this fee is administered fairly, the Office of Research and Sponsored Programs (ORSP) must receive a copy of all liaison agreements. Provided that this is adhered to, the liaison agreements may be signed off in the department, center or institute unless an official university signature is required by the sponsor. This policy includes all agreements, even those where the fee is received directly as a gift to the liaison program or through the Development Office.

The procedure for liaison project proposals continues as follows: all liaison project proposals are to be sent through the ORSP for appropriate signatures and transmittal. In cases where the project does not require a proposal, the budget for the project must be discussed with the ORSP. When an award is received from the sponsor, the ORSP will sign the documents and approve the project account as in the case of research grants. ***Accounts cannot be obtained for liaison projects/memberships or agreements unless they have been approved by the ORSP.***

The unit administering a liaison project may charge the sponsor an in-house indirect cost or administration fee in addition to the university charge. This additional charge remains available to the liaison program and not to the university.

All full fledged research contracts and grants developed through the liaison programs will continue to bear full indirect costs.

Any questions regarding the application of the project administration charge should be addressed to the Office of the Vice Provost for Research.

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cc: President's Council, J. Cheezum, R. Huth, K. Ostberg, M. Reilly, J. Tiefenbrunn

**Chemical Engineering Becomes an Independent Department:** The 1952 cleavage of Chemical Engineering as a free-standing department from Chemistry – a milestone event in the history of the Chemistry Department -- was discussed by the former Department's first chairman (Alan S. Foust). His report, *The Bicentennial: Lehigh University's Contribution to Engineering Education* (January 1976) is filed in the Lehigh faculty archives. In 1895 with the direct encouragement of the new President Thomas M. Drown who'd previously chaired the chemistry and chemical engineering programs at MIT, Chandler reluctantly created a separate major in industrial chemistry. After his death not only was his favorite degree (the A. C.) terminated but a full B.S. in Chemical Engineering major was launched (1907). By Ullmann's chairmanship there was a new structure, two departments (of Chemistry and Chemical Engineering) under a single chairman. The dual department arrangement continued under Neville who hired two well-known chemical engineers (Leonard Wenzel and Alan S. Foust) and with them laid out plans to launch a Department of Chemical Engineering. When in 1952 Neville gave up the dual department chair and was promoted to Dean of the Graduate School, he was replace by Earl J. Serfass as chairman of Chemistry and by Alan S. Foust as chairman of the newly created Department of Chemical Engineering. The two departments continued to share space in Chandler-Ullmann until 1965-67 when Chemical Engineering relocated to Whitaker Laboratory. All graduates who'd received the B.S. in Chemical Engineering from the combined department received a letter from Lehigh asking them if they wished to be considered alumni of the new Department of Chemical Engineering. No record exists as to how many accepted that invitation.

**Undergraduate Education Goes Coed:** At their meeting on 29 May 1970, after much debate at Board level and receipt of a comprehensive report by a broad-based committee, chaired by Carey B. Joynt, Professor of International Relations, the trustees reached a milestone decision – to admit women undergraduates to Lehigh University. Students, alumni, faculty, and administrators served on the Joynt committee which by a 12 to 1 vote had decided that it was time for Lehigh to end a 115 year tradition as an all-male school. The trustees agreed. One-hundred sixty-nine women were admitted in 1971-72 and another 362 in 1972-73. Most entered as freshmen, perhaps a dozen as sophomores, and one entered as a junior. This decision, while momentous for Lehigh overall, was not as significant for the Chemistry Department which since 1918 had admitted women for M.S. studies and, after 1941 for doctoral studies. The Department had graduated a dozen women at the M.S. and three women as Ph.Ds by the time the Joynt Report was implemented.

In Spring 1972 a new women's restroom and a private women's lounge with couch were added on the ground floor of Chandler-Ullmann. In the design of Mudd and Neville an equal number of male and female facilities were included. Quickly the female B.S. chemistry students such as Emily Winn-Deen, Diane Harris Boschelli, Margaret (Peggy) Kittek, Michelle Sattler and many others were achieving pace-setting undergraduate records and going on to successful professional careers as group leaders, project directors, CTOs and CEOs. Bigger hurdles were leaped a decade later when Chemistry added its first female professors, Natalie M. Foster in 1985 and Linda Lowe-Krentz in 1986. Acceptable diversity is still lacking in the faculty and student ranks but female undergraduate and graduate majors now number ca. 40% of their male counterparts. (For more detail see "A History of Women at Lehigh," from *Lehigh University: A*

*History of Education in Engineering, Business and the Human Condition,* by W. Ross Yates, Associated Press Publishers, 1992.)

**The Selection of Leaders: Two Quantum Leaps for Research** How the department has selected its chairs (or more correctly, how the department has been allowed to select its chairs) has varied over the 150-years. Wetherill made his employment agreement directly with the University trustees. There was no department in existence and he brought a large quantity of valuable lab equipment for which the Board contracted to separately reimburse him. That bill was unsettled at his untimely demise and his widow had to make the trustees pay up. Similarly, in 1871 President Coppee personally interviewed and hired Chandler because the department contained no other faculty who would be concerned about the choice. Chandler was an unlikely but very fortunate choice. He held a BS from Union College and had worked for eight years as an analytical chemist in a copper smelter and a fertilizer plant. He then took up graduate study under his elder brother at Columbia University and had barely finished his M.S. just months before the chairmanship at Lehigh opened. Coppee liked the energetic 29-year old and made him an offer. In 1872, provided with strong letters of recommendation, a year of teaching experience at Lehigh, and evidence of publication, Hamilton College in Clinton, NY, awarded Chandler a doctorate on the basis of his accomplishments. Chandler had never enrolled or studied at Hamilton.

Schober, Ullmann, Neville, Serfass, Amstutz, Schray, Larsen, and Klier spent most or even all of their careers at Lehigh and as senior professors they were "known quantities" with impressive research records. All were consensus candidates for the chair position when it opened although several of them had to be strongly encouraged to assume the challenge. While the administration did consult the chemistry faculty on these individual advancements, the decision was essentially the Dean's and the Provost's and no general search was conducted.

When Amstutz retired in 1968, Dean Karahash appointed a search committee of department faculty, an ad was posted, applications were received, and ranked. The committee was ordered to share all files with the Provost, Al Zettlemoyer, who was also a Professor of Chemistry. One candidate completed a campus visit and during the on-campus interview of the second (Frederick M. Fowkes), the candidate (a corporate research director with no teaching experience), terminated the scheduled round-robin meetings with individual faculty in the middle of the day by stating that he would be accepting the position. The chemistry faculty was flummoxed! He already had an offer in hand from the Provost, a long-time professional friend, and had been invited to campus to evaluate the faculty, not the other way around. The Provost ordered that any further interviews of ranked candidates be terminated. Fowkes assumed the chair under a cloud of cronyism but soon turned out to be one of the best chairmen the department ever had.

He led the successful campaign to justify, finance, design, and construct the Seeley G. Mudd Building. For months in the Spring of 1971, Fowkes carried around campus in his briefcase an 18 inch piece of blackened iron natural gas line dug from the first floor wall of the Chandler-Ullmann Building. This 86-year old segment of pipe resembled a sieve in that it had been corroded from the outside in. Gas had been leaking undetected from pipes all over the ancient laboratory structure. The steam, water, and even the sewer lines were accidents waiting to

happen and because Chandler had designed these services to be invisible, most were buried deep in channels carved in the stone, they could not be repaired.

Fowkes jawboned administrators, trustees, and wealthy alumni until the commitment to a new building was voted. Thereafter, he consulted widely with his faculty on design features for each lab which his colleagues felt were essential for their new personal space. A Building Planning Committee of the faculty visited newly opened chem labs at Kent State, Fordham University, University of Vermont, Rochester Institute of Technology, and University of Kentucky to see what were considered innovative features of design at that time (1973). Bethlehem Steel made available one of its architects to serve as liaison to the Planning Committee. Steel also provided unlimited flights on one of their corporate airplanes so the chemistry faculty committee could fly to visit the model laboratory buildings. When the job was done, the building erected, and the department moved in, Fowkes' colleagues decided to place his bust in the lobby in appreciation of his tireless work in creating a building which served the needs of all the chemistry faculty.

Regarding the administration's selection of Fowkes as department leader in a top-down process, it would be 35 years until the University administration would again assume such a dominant leadership in a chair search. Fowkes and Karakash made sure that an open democratic process was followed in selecting Fowkes' successor.

With the retirement of Fowkes, Engineering College Dean John Karakash appointed a search committee of chemistry faculty whose choice candidate was G. Doyle Daves. Daves was then the Department Chair at the Oregon Graduate Center, Beaverton, Oregon. But, after visiting and receiving an offer from Lehigh he was reluctant to accept the challenge. Dean Karakash flew to Beaverton to meet with Daves and his family to sell them on life in Bethlehem and the career opportunity possible at Lehigh. Daves accepted and he with the help of an extremely supporting set of senior Lehigh administrators ushered in a golden age of Lehigh chemistry.

**The Period of the "Senior Hires" Moves the Department into the National Spotlight:**

Karakash and his successor, the Engineering Dean Donald Bolle, Provost Arthur E. Humphrey, Vice-President for Research Joseph Goldstein, and Vice-President for Development Paul J. Franz, Jr. all committed to helping Daves build a nationally-ranked department. Bolle, Humphrey, Daves and their respective families became very close socially and visited frequently outside of work. They all became warm personal friends and remained so throughout the rest of their lives. Out of such trust and friendship, Daves' plans for growth of the department became the administration's plans, too. Franz spearheaded a major development fund drive which generated more than $2M. Bolle and Humphrey cleared five slots for full-professor hires with instant tenure and handsome start-up packages. Daves suggested a formula in which senior hires holding current grants at their present university could move to Lehigh, bringing their grants of course, and have the entire indirect cost made available for their direct research support. It was a very attractive incentive. Daves, Larsen, Alhadeff, Behe, and Regen were hired under this system.

Outstanding assistant professors (Roberts, Lowe-Krentz, and Foster) hired by Daves quickly garnered NIH, foundation, and NSF funding with Roberts being named as an NSF Presidential

Young Investigator. All this talent – mostly hired in less than a two year period (1983-1985) – resulted in a surge of research funding and graduate enrollment (which topped 90 for the first time in the department's history). Under Humphrey and Bolle the administrative flexibility was amazing. TA slots topped 26 and a mechanism was found to allow the department to separate the TA stipend from the tuition grant so that even more graduate students could be supported. In the NSF-NRC ranking of graduate universities Lehigh jumped from below 100 to 34th in the nation.

The decade of the 1980s (specifically 1981 to 1987) was a golden age for the department which was not to come again until the hiring of Flowers in 2003. And here again Daves played a critical role.

**The Department is Moved from the Engineering College to the Arts College: (Note that two documents dated March 20 and March 27, 1987 are attached which relate to the following text)** A fifteen year period of darkness descended on the department from 1988 to 2003. The triggering event was the decision by President Peter Likins (1982-1997) "to complete what he called the transformation of Lehigh that began under Deming Lewis." (see University Biography of Presidents http://www1.lehigh.edu/about/history/likins). The "transformation" Likins -- himself an engineer – was talking about was changing the public perception of Lehigh from that of an engineering school to that of a general university, from the *Engineers* to the *Mountain Hawks,* and from a reputation that rested on almost exclusively on technological achievements to one that showcased the arts and humanities.

Likins promoted many pathways to that goal. New programs, new departments, and majors were launched in the arts and humanities areas. Programmatic funding was increased in the Arts College and, in 1986, a trustees committee appointed at the request of Likins and chaired by William Hittinger, Board member, proposed "modifications of administrative structure." These modifications included moving the Departments of Chemistry and Physics from the College of Engineering and Applied Sciences to what was referred to by the Lehigh administration as being "a new College of Arts and Sciences." The newly arrived Provost, David A. Sanchez, requested that Chemistry and Physics graciously accept their new home ("your joining the College will greatly increase it") and not vote on an issue that had already been decided at the highest level. The Department did vote, however, unanimously against the relocation and it elected a committee of Professors Leidheiser (as chair), Kraihanzel, and Schray to plead with the Provost and President to reconsider. (see following files)

Among many issues which concerned the Department in March 1987 when this relocation was announced were two. Faculty members in the Arts College seemed to be frequently gathering in committee meetings. Lots of voices were heard and considered in lengthy sessions by committees which had little or no power but on which the Dean waited for advice. The snail's pace activity of the Arts College Policy Committee particularly concerned the chemists. On the other hand, the Engineering College functioned with a powerful Council of Chairs which met regularly with the Dean of Engineering and made sweeping decisions. The individual chairs in Engineering discussed pending issues with their faculties, took the pulse of their colleagues, and quickly reached decisions. As the Provost noted in describing Arts College practices, "there

does exist a Dean's Council of the chairs of the departments…meeting when needed." Governance was light – but very efficient – in the Engineering College faculty.

The other concern was for research and the financing of it. Research meant something different to Arts and Humanities faculty (the word Scholarship was more appropriately applied) than it did to scientists and engineers. It didn't require hours of effort writing proposals, huge sums of money to pay for capital instrumentation, research assistants, use charges, and supplies. Money was much more available in the Engineering College and emergency needs could be addressed. In 1981 Chemistry's major infrared spectrometer was destroyed in a power surge. A request to the engineering dean (in this case John Karakash) resulted in his call to a wealthy alumnus he knew with a request for a $3500 donation. Chemistry had its new IR within a month. When the Department's Chair Search Committee picked Daves and Daves demurred about accepting the challenge, Dean Karakash flew to Oregon to meet with the entire Daves family and convince them that life in the Lehigh Valley was highly attractive.

Professor Leidheiser, exhausted by years of chairing the Center for Surface and Coatings Research (CSCR), resigned from that position and wished to serve the department in other ways. Unfortunately, all of Leidheiser's salary was tied to his task as a Center Director and there were no slots open in Chemistry. The Engineering Dean (in this case Donald Bolle) arranged for the Alcoa Foundation Chair to be temporarily diverted from Metallurgy/Materials where it had resided for more than 50 years and assigned to Chemistry with the understanding that we'd give it back when Leidheiser retired. The Engineering Deans and our Engineering colleagues made

Lehigh University

David A. Sanchez, Provost

Alumni Memorial Building 27
Bethlehem, Pennsylvania 18015
telephone (215) 758-3605

March 27, 1987

MEMORANDUM

TO: Faculty of the Department of Chemistry and Physics

FROM: David A. Sanchez DAS

SUBJECT: Some Misconceptions About Governance in the College of Arts and Science

Ever since I arrived on campus and have worked with your chairmen and faculty towards smoothing the transition of your departments to the College of Arts and Science, I have been continually faced with concerns about the governance of that college. Frankly, I could never quite understand the source of the problem, so like a good scientist I decided to investigate.

The first and primary concern seems to be the College Policy Committee. A copy of their description and mission from R&P is attached and the key phrase is that it "acts as an educational policy committee." This means it has no budgetary role and serves as the University Ed Pol Committee does, dealing in questions of academic requirements, programs etc. I think you can appreciate that in a College with 17 (soon to be 19) departments, as opposed to 8 departments, the economy of faculty time and effort needed to accomplish the day-to-day business of education merits such a committee.

I should note that there does exist a Dean's Council, which consists solely of the chairs of the departments. It is the council of elders of the College, meeting when needed, once a month on the average.

The second concern is the relation of the chairs of the College and the dean as well as the associate deans. First of all, with regard to the preparation of budgets the chain of chair to dean to provost is exactly the same as in the other three Colleges--no committee intervenes in this process. My investigations indicate that the normal working relations between chairs and their dean are no different either.

When your two departments move into the College there will be in place two associate deans, whose functions will be undergraduate affairs, and graduate affairs and research, respectively. They will not be divisional deans, but will be those persons whose responsibility will be much of the operational activity, planning and reporting needed to make your academic and research programs flourish.

I can sympathize with your apprehension at moving from a College with 8 relatively homogeneous departments of much the same size to one as variegated in disciplines and size of faculties as the College of Arts and Science. But it is that variety which is its strength, and your joining the College will greatly increase it. You will find to your surprise that a department of three or four faculty can demonstrate the same standards of excellence in research and teaching as those of your departments, and that is what truly makes a great college.

I had a very pleasant visit with a delegation of concerned faculty from the Chemistry Department (which partially prompted this memo), and will be glad to meet again with any group or individuals from your departments. Professor John Hare, Chair of Philosophy and the Arts and Science Policy Committee, has very kindly offered to meet with your faculties, and I think this would be even more beneficial than meeting with me. Cheers.

dw
Enclosure
cc: Dean Donald Bolle
Dean John Hunt
Dr. Norman Melchert
Dr. John Hare

### 1.3.3.1.1 College of Arts and Science policy committee

The college of Arts and Science policy committee consists of nine members elected by the faculty of the college, three elected each year for three-year terms, and the representatives to the college faculty from the College of Business and Economics, the College of Engineering and Physical Sciences, and the College of Education. In making nominations for this committee, the nominating committee attempts to maintain equitable distribution among the disciplines represented in the college. Vacancies in unexpired terms are filled by appointments by the dean after consultation with the committee chairman. The committee elects a chairman and a secretary yearly from among its members. The committee establishes its own rules of procedure.

The College of Arts and Science policy committee acts as an educational policy committee. It is concerned with continuing improvement of the college and considers all proposals offered to this end. These proposals may originate within the committee, or they may be submitted by other members of the faculty or the dean. The committee makes such recommendations as it deems desirable to the dean or to the faculty, or to the university committee on educational policy.

Lehigh University

*Henry Leidheiser, Jr., Professor of Chemistry*
*Alcoa Foundation Professor*
*Director, Corrosion Laboratory*
*(215) 758-3569*

*Department of Chemistry*
*and*
*Zettlemoyer Center for Surface Studies*
*Sinclair Laboratory 7*
*Bethlehem, Pennsylvania 18015*

March 20, 1987

To: Members, Chemistry Department Faculty

From: Ad Hoc Committee (Kraihanzel, Schray, Leidheiser)

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The committee met with the Provost on March 19 for approximately 45 minutes. The comments of the Provost may be summarized in the following statements:

(1) He is interviewing candidates at the present time and the interim dean will be announced within the next few weeks.

(2) He is very pleased that Doyle Daves will continue as department chairman for at least another year.

(3) He believes that major changes in the administrative structure of the College of Arts and Science (or as the Hittinger report states, "a new College of Arts and Sciences") will occur and that he will take a personal interest to see that they do occur in conformity with the Hittinger Report. He did say that while he would insist on some modifications of administrative structure under the temporary dean, other structures would have to remain in place until the permanent dean is on board, and we would have to "be patient."

(4) He believes that the presence of an interim dean will provide the Chemistry Department with the opportunity to aid in the development of protocols for a new administrative structure.

(5) In conformity with Recommendation #3 of the Hittinger Committee, he will see that a member of the physics or chemistry faculty will be appointed to "provide support for faculty affairs (including research" as an aide to the dean of the College of Arts and Science(s). Note: The quote is from the Hittinger Report and is not the wording of the Provost.

(6) The budget of the department after July 1, 1987 will be determined and monitored by the dean of the new college and Provost Sanchez. The budgets of the departments will not be determined by a committee.

(7) He has recommended to Dean Bolle that faculty members from chemistry and physics serve as advisory (or perhaps liaison) members on Dean Bolle's council of engineering department chairpersons.

(8) He will talk with Dean Bolle about a mechanism to assure continuity in departmental leadership after June 30, 1988. He will take the leadership in assuring that we have that continuity. Budget considerations will be a factor in the selection of a department chairperson, but he did seem receptive to an open search.

things happen. Karakash and Bolle walked our hallways, popping heads into faculty offices and asking how they could help. Chemists loved and appreciated their educational and administrative links to the engineers – which had existed almost since the founding of Lehigh -- and were frightened by a top down demand that we switch to the College of Arts & Sciences.

We protested again, gave up, and resigned to our fate with the hope (as stated by Provost Sanchez) that our presence would bring about governance changes in A&S because "a new College of Arts and Sciences will occur." Daves resigned at once (March 1987) as Chair and began an immediate job search to leave Lehigh (his chemistry colleagues pleaded with him to stay and he agreed to another calendar year). Humphrey resigned the Provostship just months before President Likins announced the restructuring. Franz left Lehigh shortly thereafter (retired 1988) and Goldstein departed for a Deanship at the University of Massachusetts. The team that had created Chemistry's Renaissance was gone in a heartbeat. No changes took place in the new college of Arts and Sciences other than a gradual attrition of Chemistry's position. From this point on and in many unfortunate ways the Department found itself at odds with subsequent Deans and Provosts.

When in 1987 Daves resigned as chair, the department had 26 faculty (including Fowkes as an "active emeritus") and 25 teaching assistants. While undergraduate enrollments grew, Dean after Dean would not permit filling vacant slots which arose – mostly from retirements -- and faculty numbers dropped to 12 in 2004. At one point because of research leaves and sabbaticals the department had 10 working professors on site. TA numbers dropped to 14 and the department was permitted (and indeed encouraged) to buy its own teaching assistants with revenues earned from the distance education program. For several years it did reluctantly buy two TA positions.

In evaluating a tenure candidacy the Dean of Arts and Sciences encouraged us to think only of quality issues and not to worry about losing the slot if tenure were to be denied to the candidate. The faculty voted to deny tenure; the Dean took the vacant slot anyway saying it was badly needed elsewhere. Subsequently two other candidates came up for tenure with the overwhelming support of the Department and the requisite college/university committees only to have Provost Yoshida deny both of them tenure. The department protested in every way possible and appealed even to the trustees on the tenure denials. The administration expressed exasperation at the Department and in one memorable quote from President Farrington it learned, "Lehigh does need to teach chemistry but it doesn't need a Chemistry Department to do it."

Finding a new leader amidst all the grief and mistrust was nearly impossible. Larsen reluctantly became chairman for a second time in 2001 with the department in a deep sense of crisis exacerbated by a new and unfriendly administration. In 2002 the Dean, Bobb Carson, believing that the Department was too shrunken to manage a quality doctoral program, forced the Department to close the Ph.D. program and to rescind letters of admission already mailed and accepted by prospective graduate students. Fortunately, he reversed himself on the doctoral closure within the year and came up with a way out of the Dilemma of the Dark Ages.

In 2002, in private negotiations with G. Doyle Daves, then retired as Provost from Rensselaer Polytechnic and living in New Mexico, Dean Bobb Carson and Provost Ron Yoshida persuaded

Daves to return to Lehigh as an appointed interim chair with one charge. He was to personally conduct a search for an outside chair who'd be given promises and commitments to bring the department up to strength and restore the national visibility it had once possessed two decades ago under his own chairmanship. The last time the Administration controlled the selection of a chairman was with recruitment of Frederick M. Fowkes in 1968.

With extensive letter writing, advertising, and networking – but without a departmental search committee and with constant interaction with Dean Carson – Daves located Robert A. Flowers II (LU PhD 1991) then at Texas Tech. Carson, Yoshida, and Daves negotiated directly with Flowers – who himself was as reluctant as Daves had been 22-years before. Flowers accepted a position of Consultant to the Department in Fall 2003 which was transformed into a regular faculty position and thence into chair in January 2004. This time, by-and-large, the multitude of administrative promises were kept. In 12 years, Flowers filled 15 faculty positions (one, Bruce Koel, at senior full professor level) and nine staff positions bringing about a transformation never before seen in the department. At present, including the Professors of Practice, the department has 19 faculty members of whom three are women. (For further details the reader is referred to the biographies of Professors Larsen and Flowers in the Organic Chemistry chapter of this history).

The vigorous youthful faculty brought to Lehigh by hirings under the Flowers chairmanship and the few senior-level continuing professors are PIs on 19 grants with an indirect cost recovery for Lehigh of > $1M per year -- the highest effective rate of any department. A September 2015 internal report from Lehigh's Office of Research shows that while the university's audited overhead rate is 61% the effective recovery of that target is only 32.4% as the average of all departments. Chemistry's recovery rate on indirect costs, however, is 58.2% and the chemistry faculty displays a remarkable success rate of 31% overall (15% for NSF) in proposals submitted which receive funding. Chemistry is the number one department in the College of Arts and Sciences both in federal research funding and in expenditures on research. The size of the Ph.D. program doubled under Flowers (to 44 at present of which 17 are women) and the number of students taking courses in chemistry doubled, majors have increased significantly, and the department has some of the highest student course enrollments in the College. The senior class of chemists completing in May 2016 has 31 seniors of which 12 are women. There are a total of eight regular chemistry, four pharmaceutical chemistry, one engineering chemistry, and 18 biochemistry majors.

To maintain the momentum of growth and to yet allow Flowers to return to fulltime teaching and research, the department favored the search for a senior hire – a chair-elect -- who could overlap Flowers, establish a personal research program, and then step into the chairmanship. Following a nationwide search in 2012 David A. Vicic was brought in as a senior hire, promoted to full professor, and succeeded to the chairmanship in July 2015. From the perspective of 2016 – a new chemist-president (John Simon) in place and a reinvigorated department at work – the future looks bright indeed.

## The Chairs of the Sesquicentennial Period

| | |
|---|---|
| Charles Mayer Wetherill | 1865-1871 |
| William Henry Chandler | 1871-1906 |
| William Bush Schober | 1906-1914 |
| Harry Maas Ullmann | 1914-1938 |
| Harvey Alexander Neville | 1938-1952 |
| Earl James Serfass | 1952-1959 |
| Edward Delbert Amstutz | 1959-1968 |
| Frederick M. Fowkes | 1968-1981 |
| G. Doyle Daves | 1981-1988 |
| Henry Leidheiser, Jr. | 1988-1989 |
| John W. Larsen | 1989-1992 |
| Kamil Klier | 1992-1996 |
| Keith J. Schray | 1996-2001 |
| John W. Larsen | 2001-2002 |
| G. Doyle Daves | 2002-2003 |
| Robert A. Flowers, II | 2003-2015 |
| David A. Vicic | 2015- |

## 75 Years of Analytical Chemistry
## By James E. Roberts

If the limestone contained more than 30 % silica, the iron maker worried about the additional slag produced in his process. If the pig iron casting was too high in carbon content, it became too brittle to turn into high quality railroad rails. If the coal intended for the coke works was high in carbonates or sulfates, toxic gases were emitted during movement of the coke from the coke works to the iron furnace. These are only three of the many crucial analyses carried out in the early days of the company that became Bethlehem Steel. The people doing these analyses were analytical chemists. Thus many early industrialists including Asa Packer, Robert Sayre, and John Fritz held chemists in high regard. Chemistry was one of only five departments approved by Asa when Lehigh University was incorporated in 1865. When Lehigh's founder was told there wasn't enough space on his tiny campus for an important blow-pipe analysis lab, he ordered the station master of the South Bethlehem Lehigh valley train station to clear a spare room in the station for the lab. This is one of the few instances when Packer actually acted on behalf of the university he founded. Chemistry mattered!

The first and second department chairmen bought into Asa's vision of a technological school that would help support industry, and led the department toward analytical chemistry to teach students how to make the measurements vital to industry. More of this story, along with Lehigh's unique degree, the A.C. (for Analytical Chemist) is told in the biographies of those chairmen (Wetherill and Chandler) in the Organic Chemistry section.

In the early days of Lehigh, analytical chemistry was primarily conducted with chemical methods involving near-quantitative reactions under controlled conditions to determine how much of a particular element was in the unknown sample. Titrations are representative of such reactions; in a titration a specific, known reagent is reacted with a sample – a color change (or sometimes a physical change) signals completion of the reaction. The amount of reagent added to obtain the color change correlates with the amount of the analyte (the desired material) by a known relationship. Many titrations were developed such that analyses within a few parts per thousand were considered the mark of an experience analytical chemist. With the A.C. degree, graduates were prepared to take their "chemical kit" and venture forth into the industrial world.

Analytical chemistry is broken into two broad branches: qualitative analysis and quantitative analysis. These two areas can be thought of as "What is it?" and "How much is there?" respectively. But in reality, every chemist is an analytical chemist to some degree. For example, the organic chemist must determine if a given transformation has taken place, the inorganic chemist wants to learn the composition of a new material, the biochemist/pharmaceutical chemist must ascertain the right dosage for a drug candidate, and the list goes on. Many analytical chemists have roots in physical chemistry, as practitioners of the latter discipline are responsible for the development of many of the modern instruments used by analytical chemists. Some would argue that analytical chemistry is "central" to the field of chemistry and indeed all molecular-based studies. In that vein, analytical chemistry has had many practitioners on the faculty at Lehigh University over the years.

In Billinger's history of the first 75 years of Chemistry and Chemical Engineering at Lehigh University, there are several faculty members listed in 1941 as having duties that at least touch on one of the two main areas of analytical chemistry. The list includes: **Harold V. Anderson**, **George C. Beck**, **Robert D. Billinger**, **Alpha A. Diefenderfer, Thomas H. Hazlehurst**, **Earl J. Serfass**, **Hilton A. Smith**, and **Judson G. Smull**. At that time there were also a number of instructors and assistants that helped primarily in the laboratory classes; today many of those duties are carried out by graduate student teaching assistants, overseen by a staff member/faculty member team for general chemistry and organic chemistry, or a faculty member for the more advanced lab classes.

In Billinger's 1941 essay on the first 75 years of department history, there is little detail as to the research areas of these faculty members. But it is clear that a few of them would have been considered analytical chemists, although the argument could be made that physical chemistry was a significant contributor to their world-view and areas of expertise.

**Alpha A. Diefenderfer** earned an A.C. degree from Lehigh in 1902 and an M.S. from Lehigh in 1908. He and his family were at Kaiser Wilhelm University in Berlin from 1927 to 1928 witnessing the collapse of the Weimar Republic and the rise of Hitler as Führer. Strikes, protests, and closure of universities made it impossible to pursue the degree and Alpha came home without it. His Lehigh faculty colleagues recognized his heroic effort and his long service to the department by promoting him to full professor in 1930. Alpha is listed in the 1908 yearbook as a newly hired Instructor, one of the last graduates of the A.C. degree track, and a member of the student chemical society. He remained a lifelong Lehigh loyalist in advising student affiliates and campus fraternities. When the Lehigh trustees voted to allow all holders of the old A.C. degree to receive a B.S. diploma, Alpha did so. He retired from the Chemistry faculty in 1946 but continued personal research and maintained an office in the Chandler Building until 1966. Billinger lists his chief duties as "Prof. of Quant. Anal. and Assaying" from which one concludes that at least a significant amount of his time was spent as an analytical chemist. It is also noted that he invented "numerous devices" to make time management more effective for students in the quantitative analysis laboratories, but no further details are given. He published seven different papers while at Lehigh. For many years he taught the quantitative analysis lab, a mainstay of the undergraduate curriculum. For the first lab class of the semester, the students would line up on the stairs in Chandler Laboratory, and start the march to the underground laboratory with a song that started "Limestone, Iron, and Spiegeleisen … Dief'll make ya analyze 'em." Apparently it was a tradition that many people came to witness. The Department of Chemistry has an endowed award for undergraduate students that is named in his honor.

**Harold Victor Anderson** (b. 1890) arrived at Lehigh in 1918 as a part-time graduate student and finished an MS degree in 1925. He moved to the University of Illinois to pursue a doctorate in X-ray powder diffraction, but did not finish the degree. After four years at Dixie Portland Cement Company, he came back to Lehigh and taught general chemistry, qualitative analysis, and quantitative analysis for 42 years. The Lehigh Valley had a substantial cement industry at the time, and Anderson provided analyses for several cement companies based on his previous experience. While he published a dozen papers, many involving X-Ray powder diffraction, on the analysis of cement and limestone (the "precursor" and major component of cement), he is best known for his textbooks. With Professor James Scott "Shorty" Long he wrote Chemical Calculations which came out in revised editions in 1924, 1928, 1932, 1940, 1948, and

1955. The last revision was exclusively his own since Professor Long had departed for the faculty of Southern Mississippi University. Anderson also wrote a text on Qualitative Analysis (with Professor Thomas H. Hazlehurst of Lehigh and Long) but it went through a mere three editions.

Born in 1906, **Thomas H. Hazelhurst Jr.** earned his BA from Duke in 1921 and his Ph.D. from Johns Hopkins in 1927 at the age of 21. He joined Lehigh as an instructor in Chemistry, and was promoted to Assistant Professor in 1930, Associate Professor in 1939, and full Professor in 1945. In Billinger's 1941 treatise, the book on Qualitative Analysis with Anderson and Long (later Anderson and Hazelhurst) is listed as in the third edition of this long-lasting and popular analytical textbook. Like many of the faculty he had interests in both physical and analytical chemistry and he taught in both areas. His personal research was on the wetting of solids and methods for precise determination of surface tension. Hazelhurst also published three papers in the area of thermodynamics, ten in chemical education, and five in the field of colloid chemistry. He died in 1949 of a highly aggressive form of cancer.

**Earl J. Serfass** was born in Allentown, and graduated from Allentown High School in 1929. He earned all three of his advanced degrees from Lehigh: B. S. in Chemical Engineering in 1933, M. S. in 1935, and Ph.D. in 1938. He started as an Instructor and became an Assistant Professor in 1939. Although profiled in the Physical Chemistry section, Serfass was one of the "crossovers" between physical and analytical chemistry. Some of his early experiments with X-ray analysis under high vacuum conditions were the direct antecedent of what became X-Ray Photoelectron Spectroscopy (XPS, also known as ESCA – Electron Spectroscopy for Chemical Analysis). Even today Lehigh has a significant effort in XPS with the Scienta ESCA (see The Rise of Instrumentation section for additional details).

**Ralph Muraca** was a Lehigh man all the way, earning a B.S. in 1944, M.S. in 1947, and Ph.D. in 1950, all in Chemistry while working with Serfass. He became an Assistant Professor in 1951, and served as Assistant Chair of the department for many years. Due to his relationship with Serfass, he sometimes subbed for him in the analytical lecture and lab courses, but he also taught an Introduction to Analytical Chemistry for Engineers course. He left Lehigh in 1958 to become the director of analytical chemistry for General Electric in San Mateo, CA.

In 1942, **Velmer B. Fish** received his Ph.D. degree from the University of Iowa. He arrived at Lehigh in 1948, with a research program involving bulky, sterically hindered aromatic ligands which selectively bind various metal ions for UV-VIS absorption analysis. His primary profile is in the Organic Chemistry section. In addition, Fish ran a CHN combustion lab for elemental analysis for various projects, including many of his faculty colleagues. He died suddenly and unexpectedly of septicemia in 1968; an advanced graduate student (Ron Evilia, who later had a successful career at the University of New Orleans) had to take over his course of quantitative analysis on essentially no notice.

Juniata College (in central PA) awarded a B.S. degree to **David M. Hercules** in 1954. He attended graduate school at MIT, earning the Ph.D. in 1957 under Lockhart B. Rodgers. He joined Lehigh late that summer, and started working to build a high resolution spectrofluorometer to study photo-induced luminescence. While at Lehigh, Hercules had summer positions at United States Steel Corporation and Sun Oil Company. Here is another physical chemist with interests in analytical chemistry. In 1960, after

three years at Lehigh, he returned to Juniata College for three years. His career then encompassed faculty positions at MIT, the University of Georgia, the University of Pittsburgh, and finally Vanderbilt University. His innovative research and interests led him to several important discoveries, especially in the fields of surface science and catalysis. He later moved his research focus toward mass spectrometry. Hercules received a number of national and international awards, including a Humboldt Fellowship. David revisited Lehigh on many occasions and served six-years on the Department's Visiting Committee.

**Robert S. Sprague** came to Lehigh in 1957 in part because of his skills as an X-Ray spectroscopist. Bob held a B.S. from Washington and Jefferson (1943) and a Ph.D. from the University of Illinois (1949). Although he is profiled in the Inorganic Chemistry section, some of his work was of an analytical nature as well, for in his early years he continued the x-ray analytical studies begun by Anderson. Bob is perhaps best known as the long-time teacher of the first semester general chemistry course, taken by over half of Lehigh's incoming class each year. Before he retired in 1988, Sprague ventured that he had taught well over 15,000 students during his career at Lehigh.

**Alfred James Diefenderfer** earned his B.S. at the University of Pittsburgh (1957) and his Ph.D. at MIT in 1961. He then (1961) joined the Lehigh faculty where he began a vigorous and well-funded research program; he was promoted and tenured in 1965. He left Lehigh in 1973 to become the chair of the Department of Chemistry at Old Dominion University in Norfolk, VA, and from there to department chair and Dean at California State University-Fullerton. A true analytical chemist, his research area was polarography, with an emphasis on the analysis of halogenated materials, with some work in atomic absorption spectroscopy. Jim introduced modern electronics to the curriculum, and published a textbook on the application of electronic measurements in chemistry – it went through several editions with Saunders Publishing Company. As "Principles of Electronic Instrumentation," the text was in press from 1972 to ca. 2000. The textbook and a lab manual that accompanied it were the major pieces to a very popular one-week short course which Diefenderfer launched at Lehigh and ran in several locations throughout the USA. In concert with his interests in instrumentation, Jim joined Jerry Daen in developing an National Science Foundation-funded course in advanced instrumentation and physical chemistry. The course was very challenging. At the final exam, they offered that students could skip the final exam and if they accepted their current grade in the course. EVERY student chose their grade to date rather than face that final exam, even students who had D's at the time! In 1967 Jim became part of a large Science Education Improvement Program in India sponsored by the National Science Foundation, the Agency for International Development, and several other financial backers. The program's purpose was to train a new generation of science teachers in India on cutting edge science as practiced in developed nations. Jim soon found himself in Kanpur, India, teaching high school and college teachers on how to keep lab instruments in repair. The program ended in 1973. When he died in 1989, Diefenderfer was the Dean of the College of Science and Mathematics at California State University, Fullerton, CA.

In 1964, **Matthew Hulbert** earned a B.S. in Chemistry from Washington and Lee University, then finished his Ph.D. at the University of Wisconsin in 1969. He immediately joined (1969) Lehigh as an Assistant Professor in analytical chemistry. Hulbert's interest in the fate of various materials in the environment was a great fit, as Lehigh was administering a marine research lab at Stone Harbor at the time. His primary research tools for analysis included cyclic voltammetry and polarography. He taught

courses in analytical chemistry, marine chemistry, and participated in the short-lived integrated Physical Chemistry – Inorganic Synthesis laboratory course. He left Lehigh in 1974 for a prestigious post-doc at the National Oceanic and Atmospheric Administration. After becoming a faculty member at Connecticut College, he transferred to the corporate world as a quality specialist in the pharmaceutical industry for Mallinckrodt, Cephalon and later for Teva Pharmaceuticals. Matt is presently with Biopharm Forge, a company which provides analytical and regulatory consulting to a number of pharmaceutical companies.

**Michael Hughes** joined Lehigh University as an Assistant Professor in 1975 in the position vacated by Matt Hulbert. He had completed his BS-Chemistry at SUNY-Albany in 1965 and his PhD in analytical chemistry from Syracuse in 1971. Another electrochemist, he utilized differential pulse polarography on aromatic systems in his research. He also developed new electrochemical methods; of note was a rapid scan method for voltammetry. Mike, like Matt Hulbert, was an active member of Lehigh's Center for Marine and Environmental Studies which – at that time – operated an Atlantic coastal research center in Stone Harbor, NJ. Using his electrochemical skills, Mike and his graduate students developed assays for humic acids and toxic metal ions in tidal marshlands. He left Lehigh in 1979 to join AT & T Bell Laboratories in Allentown, PA, as an analytical chemist. With the cessation of research at Bell Labs, Mike joined an electrochemicals start-up located in the Lehigh Valley and helped them bring several products for chip preparation to the marketplace. Mike is now retired in the Lehigh Valley.

**Robert Stanleigh "Bob" Rodgers** joined the Lehigh faculty in 1973 from a visiting assistant professorship at Michigan State. Bob was a BS/MS grad (1966) of Brooklyn Poly and a PhD grad of Clarkson University (1971). He had followed his mentor, the well-known analytical chemist and textbook author Professor Louis Meites, who moved from Poly to Clarkson. After Clarkson he moved west to take a two-year postdoctorate at CalTech (1970-72) with Fred Anson and then began a teaching career. At Lehigh, Bob inherited Jim Diefenderfer's courses and labs in electronics for chemists and also taught instrumental analysis and electrochemistry. Bob's research area was computerizing laboratory instrumentation at a time in which very little hardware came with built-in computerized functions. He left Lehigh in 1979 for a Senior Scientist position with a company about to be renamed Princeton Applied Research. In 2001, he moved to Gamry Instruments in Warminster, PA, from which he retired in 2008. He passed away in October 2010

**William Ohnesorge** (on the Chemistry Faculty from 1965-1990) was another electrochemist by training, although he also had interests in luminescence. Bill, who held a ScB from Brown, 1953, and a PhD from MIT, 1956, joined Lehigh as an Associate Professor in 1965. He had been a tenured member of the chemistry department at the University of Rhode Island. At Lehigh he published over 20 papers in the two disciplines of luminescence and electrochemistry. Bill took a sabbatical leave at a Canadian hospital to learn the emerging discipline of clinical analytical chemistry and created a course in that field upon his return to campus. Around 1980, he served as a "faculty program rotator" at the National Science Foundation for two years. As such, he was responsible for the NSF Chemistry Division's program in analytical chemistry, performing the myriad tasks involved in assigning reviewers for proposals and the entire process of awarding grants in that area. Upon returning to Lehigh, he gave several talks to faculty from several disciplines on the grant writing/approval process, helping numerous colleagues to

successfully obtain NSF funding. He served the Department as Assistant Chairman for many years, retired in 1990 and passed away in 1998 at the age of 66.

As part of **G. Doyle Daves'** expansion of the Chemistry faculty (see *Organic section*), **James E. Roberts** joined the faculty in 1985. Roberts had studied nuclear quadrupole resonance as an undergraduate (U. of Illinois at Urbana), electron paramagnetic resonance/electron nuclear double resonance with Brian Hoffman (Northwestern U), and solid-state NMR spectroscopy with Robert G. Griffin (MIT). Upon his arrival, the NMR lab was substantially upgraded with purchase of a 300 MHz NMR for solids, followed shortly by a 500 MHz NMR for liquids (shared with Air Products and Chemicals – see *The Rise of Instrumentation* section). Roberts has published 70 journal articles, mentoring a dozen Ph.D. and roughly 30 M.S. students. Shortly after arriving at Lehigh, he received a Presidential Young Investigator Award from the National Science Foundation, in part because of his pedigree. In 1997, after four years as Treasurer, he was elected as the Chair of the Experimental NMR Conference, the premiere general conference in the field that covers all aspects of NMR spectroscopy. Although trained as a physical chemist, Roberts quickly became known as "THE analytical chemist" due to his teaching of the analytical curriculum after Ohnesorge, who retired shortly after his arrival. Students talk among themselves about the importance of significant figures and units, because they know he will question them about them if they are presented improperly. Perhaps Roberts' real impact at Lehigh is in the classroom – as described below he has been the main force in revising the curriculum in analytical chemistry since his arrival, although he has also taught in the general chemistry courses.

In 1994, **Michael S. Freund** joined the Chemistry faculty. Freund received his Ph.D. in 1992 from the University of Florida and then became a Postdoctoral Fellow at Cal Tech, where he helped to initiate a multi-investigator interdisciplinary research program on the development of olfactory-inspired sensor arrays (electronic nose) that broadened to include NASA and DARPA. The detector had a large array of chemically diverse sensors based on conducting polymers. Because analytes would partition uniquely among the many individual sensor elements, a pattern unique to each analyte was produced. Chemometric and pattern recognition techniques were then used to identify and quantify analytes in a manner analogous to the mammalian olfactory system. Much of his work at Lehigh focused on conducting polymer synthesis and surface modification. Mike developed collaborations with Ralph Jaccodine (ECE) in the area of scanning tunneling microscopy characterization of semiconductor structures and Gregory Ferguson (Chemistry, see **Inorganic Section**) in the area of electrochemically directed self-assembly. In 1999 he returned to Caltech as the Director of the Materials Science Center in the Beckman Institute and continued developing his research in chemical sensing. In 2002 he moved to the University of Manitoba, attaining the ranks of Professor in the Department of Chemistry and Adjunct Professor in Electrical and Computer Engineering. At U. of M. he was awarded a Tier 2 and eventually a Tier 1 Canada Research Chair. In addition he helped to establish the Manitoba Institute for Materials, served as its Director, and led its expansion with the addition of a suite of electron microscopes in newly renovated space. During his thirteen years at the University of Manitoba he was either lead or co-PI on projects totaling approximately 30 million dollars in research and infrastructure funding. Mike now holds the positions of Professor and Head of Chemistry at the Florida Institute of Technology. Dr. Freund has published over 90 articles and has been issued 27 US patents.

**David A. Moore** was hired to fill an analytical chemistry position in 2007, although he was trained as a physical chemist. A specialist in IR spectroscopy and low temperatures, his group is measuring very low activation energy processes at temperatures ranging from 5 – 50 K by matrix isolation – a procedure he calls "freeze-frame spectroscopy." While he has taught the main analytical chemistry lecture course, Moore is also profiled in the Physical Chemistry section, in part because the majority of his teaching responsibilities have been in that area and general chemistry.

**The Analytical Chemistry Curriculum, 1940-2015**

For many years, the analytical chemistry curriculum changed only very slowly. In 1940, a substantial amount of the laboratory work was in either Qualitative Analysis or Quantitative Analysis; both were year-long laboratory experiences. It is interesting to note that chemistry lab courses required a deposit of $15 to $40 for each lab experience; unused funds were refunded at the end of the semester. These fees were the highest curriculum-dependent "additional" expenses in the university at the time. Sometime later, a "universal lab fee" was instituted for all students in appropriate degree programs.

From the 1940s through the 1980s, there was a slow but steady shift toward instrumental methods in the fundamental analytical chemistry lecture course, with the theory of how each type of instrument functions being the focus. Much of the qualitative analysis experiments were always performed in the first year lab sequence, but the content of those two lab classes slowly changed away from strictly qualitative analysis to a mixture of experiments that include many aspects of modern molecular science. The quantitative analysis laboratory class was the entire second year in 1940. A similar course that was virtually all titrations remained a required course until the late 1980s. For the entire period there were also required laboratory courses in organic chemistry and in physical chemistry, with an inorganic chemistry lab required for most of those years. The developing instrumental analysis techniques gradually became incorporated into all the lab classes. In 1988, Roberts (see above) teamed with Kraihanzel (see Inorganic Chemistry section) to create two separate courses to augment the traditional lecture course in analytical chemistry. A new lecture course focusing on modern instrumental methods was developed, and a companion laboratory was created with experiments to use the instrumental methods available within the department (see The Rise of Instrumentation companion piece). These courses were typical of those at many other colleges and universities at that time: students were given a sample (sometimes pure, sometimes not) with instructions on how to perform a qualitative or quantitative analysis, and then they entered the lab and followed the prescription. At the time, an advanced organic laboratory (beyond the full year of primarily organic synthesis) was also a required class; together these two labs represented the "capstone" lab experience for Bachelor of Science in Chemistry degree students.

In 2004, Roberts proposed another substantial change. He developed a full-year laboratory sequence to replace the organic analysis lab, the instrumental analysis lab, and the instrumental analysis lecture classes, replacing three 2-credit courses with two 3-credit lab-based courses with some supplemental lectures. The fundamental analytical chemistry lecture course remains, but the new "unified" lab sequence serves as the capstone laboratory experience for Chemistry majors. The course design principle is that students perform their own synthesis reactions, and then use different analytical methods to make specific measurements on their own samples. After all, this process mimics what is usually done in the

real world. For some experiments, students work in small groups and must divide the workload among the group members, which includes writing the final report. The first semester is based on organic chemistry, while the second term is primarily inorganic chemistry. As the year proceeds, fewer specific directions are given for each experiment, and the students must make more choices on their own. The final five weeks are an "independent project" for which each student must peruse the primary literature and reproduce at least two steps of a reaction sequence. Preparation for this final project mimics what must be done in a research project, with several required checkpoints during the semester. The lab reports are written in the forms used to communicate to other chemists today: a full manuscript to be submitted to a peer-reviewed journal, a rapid communication, a poster, a "memo" to their supervisor, and a 15 minute oral presentation for their independent project. In the summer of 2013, a new laboratory was renovated to accommodate the year-long unified lab class; it is equipped with eight 8-foot modern variable air-volume hoods, accommodating up to 16 students at one time. The lab was designed to handle other advanced lab classes also – an advanced biochemistry lab has been taught in the facility for each of the last two years.

# 75 Years of Biochemistry at Lehigh from 1940 – 2015
# By Joseph Merkel, Jack A. Alhadeff, and K. Jebrell Glover

Biochemical information was taught at Lehigh from at least 1896 to the present but in the earlier years the content was included in other courses not entitled *biochemistry*. Professor **William Bush Schober** (b 1864 - d 1935) had in 1896 translated from German the famous textbook by Gatterman, *Practical Methods of Organic Chemistry*. Schober taught from the text from 1900 till 1914 and included therein were examples of biological compounds and a few reactions (mostly fermentations).

**Edwin Raymond Theis** (1896 - 1953) came to Lehigh as an associate professor in 1927 and brought with him a Leather Research Institute. Theis, who had been a researcher in tanning laboratories in Cincinnati and Detroit, had a long background in leather chemistry. At Lehigh, he and a colleague, G. D. McLaughlin, wrote a very popular monograph on *The Chemistry of Leather Manufacturing,* which went through multiple editions printed by Reinhold Press and the American Chemical Society. University records show that Theis's unit, always within the Department of Chemistry was initially named the Division of Industrial Biochemistry, then the Biochemistry Division and finally the Leather Research Institute.

Theis died in 1953 and was replaced as director by **Robert L. Stubbings** who had completed his Lehigh PhD (1949) under Theis. Stubbings, who did not hold regular faculty rank (he was a Research Assistant Professor), managed the institute until 1962 when he left Lehigh and moved his institute to the Milwaukee School of Engineering where it existed until 1971. Theis taught biochemically-oriented courses on protein structure, protein analyses, and lipid chemistry. These courses were hardly general biochemistry but were rich with content needed by Theis's graduate students to perform their contract research. His biochemical research interests were focused on how the protein structure of animal skin changed upon chemical dehairing of the hides, tanning, and subsequent processing of the leather. In the 1940s and early 50s Theis published a numbered series of papers on the molecular level reactions between formaldehyde and proteins in the *Journal of Biological Chemistry*. He also published similar material but more closely tied to the observable changes in the leather surface during tanning by formaldehyde in the *Journal of the American Leather Chemists Association.* The Theis laboratory used centrifugation, electrophoresis, and protein precipitation techniques common to the biochemistry of the period. They even built early version electrophoresis equipment before such instruments became widely available but their major research goal wasn't the understanding of fundamental molecular pathways but in producing an improved leather.

Stubbings' reputation for competence, engaging personality and honesty lasted long after his death. In 1983, faculty member Ned D. Heindel submitted a $25,000 grant application to the Elsa U. Pardee Foundation (Midland, MI) for research on anticancer agents. Cancer research was one of the stated goals of the foundation which had been established by a multimillionaire Dow Chemical executive James T. Pardee in honor of late wife. Pardee was partner and co-founder of the Dow Company and was richly rewarded for his efforts in creating that firm. Heindel was amazed when his proposal submission triggered a swift visit by the Foundation's Director, a retired Dow agricultural chemist named William Webster Allen. Allen insisted on a

visit to the Lehigh campus and on seeing the wing of the old Chandler Lab where the Leather Institute once existed.

Over lunch Allen described what a brilliant, hard-working, and honest chemist Theis had been. In 1948 a devastating anthrax epidemic in Mexico killed thousands of cows. Dow Chemical, then a major supplier of leather processing chemicals and pigments for dyeing leather, saw an opportunity to turn the epidemic into profit – Dow would go into the new business of selling leather (as well as the chemicals to turn it into products) to shoemakers, luggage makers, and clothing manufacturers. Tons and tons of hides were purchased in Mexico but U.S. Authorities mandated a vigorous sterilization with harsh chemicals and heat to insure the death of all anthrax bacilli before the hides could cross the border.

When the hides arrived at Dow's labs they proved to be impossible to process, to pigment, or to emboss. The sterilization had ruined the leather. Theis's reputation in leather processing was well known and Dow Chemical issued him a contract for a precise amount of money to solve the problem. Theis put all his students and technicians on the problem and within several months he had a treatment to reverse the chemical damage and make the hides pigmentable. He wrote a report, taught the company his method, and returned about 30% of the company's contract. He'd solved the problem for less than his original request and he didn't feel he was entitled to the company's money. Allen who'd been the project liaison between Dow Chemical and Theis's Leather Institute in 1948 said no one at Dow then or now had seen an academic return corporate dollars. Allen signed a check for $25,000 for Heindel's research and said he "hoped it would be as successful for the world as Theis's had been 35 years earlier." Alas, it wasn't.

Theis died before retiring and with the departure of his young assistant, Stubbings, **Thomas E. Young** (b. 1925 – d. 1992) who arrived in 1958 created a biochem offering. Young (LU BS '49, MS '50; Illinois PhD '52) had worked for Dupont and had taught at Antioch College before being hired by Lehigh. Young taught an abbreviated biochemistry course until 1961 (when Professor Merkel arrived) but taught organic chemistry and heterocyclics for his entire career. He created a graduate research program modeling the biosynthesis of the skin pigment melanin by electrochemical oxidation of dopamine. Professor Young retired in 1989 to pursue his passion, civil aviation.

Schober, Theis, and Young taught some biochemistry and the research pursued by Theis and Young had a biochemical flavor to it, but none of them was a card-carrying biochemist nor would they have considered themselves one. Most of Schober's and Young's graduate students took degrees in organic chemistry, and the chemistry graduates of the Theis lab were physical or analytical chemists.

The Lehigh faculty's first biochemist with PhD and postdoctoral experience in the field was **Joseph R. Merkel** who arrived in 1962 as Associate Professor of Biochemistry. Merkel (Moravian BS '48; Purdue MS '50; Maryland PhD '52) had been a Waksman-Merck post-doctoral fellow at Rutgers in 1952. In 1953, supported by a Lalor Foundation Fellowship, he worked at the Marine Biological Laboratory, Woods Hole, MA.

After Woods Hole, Merkel became a research associate and instructor of microbiology at the Institute of Microbiology, New Brunswick, NJ, and then (1955) Director of the Ft. Johnson Marine Biological Lab at the College of Charleston, Charleston, SC.

Merkel arrived at Lehigh with a deep professional interest in the biochemistry of marine organisms, especially collagenolytic bacteria, and with experience in setting up a laboratory from scratch. He would need that latter skill because Lehigh had no facilities to teach modern biochemistry. Merkel was hired by Department Chairman **Edward D. Amstutz**, and was simultaneously appointed to both the chemistry faculty and to the research staff of the Marine Science Center (later renamed the Marine and Environmental Studies Center), then headed by Keith Chave.

Professor Merkel was successful in obtaining Office of Naval Research (ONR) and NSF grants which supported his on-campus students and field research in Bermuda and Hawaii. As he remembered, "I began work in Chandler lab until I finished a lab and research facilities on the top floor of Williams Hall. Most of the early biochemistry lectures were held in Chandler with the lab courses held in Williams. Our grad students who finished while we were in Williams Hall were Tibor Sipos, Tom Freund, Henry Zeigler, and two M.S. students."

The biochemistry graduate degree program at the time included courses in chemistry and biology. Guided by Merkel, the department created two 3-credit courses and two accompanying laboratories. Appropriate advanced topics courses were also created. Lectures in the gateway courses (Chm 371-372) had 40-60 students and the corresponding lab courses averaged 12 – 24 enrollees. As the sole biochemist, Merkel was the instructor in all those newly created courses. When Lehigh University and the Seeley G. Mudd Foundation made funding available to build the seven-story Mudd Laboratory, Merkel helped Chairman, **Frederick Fowkes** design and build the 6th floor of the building as a dedicated biochemistry facility. Use of the older Williams Hall facility was turned over to the biology department. The first biochemistry graduate students trained in the new Mudd Laboratories were Joseph Dreisbach, Clarence Lee and Linda Neiman. Professor Merkel retired in 1988.

The retirement of **Edward D. Amstutz** (1971) as a chaired (Howard S. Bunn Chair) full professor of long service gave the department a unique opportunity to expand its biochemistry program. The administration allowed **Frederick M. Fowkes**, Department chair, to split the Amstutz salary line into two halves and use those halves for the hiring of two assistant professors, one in bio-organic chemistry (**Keith J. Schray**) and the other more central in traditional biochemistry (**Stephen W. Schaffer**).

**Schray** (University of Portland BS 1965, Penn State PhD 1970) arrived at Lehigh in 1972 fresh from a two-year postdoctoral experience at the Institute for Cancer Research (Fox Chase, PA). At Lehigh he developed a graduate course in bioorganic mechanisms, briefly taught the gateway course in biochemistry (Chm 371), and supervised the biochemistry teaching laboratory for a decade. Schray had been pointed to the new Lehigh position by Steve Benkovic, his doctoral advisor at Penn State, who had obtained his undergraduate degree in chemistry at Lehigh.

In an interview Schray pointed out that his postdoctoral advisor, Irvin Rose (Fox Chase), introduced him to bio-mechanisms in carbohydrate metabolism with a project on anomeric specificities of pentose isomerases (Schray and Rose, *Biochemistry*, 1971, 10: 1058-1062). Schray went on to note – with a twinkle in his eye -- that while Rose subsequently won the Nobel Prize in Chemistry (2004) for his discovery of how living cells recycle and dispose of unwanted molecules, that wasn't for anything he'd been involved in.

At Lehigh, Schray rose rapidly through the ranks by dint of excellent teaching, good government funding, and good research. His research area more specifically was in enzyme mechanisms moving subsequently into analytical biochemistry, primarily enzyme immunoassays. Schray subsequently served the university as Director of the Division of Biochemistry and Biophysics of the Center for Health Sciences and served the Department as Assistant Chair and then Chair, 1996-2001. While he has won numerous teaching awards he noted that the ones he valued most personally were the student Stabler Award, and the Alumni Award presented by the 10-year alumni class. He retires in January 2016.

The second of the two hires which the department added from cleavage of the salary line held by the retiring Professor Amstutz was **Stephen W. Schaffer**. Schaffer (Buena Vista College BS '66, U Minnesota PhD '70) was hired in 1972 and started his Assistant Professorship in 1973. He arrived at Lehigh from a postdoctoral position at the University of Pennsylvania. Funded by NIH grants, Steve and his students studied the effect of taurine and sarcolemmal calcium binding on cardiomyopathy. An additional research area pursued by the Schaffer team involved mechanism studies on how glutathione regenerates reduced pancreatic ribonuclease A. After obtaining tenure and promotion to Associate Professor in 1979, Schaffer left Lehigh in 1981 for a position as Associate Professor of Pharmacology at the University of South Alabama.

In the decades of the 60's, 70's and 80's Lehigh – like many doctoral research universities -- experimented with creation of faculty positions supported through the research arm of the university with externally-funded faculty supported by grants. In academic jargon of the day these were called "soft money" positions. A visiting committee had suggested to the administration that the applied molecular health sciences represented a domain where faculty and staff might be sustainable by continuous soft money. Some departments (Biology was one of them) were resistant to adding faculty whose line slots were not firmly underwritten by tuition. Chemistry, however, was willing to participate in the biomedical experiment for the department had a long history of employing research faculty supported by contracts and grants in surface, printing ink, and coatings chemistry. Joseph Libsch, Vice President for Research, announced two biochemical/biomedical positions created by funding from the university's recovered research indirect costs. These positions were added to the chemistry faculty.

**Thomas C. Cheng** (Wayne State BS, U. Virginia PhD '58), a classic biologist-parasitologist using biochemical techniques, who had previously been a Professor at the University of Hawaii, was brought to Lehigh in 1968 to create a Center for Health Sciences as a conduit for external funding. Cheng (b. 1930 – d. 2000), an international authority in the fields of parasitology, molluscan biology, and chemically-induced self-cleansing of polluted shellfish, was appointed in Chemistry after his preferred academic home, Biology, declined to host the position.

Cheng's research team was moved into the laboratories of the Printing Ink Institute on the first floor of the Chandler-Ullmann Building when that institute moved to its own facility, the Sinclair Laboratory, north of Packer Avenue along Asa Drive. Cheng had multiple grants and contracts whose major goals were protecting (or detoxifying) oysters, shrimp, clams, and lobsters exposed to pollution. Chelating agents such as EDTA, 8-hydroxyquinoline, and citric acid were studied as promoters of shellfish cleansing. With the assistance of Lehigh's president (W. Deming Lewis), the Center for Health Sciences was allowed to create its own doctoral track (Physiological Chemistry, later renamed Pharmaceutical Chemistry) as a pathway to educate Cheng's students. The degree track was a broadened version of a standard PhD in Biochemistry and with the closure of the Center for Health Sciences, the degree was hosted within the Chemistry Department until it was phased out in 2007. At Lehigh, Cheng taught courses on pathobiology and pathophysiological chemistry. In 1980, Professor Cheng left Lehigh for the Medical University of South Carolina to create a Marine Biomedical Research Program.

The second of the research stem hires, **Yuji Hazeyama** (Musashi Univ. B.E. '66, M.E. '69, Berkeley PhD '74, U. Michigan, postdoc), joined the department as an Assistant Professor in 1979. Hazeyama was an electrical engineer with substantial postdoctoral training in animal modeling and electro-physiological studies. His research involved the metabolic regulation of the cardiovascular system and the development of sensors and monitoring devices to probe that system. He taught physical chemistry and topical courses in physiological chemistry. Hazeyama left Lehigh in 1983 for a senior position with Elsevier Publishing (Japan).

The "soft money" approach to faculty expansion began to collapse in the mid-1980s as federal agencies began refusing to fund faculty salaries on a full-time, year-around basis and the overhead monies proved insufficient to cover these payrolls. Lehigh began releasing the non-tenured soft money faculty but by 1990, during the provostship of Alan Pense, the problem had become critical regarding support for the tenured research faculty. Pense created what he called "the provost's pool" (many faculty inserted the word "cess") and sequestered already budgeted funds from department and center budgets to underwrite the missing salaries of individuals who had been tenured in these slots not supported by tuition revenues. Chemistry had 5-6 faculty in this category but these were its polymer and surface/coatings chemists not its physiologically-oriented biochemists. Gradually, between 1990 and 1997 most research-funded faculty were transferred to standard departmental budgets. Cheng and Hazeyama, who had been tasked with raising major portions of their own salaries and who had been having trouble doing so, had departed long before this crisis hit.

A major change for the department came in the decade of the 80's with the hiring of **G. Doyle Daves** in 1981 as Professor and Chair to replace the retiring chair, Frederick M. Fowkes (b. 1915- d. 1990). Daves (BS Arizona State, PhD MIT) had a well-funded and highly visible research program in bio-organic chemistry at the Oregon Graduate Center. Daves developed C-nucleosides as anti-cancer agents and employed mass spec and NMR techniques to identify mammalian (elephant!) pheromones. Daves brought a vision of how a strong biochemistry faculty could bridge Chemistry to Biology and could attract students with a life science career interest into the department.

Daves' first hire (in 1982) was **Jack A. Alhadeff** (BA, University of Chicago 1965; PhD, University of Oregon Medical School, 1972) who came to Lehigh as Professor of Biochemistry. He previously was a Postdoctoral Fellow, Assistant and Associate Professor of Neurosciences in the School of Medicine at University of California San Diego. Shortly after his arrival at Lehigh, Alhadeff was appointed Director of the Division of Biochemical Sciences by Doyle Daves. Alhadeff set up a research laboratory in the Mudd Building and did research in the area of biochemical basis of human diseases (at the protein level) including Cystic Fibrosis, Fucosidosis, Diabetes and Cancer. Alhadeff had support from various sources including NIH, NSF, American Lung Foundation, American Cancer Society, Cystic Fibrosis Foundation, Merck Pharmaceutical Inc., Pool Trust Fund of Lehigh Valley Hospital, and St. Luke's Hospital.

At Lehigh, Alhadeff trained undergraduates and graduate students in his laboratory and produced 17 PhDs during his tenure at Lehigh. Numerous papers were published by his research group in refereed biochemical and biomedical journals. Alhadeff was invited to join the Biochemical Society of London, and was also a member of the Society for Glycobiology , American Chemical Society, and the American Association for the Advancement of Science. Alhadeff gave numerous presentations on his research at local, national and International scientific meetings. Alhadeff taught in the undergraduate program (Biochemistry, Biochemistry Laboratory, Technical Writing, Freshman Seminars) and developed several graduate Biochemistry courses including Pathophysiological Chemistry, Biochemistry of Complex Carbohydrates, and Chemical and Biochemical Separations. Alhadeff won a five-year NIH Research Career Development Award, the Briody Award for Teaching and Advising in 1988 and was nominated by the University to compete for the Case National Professor of the Year Award in 1996. He retired from the University in 2010.

**Michael Behe** was appointed to the Lehigh faculty in Chemistry in 1985 from a tenured associate professorship at Queens College in New York City. Mike had received his BS in chemistry from Drexel University (1974) and his PhD (1978) from the University of Pennsylvania for his doctoral research on sickle-cell hemoglobin. He went on to hold a Jane Kauffman Postdoctoral Fellowship at NIH where he began research on nucleic acid structure. He continued work on nucleic acid structure and on nucleic acid protein interactions at Queens until he transferred his NIH-funded program to Lehigh. While in the Lehigh University Department of Chemistry Mike's research laboratories and office were located on the sixth floor of the Mudd Building and his research focused on Z-DNA and on protein folding mechanisms. Mike relocated his research facilities to Iacocca Hall in 1989 and in 1996 he requested a transfer of his appointment to the Biological Sciences department. Mike has developed an interest in intelligent design and irreducible complexity in biological systems and has published his views in two monographs *Darwin's Black Box: The Biochemical Challenge to Evolution*, Free Press (1996, first edition; 2006, second edition) and *The Edge of Evolution*, Free Press (2007). He was promoted to full professor in 1997.

**Linda Lowe-Krentz** was hired as a Biochemist in 1986, one year after Behe had joined the Lehigh faculty. Linda had obtained her BA in Chemistry at Northwestern in 1974 and her PhD in Biochemistry and Molecular Biology from Northwestern University (1980). Subsequently, she carried out postdoctoral work at the University of Health Sciences/The Chicago Medical School. She was appointed as a research Assistant Professor there in 1985 and received funding from the

American Heart Association for biochemical studies she began at Chicago. After arriving at Lehigh in 1986, she obtained research funding from the W.W. Smith Charitable Trust (Philadelphia) and from the National Institutes of Health to study heparin based signal transduction in the vasculature. Linda was also experienced in mammalian cell culture when she joined the Lehigh faculty. At Lehigh she has regularly taught the second term of Biochemistry and developed courses in Lipid and Membrane Biochemistry and in Signal Transduction.

To expand the Chemistry Department by three biochemistry hires (Alhadeff, Behe, Lowe-Krentz) in just four years required top-level administrative assistance especially for the latter two additions. Chairman Doyle Daves enlisted the help of Provost Arthur Humphrey in building biochemistry as a supporting discipline for Humphrey's own planned expansion of biotechnology. Humphrey, a chemical engineer with research interests in bio-processing of organism-derived products, had recently arrived from the Dean of Engineering position at University of Pennsylvania. He served Lehigh as Provost from 1981 – 1988 often expressing a central vision of using Lehigh's traditional strengths in engineering with new hires in biochemistry and molecular biology to move the university into the emerging areas of biotechnology, bioengineering, and biomedical engineering.

Periodically, Lehigh like most other universities, initiates faculty additions in order to foster currently hot cross-department research areas. Over the years these hires have variously been called program-specific employments, interdisciplinary appointments, or the contemporary (2015) favorite term, "cluster hires." In the mid-1980's Professors Arthur Humphrey, Marvin Charles, and Janice Philips of the Chemical Engineering Department were developing a biotechnology subdiscipline involving bulk-level cell culture to produce peptide therapeutics. The addition of a nucleic acid biochemist (Behe) and a cell culture molecular biologist (Lowe-Krentz) with skills in that area was seen by the administration as a way to promote interdisciplinary research in process optimized cell culture.

The construction of sterile cell culture facilities was commenced on the 6$^{th}$ floor of the Chemistry Department's Seeley G. Mudd Laboratory but meanwhile Lehigh had purchased the Mountaintop campus and a decision had been made to relocate chemical engineering and biology (but not chemistry) to that remodeled facility. At the same time the university reorganized, broadened, and renamed the academic domain of biology as *Biological Sciences*. With their collaborators gone from the lower campus, with superior facilities in Iacocca Hall, and with a newly created academic unit that more closely matched their interests, both Lowe-Krentz and Behe relocated their offices, labs, and their academic appointments. Lowe-Krentz and Behe continue to contribute to Biochemistry teaching and that academic track is now shared by the two departments.

Use of the 6$^{th}$ floor of Seeley Mudd for its originally designed purpose (biochemistry teaching and research) ceased for almost a decade and inorganic and organic faculty made use of the space. Alhadeff and Schray, biochemists with appointments in Chemistry, retained for a while dual offices in both Mudd and in Iacocca but they used research laboratories only in the latter. With the retirement of Alhadeff (from research in 2005 and from teaching in 2010) and with the dedication of Schray to undergraduate organic teaching until his retirement December 2015,

Chemistry found itself unrepresented in experimental research in the growing field of biochemistry.

The hiring of **Robert A. Flowers, II**, as chair (2004) galvanized the department to commit to having an active research component in biochemistry again. Chairman Flowers was able to open a slot for a biochemistry hire and to appoint a search committee which in 2006 selected **Kerney Jebrell Glover** for the position**.**

**Glover** arrived at Lehigh having completed a postdoctoral experience in the laboratory of Professor Barbara Imperiali at MIT. His doctorate (2001) and his MS in chemistry (1998) were from University of California, San Diego and his BA-chemistry was from Williams College. At Lehigh the primary focus of his research has been in the investigation and characterization of membrane proteins and their interactions with lipid bilayers. Of particular interest to the Glover research group has been caveolin-1, a membrane protein that is pivotal in the formation of plasma membrane invaginations known as caveolae. Caveolae are involved in a wide variety of essential cellular functions, and their misregulation has been implicated in cancer, Alzheimer's disease, and many other human diseases. However, atomic level details of caveolin-1 remain unclear. Many of the group's current projects focus on the elucidation of the three-dimensional structure, molecular interactions, and topology of caveolin-1 within the plasma membrane in an effort to better understand the role that it plays in the formation and maintenance of caveolae as well as overall cellular homeostasis.

Glover was granted tenure and promoted to Associate Professor status in 2013 and was also named the *Class of '61 professor*. In addition, he received Lehigh's Libsch Early Career Research Award in 2014.

In addition to start-up funds for Glover's own use, Flowers was able to finance a major remodeling of the 6$^{th}$ floor. This included installation of a new cold room with stainless steel furnishings, a warm room for bacterial growths, a cell culture room for mammalian cells, two instrumentation rooms, and two preparatory rooms which house an autoclave, dishwasher, centrifuges, freezers, and a water purification system.

A second new slot in biochemistry was authorized in 2010 and Flowers and Glover organized a search for a young colleague. **Damien Thévenin** was hired as a Biochemist in 2011. Damien had obtained his BS in Structural Biochemistry at the University Paul Sabatier (Toulouse, France) in 1999, his MS in Biology and Technology for the National Institute of Applied Sciences (Toulouse, France) in 2000 and his PhD in Chemistry and Biochemistry from the University of Delaware (2006), working on the folding and oligomerization of G Protein-Coupled Receptors. Having developed a strong interest for membrane protein biophysics, Damien joined the group of Prof. Donald Engelman at Yale University for his postdoctoral research. After arriving at Lehigh in 2011, he obtained two grants from the National Institute of Health to develop new targeting strategies to selectively deliver drugs to tumors, and to study how receptor protein tyrosine phosphatases physically interact and transduce signals across cell membrane. Damien has regularly taught the first term of Biochemistry and developed courses in Molecular Biophysics and in Advanced Biochemical Laboratory Methods.

Today the Biochemistry Division of the Chemistry Department offers an ACS Certified BS in Biochemistry which graduates approximately fifteen majors per year. The number of graduate students seeking a doctorate in biochemistry is presently 10. In staff, students, and facilities biochemistry at Lehigh has come a long way since Schober first gave undergraduates a few lectures on fermentation a century ago and Theis created a biochemistry course to serve his Leather Research Institute in the 1930s.

## 75 Years of Inorganic Chemistry at Lehigh from 1940 – 2015
## By Charles S. Kraihanzel and Gregory Ferguson

Today (2015), chemists are accustomed to thinking of themselves as belonging to a type – analytical, biochem, inorganic, organic, or physical. Some of us may even use other subdivisions like materials, pharmaceutical/medicinal, environmental, polymer, etc. Classifications, however, were simpler back when Lehigh was chartered. Our first Chairman (and only faculty member), **Charles Mayer Wetherill**, Ph.D., M.D. was not only the Chemistry Department's founder but he wrote and taught its curriculum from 1866 till his death in 1871. Before and during his time at Lehigh, Wetherill worked on food preservation, fat structure, composition of waters from spas and mineral springs, explosives, luminosity of gas flames, fermentation (he wrote a book on "Manufacture of Vinegar"), and mineral classification. He was a superb inorganic-analytical chemist but his interests were actually very broad in the field of Chemistry. His curriculum was heavy with ore, gas, and water analysis; remote in-the-field assay methods; mineral characterization; and analytical methods.

The lab-space issue was critical. Chemistry's first home was a room in Christmas (now Christmas-Saucon) Hall but in 1868 it was given part of the first floor, east end of the newly constructed University Center Building. Over 50 students were taking chemistry courses – the degree was called the A.C. (Analytical Chemist) -- and by 1871 there were more than a dozen majors. Wetherill drafted a post-graduate chemistry curriculum but he didn't call it an M.S. or a Ph.D. and it only enrolled one student (Samuel Philip Sadtler, 1847-1923) in Wetherill's time at Lehigh. In his last year of his life, Asa Packer intervened on Wetherill's behalf when he requested more chemistry lab space. Asa ordered the remodeling of the second floor of his Lehigh Valley Railroad's South Bethlehem Telegraph Office as a lab to teach chemical blowpipe analysis. Students had to take their practical exams upstairs amidst a random audience of railway workers and townsfolk stopping by to send and receive telegrams downstairs.

By today's criteria, we might call Charles Mayer Wetherill Lehigh's first *inorganic chemist* but if he really understood the way 21st century chemists classify their discipline, he may have chosen to be called an *analytical chemist*. In 1853, he had prepared for the New York Crystal Palace Exposition of the Industry of All Nations an exhibit of Pennsylvania minerals and chemical products derived from them. He prepared a scholarly guidebook to his exhibit. After the Exposition closed, he made a journey through Michigan and other North Central states to locate and index their mineral deposits. During the Civil War he was appointed by President Lincoln to optimize the formulation of gunpowder being used by the Union Army and when he arrived at Lehigh he set up his lab to do mineral analysis. The first paper based on his first six months of lab work was "Experiments on itacolumite (articulite), with the explanation of its flexibility & its relation to the formation of diamond," and it appeared in the *American Journal of Science & Arts*, v.44, July 1867.

Wetherill was so proud of the first publication from this new university that he constructed a handsome wooden, glass-covered case, inside of which he pasted a title "Analysis of the Bending Rock," a long slim segment of the very itacolumite he had used showing placement of his drill

holes, some glassware he had employed in the analysis, and a reprint of his paper. This display was often exhibited in the Department but appears to have been discarded in or about 1974 when the Department moved from Chandler Laboratory to Seeley G. Mudd.

Wetherill was replaced by **William Henry Chandler** who served as chairman and professor from 1871 to 1904 and continued the trend of emphasis on ores, minerals, and analysis. The only degree continued to be the A.C., but the Department did grow and add other faculty in this period. Joseph P. Richards, an A.C. graduate in 1886, did a senior honors thesis on aluminum salts and alloys. He returned to Lehigh in 1890 to take an M.S. (1891) and our first Ph.D. (1893) on copper, copper salts, and calorimetric measurements thereof. By any reasonable yardstick this was inorganic chemistry. The history of Lehigh's inorganic chemistry program from Richards through to 1940 has been described by Billinger.

In 1940, **Chem 6. Inorganic Chemistry** and **Chem 7. Inorganic and Physical Chemistry** were the first two courses taken by chemistry and chemical engineering majors at Lehigh. For chemistry majors, two advanced Inorganic courses were taught by Mr. McReynolds. The course descriptions for these courses were quite ambitious, and it is interesting to note that the cited topics still are covered in advanced undergraduate and graduate courses at the beginning of the twenty-first century. Obviously, the content has expanded immensely with new discoveries, theories and concepts being included.

Between the years 1940 and 1953 **Frank J Fornoff** (A.B. Illinois 1936 and Ph.D., Ohio State 1939) carried the load of teaching the advanced courses and introduced another inorganic undergraduate course entitled "Systematic Survey Inorganic." Billinger has already referred to the fine manner in which Fornoff committed himself to lectures, recitations and administrative duties. One of his lasting contributions was the construction of a large illuminated periodic table for the main lecture hall. This same periodic table has been modified and resides in the main lecture room in Neville Auditorium. Fornoff and **Harvey A Neville** were the inorganic research staff. Nevillle was the department chairman and later became President of Lehigh University. Fornoff left the University in 1953. Prior to his leaving, the advanced level inorganic courses were renumbered to 302, 402 and 403, the same number that would be used for the next 50 years.

In the following year, Assistant Professor of Chemistry, **Ralph Gustav Steinhardt** (B.S. Chem Lehigh 1940, MS 1941; B.S. Chem. E. Virginia Polytech. 1944 and Ph.D, Lehigh 1950) led the undergraduate advanced course Chem 302. Steinhardt had returned to Lehigh after completing a B.S. Chem Engineering degree at VPI and then working in the Engineering Detachment at Los Alamos on the Manhattan Project. Steinhardt – who dearly loved Bethlehem's Bach Choir – came back tp Lehigh to complete his doctorate in chemistry, which he obtained in 1950. He taught classes and laboratories in inorganic chemistry. He was promoted to Assistant Professor in 1953. This same year, a Research Assistant Professor **Raymond R. Myers** (B.A. Lehigh 1941, M.S. Tennessee 1942, Ph.D. Lehigh 1952) taught the 400-level courses.

This appears to have been the only advanced course Steinhardt taught. He left Lehigh in 1955 for the faculty at VPI and subsequently for Hollins College (now University) where he retired and then died (in 1994). At Hollins Steinhardt patented the self-slitting spectroscope, which allowed a large number of P-chem students to observe a spectral phenomenon simultaneously in a teaching

classroom. He also took frequent research sabbaticals at Brookhaven and Oak Ridge National Labs as well as at Cornell and Stanford Universities.

In 1955 **Robert C West** (B.A. Cornell 1950, A.M. Harvard 1952 and Ph.D. Harvard 1954) joined the chemistry department. West had worked with the well-known organosilicon chemist Eugene Rochow. West and Myers shared the inorganic teaching for two years before West accepted a position at the University of Wisconsin in Madison, WI. Although West had several research interests over the years, a major part of his research was with organosilicon compounds. The work included syntheses and characterizations of multiply bonded silicon derivatives, silylenes and more recently silicon analogs of drugs. He has a remarkable list of publications and has received numerous rewards for his research accomplishments. Upon his retirement, he was named the Rochow Professor at Wisconsin.

With the loss of West, Myers assumed teaching all inorganic courses until **Robert S. Sprague** (B.S. Washington and Jefferson 1943, Ph.D. Illinois 1949) joined the staff in 1957. Sprague introduced two new courses entitled "Systematic Inorganic Chenistry" and "Inorganic Preparations," taught Chemistry 403, and assisted Professor Anderson in the courses on radiation methods and X-ray research. Myers continued to teach Chem 302 and 402. Myers and Sprague continued this teaching mode through the 1962-63 academic year.

Myers – like many faculty of his day – bridged several areas of chemistry including inorganic and polymer (coatings) chemistry. After his Lehigh BS, Myers became a research chemist for Monsanto Co. (1942-46) and then for Jefferson Chemical Co. (1946-50). He returned to Lehigh, finished his PhD, became Research Associate (1952-53), and then proceeded through faculty ranks to research professor of chemistry (1953-65). When he left Lehigh in 1965 for Chemistry Department of Kent State University (Ohio) his faculty colleagues named him an honorary Lehigh faculty member.

After Lehigh, Myers was chairman of the chemistry department at Kent State University, 1965-77, and endowed chairman of the chemistry department, 1977-85. At Lehigh and at Kent State Myers was well-funded from industrial sponsors for his research on coating rheology and in Chandler-Ullman Hall he organized a Paint and Varnish Institute to conduct that enterprise. At Kent State he also held the title of research director of the Paint Research Institute, 1964-83. He chaired the Gordon Research Conference on Coatings in 1962 and was a consultant to numerous government agencies and private companies.

He received the ACS National Award in chemistry of coatings and plastics in 1971. He also received the distinguished service medal of the Society of Rheology in 1985 and the A. Cressy Morrison Award of the New York Academy of Sciences in 1958. Ray Myers and his wife Hilma loved the Lehigh Valley and when he retired as Chair at Kent State they moved to Bethlehem where he lived till his death at age 78 in 1998.

**Charles S. Kraihanzel** (Sc.B. Brown 1957, M.A. Wisconsin (org.) 1959, Ph.D. Wisconsin (inorg.) 1962) joined the department in the fall of 1962 following a year postdoctoral appointment with Prof. Albert Cotton at M.I.T. Kraihanzel received his Ph.D. with the previously mentioned Robert C. West at the University of Wisconsin. Myers continued to teach Chemistry 302 while

Sprague and Kraihanzel shared the other courses through 1965-66.

Myers position at Lehigh was Research professor. His major research interests were in rheological chemistry as he studied films and other related materials. One particular study with an inorganic content was the study of films of long-chain acid salts of transition metals. This was basically a coordination complex /ligand field study. Myers left Lehigh in 1965 to become Chairman of the chemistry department at Kent State University in Ohio.

Kraihanzel's previous experience with organosilicon compounds at Wisconsin and metal carbonyl complexes at M.I.T. provided the bases for many of his research activities. Specific activities included syntheses and uses of organosilylacetylenes in organic chemistry and metal complex chemistry. There was also some work reported on triorganicsilylcyclopentadienes which were of interest as "ring whizzers." Many studies were carried out with phosphine substituted methylmanganese carbonyl complexes. Mechanisms for the stepwise reactions were developed using a combination of proton nuclear magnetic resonance and metal carbonyl stretching frequencies. This work was related to the so-called cone-angle effect between ligands in complexes. Another study the reactions of halophosphine-substituted carbonyls led to complexes of unusual ligands such as diphenylphosphinous acid and esters. Perhaps the most interesting compounds were those that underwent methane elimination by carbon-hydrogen bond formation. In a completely different vein, transition metal complexes of diacetamide were synthesized and characterized as isoelectronic analogs of acetylacetanato complexes. Complexes of diamido ions were also prepared for the first time, in spite of numerous attempts reported by inorganic chemists at other institutions.

**Thomas R. Ortolano** (B.S. Loyola University of the South 1960, Ph.D. Louisiana State University 1964) joined the department after a year of postdoctoral study at Illinois. Tom was interested in the electronic structures of transition metal complexes. The initial grant that he received from NSF was principally focused on production of a device that would allow study of the vis-UV spectra of complexes in the gas phase in an attempt to get better resolution of the individual absorption bands through elimination of any broadening of the bands due to solvent effects. It was a very ambitious project that required construction of a long-path length cell to overcome the dual problem of low concentration in the gas phase and the relatively low molar absorptivity of metal complexes. Designing the optics and achieving the low pressures to get the complexes into the gas phase was not successful. His interest turned toward solution studies involving Lewis-base adducts of copper and nickel complexes of coordinatively unsaturated compounds to investigate both their electronic structures and the thermodynamics of adduct formation. He also focused on syntheses and characterization of metal complexes of sulfur donor ligands. Tom decided to leave Lehigh in 1972 and became a student counselor in the Bethlehem Area School District. He died in 2011.

In 1967, **Kamil Klier** (Dipl. Chem., Charles (Prague) 1954, Ph.D, Czechoslovakia Academy of Sciences (Czechoslovakia) 1961) immigrated to the United States from the Czech Republic and was appointed to an associate professorship. Although he was not identified as an inorganic chemist, he was able to assume teaching of the advanced bonding courses taught in the inorganic division. In the years to come, Klier proved to be an outstanding teacher and research chemist. He carried out a number of excellent studies of high-pressure catalysts involving zeolites and the

like. Some of the studies required use of the Guoy Magnetic balance Kraihanzel had built for the inorganic lab courses and his research.

In 1975, the Mudd Building and Neville Hall were opened and the teaching of all inorganic courses continued to be shared among Sprague, Kraihanzel and Klier. Although Sprague continued to be the primary lecturer and director of laboratory for the introductory courses, others in the department took turns as lecturer. In 1983, Sprague became assistant chairman and continued in this position until his retirement in 1988. A major addition to the department in this period was the creation of a computing lab on the fourth floor. In 1980, Kraihanzel had a sabbatical leave at Aberdeen Proving Ground where he became very familiar with use of computers for molecular modeling. Upon his return, in conjunction with the computing center a second computer room with high level computers for doing modeling calculations was created. In time, both labs became very busy for undergraduate experiments, graduate courses, and research. Klier's assistance with the development of the modeling system was very valuable. Much of his later research would rely heavily on computer modeling of catalysts.

As mentioned above, the introductory chemistry courses had been primarily the responsibility of the inorganic section for many years. These courses were taken by all students in the University. Shortly after the move to the Mudd Building, the teaching of the introductory courses was rotated among a number of different faculty members. In 1991, Kraihanzel experimented with the creation of a new two-semester course designed for students who were considering a chemistry major or any other major which would entail taking a significant number of upper-level chemistry courses. Each of the two three credit course was accompanied by a one credit lab which would include experiments of a somewhat higher level than those in the standard course. The courses were called Concepts. Models and Experiments and were originally numbered 75/76. This addition to the department offerings proved to be successful and still continues into 2015 with the same name but is listed as Chem 40/41. Teaching this course sequence has remained primarily the responsibility of the Inorganic Division, though with significant contributions from colleagues in Physical Chemistry.

Kraihanzel retired in 2001 and died in Bethlehem in March 2015. Klier retired as a distinguished professor in 2011.

In 1990, **Gregory S. Ferguson** (B.S., College of William and Mary in Virginia; Ph.D., Cornell University; Postdoc, Harvard University) joined the faculty. He completed his graduate work in the area of organometallic chemistry with Pete Wolczanski, and then was an NIH postdoctoral fellow working on surface chemistry with the renowned George M. Whitesides. Upon arriving at Lehigh, Greg began developing the surface chemistry of hydrocarbon elastomers, which led to a series of papers describing the relationship between interfacial behavior and bulk rubber elasticity. These studies resulted in the preparation of surfaces that responded reversibly to changes in temperature, and ultimately to "smart adhesion" between such surfaces and another solid. The smart adhesion work was highlighted in *Nature*, *Scientific American*, *The Sunday Times of London*, as well as other reviews, newspapers and trade publications. During the pre-tenure period, he also initiated a project involving the sequential adsorption of organic polyelectrolytes and single sheets of silicate clays to produce multilayered structures with sufficient order to diffract x-rays. The initial work was published in *Science* in 1994, and his subsequent studies

extended the method to include a variety of inorganic nanoparticles and organic polymers. The *Science* paper alone has been cited in over 60 review articles and many times that number in research articles. This synthetic approach to thin-film synthesis is currently broadly known as the layer-by-layer (LbL) method.

After being awarded tenure in 1996, he began a collaboration with **Michael Freund**, an Assistant Professor and electrochemist in the Analytical Division of the Department, to follow-up on some early experiments Greg had done with an undergraduate student during his first summer at Lehigh. The focus of this project was developing a regioselective method for forming self-assembled monolayers (SAMs) of alkyl thiolates on selected gold electrodes, in the presence of other gold electrodes. This work led successfully to papers describing a method involving oxidation of alkyl thiosulfates and was highlighted in *Chemical & Engineering News* and *Analytical Chemistry*. The collaboration also produced a related and timely paper elucidating the role of the gold substrate in accelerating or inhibiting the oxidation of SAMs in the presence of ambient air and light. Freund left Lehigh in 1999, and since then, Greg's group has worked independently on the regioselective formation of SAMs, including development of a second method based on the protection-deprotection strategy commonly used by synthetic organic chemists. His most recent research has focused on the surface chemistry and optical properties of gold-oxide thin films. He was promoted to Full Professor in 2012.

In 1998, **Li Jia** (B.S., Lanzhou University; Ph.D, Northwestern University; Postdoc, University of California, Berkeley) joined the faculty. Li's graduate work with Tobin Marks and postdoctoral position with Richard Anderson provided him an ideal background for the catalysis studies he began upon his arrival in Bethlehem. His research focused primarily on the design of new cobalt catalysts for the synthesis of CO-containing polymers. These successful studies resulted in a series of papers that caught the attention of leaders in his field and have been cited in reviews of the area published in *Chemical Reviews, ACS Nano*, and *Chemical Communications*, among others. A second project in his group focused on a clever interfacial technique for patterning assemblies of sub-micron colloidal particles. This work has also been cited in reviews published in *Chemical Society Reviews*, *Angewandte Chemie-International Edition*, and other journals. Much to the chagrin of the department, Li left Lehigh in 2005 to accept a position at Rohm and Haas, where he worked for two years before taking another academic appointment at the University of Akron, where he resides currently.

In 2006, **Kai M. Landskron** (B.S., University of Bayreuth; Ph.D., Ludwig Maximilians University, Munich; Postdoc, University of Toronto) joined the faculty. Kai filled a real niche in the department, as a "card-carrying" solid-state inorganic chemist, and his graduate-level course in solid-state chemistry has similarly enhanced the breadth of the department's graduate curriculum. Kai's graduate work with Wolfgang Schnick focused on high-pressure inorganic chemistry, and his postdoctoral studies with the prolific Geoffrey Ozin provided him experience with sol-gel methods that he would soon put to good use at Lehigh. As an assistant professor, Kai succeeded quickly, publishing numerous papers exploring the synthesis of novel mesoporous inorganic phases using template sol-gel, solvent-free nanocasting, and ultrahigh-pressure methods. The latter studies were facilitated by a fruitful collaboration with the Geophysical Laboratory at the Carnegie Institution of Washington and are described in a recent review from his group in *Accounts of Chemical Research*. In an important extension of his synthetic work, Kai has also

examined the use of mesoporous solids for the sorption of green-house gases ($CO_2$ and $CH_4$) of both environmental and economic importance.

Kai's research results have been included in reviews published in *Chemical Society Reviews*, *NPG Asia Materials* and *Energy & Environmental Science*, as well as others. In addition to his independent research, Kai also forged productive collaborations with the Liu, Moore, and Glover groups, resulting in several additional papers, many of them well-cited. Kai was promoted to Associate Professor in 2012.

Over the past several years, the instrumental infrastructure on campus supporting the research of faculty members in the Inorganic Division has grown to include a small-angle x-ray diffractometer, a single-crystal x-ray diffractometer, and a spectroscopic ellipsometer. In addition, the upgrade of the hoods and air-handling system in the Mudd Building in 2006 was crucial in providing the necessary hood space to accommodate modern research in this area.

## 75-Years of Organic Chemistry at Lehigh University (1940-2015)
## By Ned D. Heindel

Organic chemistry as a sub-area of chemistry came late to Lehigh and it never achieved the number of faculty slots traditionally allocated to organic at other major research universities. In 1940, only two of the tenure track faculty out of 15 were organic chemists, in 1948 it was three out of 15, in 1964 it was three out of 14, and in 2015 it achieved an all-time high of six out of 17. Perhaps because Chemistry was a department within the Engineering College until 1987 or perhaps because of the strong engineering and materials thrusts associated with Lehigh's research programs which were served by the Department, organic had traditionally been an under represented sub-discipline. Surging enrollments in biology in the second decade of the 21st century and growth of the hyphenated bio-areas have increased the pressure to provide more organic chemistry teaching to undergraduates. This factor has led to augmentation of the organic staff.

Our founding chairman, **Charles Mayer Wetherill** (1825-1871) was broadly educated in analytical chemistry (with James Booth – U of P), in gases (Gay-Lussac – Paris), and in agricultural/food chemistry (Liebig – Giessen). His AB (1845) was from the University of Pennsylvania and his Ph.D. (1848) was from the University of Giessen under the mentorship of Justus von Liebig for a dissertation on fermentations. In 1853, New York Medical College award him an honorary M.D. Wetherill had very little personal interest in organic. His research, publications, and teaching emphases were on the chemistry of illuminating gases and on analytical chemistry of ores (mainly zinc), wine grapes, sugars, syrups, animal fats, and explosives. When he wrote the first curriculum for the Department it was heavily biased towards analytical chemistry, field assaying, flame analysis, and blow-piping and, in fact, he had the trustees name our undergraduate degree as A.C. for Analytical Chemist. The original Lehigh catalog and subsequent catalogs for decades called the department, the School of Analytical Chemistry. Under both Wetherill and his successor **William Henry Chandler**, Lehigh did not grant a B.S. and nearly all the graduates became industrial analysts.

Under Chandler, who succeeded Wetherill and chaired the department from 1871 to 1905, the department staff was small but the analytical tradition continued. Advanced undergraduates served as instructors for lower division students, a handful of A.C. grads were retained to help with the teaching, and one regular instructor, **Frederick William Spanutius**, M.S. (Ohio State - 1890), was hired to teach Qualitative Analysis, Assaying, and Industrial Chemistry. Spanutius served largely as an assistant to Chandler from 1892 to 1904.

The first organic chemistry faculty member to be hired was **William Bush Schober** (b 1864 – d 1935). He was hired by Chandler in 1892 immediately after obtaining his PhD from Johns Hopkins University. Hired at instructor level he wasn't promoted to full professor status until after Chandler's death at which time he also assumed the department chairmanship. Schober was a well-trained organic chemist whose dissertation at Hopkins (under Ira Remsen) had been on dyestuff syntheses and characterizations. Shortly after arriving at Lehigh he took on our department's second Ph.D. student H. E. Kiefer and supervised his dissertation on sulfonated azo

dyes. (Chandler himself had supervised the department's first PhD – Joseph Richards (1893) – who did his research on synthesis and characterization of copper salts).

In 1896, Schober translated from German the famous textbook by Ludwig Gatterman (1860-1920), *Practical Methods of Organic Chemistry*. His was an authorized translation checked and approved by Gatterman himself, a professor at Gottingen, Heidelberg and later (after 1900) at Freiberg. As new and expanded German editions appeared Schober produced the subsequent English translations in 1901 and in the year of his retirement, 1914. From the second edition onward, Schober was assisted in the translation by **Vahan Simon Babasinian** (b 1876-d 1939). Schober and Babasinian taught from the text for most of their Lehigh careers and it was Schober who terminated Lehigh's rather unorthodox A.C. degree and replaced it in 1905 with a more traditional broader B.S. degree containing significant organic chemistry.

During Schober's chairmanship a course on advanced organic chemistry was added and Schober himself taught it while his young organic protégé, Babasinian ("Dr. Babs") advanced through the ranks to a professorial status where he merited the successorship. Hired by Schober as Instructor in Organic Chemistry directly from his Brown University doctorate (1906) he too was appointed to a full professorship only after Schober's retirement in the same way that Schober had to wait for Chandler's retirement to advance. Lehigh was very parsimonious with the designation of full Professor until the 1930s. During World War I, Dr. Babs had been inducted into the U. S. Army Chemical Warfare Service and assigned to a chemical weapons research group located at American University in Washington, DC. Here he got to know many leading industrial and academic chemists, connections which would serve him well in his later career. Lehigh granted him a special leave for this assignment and he returned to full academic duties in 1920 receiving his final promotion in 1922.

While Babasinian died in May 1939 and thus is not an active department member during the 1940 – 2015 period covered by this history, he nevertheless played a strong role in shaping the department of today. His research was corporate-sponsored, was related to practical problems (color-fast dyes), and resulted in Lehigh patents which were licensed to industry, in his case DuPont. Until the coming of federal grants from NIH (1938) and NSF (1950) as a way to fund graduate research in private universities, Lehigh's model had been to seek industrial support for graduate students on projects likely to be of direct commercial value. (In 1915 virtually all of the department's external research funding came from chemical industries while in 2015, less than 8% of the Chemistry Department's external research budget comes from corporate sources. Industrial support has shrunk significantly as a percent of the total as governmental grants and contracts have become more common.) Also, Dr. Babs' interest in the synthesis and mechanisms of heterocyclic compounds initiated a tradition later continued by **Edward D. Amstutz, Thomas E. Young, and Ned D. Heindel.**

Nelson Leonard (1916 – 2006), the late distinguished professor of organic chemistry and member of the National Academy of Science from the University of Illinois, did his senior honors research under Professor Babasinian (1936-37). Nelson remarked in his autobiography that Dr. Babs assigned him a project to study electrophilic substitution onto unsubstituted and mono-substituted thiophenes. Leonard found Babasinian to be very aware of national and international centers of organic research and Dr. Babs encouraged the young Nelson to read the

papers of faculty at Oxford (UK). With Babasinian's enthusiastic support, Leonard landed a doctoral fellowship to Lincoln College (Oxford) but the outbreak of WW2 necessitated that he return to the States before completing the degree. Nearly seven decades after he left Lehigh, Leonard was still remembering Dr. Babs as the students' favorite source of real world information and a much-consulted advisor to the undergraduates of his generation.

**Judson ("Jud") Gray Smull** (b 1882 – d 1978) (BS Chem Lehigh University 1906 and MS Organic Chem 1921) joined the faculty as an instructor in organic chemistry in 1919, was promoted to Associate Professor in 1947, and retired in 1950. He retained a small laboratory in the west wing of the Chandler-Ullmann Building and until 1967 he frequently came into the lab to conduct syntheses. Jud was interested in chemically modified plant oils as polymers for paint and especially in accelerating the drying of such paints by cross-linking the polymer chains with maleic anhydride. His research was supported by National Lead, a leading paint manufacturer. Several of his paint improvements made considerable revenue for National Lead and they provided partial pension support to him in his retirement. Jud – who was one of the department's first B.S. graduates -- had originally been hired as a research and teaching assistant for Professor **Ullmann** and later for **Professor Harvey Neville**. Jud's son, grandson, and great-grandson all attended Lehigh.

An organic chemist with pharmaceutical interests, **Nelson Roy Easton** (AB Middlebury 1941, PhD Illinois 1946) joined the Lehigh faculty as an assistant professor in 1947. Easton's research was in the synthesis of synthetic morphines intended to break addiction cravings in addicts. Easton theorized that the established anti-addiction properties of methadone might be enhanced if the gem-diphenyl rings and the ketone carbon were constrained in a five-member carbocycle. He enlisted two doctoral candidates and several M.S. students and launched a vigorous research program assisted by **Velmer B. Fish** of Lehigh's analytical chemistry faculty. Fish (PhD Iowa 1942) had worked in microanalysis for J. T. Baker Chemical Co. (Phillipsburg) until recruited by Lehigh (1948) to teach qualitative and quantitative organic analysis and run a combustion analysis service for organic compounds generated by Lehigh faculty and students. Fish's personal research was in the analytical application of biindolyls as highly chromophoric ligands for metal ions and he was capable of synthesizing his own organic bidentates as needed. Fish is hard to classify by rigid definitions of the sub-fields of chemistry because he taught, researched, and published in both analytical and organic journals. In his own time Fish was viewed as an analytical chemist. But, he joined Easton's synthetic organic project and took over the supervision of his PhD and MS students when Easton resigned suddenly (1952) for a senior research position in medicinal chemistry at Eli Lilly Pharmaceuticals in Indiana. Fish was promoted to associate professor in 1954 and died on the job of a septicemia on 6 August 1968.

The key intermediate compound which Easton sought for his potentially improved methadone was 2,2-diphenylcyclopentanone for which Stuart S. Kulp (Lehigh PhD 1957) obtained a process-suitable pathway. Kulp, who spent a long career as chair and professor at Moravian College, co-published his doctoral work with Easton and Fish in a series of papers, see *J. Medicin. Chem.*, Vol. 6, pp 516-519 and other papers cited therein. It appears that the target pseudo-methadone compound – which sported a dialkylamino side chain on Kulp's platform – was made by Easton during his years at Eli Lilly and on biological testing apparently was not superior to methadone.

The roots of what the Department became in the 1940 to 2015 period were planted early in the 20th century. Professor **Harry Maas Ullmann** (PhD Johns Hopkins 1892) had become the gray eminence of industrial organic chemistry in the period between the Wars. He and Schober added the courses and the laboratory work which transformed Lehigh's chemistry program to more than analytical. In fact, Schober and Ullmann arranged for the trustees to offer to everyone who'd received an A.C. degree under the Wetherill-Chandler era to exchange that diploma for one that read B.S. in Chemistry. Ullmann advanced from Instructor (1894) to Professor (1912) and chaired the combined departments of chemistry and chemical engineering from Schober's resignation in 1914 to 1938. Although he officially retired (1938) and ceased teaching before the period of this 75-year report, he maintained his lab and conducted research until 1948. With Jud Smull as his assistant and co-worker he exploited natural long chain fatty acids and esters as property modifiers for lacquers, varnishes, and inexpensive plastics. Ullmann used his retirement years to write patents and four were granted to him in the late 1940s. It was Schober and Ullmann who created an Organic Chemistry Division at Lehigh.

After Ullmann's retirement, the Department was led through the tempestuous times of World War 2 by a versatile physical chemist, **Harvey Alexander Neville** (1898-1983), see *Physical Chemistry* section for his biography. In leadership and in personal research Neville was the right personality for the time. A cultured, elegant, always well-dressed southern gentleman (BS Randolph-Macon), he often wore a tuxedo to the annual Sigma Xi dinner and the year-end faculty awards dinner. Neville had the sparkle dust of the Ivy League upon him (Princeton PhD and postdoctoral teaching). He had been hired by Ullmann in 1927 as part of a plan to re-start the department's doctoral program with a core of highly credentialed faculty. After awarding two outstanding doctoral diplomas in the Gay-Nineties the department had shelved the granting of the PhD in 1895 until it was brought back under Ullmann.

Neville fit the model for graduate research mentoring as required by the Lehigh of the 1930s and 40s. He brought in considerable industrial funding including a long term contract to improve the shelf-stability of chocolate candy, but he also proved adept – especially during the War – at attracting government money. Military research some of it classified, and officer training programs in practical chemistry were part of the new mission. During his chairmanship, 1938 – 1952, Neville arranged the separation of Chemical Engineering as a free-standing department, expanded the research center model for graduate student support, and provided central administration support of the graduate program. He did this through a series of career-climbing moves as Director of the Institute of Research (now the Office of Research and Sponsored Programs), Dean of the Graduate School, Provost, and finally President. In 1961, Neville moved on to become Lehigh first up-from-the-faculty president and in the three years of service in that office he started other research centers in other departments. Neville helped his successor as chair, **Earl James Serfass** (see *Physical Chemistry* section for biography), to open a number of new chemistry slots. Serfass and Neville guided those searches to hire faculty intended to build Lehigh's research image.

In 1954, Serfass hired two Harvard products as assistant professors, **Edward M. Kosower** and **Robert C. ("Bob") West**. The former was a physical organic chemist (PhD UCLA 1952, postdoc Harvard with Westheimer) and the latter was an organometallics chemist (PhD Harvard

1954 with Rochow). Both did start research programs at Lehigh but were enticed away two years later (1956) by the University of Wisconsin-Madison. In 2015, both are still active researchers in emeritus status at Tel Aviv University and Wisconsin respectively. Kosower and West remember the Lehigh chemistry of their years as dominated by **Albert C. Zettlemoyer** ("who ran an Ink Institute concerned mainly with colloids" – Kosower) and Edward D. Amstutz ("a well-known heterocyclic chemist who did the courting of me for the Lehigh position" – Kosower). West noted that in 1954 "Earl Serfass rivaled Zettlemoyer for having the largest research group but I don't think there were more than twenty graduate students to go round."

Kosower and West were not happy at Lehigh which the former described as having "little equipment and limited internal research support," and the latter described as "instrumental hardware available was minimal and the available grad students were borderline competent." Kosower went on to add, "I did not have many contacts with other faculty except for Bob West but I do remember having many friendly chats with **George L Brownell**."

Asked to comment on his experiences at Lehigh, Kosower remarked, "During my time at Lehigh I had one M. S. student named John C . Burbach who worked with me on the effect of methyl substitution on complexing of pyridinium ions. His results led me to consider Mulliken's charge transfer complexing and then to the basis for Z-values, based on the sensitivity of the absorption maximum of pyridinium iodides to solvent. Thus, my research at Lehigh was central to my later career in science. We published a paper on Burbach's results. E. M. Kosower and J. C. Burbach, *J. Am. Chem. Soc.* 78, 5838-5842 (1956). 'Equilibrium constants for pyridinium iodide charge-transfer complex formation.' Actually, Burbach's work was preceded by research carried out by a Lehigh undergraduate, Paul Klinedinst, in a study that also led to a publication, E. M. Kosower and P. E. Klinedinst, Jr., *J. Am. Chem. Soc.* 78, 3493-3496 (1956). 'Additions to pyridinium rings II. Charge-transfer complexes as intermediates.' Paul went on work for my former mentor, Saul Winstein, for his Ph.D. and eventually became a Professor in Chemistry at California State University Northridge. My teaching duties at Lehigh were in the organic area. I taught an advanced course in physical organic chemistry to a modest number of students. I remember one particularly bright fellow, Alfred M. Stock.

**George L. Brownell**, like his friends Kosower and West, was only briefly a member of the Lehigh chemistry family. He was hired as an Assistant Professor in 1955 to assist the senior faculty in both organic and physical chemistry by supervising the entry level labs and the seminar program. Brownell taught the Advanced Topics and the Natural Products courses in organic and even managed the seminar program in biochemistry. He held a BS from Rensselaer Polytechnic (1947) and a Ph.D. from Ohio State (1953).

The departure of two organic faculty members in 1956 – Kosower and West – resulted in additional teaching assignments for Brownell, who would also soon resign (1958). A quick search in the summer of 1956 for a new Assistant Professor of Organic Chemistry turned up a promising young organic chemist, **Robert Sumner Rouse**, who was then writing his doctoral dissertation at Yale (BS '51, PhD '57 both from Yale). Rouse was willing to start in September and to finish his PhD while teaching at Lehigh. He soon found himself sharing Advanced Topics in Organic Chemistry, Advanced laboratories, General Organic, and seminar with Amstutz and

Young. Rouse handled the Theoretical Organic course by himself and, of course, the Heterocyclic course remained under Amstutz's control.

Rouse developed an interest in faculty governance. He sought appointments to key university committees one of which was the prestigious University Visiting Lecturers Committee. Having obtained an administrative appointment (Department Chair and subsequently Dean of the Faculty) at Monmouth College, Rouse resigned suddenly on 31 January 1962 and departed. Once again the department was in crisis over teaching assignments. In September 1979 at Monmouth, Dean Rouse achieved an unwanted region-wide visibility. A highly publicized strike of the faculty shut down the college and thrusted Rouse into the spotlight in the local press. He was selected by the trustees to negotiate with the faculty, an activity that lasted several days but led to a successful settlement of the strike. Rouse completed his career and retired at Monmouth.

During these unsettled years of turn-over among the young organic faculty, the mantle of being the senior organic faculty member had fallen to **Edward Delbert Amstutz (**1909 – 1983) who had been hired in 1938 to fill Ullmann's faculty slot – but not his chairmanship -- from an instructorship at Union College (1936-1938). Amstutz had obtained his PhD (1936) from Cornell where he taught briefly as a postdoc until moving to Union College and then to Lehigh. "Easy Ed," as the students called him behind his back – an affectionately understated appellation since he was reputed to be the most demanding and hardest grading member of the faculty – was a heterocyclic medicinal chemist. Amstutz had an impressive career in teaching, research, and administration. He was named the first Howard S. Bunn Distinguished Chair Professor in 1962, succeeded to the Department Chairmanship on the retirement of **Earl James Serfass** in 1959, served as chair till 1967, and retired in 1970.

In his span of 42 years Amstutz saw (and in some cases guided) more change in the department than had ever been experienced up to that time. Amstutz's own research was initially supported by industrial contracts (Warner-Lambert Pharmaceuticals) and by corporate gifts (Althouse Color and Dye, J. T. Baker Chemical) but as the less restrictive federal funds became more widely available he made the transition to submitting proposals and seeking grants from NIH and NSF. He obtained Fulbright support for a sabbatical in Spain and returned with two Spanish students to study at Lehigh. Very early planning, space needs assessments, and growth predictions which eventually led to the construction of the Seeley G. Mudd Building, also began under Amstutz's chairmanship. Studies by a committee of faculty and consultants showed it would be virtually impossible to knock down the Chandler-Ullmann stone fortress, clear the site, rebuild a modern chemistry building in the same space, and keep the department operating during the process. A decision to build a chemistry laboratory north of Packer Avenue on land seized from many small owners of row homes under an eminent domain/urban renewal project was reached early in the chairmanship of Frederick Fowkes.

Repeated crises in filling teaching needs as young faculty departed what they perceived to be less than desirable career positions, was but one of many problems that came up during Amstutz's chairmanship. Several long-running research centers – industrially well-funded but generally considered to be exploitive of graduate students – were closed or departed Lehigh with the blessing and encouragement of Amstutz: Chocolate/Confectionary, Leather, Paint and Varnish

were a few of these. The winds of changes were blowing more-and-more of the academic research support from industrial sponsors to federal sponsors.

So-called "soft-money" or research faculty positions had become common at Lehigh – and frankly at many other institutions – in the 1950s and 60s but they had in fact existed all the way back to the founding of the University system in America. Jud Smull, Dr. Babs, and even Ullmann had in part supported their salaries by bringing in industrial funding. In his more than a decade in upper administration, Harvey Neville had envisioned such not-supported-by-tuition-dollars slots as a mechanism to expand the faculty. Titles of "Research" began to appear in front of faculty ranks. At first most of these individuals were Lehigh PhD graduates being retained in a more elevated post-doctoral status before moving on to more regular jobs. For example, **Robert L. Stubbings** (LU PhD 1949), **William Comstock Walker** (LU PhD 1946), **John Joseph Chessick** (LU PhD 1952), and **Raymond R. Myers** (LU PhD 1952) were all retained by the department as Research Assistant Professors after obtaining their doctorates. Mostly these individuals were junior investigators working for a well-funded regular faculty member from whose contracts they derived their twelve month salary. On occasion each did some teaching: Stubbings ran a Leather Chemistry Seminar, Myers taught Advanced Inorganic Chemistry, Chessick helped out in the physical chemistry laboratories, and Walker assisted in the chemical engineering unit as well as in Zettlemoyer's Ink Institute – chemistry and chemical engineering were two departments under one chairman until 1951.

Problems, however, began to arise as external support for academic year faculty salaries began to dry-up, annual salary increases of the individuals strained budgets, and the individual holding the research slot stayed at Lehigh for an extended time. Extended stays presumably meant promotions in rank and – following AAUP common practices – meant tenure after the sixth year. Granting tenure when the position depends on a constant flow of grant and contract monies to support it, has always been highly problematic at most Universities. Myers, for example, was promoted from Assistant Research Professor to Associate Research Professor in 1957 and on to Full Research Professor in 1961 but nevertheless leaped to the opportunity to obtain a hard-money (tuition supported) professorship-chairmanship at Kent State. Myers departed in 1965 and the rest of the research faculty scattered to industry and to other teaching positions.

However, Lehigh and the Chemistry Department did continue the occasional use of "Research" titles as a way to bring in specific skills thought to be essential for the Ink Institute and the surface and materials centers. Early in their careers at Lehigh a few physical chemistry faculty members (**Eugene M. Allen, R. Doreswamy Iyengar, Henry Leidheiser, Fortunato Micale, and Gary Simmons**) who became part of the then highly successful Center for Surface and Coating Research, did possess a "Research" insertion in their titles or a designation as a center/institute director, to signal that these slots were externally supported. With one exception (Micale), members of this new generation of research faculty were not Lehigh doctoral graduates but external hires most of whom were well-renowned chemists brought in at senior ranks: Allen and Leidheiser came in as research professors and Iyengar as research associate professor.

As noted in the section on *75-Years of Biochemistry*, the Chemistry Department also briefly hosted (1968-83) within its faculty ranks two health-related biologists brought in to strengthen the newly created Center for Health Sciences. **Thomas C. Cheng** (1968-1980) brought in as a

full professor and **Yuji Hazayama** (1979-1983) hired as a highly experienced assistant professor. Their salaries were paid by the Office of the Vice President for Research with indirect cost recovery dollars generated from NIH grants. Both were, in fact, "soft money" faculty – not substantially different from Allen, Chessick, Iyengar, or any of the others mentioned herein -- although neither bore the "research" designation in their title because their support came from a re-direction of Lehigh non-tuition dollars. Both were constantly reminded to seek to cover their salaries from their grants. Both left for more stable positions. Their story is told in the *Biochemistry* section.

At one point in the 1960s the Chemistry Department listed 25 faculty members but tuition-derived dollars underwrote only about 15 equivalents of those positions. The designation of some faculty as "research" or as directors of research units, continued until 1986-87 when the designation was dropped entirely and all soft-money slots were underwritten by central university funds – at some considerable pain to the departmental discretionary budgets. It had become virtually impossible for chemistry faculty to raise academic year support from corporate or governmental sponsors in non-medically related universities. The transfers of Lehigh's internal non-salary operational funds from virtually all departments into a new pot to cover the salary deficits in these "Research" slots was called "the Provost's pool," a term used by Provost Al Pense himself. No such research designations are part of faculty titles in the chemistry department today.

Dealing with underfunded Centers and "soft money" faculty positions was just one of Amstutz's many challenges as chairman. It was during Amstutz's time that infrared spectrometers, mass spectrometers, and NMRs became requisite – but expensive – tools of graduate research chemistry departments. At first Amstutz was able to make arrangement for students to obtain spectra at nearby companies. Infrared access was supplied by General Aniline and Film (Easton). Mass spectra were obtained at Bethlehem Steel (Bethlehem) and a few early NMR spectra were run at Sadtler Laboratories (Philadelphia). Gradually by fund-raising, industrial gifts, investment of surpluses raised by the distance education program, and equipment-specific grants, the department has acquired its own sophisticated hardware.

Typical of how these early corporate associations worked is a paper published by Amstutz with two of his graduate students on identifying the IR bands associated with "free" and "hydrogen-bonded" $SO_2$ groups in organic molecules (see *J. Am. Chem. Soc*., 1951, **73**: 1220- 1224). Using a large chemical library of Ar-$SO_2$-Ar' compounds which Lehigh students prepared and had tested as anti-TB candidate drugs (Warner-Lambert), the students then gained entry to corporate labs to run the necessary infrared spectra on early model Baird and Perkin-Elmer instruments. About 10 publications came out of this combined synthesis, drug-development, and bond-identification infrared spectroscopy. The corporate collaborators are well acknowledged in the publications. Amstutz eventually brought all such instrumentation in-house with the last major acquisition being nuclear magnetic resonance. Many alumni still remember the arrival of the first Varian A-60 NMR in 1962.

While many faculty found the new NMR useful, it was absolutely essential for the natural product syntheses and organophosphorus research of **Irving J. Borowitz** who was hired from CCNY in 1962 to supplement the organic chemistry faculty at Lehigh. A CCNY student, Morris

Anschel (LU PhD 1967) came with Borowitz from City College. At Lehigh, Borowitz (BS 1951 CCNY, PhD 1956 Columbia University) created a natural products course in which he taught modern instrumental methods contrasted with classic degradation techniques to elucidate polycyclic structures. He co-taught a course on theoretical chemistry and shared supervision of the advanced organic laboratories with **Thomas E. Young.** His research was supported by NSF, PRF, and NIH and – among other topics – probed the complex reaction mechanisms of trivalent organic phosphorus compounds with conjugated ketones and organo-halide alkylating agents. He published a numbered series of more than a dozen papers on organophosphorus chemistry in *J. Am. Chem. Soc., Tetrahedron Letters, and J. Org. Chem.* Borowitz and most of his graduate group left Lehigh for Yeshiva University (NYC) in 1965 while **Thomas Young** assumed the mentorship of one student left behind, Robert D. Rapp (LU PhD 1967).

In his years as Department Chair and as senior organic chemist, Amstutz seemed to favor hires that cloned his own interests. He had managed to convince his faculty colleagues to make his course in Heterocylic Chemistry a required course for doctoral candidates. At the time of hiring **Borowitz** was generating a library of heterocyclic compounds from his organophosphorus reactions, **Thomas Young**, too, worked on heterocycles (indoles and thiapyriliums), and **Ned D. Heindel** on quinolone antimalarials. All three were Amstutz's choice for faculty positions. "Easy Ed" thought heterocycles were the core of organic chemistry!

**Thomas E. Young**, (1925 – 1992), who served in the U. S. Army in the European theater of combat in WW2 came to Lehigh as a student under the GI Bill and earned his BS in 1949. He conducted his undergraduate research under Amstutz and remained at Lehigh for an MS (1950). He subsequently took his doctorate with Roger Adams at the University of Illinois (1952). Before Amstutz hired him back to Lehigh, Young had previously worked at the DuPont Company, Wilmington, Delaware, and as an Assistant Professor at Antioch College, Yellow Springs, Ohio. He commenced a long and productive career at Lehigh in 1958 and because of his extensive industrial and academic experience was promoted (to associate) and tenured in two years. Young became full professor in 1966 and retired in 1989. He died at age 67 in 1992. Young's research was supported by the NIH and the Petroleum Research Fund as well as corporate sources. He published >30 papers, mentored about a dozen Lehigh doctorates, and held five patents but was perhaps proudest of the fact that in retirement he took aviation training and received a private pilot's license. His chemistry involved organic electrochemistry, modeling of the steps in the melanin biosynthetic pathway, syntheses and spectral correlations of thiapyrilium salts, and syntheses and complexations of highly functionalized indoles.

Young was a strict but popular teacher for Lehigh undergraduates and graduate students. He inherited Amstutz's reputation as the stern, hard-grading professor (but with a passionate concern for learning and an unlimited patience for one-on-one teaching to those who were struggling). He also inherited Amstutz's association (and research sponsorship) from Warner-Lambert Pharmaceuticals and the teaching of Amstutz's favorite course, heterocyclic chemistry. Young created his own advanced topics course on computational chemistry which fit nicely into the Physical Organic course which Kosower had started in 1954. Young's lecture style was to closet himself in his office for an hour or two before each lecture reviewing the material he planned to cover. Then armed with the briefest of notes on a 3"x 5" card – which he seldom looked at in class – he would produce a sunburst of reactions and mechanisms leading out from

the core heterocycle which was the subject of that lecture – oxidations, reductions, rearrangements, electrophilic attacks, nucleophilic attacks, and major utilities of that family would all be strewn across the blackboard. His unique lecture style – linked to his wearing of multiple sweaters and the successive removal of these as he heated-up delivering his animated sunburst lectures – was often lampooned by students during skit-time at the annual Christmas dinner. Since Young seldom attended he probably didn't know of that exercise of student humor.

Throughout his career, Young remained a much-trusted protégé of Amstutz. Young had been appointed by Amstutz to handle graduate student recruitment, allocation of fellowship funds, management of the Departmental Library and the organic stockroom. When Amstutz was on sabbatical leave or was on summer vacation (usually in Michigan) he turned the management of the department and the payment of its bills over to his younger colleague. Young also ran several faculty search efforts including ones to find replacements for Borowitz and for Amstutz himself.

Beginning in October 1965 five synthetic organic chemists – most with interests in heterocyclics – were interviewed for the Borowitz position. **Ned D. Heindel** (BS-Lebanon Valley - 1959, PhD Delaware - 1963, postdoctorate Princeton - 1964), an organic-medicinal chemist who then held a shared appointment at Ohio University (Ironton, Ohio) and Marshall University (Huntington, West Virginia), was hired. He relocated to Lehigh in June 1966 bringing research support from U.S. Army Medical Command, PRF, Research Corporation, and Stuart Pharmaceuticals (soon to be renamed Astra-Zeneca Pharmaceuticals) and with three graduate students. At Lehigh, Heindel built a research program in drug and diagnostic product development, assisted **Thomas Cheng** (see *Biochemistry* section) in creating a doctoral program in Physiological (later renamed Pharmaceutical) Chemistry, and directed the Center for Health Sciences (1980-1987). He inherited the teaching of Amstutz's course in heterocyclics, arranged for its listing as an elective not a requirement for graduate students, and created his own course in Medicinal and Pharmaceutical Chemistry. In his five-plus decades at Lehigh, Heindel mentored 40 doctoral students, >165 MS students, and 22 postdoc/research scientists, authored more than 300 papers, and was awarded 15 patents. He was promoted to professor in 1971 and received the Howard S. Bunn Chair of Organic Chemistry in 1976. At Lehigh he consulted for nine pharmaceutical companies, engaged in contract research for six of them, and obtained continuous NIH funding for anti-inflammatories, tumor-imaging agents, anti-cholinergics, and nitric oxide synthase inhibitors. Three drugs (SRX246, SRX251, and Elder E-143) from his laboratories advanced to human clinical trials, one patent was sold (to Elder now Valeant Pharmaceuticals), two patents were out-licensed for development (to Baxter Corp), and two more were assigned to Azevan Pharmaceuticals.

Because he bridged biochemistry and organic chemistry, **Keith J. Schray** (1972-2015) is mentioned in both chapters of this departmental history. Wearing his hat as an organic chemist he supervised students in the synthesis of enzyme active site inactivators and protein-protein linkers. He developed a unique approach to the teaching of the two-semester general organic course receiving NSF funding to developed peer-led study groups. He placed a cameraman in the lecture hall and videotaped his lectures mounting them on the course-site. He personally ran countless evening review sessions even going into the student living areas to meet the undergraduates where they lived. Schray's many awards for teaching excellence are summarized

in the Biochemistry chapter. As a faculty researcher he mentored 14 PhDs and 1 DA and supervised 19 MS students plus many undergraduate researchers. He retired in January 2016.

Schray's position had been one of the expansion slots engineered by Amstutz's replacement as chair, **Frederick M. Fowkes** who also built on the space needs studies conducted by his predecessor to justify, design, and erect the Seeley G. Mudd Laboratory which opened in 1975. Even more change, however, came to the department with the retirement of **Fowkes** as professor and chairman in 1981 (for biography see the Physical Chemistry section). The department hired **G(lenn) Doyle Daves, Jr.**, then chair and professor at the Oregon Graduate Center. Daves came to Lehigh with an impressive record in teaching and funded research plus a vision for rapidly enhancing the stature of the department. Daves had obtained his BS at Arizona State (1959) and his PhD at MIT (1964) under the famed organic chemist, John Sheehan, on a heterocyclic synthesis project involving anthranilic acids and isocyanates. Daves went on the complete a postdoctoral experience at Stanford Research Institute with Karl Folkers – then recently arrived from Merck where he had been Vice President for Exploratory Research. After SRI, Daves joined the faculty at the Oregon Graduate Center. He served Lehigh as chair till 1988, spent a subsequent year on the faculty, and departed for the position of Dean, School of Science, Rensselaer Polytech Institute, Troy, NY. Daves came out of retirement in 2002 to return to the Department as Acting Chairman and conduct the nationwide search which led to the hiring of our 14$^{th}$ chair, **Robert A. Flowers, II.**

While in his first cycle through the department chair at Lehigh, Daves arranged the hiring of a series of highly research-visible senior faculty each of whom transitioned to Lehigh with grants and, in some cases, with graduate students. In addition to himself as a well-funded senior external hire, Daves also brought professors Alhadeff, Behe, Regan, and Larsen and assistant professors Foster, Lowe-Krentz and Roberts. (The biographies of Alhadeff, Behe, and Lowe-Krentz are covered in the *Biochemistry* section and that of Roberts appears in the *Analytical* section). The effect on the department was electric, graduate enrollment topped 90 students and the department's ranking (in the NAS/NSF system) soared from under 100 to 34$^{th}$ in America. Daves's research at Oregon and SRI had linked mass spectroscopy and multi-nuclear magnetic resonance to the solution of thorny problems of natural product structures. His work on mammalian (elephant) pheromones and specialized mass spec methods for low volatility compounds had captured attention in the chemical literature. The enhanced research momentum from Daves and the four senior hires quickly brought state-of-the-art instrumentation, *e.g*. 500 mHz NMR, Scienta ESCA, Finnigan mass spectrometer, solid state NMR, laser Raman, and many other components which elevated the research stage at Lehigh.

One of the faculty utilizers of the new 500 mHz NMR was Assistant Professor **Natalie M. Foster** (BS Muhlenberg 1971; MS, 1973, DA 1977, PhD 1982 Lehigh) whom Daves hired in 1985 from a postdoctoral experience in high field NMR with Professor David Grant, University of Utah. Foster, in fact, had served the department over the previous decade in general chemistry teaching as she advanced through her various degrees interspersed with teaching stints at Swain Preparatory School and Cedar Crest College in Allentown. Foster took her Lehigh PhD in organic chemistry, taught the undergraduate organic course, and quickly developed her own unique spectral assignments course which blended her knowledge of organic chemistry with her love for NMR and mass spec. The course, with its associated problem-solving session, was

popular with both the on-campus and the distance education graduate students. Her personal research, funded by NIH, was on the effects of localized paramagnetism (usually from paramagnetic porphyrin complexes) on the relaxation of proximal hydrogens in organic polymers and gels. She published on use of radioactive porphyrin complexes in tumor detection (work done collaboratively with researchers at Hahnemann Medical College, now Drexel, in Philadelphia) and on the syntheses and characterizations of metalloporphyrins. She graduated seven doctoral grads and more than 30 M.S. students and brought innovative laboratory instruction (the so-called "studio" method) to the general chemistry curriculum. With other coauthors at Northeastern University she launched with Norton Publishing a series of continually-improving general chemistry textbooks of the "atoms first" and traditional types and she retired in 2014 to devote full time to her science writing.

Daves own NIH-funded research set the standard for faculty expectation in quality and quantity. He exploited novel organometallic (tin, palladium) reactions as pathways to pharmaceutically important C-glycosides and produced a series of postdocs and PhD graduates who entered the elite research labs of Astra, Merck, Roche, Mobil, and other big chem/big pharma employers. Daves created and taught popular graduate courses on spectral analysis and taught his version of the natural products course formerly taught by Borowitz.

Daves's second full professor hire was **John W. Larsen** (BS Tufts 1962, PhD Purdue 1966). Larsen, who had previous appointments in the Chemistry Department at the University of Tennessee and the Chemistry Division of the Oak Ridge National lab, joined Lehigh in 1984. At that time Lehigh Chemistry had several very well-funded internationally recognized research groups but inadequate central research support. Major multi-user expensive equipment was nearly absent. Upon arrival in Bethlehem, Larsen was approached by Exxon with an offer of a joint appointment at Lehigh and the Exxon Corporate lab in Annandale NJ. An agreement was reached and Exxon paid 1/3 of Larsen's salary to Lehigh so he could also work at Exxon. This arrangement lasted for 10 years.

A physical-organic chemist, Larsen had developed in the late 60s what he called "a bizarre interest and expertise in coal chemistry" and this expanded with the energy crisis of the 70s. His coal research eventually metamorphozed into a research program in organic geochemistry that concentrated on the chemistry of petroleum formation and the structure of kerogen – the petroleum precursor. Because of his recognition as a fuels chemist, Larsen was tapped by the ACS as founding editor of its new journal in the area. For 15 years he served as Editor-in-chief of *Energy and Fuels*, an American Chemical Society journal. His primary teaching duties were freshman chemistry and graduate level physical-organic.

He served as chairman for the first time from 1989 - 1992. In the middle of this term Lehigh had a financial crisis. One faculty position was cut, several were left unfilled, and the number of graduate teaching assistant positions was cut sharply. Immediately on transfer of the chairmanship to **Kamil Klier** (1992 – 1996) those three unfilled faculty slots were cut. All of this was done without explanation or information to the chemistry faculty about expectations. Unable to plan for the future and forced to modify or cancel programs because of the budget cuts, department morale plunged and remained low for 15 years until hiring was again resumed

in 2005. At one point the number of active faculty in chemistry dropped to ten, a number well under that needed to sustain required classroom teaching.

One new and important program was started during Larsen's first chairmanship: a program in distance education in which classes were taught by TV (later by computer-based on-line programming) to students at 51 industrial sites and research was carried out in the industrial lab, co-directed by Lehigh faculty. This program was sold to a recalcitrant department and administration as a revenue source for much-needed equipment and staff support. In 1992 the department was allowed to take a loan from the administration to purchase a much-needed upgrade in magnetic resonance instrumentation. By a very formal loan contract with the Treasurer's Office – which included substantial interest payments on the unpaid sum -- a Bruker AMX 360 multi-user NMR with both solution and imaging capability was acquired. Revenue normally paid to the department from the distance education program was attached by the university (for ca. 4.5 years) until the loan was paid off. The distance education M.S. program was a highly successful and unique program which generated significant revenue for the department. In 2013 enrollment of distance education students was permitted only for certificate programs in Regulatory Affairs, Pharmaceutical Analysis, and Pharmaceutical Chemistry.

Larsen reluctantly became chairman for a second time in 2001 with the department in a sense of crisis exacerbated by a new and unfriendly administration. One memorable presidential quote: "Lehigh does need to teach chemistry but it doesn't need a Chemistry Department." In 2002 Larsen resigned and left Lehigh in for a position on the Penn State Graduate Faculty and a research appointment there. In retirement Larsen remarked that he "has been pleased to see the restoration of strong and thoughtful leadership both within the department and the university."

Another of Doyle Daves' senior hires was **Steven L. Regen**. In 1985, Daves persuaded Regen (AB Rutgers 1968, PhD MIT 1972 with G. M. Whitesides) to relocate from Marquette University. Regen had taught at Marquette from 1972 to 1985. At Lehigh Regen has been named University Distinguished Professor. With external funding from NIH, NSF and the U.S. Department of Energy, Regen has conducted wide ranging research in bioorganic, medicinal, and materials chemistry. His interests include Langmuir-Blodgett films, self-assembly, and biomembrane structures. Regen's group has been applying NMR methods to the study of lipid-peptide interactions, lipid-protein interactions, and lipid-lipid interactions in the presence of natural and unnatural membrane-perturbing agents. His teaching duties include courses in lipids and membranes, general and advanced organic chemistry, and undergraduate research en masse. Among many honors and distinctions Regen has received Lehigh's highest research recognition, the Joseph F. Libsch Research Award (1996).

Chemistry's success in indirect cost recovery, total publications, attractiveness to students, and high level of external funding made the Department an ideal chess piece in the first major University restructuring. Daves had to preside over the transition of the Department of Chemistry from Lehigh's strongest college – the College of Engineering and Physical Sciences – to what was then the weakest undergraduate college -- the College of Arts and Sciences. This transition, which similarly moved the Department of Physics, was decreed by University President Peter Likins who envisioned it as a way to position Lehigh as a more cosmopolitan

institution and less of an engineering school. The move was part of a program to "balance" the strengths of the colleges and alter the public image of Lehigh.

The nickname change for the athletic teams from "Engineers" to "Mountain Hawks" took place shortly thereafter. The department shifts, which officially took place on 1 July 1987, were explained in the 1987-88 University catalog, page 68. For as long as Lehigh had had the substructure of colleges, Chemistry and Physics had been units of the College of Engineering. On a short term basis Chemistry faculty members were assigned to the many committees through which the Arts College managed governance. Later chemists and physicists had to compete with their new A&S colleagues for seats on those same committees. While in time the chemistry faculty adjusted to their new reality, the impact of the transition on the quality of department operations may never be assessed.

After Doyle Daves resigned the chairmanship, **Henry Leidheiser** (see section on Physical Chemistry) became chair for the terminal year of his Lehigh career (1988-1989). He was followed in the position by John W. Larsen (1989-1992). The department was still adjusting to the economic impact of the transfer of soft-money faculty onto hardened slots and to its transition from the Engineering College to the Arts College. Chemistry teaching assistantships were reallocated to other departments decreasing the department's allocated number while professorial level retirements (Allen, Daves, Leidheiser) went unfilled.

Larsen filled one junior faculty position in the fall of 1991. **John Benbow** (BS-Lehigh 1982, PhD Indiana 1990), was hired as an Assistant Professor from a postdoctoral position at Yale (with Samuel J. Danishefsky) to fill the gap in organic chemistry teaching left by the departure of Daves. Benbow arrived at Lehigh in January 1992 and soon launched a program in natural product synthesis. With NIH grant support Benbow and his students undertook the synthesis of popolohuanone E, a marine natural product with potent anti-tumor activity. Several publications appeared on the synthesis of model systems. Benbow left Lehigh in 1999 and joined the research staff of Pfizer Pharmaceuticals. Benbow was promoted to Senior Principal Scientist at Pfizer and from 2003 to 2009 headed a lead compound development group working primarily on pharmaceuticals for diabetes and osteoporosis.

As noted above, Larsen was followed in the chair by Kamil Klier (see biography in section on Physical Chemistry) 1992-1996, and subsequently by **Keith J. Schray** (see biography above and in section on Biochemistry) 1996-2001. Larsen returned as chair for a second term (2001-2002) during which time repeated requests by the department to be permitted to hire an external chair and to be permitted to grow were granted by the administration. G. Doyle Daves was brought back from retirement in New Mexico to conduct the chairmanship search (2002-2003); a search which resulted in the hiring of Robert A. Flowers with an administration commitment to a rebirth of the department by faculty restaffing.

**Robert A. Flowers II** joined the department as a consultant in the Fall of 2003 and assumed the role of chair in January, 2004. Flowers received his B.S. in Chemistry from East Stroudsburg University in 1986. He took some time off working various jobs including a fork lift operator and janitor. He started graduate school at Lehigh in 1987 and obtained his Ph.D. with John Larsen in 1991 working on single electron transfer reactions in coal. After graduating from

Lehigh, he moved to Duke University as a postdoctoral research associate with Professor Ned Arnett where he worked on several projects including: 1) calorimetric and electrochemical studies of the heterolysis and homolysis energies of C-C and C-heteroatom bonds and their associated radical ions, and, 2) thermochemical studies of the oxygenation of vitamin K.

In 1994, Flowers moved to his first independent position as an assistant professor at the University of Toledo. He received tenure and was promoted to associate professor in 2000. During his time at Toledo, he received the University outstanding teaching award and was named a Master Teacher in 2000. In 2001, he moved to the Department of Chemistry & Biochemistry at Texas Tech University and was promoted to professor in 2003. While he was at Texas Tech, he received the Chancellor's Council Distinguished Research Award in 2002. Flowers was recruited to Lehigh to serve as department chair in 2003 and joined the faculty full-time in January of 2004. Since coming to Lehigh, Flowers received the Eleanor and Joseph F. Libsch Research Award (2012), and was elected a Fellow of the American Association for the Advancement of Science (AAAS) in 2012. In 2008, he was named the Danser Distinguished Faculty Chair.

Flowers' research group is focused on the mechanistic analysis and development of electron transfer reagents in organic synthesis, organometallic chemistry, calorimetric analysis of protein-ligand interactions, ion transport and molecular recognition, and applications of back-scattering interferometry in molecular recognition. In many of these studies, he collaborates with colleagues and often has international visitors in his lab who come to learn about his approach to mechanistic chemistry. To date, he has published over 100 peer-reviewed papers, a book, and four book chapters. He has given over 80 invited U.S. and international lectures on his research at Universities and professional meetings. He has also served on numerous national and international funding panels.

Although Flowers is very proud of his success in research and teaching, he views his biggest accomplishment as rebuilding the chemistry department at his graduate alma mater. In 12 years as chair, he worked with his colleagues to restructure the department, moving the graduate office to the 7th floor of Mudd, reorganizing staff positions, creating several positions to serve the undergraduate teaching mission, and changing the approach to undergraduate instruction and laboratory teaching. During his time as chair, he was responsible for hiring 15 faculty and played an important part in nourishing their success. He also worked with the administration to rebuild infrastructure, from new HVAC and lab renovations, to expensive startups, and major instrument upgrades required to carry out high quality research. During the last few years of Flowers leadership, the chemistry department ranked first in several categories in the College of Arts & Sciences including research expenditures, federal research funding, and size of the Ph.D. program. In addition, the number of students taking courses in chemistry doubled, majors have increased significantly, and the department has some of the highest student course enrollment in the College.

The last two tenure track faculty to be hired under Flowers chairmanship were **Marcos Pires** ( a bio-organic chemist) and **Mark Chen** (a synthetic/polymer chemist).

**Marcos Pires** joined the Lehigh University faculty as an Assistant Professor in 2011. Pires, originally from Brazil had come to the United States in 1992 to accompany his academic father who'd received a fellowship to study economics at Cornell University. Pires enrolled at Ithaca College where he and his two sisters were undergraduates at the same time. In his undergraduate research Pires worked primarily in computational chemistry. His studies involved the evolution of methanol clusters to model the transition of methanol gas into a condensed state. With the assistance of his faculty mentor (Vincent DeTuri), Pires published a paper on the data he had gathered over his 3 years working at Ithaca College.

After graduation in 2003, Pires sought a change of scenery and moved to the Midwest to Purdue University to pursue his doctorate. When he started graduate school he was convinced he didn't want to do organic chemistry or biochemistry but he was soon completely enthralled by the work of Jean Chmielewski. He joined her research group which is focused in the bioorganic/biological chemistry area and never looked back. The students trained in the Chmielewski group had to be competent synthetic chemists to do their projects because they need synthetically-derived probes to understand a biological system and sometimes to serve as potential therapeutics.

While at Purdue, Pires tackled two main projects. An important mechanisms of clinical drug resistance is the over-expression of P-glycoprotein (P-gp) which has at least two substrate binding sites. Pires designed and synthesized a library of bivalent agents composed of two copies of the P-gp substrate emetine, linked by tethers of varied composition and lengths. Pires extended this same strategy to reversibly-linked homodimers of the well-known P-gp substrate, quinine. Several quinine-based and emetine-based homodimeric compounds were found to be potent inhibitors of P-gp and reverse multidrug resistance in resistant cell lines.

Pires' second project involved self-assembly of collagen peptides via metal coordination. He developed a ligand-modified, collagen triple helical peptide that rapidly and reversibly assembles in the presence of metal ions to form microspheres of reproducible size and shape. Pires demonstrated that the surface and the core of the microspheres readily sequestered small organic fluorophores and the chemotherapeutic agent doxorubicin. He also demonstrated that unsatisfied metal/ligands exist on the surface and within the microspheres, and that these may be easily modified with His-tag functionalized molecules. He went on to generate a second-generation set of peptides that in the presence of metal ions assembled into large fibrous networks with a distinct architecture.

Upon graduation in 2009, Pires undertook a postdoctoral appointment in the laboratory of Dr. William DeGrado at the University of Pennsylvania. While at UPenn, he received the prestigious F32 fellowship to work on artificial metalloenzymes. He also worked on the DFsc series of peptides where DFsc represented one of the first de novo designed proteins that activate dioxygen for oxidation reactions. Minimal model proteins which incorporated elements responsible for reactivity have generated significant insight into the relationship between the protein environment and the reactivity of diiron proteins. A novel artificial non-heme diiron protein (DFscH3) that mimiced the unusual metal binding site (4 Glu/3 His) of the protein AurF was designed. Pires studied the properties of DFscH3 and discovered that it possessed the same N-hydrogenase activity of AurF.

In 2011, Pires moved to Lehigh University to start his own research group and to teach Organic Chemistry I and Bioorganic Chemistry. The Pires research group is currently pursuing methods to modify the surface of bacterial cells. Students and postdocs in the group have become adept at building complex organic molecules as probes and in working with a wide variety of bacteria and mammalian cell models.

**Mark Chen** joined the Lehigh faculty as an assistant professor in the fall of 2014. Mark received his B.A. in Chemistry from Harvard University in 2004. During one summer in his earlier college years, he worked at Genentech, Inc. in South San Francisco, CA in the Protein Chemistry department where he assisted in peptide sequencing via mass spectrometry. In his latter college years, Mark joined the lab of M.-Christina White, an assistant professor at Harvard at the time, to begin his foray into C-H bond oxidation methodologies. Upon graduation he chose to continue his research in the White Lab at Harvard by entering the Ph.D. program, which led to a move to the University of Illinois-Urbana Champaign in 2005. As a graduate student Mark discovered two systems for selective C-H bond functionalizations: Pd catalysis for esterification of allylic sites, and Fe catalysis for hydroxylation of unactivated, aliphatic C-H bonds.

After earning his Ph.D. from Harvard University in 2009, Mark was awarded a Camille and Henry Dreyfus Postdoctoral Fellowship and joined the lab of Jean M. J. Fréchet at the University of California, Berkeley in 2010. In Berkeley he came to manage the entire Fréchet Lab alongside performing research in designing and studying conjugated materials for organic solar cells and transistors. Mark joined the Lehigh faculty in August 2014 and set up his lab to pursue questions in synthetic organic and materials chemistries. During the spring 2015 semester he taught organic polymer science, which was the first polymer chemistry course offered by the Chemistry department on campus in several years. In August 2015, he was awarded a New Investigator Award from the Charles E. Kaufman Foundation for his work in developing new organic electronic materials based on molecular biradicaloids.

**David A. Vicic** joined the Lehigh faculty as associate professor in 2012, was promoted to professor in 2013, and assumed the department chairmanship in July 2015 when Flowers returned to full time faculty status. Vicic received his B.A. in Chemistry from the Johns Hopkins University in 1994. During his college days, he also twice worked in France during his summers. The first time he was employed at Rhône-Poulenc Rorer Pharmaceutical Company (currently Sanofi-Aventis) where he synthesized derivatives of a natural product for the treatment of AIDS. The second time he worked at the Institut de Chimie des Substances Naturelles with Professor Samir Zard studying novel reactions of propargylic xanthates.

After receiving his Bachelor's degree, David then obtained his M.S. and Ph.D. degrees in the field of organometallic catalysis at the University of Rochester. He then received an American Cancer Society postdoctoral fellowship to study mechanisms of DNA damage and repair at the California Institute of Technology. David became an Assistant Professor at the University of Arkansas in 2002, and was tenured in 2007. His work at Arkansas focused on developing nickel-catalyzed cross-coupling reactions involving alkyl nucleophiles with alkyl electrophiles. After receiving tenure, he relocated to the University of Hawaii faculty later that same year. Contrary to what he had been told before arrival, there was no functioning gas chromatography/mass

spectrometry (GC/MS) equipment in the Chemistry Department at Hawaii. GC/MS was the method by which his group analyzed all of the alkylation reactions.

Therefore, for a substantial period of time before the delivery of his group's own GC/MS to an island in the middle of the Pacific Ocean, his group needed some projects with which they could maintain productivity. Vicic knew he could potentially analyze fluoroalkylations by 19F NMR spectroscopy, so he thought he could make a simple evolutionary step in that direction until the infrastructure problems at the University of Hawaii were worked out. However, little did he know that the move to study fluoroalkylation chemistry would be neither a simple evolutionary step in his research program nor a short-lived under-taking. At present, Vicic's group focuses almost entirely in fluorine chemistry.

Vicic was also elected as a Vice-Chair of the Fluorine Division of the ACS in 2015, and will assume the responsibility of Chair of the Division in 2018. In 2012 he moved to Lehigh and back to his native state of Pennsylvania (he was born in Pottsville). His current research interests lie in developing new synthetic methods, fundamental inorganic and organometallic chemistry, and fluorine chemistry. At Lehigh, he has taught Spectral Analysis, Organic Chemistry, and Organometallic Chemistry.

Thus, at the Sesquicentennial Year of Lehigh's Department of Chemistry, the Organic Chemistry Division finds itself with six organic faculty members out of an entire faculty of 17. From 1940 to 2015 the department hosted 26 organic chemists on its faculty but seldom with more than three on the staff at any one time until the present era. The six current organic faculty are mentoring 19 graduate students and 11 research scientists. Most of the department's recent doctoral graduates in organic chemistry have pursued postdoctoral training and then assumed industrial or academic positions. A few have entered liberal arts and community college teaching directly from their PhDs.

**Remembrances of the Organic Faculty 1960-1965 by Coleman Hamel (PhD 1969)**

About **Professor Tom Young** ***(Thomas E. Young, BS Lehigh 1949, MS Lehigh 1950, Lehigh Professor 1958-1989)***

Professor Tom Young can be best understood in the context that he was a Pennsylvania Dutchman and a rarity among them. He was erudite and educated well beyond the sciences. He once wrote a parody on Hamlet's "to be..." that scanned in blank verse perfectly. He was well read in science fiction and knew something about music in greater depth than the usual couple of years of piano lessons would give one. He also followed NASCAR racing and once was able to tell what was wrong with my car even when my mechanic couldn't figure it out. He was a very private person as was his wife, Hilda. Home for lunch every day and involved in few community activities; proud of the fact that he never went to a general faculty meeting. Very Dutchy work ethic. He had a bit of volatile temper. He probably knew more chemistry than any other faculty member at Lehigh. In the chem literature course I took from him, there were very few papers presented by students that he had not read and researched the references therein. Also he knew what had been found out on the subject subsequent to its publication. So it wasn't just the paper itself; it was the background and the future research. He really made you work

you're a-s off for an half-hour presentation. He went over Lovejoy's research proposals in p. chem and contributed a great deal to them. Imagine: an organic chemist knowing enough p. chem to help a colleague!!

Young always lectured without notes; " if you didn't know your subject well enough to go it alone, then you didn't know your subject." I tried my best to follow his example. When I took theoretical organic from him, he would do 6x6 matrices in his head as fast as he could write them on the board. Awesome and scary! Paul (I forget his last name, maybe Ruskin) and I would go over the notes from his courses and then meet and one of us would repeat the lecture at the board and the other would comment and then we would repeat the process. We were stuck on a matrix and couldn't figure it out when he dropped in one evening. He wanted to know what we were doing; we told him and he thought it was a good way to study. He glanced at the blackboard and said "by the way your error is right here." He didn't even have to think about it. He was so well thought of that the grad students went to his lectures even when they weren't taking his course. Once when he taught at 4 p.m. all of Irv Borowitz's students were leaving the labs to go to Tom's lecture and Irv wanted know where they were going; they told him and he nearly exploded. I learned some new expressions that day. They went anyway.

A **Professor Borowitz** digression. ***(Irving J. Borowitz, Lehigh Professor 1962-1965)***

I sat in on his Advanced Organic (Chem 358) which was held in the big lecture hall in Chandler. He would write on the board in letters about 1" high. Unreadable! We asked him to write a little larger and he would for about the next 6 letters but then the size would diminish rapidly. So one day we all brought binoculars and when he turned to the board we got them out. He looked back to see all of us with the binoculars and he exploded with laughter. End of lecture for that day. But it didn't change things much thereafter.

Back to **Professor Tom Young**.

When he lectured hetero, he would come in and he had to have a NEW piece of chalk. No stubs for him, so the undergraduates would hide the chalk. He then got his own box of chalk and put a piece in his pocket and away we went. He told me later he always had a spare piece in his pocket "just in case." He lectured so fast starting from the far left board and coming across the entire board to the right that it was impossible to keep up with him and take notes. So three of us sat in the front row and one would start taking notes. When he couldn't keep up he would say "now" and the next person would start, etc. Then we would straighten out the notes and meet and go over the notes with each other. He also had the habit of mentioning a name reaction and would just show the starting materials and products. We quickly learned to study the reaction and the mechanism and all about that name reaction. We would each take a reaction and study it and meet and teach the others. He indirectly taught us the value and necessity of cooperation. He did not like to be interrupted in class; he would say "see me afterward." I was quickly clued in that he was NOT to be interrupted for a couple of hours before class because that's when he put his lectures together. His primary files were reams of legal size yellow pads. To do so was to run the possibility of being spread molecular thin in the wall. His research involved thiapyrilium salts. And he was proud that Cy (Cyrus Ohnmacht) and Dick (Richard Lazarus) all had 98-99% perfect regression lines for their product's energies. My project resulted in two sets of random

levels spaced apart. I thought I was doomed because it had to be a 'positive' contribution to the literature. He smiled and said "easy, just write: yes, the answer is no." And I did. In my time I think Young was the only faculty member who did lab work. Cy discovered a new ring system and Tom asked me to make a few more examples of it. Turned out Cy had made the easy one and I had the tough ones.

Tom worked in his lab to help discover what was going on and we got it. One yield was only 25 mg and we published it. I even recovered the 2mg I used for to run the IR. As far as being a Dutchy, when he made up his mind, he didn't change it very often. If you got on his sh-t list, you were doomed. Since Elsie and I stayed in Bethlehem, we had the opportunity to host he and Hilda and in return be hosted by them . He showed a completely different side of himself. He had a wicked, dry sense of humor and revealed that he knew what was going in the politics of Lehigh even though he stayed away from the faculty meetings as much as possible. I always enjoyed coming back to his office when I was working and chatting with him. After he died I really missed him. Once there was a problem I found in a book and I fooled around with for a while and got nowhere. So I took it to Tom. He looked at it and really put me down without meaning to or realizing he had even done so. I quote, “Oh, that one . That took me a week to solve."

Now a couple of **Professor Amstutz** stories. ***(Edward D. Amstutz, Lehigh Professor 1938-1970, Chemistry Chair 1959-1967)***

First story:

The grad students that rode motor cycles always parked them in and behind the yellow lines, so that the other spaces were left for cars. One day we went out and found parking tickets on all the cycles because we were illegally parked. No amount of explaining did any good. Sooo the next day 40-50 cycles took up all the parking spots around Chandler. When Dr.A. came tooling in at 9:45 for his 10:00 o'clock class, there was no place to park. He was late to class and came into my lab right after class and he was livid to say the least. I explained the situation and noted that the $10.00 fine really hurt the grad students. He turned abruptly and left the room. I don't know what he did but all the tickets were rescinded that afternoon by Parking Services and we were allowed to park on the yellow lines again. The man had clout.

Second story:

When Dr.A lectured he would come into the big lecture hall in Chandler via the back door, cross to the left side and write the day's topics on the board. He then lectured; there were no questions or interruptions!! (the same technique that Tom Young adopted in his own lectures). One day as he was writing the topics, a student stood up and said in loud voice "Dr. Amstutz." Without pausing or turning his head, Dr. A replied with a drawl: “yessss.” Student: “Don't you think that problem 3 in the homework is unfair.” Again no pause or head turn. “Yesss.” The place went wild. The old riser boards were stomped so loudly that people came out of the office and other classrooms to see what was going on. When Dr. A. turned around there was just a trace of a smile on his face.

Back to **Professor Tom Young** for a moment:

When John Griswold started working with 3-methylindole, he smelled so bad that Tom told him to go home and take a shower before he reported his results. I had a similar experience. I had just isolated 3-mercaptothiophene at the rotovap on a Saturday morning. I carried the open flask to the hood; maybe it was 20'. It stank so bad that my breakfast touched the backside of my front teeth. I had to struggle to keep it all down. Tom came roaring out of his office and demanded to know what was going. I told him. He went home, after telling me to work with the stuff after 6:00 p.m. The entire wing of the building cleared out that morning..

Well there you have it, my remembrances of the organic faculty of my day (Professor Amstutz, Professor Young, and Professor Borowitz) except that there's no way to explain how much they really cared for their students and much they wanted them to do well. Amstutz and Young were just Dutchies -- they couldn't bring themselves to tell the students directly how much each one mattered to them. Perhaps from your perspective you can find a way to express this. I certainly hope so. They were good people…they need to be remembered.

# 75 Years of Physical Chemistry at Lehigh 1940-2015
# By James E. Sturm and Daniel Zeroka

**Some General History**

The Chemistry Department was significantly impacted by world-wide events and events local to Lehigh. During World War II considerable research effort was devoted to the development of the atomic bomb through the Manhattan Project and in 1950 in order to help the U.S. maintain a high-level of scientific competency, the National Science Foundation was created. The launching of the Sputnik I satellite on October 4, 1957 by the U.S.S.R. sent the U.S. into a panic mode because it was feared that the U.S. was behind the U.S.S.R. in science and engineering. This event led the U.S. government to infuse support for universities across the nation in order to upgrade science and engineering so as to build up student interest in these areas. At Lehigh, the Whitaker Laboratory was built and completed in 1965 with new faculty following to bolster science and engineering. With the arrival of President Lewis in 1962, emphasis was placed on bolstering the graduate programs across the university. In Chemistry there were 3 new faculty hires: Charles S. Kraihanzel (inorganic chemistry and organometallic chemistry), Roland W. Lovejoy (physical chemistry and infrared spectroscopy), Joseph R. Merkel (biochemistry). In 1981 Doyle Daves as a new outside chair was given authority to add several faculty members to the Chemistry Department. Those members who came during this period were Jack A. Alhadeff (biochemistry, 1982), John W. Larsen (physical organic chemistry, 1984), Steven L. Regen (organic chemistry, 1985), Natalie M. Foster (analytical and organic, 1985), James E. Roberts (analytical chemistry and NMR, 1985), Michael J. Behe (biochemistry, 1985), and Linda J. Lowe-Krentz (biochemistry, 1986). These two short time periods saw a sudden injection of 3 and then 7 new faculty members into the Chemistry Department.

**The Physical Chemistry Faculty from 1940 – 1965**

There were very few physical chemistry faculty members who served in the period 1940 to 1965 that have not been profiled elsewhere herein. In some cases, as has been frequently noted, it is hard to tell a physical chemist from an analytical one and some faculty bios appear in the analytical section. The physical chemistry stalwarts from the 1940 to 1965 period, **Serfass** and **Zettlemoyer,** were Lehigh students whose involvement with the Department began well before 1940 and continued well into the period covered by this history. They have been profiled below.

There were a handful of other faculty who played some role (albeit it briefly in some cases) in the years after 1940 but who were gone by 1965. **Harold Victor Anderson** (Lehigh period 1918 – 1961) was educated as a physical chemist, became an x-ray spectroscopist, and used the method almost exclusively for analytical purposes. He is profiled in depth in the Analytical Section. **Warren Walter Ewing** (Lehigh period 1920 - 1955) obtained his BS from Parsons College (1912) and his PhD from the University of Chicago (1920). Between his BS and his PhD he served as a missionary in India from 1912-1916. At Lehigh his research was in binary and ternary systems containing mixed metal (cadmium, magnesium, zinc) nitrates in water and he published three books and many articles (in *J. Am. Chem. Soc*. and in *Science*) from his precise measurements of such systems. Ewing's teaching responsibilities were an advanced topics course and an advanced laboratory in physical chemistry. He achieved full professor status in 1937 and retired to emeritus status in 1955. **Edwin Raymond Theis** (hired as Associate Professor 1927, promoted to full professor 1938, and died on the job 1952) was particularly hard

to categorize as a chemist. He held a BS ChE (1921) and a PhD-Chemistry (1926) from the University of Cincinnati where he worked in a very commercially successful leather and tanning center. Theis moved that operation to Lehigh at the very time Lehigh was reactivating the doctorate in chemistry. The department PhD program, previously shelved in 1896 after two PhDs had graduated, was restarted in 1937 after nearly a decade of planning for it. Lehigh needed external money to support doctorate students and Theis's program attracted considerable industrial funding. He called his laboratory the Division of Industrial Biochemistry, he taught core courses in chemical engineering as well as in biochemistry, and he used a very physical chemical approach to the study of leather. He and his students designed instruments to quantify the properties of animal hides being processed with formaldehyde and chromium salts. Theis is also discussed in the Biochemistry Section.

**Thomas H. Hazelhurst, Jr**. (hired 1927- died on the job 1949) was a classic physical chemist whose graduate research and his early years at Lehigh involved the behavior of thin films, thermodynamics of wetting, and surface tension. At Lehigh he taught and published primarily in analytical chemistry and his biography appears in the Analytical Section. **Harvey A. Neville** (faculty period 1927 – 1964) was trained (PhD Princeton University 1921) as a catalysis and surface chemist but built his Lehigh career on stabilization of fat droplets within chocolate and on the adhesion of organic coatings. He created an advanced topics course in Surface Chemistry which featured his favorite topics of contact catalysis and colloidal behavior. In his long career Neville advanced through a number of administrative positions. He held a Center directorship, the department headship, the Deanship of the Graduate School, Directorship of the Office of Research, and the Provostship all while maintaining a research activity in chemistry. He was a strong supporter of industry-funded centers and created one of his own devoted to Confectionary Science. Neville was very proud of an honorary doctorate (LLD) granted to him in 1952 by his undergraduate alma mater, Randolph Macon College. He served as Lehigh University president in 1961-64, the only faculty member to advance to the presidency.

Two other physical chemistry faculty members who functioned in the analytical area at Lehigh departed for new positions at the very start of the period covered by this history (1940). **John Clewell Mertz,** (BS ChE Lehigh 1931 and PhD Chemistry, Yale 1936), was hired by Lehigh in 1936 as an instructor in physical chemistry and was promoted to Assistant Professor in 1941. His research was in measurements of the solid solubilities of members of the copper family. At Lehigh he taught both quantitative analysis and undergraduate courses in industrial chemistry within the co-department of Chemical Engineering. He began a program to upgrade the department's instrumentation but left within a year for an instrument company in Connecticut and from there to Pratt and Whitney Aircraft in West Palm Beach, Florida.

**Hilton Albert Smith** (AB Oberlin 1930, PhD Harvard 1934) began his Lehigh career as an Instructor in 1935 and was promoted to Assistant Professor in 1939. Educated as a physical chemist, his personal research was in structural effects on the kinetics of esterification and on precise measurements of heats of reaction. One of his favorite carboxylic acid substrates was cyclohexenoic acid. Hilton, like so many other physical chemists, did most of his teaching in analytical areas; he taught the assaying course and lab. He left Lehigh in late 1941 for a faculty position at the University of Tennessee and in time became Dean of the Graduate School at that

institution. During and after WW2 he was a consultant to the energy chemistry program at Oak Ridge National Labs.

Perhaps the hardest to categorize faculty member has been **Robert Dominick Billinger** (b. 1899 – d 1980). Educated as a physical chemist, he is fondly remembered as the department's master teacher in general chemistry for >30 years and as its historian for more than 50 years. Bob came to Lehigh as a freshman in 1917 from Shenandoah in the coal regions, served for six months in the Army in WW1, and yet managed to complete a B.S. in Chemical Engineering in the Fall of 1921. He worked in industry as a chemist-metallurgist and returned to Lehigh to take the M.S. (1925). As Lehigh had not yet restarted the doctorate, Bob went first to Yale and then to Cincinnati. His formal doctoral education (PhD Cincinnati 1928) was in physical chemistry with Professor Robert Charles Cantelo (b1891 – d1940). Cantelo studied the thermodynamics of equilibria under stress ($C + H_2$, dissociation of $CH_4$, and hydrolyses of ethyl acetate). Billinger's doctoral dissertation yielded two publications with Cantelo on the ethyl acetate equilibrium problem which appeared in 1928 and in 1930 in *J. Am. Chem. Soc.* He joined the Lehigh faculty in 1929 as an Assistant Professor, was tenured and promoted to Associate in 1939 and remained at that rank until his retirement in 1963.

Billinger published four technical chemistry articles from Lehigh on ferrous metallurgy, fusion pot design, and esterification equilibria in journals such as *I. & E.C.*, *Iron Age*, and the *Baker Chemist-Analyst.* He published two dozen articles on various topics in the history of chemistry and ten articles on new experiments for use in the undergraduate laboratory. These papers appeared in *J. Chemical Education.* He co-authored three lab manuals: *Experiments in Inorganic Chemistry* (1932) and *General Chemistry Experiments* (1937 and 1941). He continued to teach Chm-179, The History and Literature of Chemistry – a popular course he had lovingly created – for two more years after retirement and he continued to author papers on chemical history presented before the History of Chemistry Division of the ACS till just five years before his death in 1980. Billinger wrote our first 75-year history which he entitled, *A History of the Department of Chemistry and Chemical Engineering: 1865-1941.* A copy is available at the Lehigh faculty archives along with a lifelong bibliography of Billinger's own publications.

**Physical Chemistry Instruction in the Last Fifty Years**

Physical Chemistry evolved at Lehigh following topics developed by the popular textbooks of the time. Important texts over the years were *Physical Chemistry* by Daniels and Alberty (with later editions adding authors Silbey and Bawendi), *Physical Chemistry* by Moore, and *Physical Chemistry* by Atkins. Some books which played important roles at the graduate level in providing theoretical underpinnings to developing areas of quantum chemistry and chemical bonding: *The Nature of the Chemical Bond* by Pauling, *Quantum Mechanics* by Pauling and Wilson, and *Quantum Chemistry* by Eyring, Walter and Kimball. In other areas *Nuclear and Radiochemistry* by Friedlander, Kennedy and Miller and *Statistical Thermodynamics* by Hill were important textbooks.

Traditional areas of instruction were covered in chemical thermodynamics, chemical kinetics, quantum chemistry and statistical thermodynamics. Laboratory instruction served to selectively illustrate basic principles involved in these areas.

Computer usage pre-1970 was reserved for specialists who could write program code and understand and modify existing program code. However, in the early 1970's more and more programs became available with a graphics component whereby molecules and molecular motion could be readily visualized. As a result the use of computers became more widespread without users needing to write and modify programs for specific tasks. This period also saw theoretical work go from an interesting add-on to research work to becoming an integral part of the research work along with the experimental observations.

Computer usage in the Chemistry Department received a significant boost in 1989 with the funding of a department computer laboratory by the Keck Foundation based on a proposal spearheaded by Professor Kraihanzel. Mudd 424 was then equipped with 15 of the latest PCs; shortly thereafter Mudd 489 was equipped with 5 UNIX work stations which allowed stand-alone work as well as the ability to connect to the University's mainframe computer. With this new computer laboratory, freshman Chemistry courses could perform modeling with graphical capability. More advanced undergraduate courses could include computer modeling of chemical bonding and a variety of physical chemistry laboratory computations dealing with error propagation and related concepts.

Present day computational work can now consider quite complex phenomena; to name a few: potential energy surface distributions for ground and excited electronic states, molecular dynamics and simulation of spectroscopic phenomena.

**What is Included**

In what follows we will address the history of Physical Chemistry during the period of 1966-2015. We do this first by talking about the faculty who taught and did research during this period. An approximate chronological listing of the faculty in physical chemistry follows along with a tabulation of the names of those faculty members, where they received their Ph.D.'s and where postdoctoral study was done, if applicable. Next, highlights of the responses to a departmental questionnaire to which 23 former undergraduate/graduate students responded are given in tabular form. The questionnaire was sent selectively to 51 former students and 45% responded. The actual responses are included as an Appendix for anyone wishing to read an individual response. We hope that the description of the faculty and the responses of the students capture the breadth of the activities going on at Lehigh at the time and the range of positions that students who graduated from the Chemistry Department at Lehigh have had. We think both groups are very admirable.

**The Physical Chemistry Faculty from 1966-2015**

**Earl James Serfass** was born in Allentown, PA. He attended Lehigh University graduating with degrees of B.S. in 1933, M.S. in 1935 and Ph.D. in 1938. He joined the Lehigh University faculty in 1937 and rose through the ranks to become head of the Department of Chemistry (1951-1959). His work regimen was intense. Well trained as a physical chemist he embraced analytical chemistry and used his knowledge of p-chem to define problems which his specialized instruments were uniquely positioned to solve. He incorporated his own company, Serfass Corporation, which designed, produced and marketed analytical instrumentation such as the Serfass Gas Analyzer, consulted with industrial chemists, all in addition to his academic

functions which included presenting the general chemistry lectures with very ambitious demonstrations during class. He slept only about 4 hours/night.

Mrs. Serfass would answer the only off-campus phone number under his name and would decide whether the caller's purpose warranted relaying the call to Earl. If so, Earl would call the person from his unlisted phone.

Earl's research at Lehigh was multifaceted as well as pioneering. With one of his postdoctoral appointees, he pursued analysis of the spatial and energy distribution of electrons photoejected by X-rays and published in 1951 a paper "X-Ray Photolectron Spectrometer for Chemical Analysis" [R. G. Steinhardt and E. J. Serfass, Anal. Chem. 23, 1585-1590 (1951)] describing the correlation of the data with the composition of the target solid. The last sentence of the Abstract of that paper is "The potentialities of the instrument for performing atomic surface analyses would appear to be considerable." Some years later, Kai Siegbahn of Uppsala's Physics Department began research on this topic which became known as XPS (X-ray Photolectron Spectroscopy). Siegbahn shared the Nobel Prize in Physics in 1981 for "his contribution to the development of high resolution electron spectroscopy."

While giving one of his general chemistry lecture-demonstrations, Earl collapsed at the front of the class. His medical doctor said, in effect, that his body could not keep up with his activity which was equivalent to five normal careers. The advice was that Earl must give up four of these careers or die. So in 1960, Earl left Lehigh to become research director at Milton Roy Corporation in St. Petersburg, Florida. Soon thereafter Earl became Chief Executive Officer of that company. Earl maintained his connection to Lehigh by being a member of the Visiting Committee of the Department of Chemistry. From 1929 when he first enrolled until his death in 1982 at the age of 69, Earl Serfass was involved with the department he loved for more than five decades.

**Albert C. Zettlemoyer** (b1915-d1991) joined the Chemistry Department in the fall of 1941 and retired in 1980. His early training was at Lehigh where he received a B.S. in Chemical Engineering in 1936 and an M.S. in Organic Chemistry in 1938; he earned his Ph.D. in Physical Chemistry from Massachusetts Institute of Technology in 1941. With World War II looming he promptly started a surface chemistry laboratory to study the catalysts for the synthetic rubber program. The already-rapid growth of his research activities accelerated considerably in 1946 when he was named to head the National Printing Ink Institute, a campus-based research center which continued under sponsorship by the ink industry for almost four decades at Lehigh. Subsequently he was promoted to a full-professor of Chemistry in 1950, a fine achievement for one not yet 35 years old. He was named Distinguished Professor of Chemistry in 1960. His banner year at Lehigh was 1966: he became the founding director of the interdisciplinary Center for Surface and Coatings Research (CSCR), which in 1987 was renamed the Zettlemoyer Center for Surface Studies; he was appointed Lehigh's first Vice President for Research; he received the Hillman Award for outstanding service as a faculty member; and he broke ground for the three-story 35,000 square foot Francis MacDonald Sinclair Memorial Laboratory (financed largely by a bequest, gifts from the printing ink industry, and a grant from the U.S. Office of Graduate Education). He ended his official service to Lehigh as Provost, a position he held from 1969 until his retirement from the office in 1980. Outside the University, Dr. Zettlemoyer has been

recognized by a number of awards: the 1957 Mattiello Lecture and Award of the Federation of Societies for Paint Technology, the 1958 National Lectureship of Sigma Xi, the 1960 Ault Award of the National Association of Printing, the 1965 honorary D.Sc. from Clarkson University, the 1966 Elmer Voight Award of the Technical Association of the Graphic Arts and the Honor Award of the American Institute of Chemists, the 1968 Kendall Company Award in Colloid and Surface Chemistry, the 1974 honorary L.L.D. form the China Academy in Taepei, and the 1985 Willard and Emma Mosher Award of the American Chemical Society. In 1981 his election as president of the American Chemical Society brought national recognition to Lehigh University and Dr. Zettlemoyer. He was certainly a colloid and surface chemist of national and international fame.

**James E. Sturm** (on the faculty 1956-1995) received his B.A. in Chemistry from St. John's University [Minnesota] (1951), Ph.D. with Milton Burton from the University of Notre Dame (1957) and did postdoctoral research with John E. Willard at the University of Wisconsin (1956). He was involved in research in chemical kinetics, radiation chemistry, photochemistry, and the collisional efficiencies of reactions of high-velocity atoms. Photochemical means was used to produce relatively high-kinetic energy atoms with sufficient translational energy, initially, to react by otherwise endoergic paths. Computer modeling of photochemical processes by both finite difference and stochastic methods was investigated. Attention was given to diffusion which accompanies non-uniform absorption of light in a reaction system. The sensitivity of computed outcomes to the magnitudes of parameters involved was studied as well. His specialties, developed during graduate and postdoctoral research, led to his offering an elective course in nuclear and radiochemistry. Professor Sturm pioneered the introduction of propagation of errors into the physical chemistry laboratory report that each student would write for every experiment that was done. Not only would an average value of a given result be reported but also the uncertainty in the average. Propagation of errors continues to be an important part of each current student's physical chemistry laboratory report.

**Jerome Daen** (b1928-d2005 and on the faculty 1958-1966) had impressive academic credentials. Following his B.S. in chemical engineering at the City University of New York, he earned his Ph.D. at the then Brooklyn Polytechnic Institute as the first graduate student under Prof. Rudolph A. Marcus, who in 1992 was awarded the Nobel Prize in Chemistry while he was a member of the faculty of the California Institute of Technology. Following postdoctoral research at the University of Maryland, Daen joined Lehigh's faculty, teaching physical chemistry with emphases on quantum and statistical mechanics. His research concentrated on interfacial dynamics. The stellar undergraduate, Stephen Benkovic did his senior dissertation under Prof. Daen's direction. Daen also mentored two doctoral students, Peter M. Jeffers and Richard Miller both of whom subsequently served on the faculty at SUNY-Cortland. Prof. Jeffers also served as chair of the Department of Chemistry at SUNY-Cortland. Prof. Daen demonstrated his versatility and leadership ability in his election to be chair of Lehigh's Educational Policy Committee. In the 1965-1966 year, Prof. Daen was on sabbatical leave as a researcher at the then National Bureau of Standards (NBS), later NIST. He decided to continue there for the rest of his productive career. Following retirement in 1998, Dr. Daen died suddenly in October 2005 at age 77 years.

**Roland W. Lovejoy** (b1931-d2010) joined the Chemistry Department in 1962. He earned his B.A. at Reed College in1955 and Ph.D. at Washington State University in 1960. His expertise was in the area of infrared spectroscopy and the interpretation of high-resolution vibrational spectroscopy of small inorganic molecules [germyl acetylene, methyl nitrite, methyl thionitrate, propynyl boron trifluoride, monodeuterosilane, chlorine nitrate, phosphine, germane, nitrogen pentoxide, and monodeuteromethane]. Professor Lovejoy and his students were frequent presenters at the Molecular Spectroscopy Symposium held during June at Ohio State University. He often likened his work to puzzle solving in which once data were collected, all of the pieces needed to fit together to solve the problem at hand.

**Fortunato J. Micale** (on the faculty 1966-1995) earned a B.A. at St. Bonaventure University in 1956, B.S. at Niagara University in 1959, M.S. at Purdue University in 1961 and Ph.D. under the mentorship of Albert C. Zettlemoyer at Lehigh University in 1965. He worked in the area of surface and colloid chemistry related to rheology and wettability of dispersed systems. He and his students made electrophoretic mobility measurements of fine particles in aqueous and nonaqueous systems and evaluated particle-particle interactions for the prediction of dispersion stability and the complex rheology of resulting dispersions. Experimental techniques were available to conduct laboratory ink transfer according to lithographic, flexographic, gravure, and intaglio printing processes. Ink transfer as a function of wetting and complex rheology of model inks was investigated. Also, experimental studies involved with measuring dynamic surface tension at the liquid/gas interface were done. Kinetic measurements of dynamic wetting for thin films of water-based systems on polymer films generated by laboratory ink transfer experiments were made. Also, there was an evaluation of liquid/solid interactions as a result of characterization of the liquid and solid surface properties

**Eugene Allen** joined the Center for Surface and Coatings Research in 1967 as Director of the Color Science Laboratory, a position which he held until his retirement in 1982. His work even now plays a very important role in the application of computer color matching programs that are routinely applied. His articles describing the mathematical methods for applying Kubelka-Monk equations to computer color matching laid the foundation on which all subsequent methods have been based. Although others in industry had previously used and partially described such formalism, Eugene Allen's complete, matrix-based descriptions placed the methods within the grasp of a multitude of users. Eugene Allen's research was recognized by several awards: in 1982 he received the Armin J. Bruning Award from the Federation of Societies for Coatings Technology in recognition of his significant contributions to the development of the science of colorimetry in the paint and coatings industries, in 1982 he was named a Fellow of the Optical Society of America, and in 1983 he received the Godlove Award, the highest honor of the Inter-society Color Council.

**Daniel Zeroka** (on the faculty 1967-2007) provided an expertise in theoretical physical chemistry: quantum chemistry, applied quantum chemistry and statistical thermodynamics. He received a B.S. degree in Chemistry from Wilkes College (1963), a Ph.D. in quantum chemistry under the mentorship of Hendrik F. Hameka at the University of Pennsylvania (1966) and a postdoctoral appointment at Yale University (1966-67) with Marshall Fixman in the field of statistical mechanics. His research focused on the following areas: the prediction of spectroscopic properties such as nuclear magnetic resonance, infrared spectroscopy and

vibrational circular dichroism spectroscopy; the electric and magnetic properties of matter; the generation of potential energy surfaces with a search for transition states that were possible; and surface adsorption of molecules onto metal surfaces with energetics and preferred sites of adsorption being considered as a first step in understanding reactions at such surfaces.

**Frederick M. Fowkes** (b1915-d1990) joined the Chemistry Department in 1968 as Chairman and Professor. Fred Fowkes earned a B.S. in Chemistry in 1936 and Ph.D. in Physical Chemistry in 1938 from the University of Chicago. At Chicago his Ph.D. thesis was in the area of surface chemistry under the mentorship of William D. Harkins. An important priority at the time he came to Lehigh was to improve and update the laboratory facilities available to the students and faculty. He worked diligently with the architects to design a modern seven-floor Seeley G. Mudd Building which came to fruition in 1975. He developed a research program in colloids and surface chemistry and interpreted his results in terms of acid-base interactions. He was recognized for a Science Citation Classic entitled "Attractive Forces at Interfaces" [F.M. Fowkes, Ind. Eng. Chem. 56, 40-52 (1964)]. Professor Fowkes organized several meetings dealing with surface science and acid-base interactions. In 1979 Professor Fowkes was honored with the Lehigh University R.R. and E.C. Hillman Award which is given to a faculty member for achieving excellence in teaching and research work, or for advancing the interests of the university. Professor Fowkes also was awarded the Adhesion's Society Award for Excellence in 1989. Professor Fowkes retired in 1981 but continued his research until his death in 1990.

**Henry Leidheiser, Jr.** [b1920-d2011] joined the Chemistry Department in 1968 as Director of the Center for Surface and Coatings (later renamed the Zettlemoyer Center for Surface Studies) and Professor. He led the center to become nationally and internationally known in a variety of areas: printing inks, colloids, emulsion polymers, corrosion, coatings, catalysis, cloud seeding, environmentally enhanced crack growth in metal alloys, and surface science. He organized several symposia and meetings of the American Chemical Society, The Electrochemical Society and the National Association of Corrosion Engineers, with many such meetings being held at Lehigh. Henry Leidheiser, Jr. built a highly successful and broadly based research program of his own in the field of corrosion and corrosion control. He won several national awards in his research area and the prestigious Lehigh University Libsch Award in 1987 in recognition of his sustained and productive research career. During 1988-89 he served as the Chairman of the Chemistry Department. In 1989 he retired from Lehigh.

**Kamil Klier** (on the faculty 1968-2010) earned a Dipl. Chem. Form Charles University Prague in 1954 and a Ph.D. in Physical Chemistry from the Czechoslovak Academy of Sciences in 1961. Before he joined the Lehigh University faculty, he had spent the previous year as a Visiting Research Professor working with Professor Albert C. Zettlemoyer. His research focused on catalysis and catalytic mechanisms. He focused on the relation between physical properties of solids, their surface structure and chemical properties, and their ability to guide chemical reactions along specific pathways. Catalysts studied include metals, metal oxides, metal sulfides, and zeolites. His research sought to provide complete understanding of systems via bulk and surface characterization of catalysts, including surface intermediates, as well as studies of mechanistic, kinetic, and quantum mechanical studies of chemical surface reactions. In 1984 he was named a University Distinguished Professor and in 1984 he received the Lehigh University Libsch Research Award. Other noteworthy awards: selection to the American Chemical Society

Langmuir Lectureship in 1987, selection to the North American Catalysis Society Burwell Lectureship in 1991 and the Heyrovsky Medal of the Czech Academy of Science in 1997. He was active in organizing symposia at professional meetings on a national level such as the Symposium on "Advanced Methods of Catalyst Characterization" held at the 1982 Materials Research Society Meeting held in Boston which was subsequently published as a special issue of the Journal of Molecular Catalysis and the 1989 International Chemical Congress of Pacific Basin Societies PACIFICHEM Symposium on "Methane Activation and Conversion" held in Honolulu. Professor Klier led the effort to acquire a SCIENTA ESCA-300 High Resolution-X-ray Photoelectron Spectrometer (HR-XPS) in 1990, originally one of the first such spectrometers in North America.

**Gary W. Simmons** (on the faculty 1970-2006) earned his B.S. from West Virginia University in 1961 and Ph.D. in Physical Chemistry from the University of Virginia in 1967. He was involved in fundamental studies of reactivity of metal, alloy, oxide, semiconductor, and superconductor surfaces and the application of these fundamentals to the understanding of catalysis, corrosion, subcritical crack growth, and coatings. The experimental techniques employed included Auger electron spectroscopy, x-ray photoelectron spectroscopy, electron microscopy, low-energy electron diffraction, thermal desorption spectroscopy, high resolution electron energy loss spectroscopy, and Mössbauer spectroscopy. He pioneered the use of Mössbauer spectroscopy for studying, *in situ*, the corrosion and passivation of cobalt surfaces while undergoing polarization. In 1991 he teamed up with Professor Klier to raise funds and install the Scienta x-ray photoelectron spectrometer (XPS), also known as ESCA (electron spectroscopy for chemical analysis). This instrument and its subsequent modifications still play and important role in surface studies at Lehigh. He was director of the Zettlemoyer Center for Surface Studies for eight years during 1985-1993. His research work was recognized with a number of awards, including the Howe Medal from the Institute of Metals. Gary retired as Emeritus Professor of Chemistry in 2007.

**John W. Vanderhoff** (b1924-d1999) after working for Dow Chemical, Midland Michigan for 20 years, joined the Chemistry Department in 1970 as Professor of Chemistry and later retired in 1997. During his Lehigh tenure he was Director of the National Printing Ink Research Institute, the founder and co-director of the Emulsion Polymers Institute, a co-organizer of the Short Course Advances in Emulsion Polymerization and Latex Technology and principal investigator for a joint university and NASA experiment which produced monodisperse polystyrene latex microspheres in space, the first commercial product to be made in space. The National Institute of Standards and Technology certified the Lehigh researcher's 10- and 30-micron polystyrene latexes as standard reference materials for calibrating cells and microscopic objects. He wrote over 200 papers and held 12 U.S. patents and 30 foreign patents. He was recognized with several awards: the Borden Award from the Amer f ican Chemical Society, the Union Carbide Chemicals Award twice, Lehigh's Libsch Award (198) for outstanding achievement in research, and an honorary doctor's degree from Niagara University where he had earned a B.S. in Chemistry in 1947. In 1984, Vanderhoff, along with Mohamed S. El-Aasser (Chemical Engineering) and Fortunato J. Micale (Chemistry) were named "Inventors of the Year" by the National Aeronautics and Space Administration for developing a process in which tiny latex microspheres were made on space shuttle flights.

**Leonard E. Klebanoff** (on the faculty 1987-1997) earned a B.S. from Bucknell University in 1979, a M.S. degree in 1980, and Ph.D. in Physical Chemistry from the University of California-Berkeley in 1985. He was involved in developing the first spin-resolved x-ray photoelectron spectrometer. This spectrometer allows the resolution of the spin component of x-ray photoemission from the core levels and valence bands magnetic metals in thin films and interfaces. The instrument allows element-specific and surface-sensitive measurements of the magnitude and direction of atomic magnetic moments at interfaces. The experimental techniques of X-Ray Photoelectron Diffraction and Surface-Extended Electron Energy Loss Fine structure were used to probe the geometric structure (bond distances and bond angles) at the interface formed between magnetic metals. Also, the first investigations of the preparation and magnetic analysis of electrodeposited magnetic monolayers using Magneto-Optic Kerr Spectroscopy were made. In 1997 Professor Klebanoff moved to Sandia National Laboratory with the position of environment team leader.

**Kenneth O. Haug** (on the faculty 1991-1998) provided expertise in theoretical and computational chemical physics with a specialization in chemical dynamic processes in condensed phases. He earned a B.A. in 1979 and Ph.D. in Physical Chemistry in 1987 from the University of Minnesota; he did postdoctoral work at the University of California – Santa Barbara. Examples of processes that were studied included: surface catalyzed reactions, reactions in liquids and clusters, and reactions at local active centers in large molecules. In 1998 Professor Haug moved to the Department of Chemistry at Lafayette College.

**Marie C. Messmer** (1996-2003) utilized Sum Frequency Generation (SFG) Spectroscopy to study molecular species at interfaces of specific importance to chromatography. Her research group attracted several undergraduate and graduate students, with the research of many resulting in publications in the literature. She was recognized with an NSF Career Award (1999-2003). While at Lehigh, Marie developed “Chem Pals”, an e-mail mentoring program designed to encourage e-mail discourse among girls of age 11-15 and science professionals.

**Tianbo Liu** (on the faculty 2005-2012) earned a B.S. from Peking University (P.R. of China) in 1994 and a Ph.D. in Physical Chemistry from the State University of New York-Stony Brook in 1999; from 1999-2001 he held a postdoctoral appointment at SUNY-Stony Brook and from 2001-2004 he held an appointment at Brookhaven National Laboratory. He joined Lehigh as an Assistant Professor. Liu’s lab studied the fundamental physical chemistry of complex solution systems, including macroions, inorganic-organic hybrids, colloids/nanoparticles, surfactants/micelles, polelectrolytes, block copolymers, and biomacromolecules. His research aimed at linking physical properties of advanced materials to their applications, and understanding certain important biological processes by simplified models. He was able to explore complex solution systems by using static and dynamic laser light scattering, Zeta potential analysis, NMR and TEM techniques.

**Dmitri Vezenov** began at Lehigh as an Assistant Professor in 2006. He was promoted and tenured at the rank of Associate Professor in 2013. His educational background includes a B.S. degree from Lomonosov Moscow State University (Russia, 1991), an M.S. degree from Case Western Reserve University (1994) and Ph.D. from Harvard University (1999), where he also carried out his post-doctoral work. His primary research interests are in the development and

applications of new tools for single molecule/single cell detection, manipulation, and analysis. This research has been pursued in three major directions: (1) designing bio-analytical platforms based on massively-parallel single molecule force spectroscopy for use in the next-generation genome sequencing technology; (2) understanding fundamentals of intermolecular interactions in soft matter, with focus on direct measurements of forces between biomolecules and nanomaterials such as DNA and carbon nanotubes; (3) quantifying the morphogenesis of bacterial cell wall through characterization of its structure and mechanical properties.

**Bruce Koel** (on the faculty 2005-2010 as Professor of Physical Chemistry) focused his research on investigating and understanding chemical reactions at surfaces. Surfaces play key roles in a wide-range of technologies: including those associated with the chemical and petroleum industries, functioning of batteries and fuel cells, production of microelectronic devices, design and fabrication of sensors and diagnostic devices, the environment, and atmospheric chemistry. By discovering novel methods to alter and control surface chemistry, the Koel group was able to develop new catalysts for specialty chemical synthesis, make advanced materials with novel properties, and build functional nanostructures. The Koel group employed a wide array of surface analytical techniques: scanning tunneling microscopy (STM), high-resolution X-ray photoelectron spectroscopy (HR-XPS), low energy ion scattering (LEIS), and infrared reflection-absorption spectroscopy (IRAS). Bruce served as Interim Vice-Provost of Research while Lehigh engaged in a national search to fill the position.

**David T. Moore** was appointed to the Chemistry faculty in 2007. His educational background included a B.A. degree from Williams College (1992), an M.S. degree from the University of North Carolina-Chapel Hill (1999) and a Ph.D. from the same institution (2001). Professor Moore's research focused on developing experimental methods to probe molecular level processes, such as nanocatalysis (involving various metallic and non-metallic nanoparticles) and carbon capture, which are relevant to alternative energy and clean energy technologies. The approach used was “freeze-frame” spectroscopy, which involved the use of matrix isolation to stabilize pre- and post-reactive complexes of reactant molecules with neutral and ionic metal clusters. These complexes were then probed using infrared spectroscopy and structural assignments were achieved based on predictions from computational studies. A major breakthrough for the Moore group was the development of the counterion co-deposition method, whereby balanced currents of positive and negatively charged anions from separate, mass-selected beams are trapped in solid rare gases: this is necessary in order to facilitate deposition of the high number-densities of ions required for spectroscopic detection, into the electrically insulating matrices. Together with Prof. Landskron, Prof. Moore was awarded one of the inaugural ARPA-E (Advanced Research Projects Agency-Energy) grants in 2009, to investigate new techniques involving the use of electric fields to facilitate gas separation for carbon capture applications. In 2009 he was awarded an NSF CAREER grant to work on the development of new spectroscopic methods to study the mechanisms of nanocatalytic reactions.

**Heather Jaeger** was appointed to the Chemistry Department faculty in 2013. Her training included a B.S. from Indiana University Purdue University at Indianapolis (2006) and a Ph.D. in quantum chemistry from the University of Georgia (2010). Her research is concerned with, in general, coupled electron-nuclear dynamics in molecular, nanoscale, and condensed-phase systems and more specifically the photo-activated processes of nanoscale materials and how

quantum confinement can be advantageous to solar cell technology. Her ultimate objective is to understand how structure and the surrounding environment impact charge evolution. The methods used were based on the fundamental equations of quantum mechanics, providing certainty that is unattainable by empirical approaches.

**Xiaoji (George) Xu** joined the Chemistry Department in November 2014. His research focuses on studying the organization and interaction of molecules in heterogeneous functional materials with chemically sensitive, super-resolution imaging techniques. Specifically, his research group uses scattering-type near-field optical microscopy with suitable combinations of visible and infrared lasers to match electronic and vibrational levels of the molecules to investigate composition, distribution and interaction of nano-domains at the material interface. The scattering-type near-field technique provides <15 nm spatial resolution, far exceeding the diffraction limit, and enables sub-ensemble studies that are not previously accessible by traditional spectroscopic methods. Currently, his group is interested in spectroscopic studies of nanostructured polymers and energy-related materials, as well as development of microscopy technique toward specific chemistry questions.

**Table of Physical Chemistry Faculty (1966-2015)**

| Name | Dates of Service | Ph.D. | Postdoctoral |
|---|---|---|---|
| Allen, Eugene | 1967-1982 | Rutgers U. | |
| Daen, Jerome | 1958-1966 | Brooklyn Polytechnic U. | U. of Maryland |
| Fowkes, Frederick M. | 1968-1990 | U. of Chicago | |
| Haug, Kenneth O. | 1991-1998 | U. of Minnesota | U.C. Santa Barbara |
| Jaeger, Heather | 2013- | U. of Georgia | U. of Rochester |
| Klebanoff, Leonard E. | 1987-1997 | U. C. Berkeley | |
| Klier, Kamil | 1968-2010 | Czechoslovak Academy of Sciences | |
| Leidheiser, Jr. Henry | 1968-1989 | U. of Virginia | |
| Liu, Tianbo | 2005-2012 | SUNY-Stony Brook | Brookhaven National Labs |
| Lovejoy, Roland W. | 1962-1993 | Washington State U. | U. of Washington |
| Micale, Fortunato | 1965-1995 | Lehigh U. | |
| Moore, David T. | 2007- | U. of North Carolina-Chapel Hill | |
| Serfass, Earl J. | 1937-1959 | Lehigh U. | |
| Simmons, Gary W. | 1970-2006 | U. of Virginia | Georgia Institute of Technology |
| Sturm, James E. | 1956-1995 | U. Notre Dame | U. of Wisconsin |
| Vanderhoff, John W. | 1970-1997 | U. of Buffalo | |
| Vezenov, Dmitri | 2006- | Harvard U. | |
| Xu, Xiaoji G. | 2014- | U. of British Columbia | U. of Toronto |
| Zettlemoyer, Albert C. | 1941-1991 | MIT | |
| Zeroka, Daniel | 1967-2007 | U. of Pennsylvania | Yale U. |

## FACULTY WITH JOINT APPOINTMENTS

**John A. Manson** (b1928-d1988 was on the faculty from 1966-1988) upon his arrival at Lehigh served as director of the Polymer Laboratory and in 1975 he also became director of the polymer science and engineering program. His education included B.S., M.S. and Ph.D. degrees from McMaster University between 1949-1956. In 1957 he completed postdoctoral studies at the University of Michigan. He was interested in the synthesis, molecular structure, properties and the behavior of polymers and polymer composites. Many of the studies that Prof. Manson was involved with had engineering as well as fundamental implications, and thus involved collaboration with other investigators in chemical, mechanical, materials, and civil engineering. He was the author of several books and hundreds of publications. He was much honored by his colleagues sharing the Libsch Research Award in 1983.

**Donald M. Smyth** (b1930-d2015) was on the faculty from 1971-1995) was appointed Director of the Materials Research Center in 1971 with joint appointments in Materials Science & Engineering and Chemistry. Don continued to lead the center until 1994. Don had been a candidate for an inorganic chemistry position at Lehigh in 1954 but not selected. He was offered the same position in 1957 but he turned it down. Prior to Lehigh, Don had been at Sprague Electric Company, then the world's largest manufacturer of capacitors. His education included a B.S in Chemistry from the University of Maine and Ph.D. in inorganic chemistry from MIT. Smyth's specialty was defect chemistry which deals with crystalline inorganic compounds, missing atoms, misplaced atoms, impurity atoms, or extra electrons or holes. Smyth authored a well-reviewed book, *Defect Chemistry of Metal Oxides*, which has also been reprinted in China. Defect chemistry was an important aspect of the high-temperature superconductors discovered in the late 1980s and continues to have capacitor and transducer applications, such as in medical imaging and submarine detection. At age 29 Smyth received the top international award for batteries from the Electrochemical Society. In 1990 Smyth shared the Libsch Research Award. In 1996 he was elected to the National Academy of Engineering, one of the highest honors accorded engineers in the United States.

## RESEARCH STAFF

**Richard G. Herman** (Ph.D. Ohio University, 1972) served as a research scientist from 1975-2008 in the area of catalysis and surface science. He also served as Adjunct Associate Professor of Analytical Chemistry (1980) and Interim Director (1989) and Executive Director (1995-2001) of the Zettlemoyer Center for Surface Studies. His research contributions covered a broad range of surface science and catalysis: new syntheses of high cetane ethers from alcohols over designed strong acid catalysts, conversion of $H_2$/CO synthesis gas to methanol and higher alcohols over base promoted oxide or sulfide catalysts, new-zeolite-based catalysts, and low-temperature processes for NOx abatement by selective catalytic reduction, improved hydrocracking catalysts for converting condensed aromatics to gasoline-range products, catalytic coal oxidation in fluidized beds, direct selective methane oxidation to oxygenates and/or C2 hydrocarbons over oxide catalysts, selective activation of methane on noble metal catalysts, gas-phase amine synthesis over heterogeneous catalysts, development of new formulations for UV/EB-curable printing inks/coatings containing activated soybean oil for acrylate replacement, and improvement of non-solvent resin powder coatings for galvanized steel.

**Richard Granata** (Ph.D. American University) joined the Center for Surface and Coatings Research (later renamed, Zettlemoyer Center for Surface Science) at Lehigh University in 1979 and continued at Lehigh until 1998, at which time he accepted a position as Professor of Ocean Engineering at Florida Atlantic University in order to continue research in corrosion. While at Lehigh he worked with Professor Henry Leidheiser, Jr., on contract research projects sponsored by Electric Power Research Institute, ARO, ONR, NAWC-WD, AFOSR, DARPA, NSF, and many industry organizations and companies. Dr. Granata's primary research areas were corrosion, electrochemical studies of corrosion, including polarization methods for evaluation of corrosion inhibitors, electrochemical impedance spectroscopy of polymer films and deterioration mechanisms of protective organic coatings. He helped teach the short course entitled, Corrosion and Its Control by Protective Coatings, and continued offering the course after Professor Leidheiser's retirement in 1989. Dr. Granata taught Chemistry 312, Fundamentals of Corrosion. He collaborated with Professors Simmons, Roberts and Regen on topics of XPS surface studies, NMR of ions in polymers and self-assembling molecules on metal surfaces, respectively. With Professors Wei, Jaccodine and Fisher, studies included aging aircraft deterioration (the Aloha Airline incident), polymer failures on microcircuits, and bridge deterioration (Mianus River Bridge collapse and Williamsburg Bridge closure), respectively. Work with the ATLSS Center resulted in the patent of Smart Paint for crack/fracture detection with co-inventors, Leidheiser and Bilder. With Dr. Madani, PALS (positron annihilation lifetime spectroscopy) studies showed the void volumes present in protective coatings filled with water upon exposure and filling was dependent upon polymer chemistry and cross-linking. In collaboration with Ohio State University, SUNY, BNL, Rockwell International and University of Erlangen, a major investigation was performed to determine the mechanism of chromate corrosion inhibition enabling the elimination of this ubiquitous, yet toxic, substance from metal surfaces and coatings.

**Alfred C. Miller** (Ph.D. Clarkson University, 1979) served as a research scientist from 1989-2013 during which time he was involved in sample preparation, spectral determination, and subsequent analysis of experiments involving the high resolution SCIENTA ESCA X-ray

photoelectron spectrometer (XPS). He also acted as a resource for questions on XPS and was basically a walking encyclopedia of XPS results that are so widely used in studies of surfaces of materials. He provided technical assistance to not only Lehigh undergraduate/graduate students/faculty but researchers from outside Lehigh University.

**Table of Faculty with Joint Appointments (1966-2015)**

| Name | Other Appointment | Dates of Service | Ph.D. | Postdoctoral |
|---|---|---|---|---|
| Manson, John A. | Materials Science | 1966-1988 | McGill U. | U. of Michigan |
| Smyth, Donald M. | Materials Science | 1971-1995 | U. of Maine | |

**Table of Research Staff (1966-2015)**

| Name | Dates of Service | Ph.D. | Postdoctoral |
|---|---|---|---|
| Granata, Richard | 1979-1998 | American U. | |
| Herman, Richard G. | 1975-2008 | Ohio U. | U. of Lund (Sweden) |
| Miller, Alfred C. | 1989-2013 | Clarkson U. | |

## Highlights of Responses to Questionnaire

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|---|---|
| Peter M. Jeffers | During his undergraduate years at Lehigh (B.A., 1961), Peter manifested high aptitude and versatility in science, athletics and even music. Besides being a star student, he was a strong performer on Lehigh's soccer and baseball teams and was given recognition. Peter stayed on for his Ph.D. degree (1964) under Prof. Jerome Daen on surface chemistry. Following two postdoctoral years at Cornell University with Prof. Simon Bauer on high-velocity chemical kinetics, Peter joined the faculty at SUNY Cortland and served there very effectively in teaching, research and administration for over 39 years. His research included attention to chemical behavior of industrially-used compounds of environmental concern. One of his general publications is "Handbook of Property Estimation Methods for Chemicals." He found it within his tremendous capacity in mid-life to excel in running marathon races in some of which he took first place. |
| Herbert H. Silber | Herbert worked his way to the Chemistry Faculty at San Jose State University; he brought in more than 10 million dollars in grant money at a non-PhD granting university. |
| James D. Lear | Jim Lear's attention to theory of chemistry manifested itself in his enrollment in the two 4-credit courses in mathematical physics given by the late Prof. Robert Folk. Jim used his perspective from these courses to solve a differential equation involved in his research on electronic excitation energy transfer dynamics. Publication of this solution led to recognition of his abilities in his career as a researcher in biophysical chemistry at the University of Pennsylvania . |
| John E. Minear | An explicit general appreciation of Jack Minear's study at Lehigh is the atmosphere of identification and solving problems of science. Jack recalls that the employment market even for PhDs was tight in the early 1970s. He found it necessary to learn new skills in product development and marketing of these products. His experience at Lehigh was well-suited to this adaptation and subsequent career. |
| Allan H. Laufer | As a result of the journal publication of his doctoral research, Allan Laufer was recruited to join the vacuum ultraviolet photochemistry group at the then NBS, now NIST. He had a very productive and well-recognized career there. |
| Margaret Kittek | Peggy was among the first 5 undergraduate women admitted to the College of Engineering in 1971; some reminiscences of growing up in Bethlehem and attending Lehigh as both an undergraduate and graduate student. Very thoughtful considerations of her time spent at Lehigh. |
| Lawrence A. Casper | Larry worked his way to be an Assistant Dean in the College of Engineering at the University of Wisconsin-Madison. |
| Gary S. Calabrese | Gary earned his Ph.D. in Inorganic Chemistry at MIT. He felt his undergraduate training prepared him well and put his beginning ability at equal to or better than other graduate students at MIT who came from more prestigious schools. Gary worked his way to Director of Research at |

| | |
|---|---|
| Gary S. Calabrese (continued) | Corning. |
| John Texter | John earned a B.S. in Electrical Engineering and then an M.S. in Chemistry, M.S. in Mathematics and a Ph.D. in Chemistry in 1976 working under the supervision of Prof. Klier. After 2 postdoctoral appointments, he was a member of the research staff at Eastman Kodak Research Laboratories from 1978-1998 specializing in dispersion and emulsion technology. In 2002 he became a Professor of Polymer and Coatings at Eastern Michigan University. He provides some interesting reminiscences, in particular his humorous description of an incident involving the decomposition of a sample of $NI_3$. |
| Thomas B. Garrett | After earning his Ph.D. at Lehigh in 1970, Tom was on the research staff at Armstrong Cork (later renamed Armstrong World Industries) in Lancaster, PA. Tom comments that faculty in Chemistry and Physics were helpful and approachable. |
| Stephen J. Benkovic | Stephen did undergraduate research with Prof. Jerry Daen. Stephen earned a Ph.D. at Cornell University and accepted an appointment at Pennsylvania State University where he is now Evan Pugh Professor and Eberly Chair in Chemistry. |
| Joel M. Ressner | After his undergraduate degree at Lehigh, Joel earned an M.S. degree in England and returned to earn his Ph.D. under the supervision of Prof. Kraihanzel. He was appointed to the Chemistry Faculty at West Chester University where he continues today. He points out that at the time he was in England he was surprised to learn how well the Chemistry Department Faculty were regarded by the Chemistry Faculty in England. He provides other reminiscences as well. |
| Charles M. Bartish | Charles studied at Lehigh (1969-1973) and earned a Ph.D. in Inorganic Chemistry in 1973 working under the supervision of Prof. Kraihanzel. He had a productive career at Air Products. He mentions that there was a trimodal distribution among the graduate students during his time of study. During his time at Lehigh, he felt that the NMR, mass spectrometer and the computing facilities were state of the art. |
| Abigail M. Oelker | Abby earned a B.S. in Chemical Engineering in 2003. She did undergraduate research with Prof. Messmer and Prof. Klier. She helped found the AXE Chemistry Fraternity at Lehigh. She earned a Ph.D. in Chemistry at Boston University having been influenced in a positive way by her research experience in the Chemistry Department. |
| Melissa Kistler Langston | Melissa earned an M.S. (2006) and Ph.D. in Chemistry (2009) under the supervision of Prof. Tianbo Liu. She reports on an incident involving the emergency showers in the hall in Sinclair Lab where there were no drains for the showers. |
| Richard Kellerman | After earning a B.S. in the UK, Richard came to Lehigh for graduate work based on contact with Prof. Zettlemoyer. He earned a Ph.D. degree with Prof. Leidheiser and did postdoctoral work with Prof. Klier. He was on the research staff of Xerox and later co-started a new company Nielson- |

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| | Kellerman in West-Chester, PA. |
| Dennis W. Hess | After earning a B.S. in Chemistry from Albright College, Dennis earned an M.S. in Chemistry (1970) with Prof. Lovejoy and Ph.D. in Chemistry (1973) with Prof. Fowkes. He worked his way to Chemical Engineering Faculties of several very prestigious universities: University of Minnesota, University of California (Berkeley), Lehigh University, and Georgia Institute of Technology. Dennis' current appointment at Georgia Tech is Professor and Thomas C. DeLoach, Jr. Chair. |
| Richard J. Miller | The dominant appreciation expressed by Dick Miller is that his graduate study at Lehigh prepared him well for his entire career as a physical chemistry faculty member at SUNY Cortland. He recognized high-quality teaching and the identification and stimulation of research ideas. His role also as a teaching assistant brought him into contact with Lehigh undergraduates whom he recognized as generally of quite high quality, consistent with Lehigh's reputation. |
| Arthur E. Waltking | As a son of a Lehigh alumnus, Art was quite disappointed at the admissions committee's assessment that his aptitude was not high enough for him "to be an engineer." Art responded that he had planned to pursue chemistry in the College of Arts and Sciences, not engineering. He was given conditional acceptance and was even required to take remedial courses in mathematics. Taking summer courses got him further along so that he could take elective courses, including nuclear and radiochemistry during his junior and senior years. This extra background made available career positions with food processing companies. One company hired him in recognition of his Lehigh B.A. degree and Art worked effectively for his whole career along with several scientists with PhD degrees. He has published widely in the trade and has even founded his own consulting firm. |
| Ronald D. Schaeffer | Ron Schaeffer is Chief Executive Officer of PhotoMachining, Inc. He has been involved in laser manufacture and materials processing for over 25 years, working in and starting small companies. He has over 150 publications, has written monthly web and print columns( currently writing a column for MicroManufacturing Magazine). He is on the Editorial Advisroy Board and is a frequent Blogger for Industrial Laser Solutions magazine. He is also a past member of the Board of Directors of the Laser Institute of America and is affiliated with the New England Board of Higher Education. Finally he is the author of the text book entitled, "Fundamentals of Laser Micromachining". He has a Ph.D. in Physical Chemistry from Lehigh University and did graduate work at the University of Paris. He is a US Army veteran of the 172$^{nd}$ Mountain Brigade and the 101$^{st}$ Airborne division. In his spare time he farms, collects antique pocket watches, plays guitar, and rides motorcycle. |
| Charles L. Cronan | Charles did his graduate research on surface chemistry with Professors Zettlemoyer and Leidheiser in Sinclair Laboratory. Among his memories related to sponsored research at Lehigh for Picatinny Arsenal to extend storage life of an explosive. He had no mishaps , but learned later how |

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| Charles L. Cronan (continued) | risky it was to handle the amounts involved. Upon completion of his Ph.D. in 1976, Charles joined the research staff of Miller Brewing Co., Milwaukee, WI. He used ESR to measure concentrations and free radicals to assess suitability of waste disposal. Charles was very productive in developing means related not only to brewing but also to other needs. Among his several patents is a method of dynamic surface tension measurement relates not only to beer suds formation but also found use in prenatal diagnosis of fetal lung development. In the mid-1990s, Charles formed his own consulting company, **Cronan Creative Solutions**, in which he continued his inventiveness with further patents. He also developed a way of monitoring heat transport through the walls of a building *en route* to choosing ways to conserve energy |
| James P. Wightman | B.S. Chemistry, Randolph-Macon College, 1955; Ph.D., Lehigh, 1960, Jim came to Lehigh in response to a visit and lecture by Dr. Harvey A. Neville and was encouraged by Prof. Herman Collier of Moravian College, both alumni of Randolph-Macon College. During his time at Lehigh as a T.A., Jim assessed very favorably the aptitudes of Lehigh undergraduates, at that time all male students. He observed a wider diversity among the graduate students. The most impressive teacher at that time was Prof. Robert West. Jim chose to do his M.S. and Ph.D. research on surface chemistry in Prof. A. C. Zettlemoyer's group. Prof. J. J. Chessick was Jim's mentor. Following a postdoctoral year at PA State University, Jim joined the faculty at VA Technical University. He performed very effectively there in both teaching and research from 1962-2001 with 161 technical publications and several awards. He was named Distinguished Professor at VA Technical University. Following formal retirement, Jim has given invited lectures on surface science to broader audiences. |
| Ira Brinn | Ira, a graduate student at Lehigh from Bucknell (1961), joined in the demonstrations by Lehigh students against the United States' involvement in the Vietnam War. He did so to the extent that was noticed by Chemistry Dept. faculty who, at a departmental meeting in early 1965, decided to discontinue Ira as a doctoral candidate. While teaching at a small college in Wheeling, WV, Ira saw the importance of further graduate study, was accepted at the Univ. of Pittsburgh, obtained his Ph.D. degree there and then had a postdoctoral year at Columbia Univ. He obtained a faculty position at Recife Univ. in Brazil and had most of his productive career at the Univ. of Rio de Janeiro. Some Lehigh faculty felt that the expulsion from Lehigh was done without appropriate warning. |

# There is an Appendix which contains the reminiscences of many alumni and previous faculty.

## The Rise of Instrumentation
## By James E. Roberts

In the early 20th century, most chemical analyses were carried out by traditional chemical reactions, sometimes called "wet chemistry," even though water was not always involved. Analytical chemists became very proficient at many different types of titrations (a volumetric measurement method capable of routine precision on the order of a few parts per thousand), often with a color change as an indication of complete reaction. After World War II, the accelerating pace of scientific development meant that new scientific measurement instruments became less expensive and widely available. Analytical and physical chemists took the lead in applying many of these new measurement devices to problems in chemistry.

The subset of the "routine" instruments commercially available in the 1950s through the 1970s that made the most significant impact on chemical analysis were infrared spectroscopy (IR), ultra-violet visible spectroscopy (UV-VIS), nuclear magnetic resonance spectroscopy (NMR), and mass spectrometry (MS). Both gas chromatography (GC) and high performance liquid chromatography (HPLC) became important for separating complex mixtures into individual components, often with a specialized detector. The GC and HPLC instruments sometimes had several detectors to enhance either sensitivity or selectivity; the two combinations that became very widely available were GC-MS and HPLC with UV-VIS detection. To illustrate how analysis modalities have changed at Lehigh through the years, the history of Lehigh's capabilities for a couple of these methods is discussed in more detail below.

Infrared spectroscopy did not become a core facility until about 1966; prior to that time one or two individual faculty owned and managed prism instruments they had privately obtained on grants and contracts. In the 1950s Professor Stubbings of the Leather Research Institute owned an early version Beckman unit for his team's use, Amstutz (as noted in the Organic Division history) used an off-site unit at General Aniline and Films (GAF) in Easton, and Borowitz acquired his own Perkin Elmer 137 (Infracord). Besides GAF, some faculty acquired their IR spectra from Philip Sadtler (Lehigh U. BS in Chemistry, 1934) who had established Sadtler Standard Spectra in Philadelphia. Phil owned a salt-prism Baird Model B and would run, publish, and sell "standard spectra" of known compounds. If a faculty member was reasonably certain of the structure of a research-derived molecule, a sample sent to Sadtler Labs resulted in the return of a spectrum and one's name on the printed/vended version of that spectrum. In 1975, Sadtler – whose grandfather Samuel Sadtler was in 1868-69 the department's first graduate student – gave Lehigh a complete set of his standard spectra (with annual updates) and paid for a room within the Mudd Building to house them. A plaque on the east aisle of the second floor remembers that gift but the Sadtler room has been remodeled into part of the department's new physical chemistry lab. When digitized, on-line spectra became available, the Sadtler family's gifts of the print copies ceased. Fifteen years ago the hard copy versions were discarded.

When the Leather Institute and Professor Borowitz left Lehigh for other employment, their instruments went with them. About 1964 a research quality Perkin-Elmer Model 21 was acquired mainly for the use of Professor Lovejoy (see biography in the Physical Chemistry Division history) but students from other groups were permitted to use it under Lovejoy's sometimes reluctant supervision. Always concerned about moisture fogging of the prism, Lovejoy would frequently de-mount it and store the object in a large

desiccator. In 1970 a Beckman Microspec Infrared Spectrometer was purchased for use in the organic teaching laboratory – especially in qualitative organic analysis – but the instrument also saw wide use in research.

From 1970 to the present the ownership and maintenance of at least one infrared spectrometer has been part of a departmental obligation. A Mattson Fourier transform IR instrument was acquired in the early 1980s and continued operating into the early 2000s. With a variety of attachments for various sampling modes, it satisfied most of the researcher's needs for over two decades. In addition, a series of ever-evolving and ever-improving grating and FT-IRs has been made available primarily for the organic laboratory and undergraduate instruction. In 2015 the department's workhorse is a Thermo Scientific FT-IR with a total internal reflectance attachment. It is routine to obtain excellent IR spectra from either solids or liquids within a few minutes of logging into the instrument. Trying to make a KBr pellet with sufficient clarity is almost a notion of the past. Identical devices are available in both the organic and general chemistry laboratories.

Professor Earl Searfass performed some early experiments under high vacuum in what some consider as precursor studies to the technique known as X-Ray Photoelectron Spectroscopy (XPS). Karl Siegbahn in Sweden later developed and publicized the technique and nicknamed it Electron Spectroscopy for Chemical Analysis (ESCA). Siegbahn received the Nobel Prize in 1981 for his work in this field. The basis of the technique is as follows: A monochromatic high energy electron beam hits a small spot on the sample under high vacuum. The incident electron often knocks out "core" electrons from elements within several atomic layers of the surface. Higher level electrons may drop down to fill the electron vacancy, producing an X-ray to shed the excess energy. These X-rays are characteristic of the element involved, so it is possible to build up an "elemental analysis" of the several atomic layers closest to the surface of the sample. In oriented samples, electron diffraction may occur, making it possible to extract structural information.

In 1986, Professors Kamil Klier and Gary Simmons (see biographies in the Physical Chemistry section) wrote a proposal to the Department of Energy to bring a unique world-class Scienta ESCA to Lehigh. They successfully put together a consortium that included AT&T's Bell Laboratories of Allentown, the Ben Franklin Center (a state of Pennsylvania funded agency based at Lehigh, the Scienta company, and several different constituencies at Lehigh University to provide the matching funds for the DOE grant. This instrument, operational by 1989, was the first of its kind in the Western hemisphere. The facility exceeded expectations, and the investments of the many partners were quickly amortized. The modular instrument has been upgraded with numerous attachments obtained through individual faculty grants. Some of the additional capabilities include an automated programmable goniometer / manipulator for photoelectron diffraction, the optics required for low energy electron diffraction (commonly known as LEED), a cryogenic attachment for analysis of volatile compounds, a high pressure sample prep chamber, and more. This major facility has been used extensively by Lehigh faculty, students, visiting scholars, and to provide service to industry in research areas ranging from semiconductor and laser technology, to design and characterization of catalysts, to analysis of causes for material fracture, to quality control of turbine blades, and to many other applications as well. Despite being a technical success, the administration of the facility has been a challenge in the face of changing administrations; the high-level

personnel support was shifted from the university budget to a self-supporting model, requiring additional industrial contracts to support the laboratory. This model meant less time was available for Lehigh researchers. But despite some bumps in the road, the Scienta ESCA lab remains the flagship of advanced surface and interface analysis for Lehigh, our students and faculty, and the scientific community at large.

The Scienta ESCA has a rotating anode, which more effectively dissipates the energy generated during X-Ray production, so a much higher X-Ray flux is possible. An X-Ray monochromator is employed so the X-Ray beam hitting the sample has much smaller energy dispersion than conventional XPS spectrometers. Despite losses in the monochromator, the resulting X-Ray beam intensity is still several-fold higher than normal instruments, which translates into higher sensitivity for most measurements. The hemispherical analyzer is much bigger than most instruments, to maintain the low energy dispersion advantage of the X-Ray monochromator. By positioning the sample properly, it is possible to preferentially detect those atoms that are closest to the surface, although overall sensitivity decreases during such experiments. It is possible to rotate samples in the high vacuum chamber; such directional studies can be important for understanding both the chemistry and structural changes that occur at and near surfaces. Because of the high level of expertise required to both utilize the instrument to full capability and maintain it, Dr. Alfred Miller was hired to oversee the instrument. After his retirement in 2013, Rob Pafcheck took over. Since late 2014, Dr. Henry Lufman has been responsible for the instrument.

The department's first mass spec was home-built by Professor Serfass in the 1930's and 1940s. This instrument was restricted to his research group. In the late 1950s, a Hitachi double-focusing mass spectrometer was obtained with a grant written in the middle 1950s. Located on the 2$^{nd}$ floor of the Chandler building, it was generally available to researchers within the department

In 1978 Lehigh teamed up with Air Products and Chemicals, Inc. to purchase a Finnegan mass spectrometer that was located at Lehigh. Air Products had an operator for the instrument that spent considerable time at Lehigh; scientists from either institution could submit samples for analysis. In the late 1980s, an updated Hewlett Packard GC-MS arrived and became the workhorse MS instrument. While suitable for low to moderate molecular weight samples, the GC portion of the instrument meant each chemical species to be measured had to be at least somewhat volatile, which placed some limits on sample selection. In 2009, a Matrix Assisted Laser Desorption Ionization (MALDI) mass spectrometer from Bruker was purchased. This time-of-flight instrument is very effective for higher molecular weight species (well over 100,000 Daltons), and does not require sample volatility, as a laser pulse rapidly heats the matrix surrounding the sample. When the matrix volatilizes, it carries the sample molecules into the gas phase at the same time; provided they have a charge, they can then be accelerated and measured by the MS detector. Dr. Sam Niedbala (a Professor of Practice) installed a Shimadzu HPLC coupled to an Applied Biosystems Sciex 3200 Q Trap triple-quad MS in the late 2000s. In 2011, new Shimadzu GC-MS and HPLC-MS instruments were purchased as part of an upgrade to the organic chemistry labs. In 2015 there are five mass spectrometers available in the MS laboratory (two GC-MS units, two HPLC-MS instruments, and the one MALDI MS).

In the late 1950s and early 1960s, NMR moved into the mainstream in Chemistry departments across America. The first NMR (a Varian A-60) at Lehigh arrived in 1962 under Amstutz's chairmanship and is covered in his biography (see Organic Division history). After a decade of service it was replaced with another permanent magnet 60 MHz unit, a Hitachi Perkin-Elmer R-20A. While nominally a multi-nuclear instrument, it appears it was very difficult to obtain any spectra except proton NMR. In 1981, a JEOL FX-90Q was purchased. While still based on a permanent magnet, this early computer controlled instrument had a unique light pen interface – the user set parameters through a series of menus on a small oscilloscope screen; the control method was clicking a pen while it was pointed at a particular lighted word on the screen. The FX90Q was a Fourier Transform device, with greatly increased sensitivity over the previous NMR instrument. Several faculty members used the true multi-nuclear capabilities in their research.

In 1985, a modern high-field NMR laboratory with facile multi-nuclear functionality was created. A 300 MHz NMR with the capability of running solid samples was purchased and overseen by Professor Roberts (see biography in the Analytical Division History). While based on a General Electric NMR Instruments GN-300, Roberts modified the instrument significantly to add specialized capabilities. The console was replaced with a Tecmag Discovery unit in 2010**.** In early 1986, a second agreement with Air Products led to a joint operating arrangement for a Bruker AM 500 MHz solution-state NMR instrument located in the same laboratory. Air Products provided the cryogens, while Lehigh maintained the instrument. Scientists from both institutions had access to the 500 during certain days of the week**.** In the early 2000s**,** the console was updated to a Bruker Avance system, which included purchase of an inverse detection probe. In 1992, the two institutions joined forces again to acquire a third NMR instrument – a Bruker AM-360 MHz unit with NMR imaging capabilities. The Chemistry Department borrowed against the profits it received from the Distance Education program to pay its share in the match with Air Products. The instrument had a wide-bore magnet, so sample up to 25 mm in diameter could be imaged. Once again researchers from both institutions used the imaging capabilities of this instrument for over 15 years. In 2015, the 300 and 500 MHz instruments are still in the NMR lab, while the AM-360 was retired roughly a decade ago.

By the 1970s, most chemistry departments had at least the following instruments available, often in a centralized laboratory, so that many research groups could access them routinely: UV-VIS, IR, GC, HPLC, MS, and NMR. Virtually every chemistry department had this core set available, while individual departments had additional, more specialized facilities based on the interests and needs of the faculty. In addition, many faculty members had specific instruments in their own research laboratories.

At that time, staff members dedicated to the operation and maintenance of these instruments started being hired. At Lehigh, the Department of Chemistry had a couple of people dedicated to either a specific instrument, or in some cases, general electronics support. With the arrival of G. Doyle Daves as Chair of the department in 1981 (see biography in the Organic Division section), the administration of instrumental measurements underwent a big change.

Daves brought in Mr. William "Bill" Anderson to become the first Director of Chemical Instrumentation. Anderson received a Bachelor of Science degree in Chemistry from San Jose State University. Shortly

thereafter he began working at the Stanford Research Institute with one of the earliest NMRs available from Varian Associates. He also started working with mass spectrometry. After a period at the Oregon Graduate Center, Anderson came to Lehigh and oversaw the building of a unified modern instrumentation lab. The numerous smaller instruments became part of an analytical services lab, but they were located in several different rooms around the building. Anderson retired from Lehigh in 1996.

Dah-Jyuu ("DJ") Wang was hired and took over for Anderson in 1996, with some overlap. Dr. Wang received a Ph.D. in Chemistry with an emphasis in NMR imaging from SUNY at Stony Brook. Wang continued overseeing all of the department's instrumentation, helping replace several of the smaller instruments over his tenure. Dr. Wang left Lehigh in 2002 to return to a position that had more NMR imaging responsibilities, his first interest in magnetic resonance.

After Wang left, Dr. Art Bates was hired (Ph.D. in Physics). Bates had already been in charge of shared chemical instrument facilities, most recently at Michigan State University. Another expert in NMR, Bates also had experience with the other instruments at Lehigh. Bates retired in 2009.

Dr. Norm Zheng arrived in the latter part of 2009. His Ph.D. studies were in solid-state NMR spectroscopy at Michigan State University. Zheng continued the traditions of the chemical instrumentation facility until he left for a job in industry in the middle of 2015.

In October of 2015, Dr. Eric Moore (Ph.D. in Chemistry from Cornell University) joined the Department of Chemistry as Director of Chemical Instrumentation. Moore's Ph.D. work involved working with home-built equipment, and a post-doctoral position at the National Institutes of Health in NMR spectroscopy served him well as a background for this multi-faceted position at Lehigh.

Over the last 25 years there have been several changes to how instruments have been handled within the Department of Chemistry. A decision was made to consolidate most of the departmentally owned instruments on the 2$^{nd}$ floor of the Mudd building, part because the physical chemistry and advanced laboratory classes were being moved to the second floor as well; both class use some of these instruments. Most of the smaller instruments were moved to a common instrument laboratory on the 2$^{nd}$ floor of the Mudd building, instead of being scattered in several different labs. At about the same time, a storeroom was converted into the current mass spectrometry laboratory. These two rooms, along with the adjacent NMR lab, were placed on a special air conditioning/heating system to better control the temperature in each room.

In between each of the Directors of Chemical Instrumentation cited above, Bill Anderson came back to "fill in" as an interim Director for several months each time. Anderson was involved in almost every significant change with instrumentation since 1981, including the renovations for and the purchase of the majority of the new instruments. In 2015, Anderson came out of retirement again and filled the department's instrumentation needs until the arrival of Dr. Moore.

The array of analytical instruments available in the Department of Chemistry in 2015 includes the following – most are in the second floor small instrument lab: two UV-VIS spectrometers, two GCs with

flame ionization detection (FID), a fluorescence spectrometer (it is actually in a separate laboratory), a circular dichroism instrument, an IR spectrometer with a total internal reflectance sample mode capable of rapid and simple measurements of either liquids or solids, a React IR with a probe that can be inserted into a reaction vial for real-time reaction monitoring, a dynamic light scattering device for measuring particle sizes in liquid media, and an HPLC with dual wavelength detection and autosampler. The 500 and 300 MHz NMR instruments are just down the hall in the dedicated NMR laboratory. A 400 MHz NMR has just been ordered to replace the 300, and is scheduled to arrive in January, 2016. It will have routine capability for both solids and solution NMR with little disruption of the instrument configuration. Adjacent to the NMR lab is the mass spectrometry facility, which includes two GC-MS instruments, one with an autosampler/injector, an HPLC-MS, a second HPLC-MS triple-quad for specialized experiments, and a matrix-assisted laser desorption ionization (MALDI) mass spectrometer that is capable of measuring high molecular weight samples. The Scienta ESCA is still in Sinclair Laboratory. All of these instruments are available to researchers from throughout the university, although it is the Department of Chemistry researchers that use them the most.

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**A Surviving Instrument from 1878: What the Well-Prepared Lehigh Chemist of that Day Needed**

Shown here is a precision assayer's kit complete with chemicals, glassware and balance. It was made in Jena, Germany, about 1870 for a Lehigh chemistry student. Such kits were then required by the department for students who wished to be serious assayers. Charles Rudolph Rauch was one of these -- an A.C. graduate (Analytical Chemist) in Lehigh's class of 1877. He later exchanged his A.C. for a B.S.-chemistry degree – something which the department allowed after 1904. Rauch was considerably older than his average classmates. He had fought in the Civil War and had worked as a watchmaker and jeweler in the Bethlehem area before going to college. He had the talent for precision work so essential to being a chemist-analyst.

In 1874 he enrolled in the Chemistry Department to study assaying which was, in fact, the only choice offered to chemistry majors at the time. Chemical analysis was of critical importance in the minerals industry as well as in iron and zinc production. Fresh from his degree Charles went West to seek his fortune. He was employed in the Silver Plume Mine (Saguache County, Colorado) and then at the nearby twin mines Empress-Josephine, where his analytical skills helped discover a rich lode and to guide the miners in following the vein deeper and deeper into the earth. Empress-Josephine became an extremely profitable mine which continued to supply silver economically into the 1970s. Rauch returned to Bethlehem after 1880 and was hired as chief chemist for Lehigh Portland Cement Company. He briefly lived in Bethlehem's Central Hotel and then purchased a residency on 75 Spring Street.

He held this job – but with increasing responsibilities and titles -- until his retirement in 1915. In 1913 he wrote a comprehensive history of his industry called "Cement Facts" which was published as a magazine by Lehigh Portland Cement. Rauch's field assayer's analysis kit was given to the Department in 1977 by his grandson, Stewart E. Rauch, Jr. (M.S. 1947) former Professor and Department Head at Moravian College. The kit was lent by the department for display in an exhibit called "Science in American Life" which ran at the Smithsonian Institution's National Museum of American History from 1993 to 2012.

Rauch's assayer's kit is in perfect condition and is preserved in the Lehigh University Archives in Lindermann Library.

The photograph was taken by the staff of the Smithsonian Institution in 1994 when the assayer kit first went on display. Each tray has been placed on a separate shelf and the analytical balance, capable of weighing to fractions of a milligram, has been assembled onto its custom designed wooden base. A miniature set of calibrated weights and a tweezers to handle them accompanied the balance.

# Vignettes in our History

## The March of Degrees (see attached brochures on many of these degrees)

In 1866, chemistry's first professor, Charles Mayer Wetherill, designed the A.C. (Analytical Chemist) degree with a curriculum intended to teach the best analytical chemistry of the 1860s. Along with qualitative and quantitative assays it included mineralogy, sampling, blow-piping, flame testing, and borax bead methods. The A.C. degree continued under Chandler until 1905 when it was terminated in favor of a B.S.-Chemistry. In 1895 the department had opened a separate concentration area of industrial chemistry which in 1907 was designated as a B.S.-chemical engineering. Until 1952 chemistry and chemical engineering were two separate degree programs under the Department of Chemistry. Thereafter the new Department of Chemical Engineering took over the B.S.-Chemical Engineering.

The original catalog – then called the Register – invited post-graduates to come to Lehigh for up to three years of free tuition for advanced study. Graduate students studying for the M.S. degree were admitted as early as 1868 with Samuel Philip Sadtler (1847-1923) a B.A. graduate of Pennsylvania College (now known as Gettysburg College) spending the academic year 1868-69 in residence before moving on to the Ph.D. program at the University of Gottingen. Sadtler did not, in fact, complete his Lehigh M.S. but three other students did so before 1900 after which the degree became more common. Lehigh launched a Ph.D. program in 1877 but closed it in 1894 after two chemistry students (Richards and Kiefer) had graduated. In fact, H. E. Kiefer had not finished his work by 1894 so he was allowed to complete the doctorate. He graduated in 1896. Ullmann brought back the Ph.D. in 1937. [Source: Robert P. More (1941) *History of Graduate Work at Lehigh*, Lehigh University Archives]

Regular biochemistry courses taught by a card-carrying biochemist (Joseph Merkel) began in 1962 and by 1972 a biochemistry degree was created which later became an ACS approved B.S. Biochemistry. Through the 1970s, 1980s and 1990s the department experimented with several interdisciplinary degrees which embraced biology and occasionally other sciences. Students took B.S. degrees as dual chem-bio majors, as chem majors with bio minors, as an Interdisciplinary Chem-Bio major, and as graduates of a broad degree known as Fundamental Science. With the increased flexibility which came to be permitted in the ACS-approved B.S.-Biochemistry degree there has been diminished interest in other hybrid degrees.

In 1970 a degree in medical focused biochemistry – an M.S./Ph.D. entitled Physiological Chemistry -- was created and in 1989 it was renamed Pharmaceutical Chemistry. The degree was dropped in 2007. The M.S. and the Ph.D. in Pharmaceutical Chemistry were popular and successful degree options with >50 graduates on campus. The pharmaceutical degree was a popular part of the department's distance education offerings with more than 100 students receiving the M.S.-Pharm Chem degree. Details are covered in the Biochemistry section of this history.

In 1974 the Lehigh Chemistry Department joined the Departments of Psychology, English, Government, and Business-Economics in adopting a new degree (the Doctor of Arts or D.A.) strongly recommended and financed by the Carnegie Corporation. Faculty positions were being

created steadily in the new community colleges popping up all over America but in many circles there was concern that the narrow, research intensive Ph.D. was poor preparation for teaching in the first two-years of college education. The D.A. was designed by a team of educational experts employed by the Carnegie Corporation as a new degree to serve that market. With the endorsement of Lehigh's Graduate School the five departments which had agreed to create the new degree submitted a successful application to the Carnegie Foundation for support to initiate the program. An initial grant of $90,000 was followed by smaller awards. A dozen graduate student fellowships and funds to build a video studio (to film practice teaching sessions) were part of the grant. Five chemists took this degree pathway and all entered lower division college teaching. The degree was inactivated in 2007 by the Department and by then most of the other 18 universities which had once hosted the program had also terminated it. Many reasons have been offered as to why the D.A. failed to catch on but one analysis by Leonard Cassuto entitled "Why We Need to Remember the Doctorate of Arts" which appeared in *The Chronicle of Higher Education,* 25 September 2015, page A32, is especially noteworthy. In brief, many universities created Ph.D. tracks in education which undermined the D.A.

In 1982 the Department created an M.S. in Clinical Chemistry in cooperation with the Lehigh Valley Hospital Center (especially with its pathology and clinical laboratories) to provide the practical training. Students were paid for their hospital practicum time and the Department covered thei stipend/tuition when they were on campus. Five students completed the degree program and all went on to do Ph.D.s in biochemistry or physiological chemistry. Due to changes in the health care laws, the hospital declined to support and train the students after 1989. The program remained in the catalogue till 2007 when it was deleted.

Interdisciplinary M.S. and Ph.D. programs in Polymers, Biotechnology, and Solid State are described below.

## Public Outreach by the Department

### 1) The GAF Lectures

General Aniline Film (GAF) underwrote a number of lectures which were held during 1978-1985 and which brought to the Chemistry Department a number of distinguished chemists, four of whom were Nobel Laureates. The GAF Lecturers during this time period were:

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| George B. Kistiakowsky | 1978 | [1957-61 Presidential Science Advisor] |
| Donald F. Hornig | 1979 | [1964-69 Presidential Science Advisor] |
| William N. Lipscomb | 1981 | [1976 Nobel Laureate in Chemistry] |
| F. Albert Cotton | 1982 | [very distinguished Inorganic Chemist] |
| Roald Hoffmann | 1983 | [1981 Nobel Laureate in Chemistry] |
| Paul J. Flory | 1984 | [1974 Nobel Laureate in Chemistry] |
| Marshall W. Nirenberg | 1985 | [1968 Nobel Laureate in Physiology or Medicine] |

These lectures benefitted not only faculty and students at Lehigh but also faculty and students from nearby colleges and universities who were invited and attended. These lectures helped to spotlight the Lehigh Chemistry Department and in many cases made a favorable impression on those attending from off-campus. A number of graduate students who later came to Lehigh had

favorable first impressions of Lehigh as a result of attending a GAF Lecture. The late afternoon lectures were typically followed by a dinner. When William N. Lipscomb visited he did present two lectures, a late-afternoon lecture and an evening lecture.

### 2) The Summer Undergraduate Research Program

At least as far back as the 1930s the department hosted undergraduate, and occasionally high school students, in summer research projects. Individual professors and centers/institutes sometimes scraped funds together to provide summer stipends. Often these programs received external funding from NIH, ACS Project SEED, NSF, and chemical industry. Seminar lectures and social gatherings were part of the programs which also had the aim of bringing potential Lehigh students into an understanding of the department and its programs. From 1970 to 1981 the department obtained funding through the ACS's Summer Experience for the Economically Disadvantaged (SEED). One high school student per summer was brought to the laboratories by this program and integrated with other students in the college undergraduate program. From 1981 to 1994, the department received funding from NIH for a minority summer research program for high school students interested in the health sciences. This program was administered out of the Center for Health Sciences with Professor Barry Bean of Biological Sciences acting as PI. Four to six minority high school students from the Lehigh Valley were funded each summer usually split equally between Chemistry and BioSciences. NSF Summer REU (Research Experience for Undergraduates) funds were obtained – on annual application – under a plan in which each NSF-underwritten student slot was matched by an industry-supported slot – thus doubling the typical 8 – 10 NSF slots to 16 – 20 supported students.

### 3) The CESAR Project (Center for Emeritus Scientists in Academic Research)

By 1990 the numbers of undergraduate researchers – both from non-Lehigh campuses and from Lehigh – had grown too large for the regular faculty, which was shrinking steadily in numbers, to handle. Simply stated, student interest in undergraduate research projects far exceeded the number of faculty to supervise such projects. Proposals were submitted to the Merck Foundation and to the Dreyfus Foundation for a new program to bring in recently retired industrial chemists to provide projects and guidance to the students. $365,000 was raised, three storage rooms within Mudd and Neville were remodeled as labs to handle both the corporate emeriti and the additional students, and funds were employed to provide summer stipends. A cohort consisting of Ted Mellin as CESAR Director (ex-Merck), Richard Merritt (ex-Rohm and Haas), Alberta Albrecht-Siemiatkoski (ex-Cyanamid and Sloan Kettering), James J. Bohning (ex-ACS staffer), Thomas Lloyd (ex-NJ Zinc), Robert Rapp (ex-Glidden Paints and Albright College), Tibor Sipos (ex-J&J), Frank Michelotti (ex-J.T. Baker) and Dennis Patterson (ex-Rohm and Haas) mentored students in the program. Most projects – as was intended – had a strong product-oriented flavor and served to introduce the students to the industrial approach to research. Safety was stressed at customary corporate levels. With the hiring of Chairman Robert Flowers and the re-opening of regular faculty hiring, new young faculty were sufficient to mentor the students. The CESAR program faded away in 2006-2008 as its remaining funds were employed in summer student support but several of the CESAR Fellows did remain now incorporated as part of regular faculty research teams.

### 4) The Public Open Houses: National Chemistry Day and Week

In the 1920s and 30s and up till the start of World War 2, the Department designated Open House Days usually on a Saturday. Glass blowing, analysis methods, and a dramatic demonstration-loaded lecture (often with the professor dressed in the black robes and hat of an alchemist), were popular draws for the general public. The program was not revived after the War but in the 1980s an ACS Sponsored Event – initially called National Chemistry Day and later National Chemistry Week – was created for a similar purpose, to educate the public about the contributions of Chemistry. These programs were held on a weekday in early November and starting about 1984 they have continued randomly to the present. Tee-shirts, balloons, badges, and even an occasional gift coffee mug were part of the hype. Attendance was largely students and their teachers from other Lehigh Valley institutions. Lehigh's own students also attended. The program resembled that first used in the 1920s as the dramatic lectures, coupled with podium-presented demonstrations, were followed by tours of the department's instrumentation. Short lecture topics were presented on "Biochemistry and Evolution" (Behe), "Biochemistry and Human Disease" (Alhadeff), "Molecular Modelling" (Zeroka, Kraihanzel, and Haug), "The Magnetism of Oxygen" (Klier), "Radiopharmaceuticals in Disease Diagnosis" (Heindel), and "Polymers in Everyday Life" (Roberts).

## Polymer Chemistry

From the 1920s to 1960s professors Long, Smull, Neville, and Tice and their students all did work with polymers – mostly as paints and coatings -- but it was an adjuvant to their customary self-designations as organic, analytical, and physical chemists. Between 1960 to 1964 several advisory committees to the office of Vice President of Research suggested that the field of polymer science had come of age and that it was time for a major research university like Lehigh to offer the degree. Conversations by the VP Research with Departments of Chemistry, Chemical Engineering, Materials Science/Metallurgy, and Physics revealed that no one department felt it had the resources to add and support a new degree.

With partial or complete salary underwriting from the budget of the Vice-President of Research, Lehigh began to hire new faculty with polymer backgrounds including Gary Poehlein (1965-appointed in Chem Eng), John A. Manson (1966-appointed in Chemistry and as Director of the Polymer Laboratory in the Materials Research Center), Leslie Sperling (1967 – appointed in Chemical Engineering) and John Vanderhoff (1970 – appointed in Chemistry). These individuals created an interdisciplinary M.S. and Ph.D. Program in Polymer Sciences which was launched in 1975 under Manson's directorship. Each participating department had the right to admit students to the program with the assumption that they would thereafter be responsible for their support. Each department contributed courses for the curriculum and ultimately questions from those courses for the comprehensive doctoral exam.

Throughout its history the interdisciplinary graduate program in polymers has never been the responsibility of any one department although only the participating departments can admit students to it. The research of these students took place largely within the various polymer-related centers and institutes which came and went over the last 35 years, *viz.* the Polymer Laboratory, the Materials Research Center, the National Printing Ink Research Institute, the

Center for Surface and Coating Research, the Zettlemoyer Center, the Emulsion Polymers Institute, the Polymer Interface Center, and the Center for Polymer Science and Engineering. The biographies of polymer science professors Vanderhoff and Manson are included in the Physical Chemistry section of this history.

## Solid State Science and Biotechnology

Since the interdisciplinary polymers program had operated successfully without a single department being committed to host it, a related concept was applied to Solid State Science (1977) and later to Biotechnology (1987). While there was not a specific degree track created in Solid State Science, the Sherman Fairchild Center for Solid State Studies made scholarships and fellowships available for approximately 15 years to graduate students working in the solid state discipline. In this system the students were degree candidates for existing doctorates in one of the collaborating departments but concentrated by course work and by research in solid state. Very few chemistry students were involved but chemistry professors Fowkes and Klier participated as scientific collaborators, served on Ph.D. committees and hired several of the physics Ph.D.'s as postdoctoral fellows in chemistry. Kamil Klier co-taught a course in the solid state program on computational chemistry/physics in which graduate students learned about Hartree-Fock and density functional theory and then how to do computer calculations on many-atom systems.

The doctorate in Molecular Bioscience and Biotechnology was a closer model to the polymer science degree. Here a new graduate track – shared by 4 or 5 departments but always including Chemistry – was administratively managed by the Center for Molecular Bioscience and Biotechnology. Neither of these program survived two decades.

| | |
|---|---|
| History 334 | American Urban History from 1880 to Present |
| Government 352 | Civil Rights |
| Social Relations 320 | Urban Ethnology |
| Social Relations 312 | Interpersonal Behavior in Small Groups |

## Dissertation/Research

The Dissertation Research requirement is fulfilled in two discrete parts: a. a project in chemical education and b. an externship in industrial chemistry. The student's committee will provide guidance and supervision in the selection and completion of both of these requirements.

The project in chemical education may consist, for example, of an in-depth analysis of the "two-track" chemical teaching programs in the two-year colleges, the development of a new or improved laboratory experiment series, the creating and evaluation of a standardized examination battery, or the development and teaching of a new chemistry course.

## Industrial Externship

Since approximately half of the graduates of two-year colleges obtain industrial employment as laboratory technicians, it is important for the D.A. candidate to develop an appreciation of the way industry utilizes the chemistry graduate at A.A. and B.S. levels. This "externship" can be fulfilled by summer or regular employment in a chemically related research and development laboratory. In the event that industrial employment would not be available or would be exceedingly inconvenient for the D.A. candidate, this requirement may be fulfilled by extensive on-site visits and by interviews with laboratory group leaders, production and plant managers, and industrial personnel supervisors. It is the intention of this requirement that the doctor of arts candidate obtain an appreciation for the field of industrial chemical employment. To that end, the candidate will be required to submit a written report summarizing his or her industrial externship experience.

## Concerning Lehigh

The university's primary academic and residential campus consists of two-hundred acres on South Mountain, overlooking the attractive and historic City of Bethlehem. There are approximately one-hundred buildings on this campus, including the new seven-story Seeley G. Mudd Chemistry Complex, ready for use in fall, 1975. The chemistry tower has been specially designed to provide for good ventilation of individual laboratories. The adjoining Sinclair Laboratory, an attractive contemporary structure, also is a center for chemistry research. Both buildings are located a few steps away from the recently constructed Mart Science and Engineering Library, containing some 100,000 volumes. An additional 550,000 volumes are housed in Linderman Library, a short distance from the chemistry centers.

Lehigh is widely known for the beauty of its wooded campus. In addition to rare plant specimens on the lower campus, students enjoy the nature preserve located high on top of the mountain. On the other side of the mountain is Lehigh's 600-acre Saucon Valley campus, featuring athletic facilities. The university's newly built Saucon Married and Graduate Students apartment complex is located on this campus.

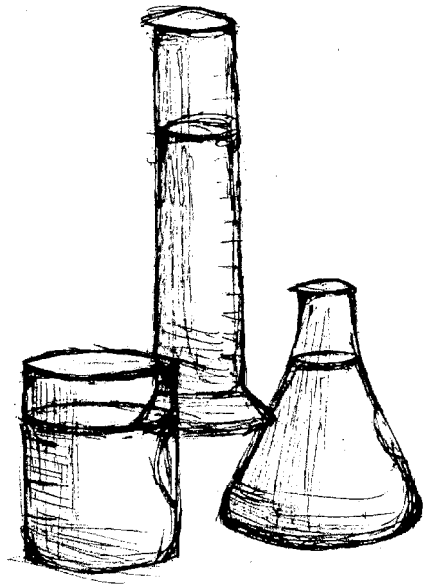
The university is private, nondenominational and coeducational. There are 2,000 persons enrolled in the Graduate School and the School of Education. There are some 4,000 undergraduates enrolled in the three colleges, including the College of Engineering and Physical Sciences, the College of Arts and Science, and the College of Business and Economics. The university employs some 1,450 persons, and among tenured faculty, approximately 85 percent hold the doctorate.

Prospective doctor of arts candidates are cordially invited to visit the campus and to confer with chemistry department representatives.

## Where to Write

For applications and information contact: Chairman, Department of Chemistry, Lehigh University, Bethlehem, Pa. 18015. The 300-page catalog will be sent to you upon request.

# Doctor of Arts in Chemistry



College Teachers for the Future
Lehigh University
Bethlehem, Pennsylvania

## The D.A. Degree in Chemistry

Lehigh University offers the degree of doctor of arts (D.A.) in the fields of chemistry, business and economics, government and psychology for those who wish to prepare for a career in college teaching. The focus of the degree is preparation for instructional positions in two-year and four-year colleges with emphasis on a broadly based, coursework background in chemistry. Admission standards are equal to those for Ph.D. programs, and the D.A. programs have been developed in accordance with guidelines of the Council of Graduate Schools.

## General Requirements

The requirements for the D.A. degree parallel those for the Ph.D. with the following exceptions: 1. a broader distribution of graduate courses in the field; 2. a minor area of study for those students wishing bidisciplinary preparation for two-year college teaching; 3. coursework and training in interpersonal awareness; 4. a supervised internship in college teaching, and 5. a project appropriate to college teaching in the field instead of a dissertation.

The program in chemistry has been prepared in consultation with supervisors of doctors of arts programs in chemistry at major universities and by reference to the guidelines established by both the Carnegie Foundation and the Council of Graduate Schools.

## Graduate Work in Chemistry

The student is expected to complete the same graduate core courses required of Ph.D. candidates in each of the following major disciplines of chemistry:

Analytical Chemistry (Chem 332)
Inorganic Chemistry (Chem 307)
Organic Chemistry (Chem 358)
Physical Chemistry (Chem 445)

The student can select any major area of chemical concentration and will then complete a minimum of two additional graduate courses (above the core course) in that field, two semesters of experimental research at the master's degree level, and two credits of graduate seminar in that major field. In addition, the research, coursework, seminars and thesis requirements for the M.S. in chemistry will be fulfilled.

One inherent part of being an effective chemistry teacher is an appreciation for experimental chemical research. Thus, although the candidate is not expected to pursue the in-depth experimental projects required of Ph.D. students, he or she is expected to gain some understanding of the difficulties, instrumental tools, approaches, laboratory equipment, frustrations and exhilarations of laboratory science by undertaking an experimental master's-level program. Students enrolling in the D.A. program with a completed master's degree which included a research component may be excused from this aspect of the D.A. requirement by petition to the D.A. Advisory Committee.

The student will also select a minor area of concentration in chemistry and complete any two additional graduate courses (above the core course) in that field. Since chemistry teachers in two- and four-year colleges occasionally teach science subjects in areas outside of chemistry (e.g., earth science, biology, chemistry or physics), the D.A. in Chemistry curriculum permits an outside-of-chemistry minor so long as the courses to be taken represent advanced-level work in that area. These minors would normally be a minimum of three or four courses in the nonchemical science approved by the student's D.A. Advisory Committee.

The examinations consist of the regular Ph.D. Qualifying Examinations in both the major and minor areas of study. In addition, the candidate is expected to compose a research proposal in some area of chemical education. Ph.D. candidates normally pass a comprehensive graduate qualifying examination in their subdiscipline of chemistry taken in the second year of fulltime graduate study. The D.A. candidate is asked to take two such exams (in major and minor fields) before the completion of three years of graduate work.

Because the D.A. degree is intended to develop greater breadth in the student than does the traditional Ph.D. degree, broader coursework and a broader examination system are employed. Also, since chemical educators are often concerned with preparing proposals to foundations and federal agencies for financial support of new teaching instrumentation, new laboratory acquisitions, and new educational equipment, D.A. candidates are asked to master the technique of writing and justifying educationally oriented proposals.

### Apprentice Teaching (six semester hours credit)

Apprentice teaching is taken on a fulltime basis for at least one semester under the critical supervision of the master teacher.

### Seminar in Chemical Education Problems
(one credit, but can be repeated three times)

This seminar is staffed and instructed by senior faculty from Lehigh University and the surrounding liberal arts colleges of the Lehigh Valley. This seminar will focus on the unique problems of teaching chemistry in state colleges, private church-related liberal arts colleges, two-year university extension schools, and community colleges. Subjects to be treated include Keller Plan instruction, contract grading, auto-tutorial methods, programmed instruction, film-strip laboratory briefings, standardized examinations, and demonstration experiments.

### Sensitivity Core (nine to 12 semester hours credit)

A series of sensitivity courses is designed to acquaint the student with the philosophy of education and the problems of minorities and to develop interpersonal awareness. Some possible selections are:

| | |
|---|---|
| Education 393 | Instructional Media |
| Education 400 | Psychological Foundations of Education |
| Education 407 | Philosophical Foundations of Education |
| Education 409 | The Two-Year College |
| Psychology 411 | Interpersonal Awareness |
| Social Relations 361 | Social Conflicts |

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# THE DOCTOR OF ARTS DEGREE:

## A Degree for College Teachers

*Prepared by representatives of the following D.A. degree granting institutions:*

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Catholic University
Idaho State University
Illinois State University
Lehigh University
Middle Tennessee State University
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February 28, 1980

**Institutional Representatives:**

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Robert C. Aden
Dean, Institutional Research and Planning;
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Middle Tennessee State University

Arnold Burkart
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Irwin Feinstein
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Dean of the Graduate School
Illinois State University

Alfred Young
School of Arts and Sciences
Atlanta University

**Others:**

Paul L. Dressel
Professor of University Research
Michigan State University

Roy P. Peterson
Associate Director for Academic Affairs
Illinois State Board of Higher Education

*Appreciation is expressed to the Carnegie Corporation and specifically to Dr. Alden Dunham for financial assistance making possible the several discussions leading to this statement.*

## The Doctor of Arts Degree

1. Purpose of the Doctor of Arts degree

   1.1 The Doctor of Arts degree is a content-based degree designed especially to

   a) prepare individuals for a career in college teaching and in the substantive disciplines, especially at the undergraduate level; and

   b) educate individuals who can and do engage in scholarly research relating to course content, the improvement of teaching, or to the development and revision of the curriculums or programs in their substantive discipline.

   This statement emphasizes the D.A. as a professional degree for college teachers and emphasizes the existence and importance of research directed to the improvement of the content, processes, and materials used in teaching. Substantive research in a discipline is not irrelevant to those concerns.

   The offering of the D.A. for purposes other than those stated above is not only inappropriate, but may also inhibit the achievement of widespread understanding and acceptance of the purposes and character of the D.A.

2. The substantive or disciplinary component of the D.A. should

   2.1 be sufficiently broad to provide a background for teaching or development of undergraduate offerings of a discipline while avoiding such broad coverage and consequent superficiality that the quality and depth of the program are lessened;

   2.2 be provided in courses and seminars appropriate for doctoral study;

   2.3 include consideration of the relationship of advanced scholarship and research to undergraduate instruction;

   2.4 use a problem or theme approach to give unity and coherence to any degree program which is based upon two or more disciplines;

   2.5 provide the instruction and experience in using the modes and methods of inquiry that characterize a discipline.

3. The professional component of the D.A. should include:

   3.1 one or more courses or seminars that deal with problems of teaching and learning, course development, evaluation, liberal education at the undergraduate level. Such courses should be planned to include such topics as development of higher education in the U.S.A., conceptions of the role and character of higher education, human learning, and characteristics and problems of college students and of the professoriate.

   3.2 one or more courses or seminars focused on instructional and curricular problems and practices in a discipline or group of closely related disciplines (e.g., natural sciences or social sciences).

   3.3 a supervised internship that, depending upon prior experience and performance, may have one or more phases of increasing responsibility. The final phase of the internship should provide an opportunity for creative and scholarly effort in course development, teaching and assessment. The internship may provide the focus of the dissertation or culminative paper and final oral. If the internship and dissertation are combined, scholarly insight into the discipline as well as into the problems of teaching should be evident. The internship experience (and any dissertation or paper based upon it) should usually develop out of the previous studies described in 2 and 3.1 and 3.2.

   3.4 A dissertation or an integrative or culminative paper demonstrating the ability of the degree recipient to perform in a professional manner implied by the nature of the degree. It should provide for the use or development of research skills in the discipline and also involve some aspects related to teaching preparation of instructional materials, developing or evaluating courses, or developing and using instructional media in the discipline may also be appropriate projects.

4. The staffing of the D.A. professional offerings and the staffing of D.A. doctoral committees should recognize that the doctoral program of a prospective D.A. may often involve courses and activities

transcending the immediate discipline that determines the major portion of the program. Faculty members with appropriate experience and competency should be sought to teach such courses and serve on committees regardless of departmental or disciplinary affiliations.

5. The coordination of the courses and requirements composing the professional component of the D.A. should be a shared responsibility of the departments offering the D.A., the graduate school, and the individuals teaching those courses. A committee chaired by the graduate dean or his designate has frequently been found to be an effective way to handle this matter.

6. Experience with D.A. candidates to date indicates that they demonstrate a high degree of variability in experiences, education, and length of service. Most of them have been involved in teaching assignemnts in community colleges or liberal arts colleges and have completed D.A. requirements while on leave or by a combination of full- and part-time study. These circumstances dictate a degree of flexibility in planning individual programs that is inconsistent with rigid specifications of core professional courses, site and length of internships, and residence requirements. Suggested or recommended electives provide the opportunity for individuals to round out either the professional or the substantive component of the degree.

   The requirement of a dissertation (or equivalent) and a final examination are widely regarded as desirable to bring the D.A. program to a definitive close (see 3.4).

Although credits and time serving are inadequate indicators of program quality and individual accomplishment, there should be some clear statement and an accompanying rationale for allocation of credits to the various D.A. program components.

The following model may serve as a guide to the planning of D.A. programs, with the expectation that justified variations resulting from individual, disciplinary, and institutional differences and commitments will be the practice rather than the exception. The model assumes a total of 90 semester credit hours—a full three years of study, including the master's and doctor's levels. Institutions that have not customarily assigned credit hours to internships or dissertations may exhibit a similar pattern but indicate a different credit hour total.

| | |
|---|---|
| Substantive courses and credits in the discipline and related fields | 55 semester hours |
| Professional core (all D.A.'s) | 9 semester hours |
| Professional courses in discipline | 6 semester hours |
| Internship ) Dissertation) or equivalent | 20 semester hours |
| Total requirement | 90 semester hours |

For some persons, interdisciplinary D.A.'s may be desirable. Whether or not programs of sound quality can be developed depends both upon the individual and the institution. The strength of the relevant disciplines, not only as disciplines, but in relation to the program focus, is essential. Only individuals whose prior education and experience permit a sound combination of breadth and depth should be permitted to develop such programs. It may be desirable to have a special committee appointed by the graduate dean to develop a general structure or set of guidelines for interdisciplinary programs and to review and approve or reject specific interdisciplinary program proposals.

# M.S. and Ph.D.
# PROGRAM IN PHYSIOLOGICAL CHEMISTRY
# AT
# LEHIGH UNIVERSITY

The graduate program in Physiological Chemistry is an interdisciplinary one aimed at preparing individuals interested in a career in biomedical research, teaching, or administration, or in some aspect of public health. Students enrolled in this program may have majored in biology, chemistry, animal science, entomology, veterinary science, pharmacy, or some other area of the life sciences. All students participating in this program are enrolled in the Department of Chemistry and are provided research space in one of the laboratories of the Center for Health Sciences.

Current research interests of the faculty include:

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NUCLEAR MEDICINE

EXPERIMENTAL PATHOBIOLOGY

EXPERIMENTAL PARASITOLOGY

IMMUNOLOGY

TOXICOLOGY

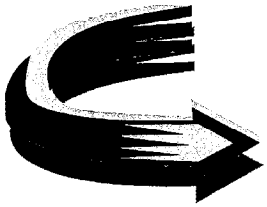
MEDICAL AND PUBLIC HEALTH ECOLOGY

Financial support is available on a competitive basis in the form of research assistantships and fellowships.

For further information write:

**Dr. Thomas C. Cheng, Director**
**Center for Health Sciences**
**Building No. 17**
**Lehigh University**
**Bethlehem, Pennsylvania 18015, U.S.A.**

# PHARMACEUTICAL SCIENTISTS:



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# LEHIGH'S EDUCATIONAL OUTREACH TO THE PHARMACEUTICAL INDUSTRY

**FACTS:**

- In partnership with the R & D laboratories of major pharmaceutical companies, Lehigh University offers live satellite broadcast as well as web-based graduate education in pharmaceutical chemistry to employees of those companies
- Many courses are specially created in response to the needs of corporate pharmaceutical researchers
- Many of these courses are co-taught by Lehigh University faculty and senior members of the research staffs of the partner companies.
- The Pharmaceutical Chemistry degree is an interdisciplinary professional degree that includes courses in Chemistry, Biological Sciences, and Business
- Over 450 BS-holding employees in the pharmaceutical industry have enrolled in Lehigh's distance education programs to pursue M.S. degrees, or for professional development. More than a dozen have gone beyond the M.S. to pursue a PhD.

Some of the participating companies whose employees are already enrolled in Lehigh's distance education programs:

| | |
|---|---|
| 3M HEALTH SYSTEMS | KODAK HEALTH SYSTEMS |
| ASTRAZENECA | MERCK |
| AVENTIS | PFIZER |
| AVENTIS-PASTEUR | P & G |
| BAYER | ROCHE |
| BRISTOL-MYERS SQUIBB | SCHERING PLOUGH |
| GLAXOSMITHKLINE | TEVA |
| J&J SYSTEMS | WYETH AYERST |

plus many others

We invite inquiries from non-member firms or from new sites of existing firms to contact us about how easy it is to become a LESN partner.

LEHIGH UNIVERSITY™

**Distance Education**

# CLINICAL CHEMISTRY

# - M.S. Program -

# LEHIGH UNIVERSITY

This graduate program is offered jointly by Lehigh University and the Lehigh Valley Hospital Center to prepare individuals for leadership positions in clinical laboratories. The program includes course work and research in basic and clinical laboratory chemistry and in the biochemistry of normal and pathological physiology.

## ADMISSION

The applicant must hold a bachelor's degree in chemistry, biology, medical technology, or a related science and must meet the admissions standards of Lehigh University's Graduate School. The student shall have completed a course in physical chemistry or shall make up that deficiency during the first year of enrollment.

## CURRICULUM

The graduate core program includes courses in biochemistry, analytical chemistry, clinical chemistry, pathophysiological chemistry and advanced organic chemistry. Students will also participate in a hospital-based clinical laboratory practicum. Completion of a research project is also expected. Elective courses are available in microbial biochemistry, advanced topics in analytical and clinical chemistry, chemical instrumentation, bio-organic chemistry, medicinal chemistry, biophysics, and in other advanced areas of biology and chemistry. Upon completion of the M.S. in clinical chemistry, students can elect to pursue Ph.D. studies in several related curricula of life science chemistry. Full transfer credit is granted for this M.S. degree toward the Ph.D. programs.

## INFORMATION AND APPLICATION

Applications for admission and financial aid can be obtained from:

Director, Clinical Chemistry Program
Department of Chemistry
Lehigh University
Bethlehem, PA 18015
(215) 861-3645

***CMBB***
***a Regional Biotechnology Center***

The Center for Molecular Bioscience & Biotechnology is located in the heart of the rapidly developing Lehigh Valley region of Pennsylvania. Allentown-Bethlehem-Easton (ABE) International Airport is just minutes away. CMBB, just two miles north of I-78, is within two hours of the greater New York and Philadelphia areas by car.

**The Landscape of an Industry**

To learn more about the Center, contact:


**Dr. Neal Simon**, *Director*, or
**Dr. Daniel Lima**, *Deputy Director*,
phone (215) 758-5426
fax (215) 758-5851


# CENTER FOR MOLECULAR BIOSCIENCE AND BIOTECHNOLOGY

LEHIGH UNIVERSITY

***A STRATEGIC ALLIANCE***

Fostering cooperative research and training between the university and industry.

Bringing flexibility, ingenuity and problem solving skills to the private sector.

## *Lehigh's Tradition of Close University/Industry Partnerships*

The Center for Molecular Bioscience and Biotechnology (CMBB), established in 1986, blends faculty expertise in molecular and cellular biology, biochemistry and health sciences, biochemical engineering, and environmental sciences to solve problems in areas of applied biological sciences—the new biotechnology.

Forty percent of Lehigh University's external research support comes directly from industry (ten times the national average for universities). Many firms with close ties to Lehigh have become industry leaders, in part because of the help they received from the university.

Located on the spacious and scenic Mountaintop Campus we have integrated biotechnology-related faculty, graduate students, and professional staff into contiguous research, teaching, and office space —a total of 45,000 square feet.

The result has been a synergistic mix of 26 faculty members, 80 graduate students, and 15 research scientists and engineers working side-by-side, sharing technical perspectives, laboratories, equipment, and classrooms.

## *Vehicles for Success... CMBB/Industry Partners*

The CMBB's objective is to promote interdisciplinary research among its 26 participating faculty members and numerous research scientists and engineers. We encourage direct participation from private industry through the following vehicles:

- ***Industrial Liaison Membership.*** Membership serves as an introduction to CMBB expertise and facilities. Often this first step leads to more extensive collaboration between your company and CMBB scientists and engineers of your choosing.
- ***Industry-Funded Projects.*** These contract R&D projects are negotiated through the CMBB to accomplish a specific study or task. Feasibility studies, product development, process scale-up and optimization, and toll manufacturing are some of the types of projects that CMBB routinely accomplishes.
- ***Consortium Projects.*** You may need a more comprehensive R&D approach involving several CMBB scientists and engineers—from basic scientific understanding to technology transfer. Because we are an interdisciplinary center, with core facilities, our staff can propose an integral R&D program managed by a consortium of biologists, biochemists, and biochemical engineers.

## *Special Equipment and Facilities*

Our laboratories contain an impressive collection of state-of-the-art equipment. Access to these instruments and facilities can provide companies—small or large—with a cost-effective alternative to acquiring specialized and expensive instruments for high risk R&D or short-term projects. A partial list of facilities includes:

Fermentation laboratory and pilot plant
Molecular biology laboratories
Mammalian cell culture laboratories

Analytical facilities:

- Microscopy
  - Scanning electron - SEM & EDS probes-qualitative and quantitative
  - Atomic force
- Separation
  - GC capillary/flame
  - HPLC - diode array detectors
  - Hydrodynamic chromatography
- Spectrometers
  - NMR 90 to 500 MHz - including solid state probes
  - Sienta ESCA 300 - x-ray photoelectron
  - Mass Spec - GC/MS
  - Raman FT
  - Infrared FT

## *Faculty and Staff*

**John H. Abel, Jr., Ph.D.**
Professor - Cell Biology
*Hormone receptors and reproductive cell biology*

**Jack A. Alhadeff, Ph.D.**
Professor - Biochemistry
*Lysosomal glycosidases and complex carbohydrates in animals*

**Agnes Ayme-Southgate, Ph.D.**
Assistant Professor - Molecular Biology
*Development, structural and functional, of Drosophila; molecular genetics*

**Barry Bean, Ph.D.**
Associate Professor - Cell Biology
*Cellular aspects of sexual reproduction and fertility*

**Michael J. Behe, Ph.D.**
Associate Professor - Chemistry
*Biophysical chemistry of nucleic acids*

**John W. Benbow, Ph.D.**
Assistant Professor - Chemistry
*Antitumor agents; natural products; synthesis and methodology*

**Lynne Cassimeris, Ph.D.**
Assistant Professor - Molecular Biology
*Mechanism of cell motility; cytoskeleton assembly and function*

**Marvin Charles, Ph.D.**
Professor - Chemical Engineering
*Fermentation: basic research, reactor and process development and design*

**Mohamed S. El-Aasser, Ph.D.**
Iacocca Professor - Chemical Engineering
*Polymer and surface characterization, monodisperse polymer particles*

**Natalie I. Foster, Ph.D.**
Associate Professor - Organic Chemistry
*Applications of NMR to studies of diagnostic and therapeutic drugs*

**Ned D. Heindel, Ph.D.**
Professor - Chemistry
*Medicinal chemistry, nuclear medicine, cancer chemotherapy, and targeted drug delivery*

**James T. Hsu, Ph.D.**
Associate Professor - Chemical Engineering
*Separation processes and biochemical purification*

**Steven Krawiec, Ph.D.**
Professor - Molecular Biology
*Acquisition of genetic material; organization of the prokaryotic genome*

**Michael R. Kuchka, Ph.D.**
Assistant Professor - Molecular Biology
*Chloroplast gene expression; nuclear/organelle/genome interactions*

**Irwin J. Kugelman, Sc.D.**
Professor - Civil Engineering
*Biological waste treatment, nutrient requirements, toxicity*

**Linda Lowe-Krentz, Ph.D.**
Assistant Professor - Chemistry
*Tissue culture studies; proteoglycan structure and function*

**Fortunato J. Micale, Ph.D.**
Professor - Chemistry
*Colloid stability and dispersion in aqueous and non-aqueous systems*

**John G. Nyby, Ph.D.**
Professor - Psychology
*Reproductive physiology; brain and behavior*

**Janice A. Phillips, Ph.D.**
Professor - Chemical Engineering and Molecular Biology
*Microbial and mammalian cell culture, enzyme kinetics; bioreactor monitoring and control*

**Martin Richter, Ph.D.**
Professor - Psychology
*Statistical design and analysis; biostatistics*

**Steven L. Regen, Ph.D.**
Professor - Chemistry
*Novel polymerized vesicle assemblies for potential use as drug carriers*

**James E. Roberts, Ph.D.**
Associate Professor - Chemistry
*Solid-state NMR techniques for analysis of solid materials*

**Eric P. Salathe, Ph.D.**
Professor - Applied Mathematics and Biomedical Engineering
*Transport and exchange in microcirculatory physiology; biomechanics*

**Jeffrey A. Sands, Ph.D.**
Professor - Molecular Biology
*Virology; human disease; genetic biotechnology*

**Maria M. Santore, Ph.D.**
Assistant Professor - Chemical Engineering
*Time-dependent behavior of polymers and proteins at interfaces*

**Jill Schneider, Ph.D.**
Assistant Professor - Psychology
*Energy utilization and fertility; reproductive neuroendocrinology*

**Keith J. Schray, Ph.D.**
Professor - Chemistry
*Enzyme and fluorescent immunoassays; protein-surface interaction*

**Arup K. Sengupta, Ph.D.**
Associate Professor - Civil Engineering
*Ion exchange and separation processes for pollution control*

**Neal G. Simon, Ph.D.**
Associate Professor - Psychology and Molecular Biology
*Gene expression in neural tissue; steroid receptor biology; cellular mechanisms of brain injury; microassay development.*

**John W. Vanderhoff, Ph.D.**
Professor - Chemistry
*Emulsion polymers and coating; monodisperse polymer particles*

**Arkady S. Voloshin, Ph.D.**
Professor - Mechanical Engineering
*Dynamic loading on musculoskeletal systems*

**Vassie C. Ware, Ph.D.**
Associate Professor - Molecular Biology
*Ribosome biogenesis; RNA processing; regulation of gene expression in animal cells*

# Remembrances of

# Lehigh Alumni and Former

# Faculty

# Reminiscences of Victor H. Cohn (B.S. 1952)

VICTOR H. COHN
3932 PROSPECT STREET
KENSINGTON, MD 20895

(301) 942-1751
VHCOHN@VERIZON.NET

February 17, 2015

Robert A. Flowers II, Chairman

Department of Chemistry

Lehigh University

Bethlehem, PA 18015

Dear Professor Flowers,

I read with great interest and nostalgia the January Newsletter, especially the piece about Professor Amstutz and the Althouse Chemical Co. In the summer of 1951 I had the honor of undertaking my senior thesis under EDA's direction. I worked on the synthesis of several halogenated quinoxalones, but even more significant was the bond we formed that continued until his death.

I grew up in Reading and while still in high school I attended each of the monthly meetings of the local ACS. Lectures were held at Albright College (two blocks from my home); some meetings were visits to one of the chemistry-related plants or labs in Reading, including Althouse. I remember the visit vividly for a demonstration they presented: A cloth was immersed in a beaker filled with a red liquid, stirred around for a minute or so, and emerged with panels dyed red, yellow, or blue. Years later when I became a new assistant professor of pharmacology at George Washington University Medical Center I was able to use this demonstration (thanks to Althouse supplying the dyes and multi-fabric cloths) to illustrate the concept of biological receptor specificity.

It is indeed impressive to see the many changes that have occurred at Lehigh in the last half-century. The intense experiences we has in the Department of Chemistry 1948-1952 resulted in some of the best years of my life. We six B.S. '52 chemistry graduates became close friends and we had the great advantage of having close relations with a faculty that numbered little more.

Victor H. Cohn

Victor H. Cohn, Ph.D.

Professor Emeritus of Pharmacology

The George Washington University Medical Center

# REMEMBRANCES of Edward Kosower (1954-56)

Edward M. Kosower
Professor of Chemistry (active emeritus)
School of Chemistry
Tel Aviv University
Tel Aviv 69978 Israel

**Dear Ned,**

**I have heard that Lehigh University has come a long way {up} since my days there on the faculty, trying to regain the reputation it once had as being in the same league as MIT. I did my undergraduate studies at MIT so of course I was impressed.**

**The faculty "stars" back then were Albert C. Zettlemoyer who ran an institute concerned with colloids and ink and Ed Amstutz who was interested in heterocyclic chemistry. Robert ("Bob") C. West came from Harvard (Ph.D.) at the same time I did (Postdoc with Frank Westheimer) in 1954. We both went to U. Wisconsin in 1956.**

**I had one M. Sc. student named John C . Burbach who worked on the effect of methyl substitution on complexing of pyridinium ions. His results led me to consider Mulliken's charge transfer complexing and then to the basis for Z-values, based on the sensitivity of the absorption maximum of pyridinium iodides to solvent. Thus, my research at Lehigh was central to my career in science. We published a paper on his results. E. M. Kosower & J. C. Burbach, *J. Am. Chem. Soc.* 78, 5838-5842 (1956). "Equilibrium constants for pyridinium iodide charge-transfer complex formation"**

**This work was preceded by research carried out by a Lehigh undergraduate Paul Klinedinst, a study that led to a publication E. M. Kosower & P.E. Klinedinst, Jr., *J. Am. Chem. Soc.* 78, 3493-3496 (1956). "Additions to pyridinium rings II. Charge-transfer complexes as intermediates" Paul went on to work for my former mentor, Saul Winstein, for his Ph.D. and eventually became a Professor in Chemistry at California State University Northridge.**

The reason that I went to Lehigh was an offer from Amstutz because of my friendship with his student or postdoc Kay Brower. In my research at Harvard I had neglected to look for a position and this offer was welcome. As you can see, it turned out well in spite of limited equipment and little research support.. I remember many friendly chats with George L. Brownell, but otherwise did not have too many contacts with other faculty except for Bob West. I think that I taught physical organic chemistry to a modest number of students, including a bright fellow, Alfred M. Stock.

I am still active, mostly in the new field of thin film infrared spectroscopy, and have a small lab and an assistant and a postdoc. I have published almost 300 papers, including 4 books, one of which is the last revision of Streitwieser and Heathcock, Introduction to Organic Chemistry.

I wish you luck in your writing of he departmental history and would like see a copy of the whole history when it becomes available.

EMK

## Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: former faculty member: Robert West (ret. University of Wisconsin)

Years you were here: 1954-56

Fields of specialization:

Where did you come from?

*Specific questions* ---

1. Who were the leading faculty in your time in—
    a) Research: Organic Chemistry (Amstutz)
       Physical (Zettlemoyer), Analytical (Serfass)
    b) Teaching
    c) Other
2. Estimate the number of grad students in your time _20___
3. Did you mentor any undergraduates? Names? No
4. Did you have grant support? No
5. Which professors had the largest research groups? Zettlemoyer, Serfass
6. What was your impression of the LU undergrads? Quite able
7. What was your impression of the LU grad students? Borderline competent
8. How well equipped (instrumentation) was the dept? Specific hardware? Equipment was minimal during my time
9. Why did you come to Lehigh? See message [got a job offer]
10. Have you stayed in touch with others from your time? Names? Contacts? Only stayed in touch with Chuck Kraihanzel
11. Any remembrances about the Department you're willing to share:

# Reminiscences of Herman E. Collier, Jr. (PhD 1955)

Degrees from Lehigh: MS (1952); PhD (1955)

Years Attended: 1950 – 1955

Fields of Specialization: Inorganic (Fornoff) and Analytical (Serfass and Muraca)

Dissertation Mentor: MS – Fornoff; PhD – Serfass

1. Faculty leaders in –
    a) Research – Amstutz, Zettlemoyer, Serfass, Easton
    b) Teaching – Fornoff, Healey,Muraca
    c) Other Faculty included – Anderson, Rhoda, Fish, Ewing
2. Number of grad students (guesstimate) 15 – 20
3. I did not mentor any undergrads
4. I was a TA in Freshman Chemistry during my Masters studies – taught recitation sessions, and later held the Socony-Mobil Fellowship during my doctoral studies.
5. Largest research groups were led by Amstutz and Zettlemoyer
6. Describe LU undergrads – all men and pre-engineers
7. Describe LU grad students - from diverse undergrad institutions, as I recall all men and most were married, more master candidates than PhD; largest number of grad students were in Organic
8. The department was reasonably well equipped but not current with regard to electronic instrumentation
9. Reason for attending LU – Dr. Harvey Neville, who was then the Dean, LU Grad School, was a grad of my undergrad alma mater and of two undergrad profs had personal and professional connections with him and LU
10. Very limited continuing connection with fellow grad students upon graduating. Currently have no connections.
11. Remembrances – appreciation for my various faculty and felt prepared for either undergraduate teaching of inorganic and analytical or specific work in industrial analytical research.

# Remembrances of Joseph Nunzio (stockroom manager)

This recounting of my days at Lehigh reflects primarily the period from **1953 to 1976 in the Chandler Building.**

- Edward "Ed" Amstutz, an organic chemistry professor, always wore a bola tie. That was his signature for students and faculty.
- Ed also had a very distinctive walk such that when his grad students heard him coming down the wooden-floored hall toward their lab they'd become very anxious.
- One of the grad students, Dewey Holland, learned to replicate Dr. Amstutz's walk exactly and delighted in arousing the other grad students thinking it was Ed who was approaching
- A. C. Molter, the University Purchasing Agent, refused to let Ed submit a purchase order on the department's funds for a B-B air rifle. Molter wrote Amstutz that "the university's policy is not to permit the purchase of firearms." Dr. Amstutz rewrote the purchase order calling the rifle an "air injection apparatus" and this time Molter approved it. Ed and I used the gun to kill the pigeons that were roosting under the eves of the Chandler Building.

You asked which faculty were the most active researchers in my time. There were four that stand out. (1) **Earl J. Serfass**, an analytical chemist who was chairman of the department for many years, (2) **Albert C. Zettlemoyer**, a physical chemist, who had organized and directed the National Printing Ink Research Institute, a major contributor to the department's research image, (3) **Robert L. Stubbings** (LU PhD 1949), a physical biochemist who'd inherited the Leather Research Institute on the death (1953) of Edwin R. Theis, its founder and his dissertation advisor, and (4). **Edward D Amstutz**, organic chemist, also department chairman.

About memorable incidents…I recall many.

- One time Ralph Muraca, assistant professor and assistant chairman under Dr. Serfass, found himself trying to drive home but discovering his gas tank was absolutely empty. He checked out five gallons of benzene from the stockroom, poured it into his tank, and proceeded to drive off in a cloud of black smoke.
- I can't remember this professor's name but I'll never forget the incident. Late one afternoon he wrote out his entire lecture on the six blackboards in the main lecture hall for his use the following morning. It took him two hours to do it. Above the blackboard he wrote "Do not erase" in English and Spanish but the following morning the boards were washed clean. In anger he tracked down the newly hired janitor only to find out that he could only read and speak Polish.
- In 1953, Dr. Serfass arranged an off-campus Christmas Party for the grad students and faculty in a big room on the 4$^{th}$ floor of the Bethlehem Steel Research Lab. Someone, with Serfass's approval made gallons of home brew Scotch out of grain alcohol and brown sugar. Once you tasted it, one never forgets its flavor!

- Dr. Serfass was clever in devising a system to wake up those students he knew would fall asleep in his Saturday morning lectures. He created a mixture of ammonia and iodine which exploded when dry and before class he painted it wet between their moveable chair-desktop and the chair base. Once someone fell asleep he'd quietly walk up to their chair, slam his hand on the desk, and let the resulting explosion teach them a lesson. No one fell asleep twice on Dr. Serfass.
- Al Zettlemoyer donated a sponsorship to a Bethlehem City Softball Team. They named themselves "Al's Aces."
- We had no computers and no FedEx. The lab store purchase requests were all entered manually and most took about two weeks to be filled via UPS.
- The emphasis in the Department was more on teaching than on research during my earlier years
- I have no photographs but I have plenty of good memories of my years at Lehigh. I haven't included a list of the grad students during these specific years but I could remember many of them. Let me know if you need them.

Joe Nunzio
Written August 13, 2014

(Joe died at age 83 on 23 March 2015. He had planned to write his reminiscences of life in the Mudd Building but he never completed that.)

# Remembrances of Cyrus J. Ohnmacht (PhD 1966)

Name: ***Cy Ohnmacht***

Degrees from Lehigh and Years for each: ***PhD 1966 (Young); Postdoctoral 1968 (Heindel)***

Years Attended: ***1962-1966; 1967-1968***

Fields of specialization: ***Organic Chemistry***

Dissertation mentor: ***Dr. Thomas E. Young***

*Specific questions ---*

1. Who were the leading faculty in—
    a) Research ***Zettlemoyer***
    ***b)*** Teaching ***Most of the chemistry facility members were good lecturers. If this heading is meant to apply to those who didn't carry out research then I can't remember the name of the Professor who taught freshman chemistry (probably Dr. Sprague) – I would name him along with Dr. Fish of the analytical department as outstanding teachers***
    c) Other
2. Estimate the number of grad students in your time ***40 – 50 – a guess***
3. Did you mentor any undergraduates? ***No***
4. How were you supported? ***(PhD) Teaching Assistant-2 yrs. & then Dr. Young's Warner-Lambert money as RA -2 yrs.***
   ***(Postdoc.) from US Army Antimalarial grant Ned Heindel had***
5. Which professors had the largest research groups? **Early *Zettlemoyer and Borowitz, later Heindel***
6. What was your impression of the LU undergrads? ***Quite Intelligent kids***
7. What was your impression of the LU grad students? ***Adequate***
   How well equipped (instrumentation) was the dept? ***Not bad for the time.***
   Specific hardware? ***Lehigh got an NMR quickly after NMR was introduced***

8. Why did you come to Lehigh? ***(1962) I was working at Eastman Kodak in Rochester, NY and had passed my army physical. I thought I'd try graduate school as an alternative. Lehigh was the only advanced degree granting University near my girlfriend's (now wife's) home in Allentown. (1967) After getting my PhD in 1966 I rejoined Kodak. My wife Joanne wasn't happy in Rochester and I was agreeable to leaving Kodak. I was fortunate to get a postdoctoral position with a new Lehigh professor – Dr. Ned Heindel***
9. Have you stayed in touch with others from your time? Names***?***
   ***I reconnected recently with Dr. Ira Brinn, who Dr. Sturm will remember. We had shared a teaching assistant office in 1962.***
10. Any remembrances you're willing to share:
    ***Looking back; mercury drop polarography just doesn't seem to be worth all the time we spent in the classroom learning all about it.***
    **In winter the fire escape just outside the old chemistry labs in Chandler Lab made a great place to stick an Erlenmeyer for a quick recrystallization.**

# Remembrances of Robert D. Rapp (PhD 1967)

I decided to come back to graduate school after several years in industry and seven years as a clinical chemist in charge of the chemistry laboratory at the Reading Hospital. When I came for my interview, the Chemistry staff made me feel at home. In fact Dr. Borowitz offered me a position in his research group under an NIH grant which he had just received. I was delighted since I was married with two children and the grant paid me more than a TA. I did however spend my first semester with a TA because the grant was approved but the funds were late in arriving. I had been teaching a course in clinical chemistry at the hospital for their laboratory technician program so that being a TA did not present a problem. Dr. Fish tried to convince me to become an analytical chemist because of my experience at the hospital lab but he did not succeed. I must say that it was great having our elemental analyses done in house. [Dr. Fish provided in-house elemental analyses to the chemistry students.]

Lehigh through Dr. Daen presented me with an experience which I shall forever cherish. Dr. Daen had done some post doc time with Peter Debye and brought him to Lehigh several times to present a lecture. He asked me to be the projectionist for his slides and I spend time talking with him on a one to one basis. He was very friendly and asked about my plans and goals.

I developed an interest in quantum mechanics while at Lehigh and I asked Dr. Lovejoy whether I could take his course even though my background in mathematics was not as comprehensive as the other graduate students. He assured me that I could handle it. He did not assume a very advanced background in math and explained every step. I was not sorry that I took his course.

I had the most contact with the work of Dr. Young and Dr. Borowitz since both groups worked in the same lab. I had considerable contact with Dr. Amstutz because when his father came to visit he would call me in to converse with his father in German. I also remember Dr. Amstutz and Joe Nunzio keeping the pigeons under control with a pellet gun purchased with department funds under the guise as a pneumatic device. Dr. Amstutz also had the perfect answer for those premeds who complained about questions in his organic class which did not come directly out of his lectures. His answer to these students was "There is no law prohibiting outside reading." Dr. Amstutz also did me a great service when Dr. Borowitz left Lehigh to go to Yeshiva. He called me into his office and told me my choices. I could go to Yeshiva with Dr. Borowitz and retain my grant or remain at Lehigh and lose my grant. He also told me that the department would like to have

me stay at Lehigh. It was an easy decision to make since I didn't want to take my family to New York City. When I told him I wanted to stay at Lehigh, his reply was " good I have an instructor position for you at Lafayette and it will pay you more than your grant. I didn't tell you about the position because I didn't want you to make a decision based on money."

I also will always remember Dr. Sturm with his witty remarks. We became good friends due in part to our common German background. We also had a somewhat common interest in timepieces. Dr. Sturm collected and repaired antique watches while I had learned the repair of old clocks from my father who was a clockmaker. Dr. Sturm taught a very fine course in thermodynamics for both the organic and physical chemistry graduate students. My graduate education at Lehigh was a very gratifying experience and prepared me well for my chemical profession. I tried to repay this debt in part by bringing my better students at Albright College to visit Lehigh and encouraged them to continue their chemical education at Lehigh.

Another interesting remembrance was the arrival of our first NMR an A-60. I was either the first person or almost the first person to use the instrument. When I went to use it I got an electric shock because the instrument was not properly grounded. The problem was fortunately corrected immediately. I was considerably older than most of the graduate students and didn't fit in but Cy Ohnmacht and Richard Lazarus were very friendly as was Tibor Sipos who worked for Dr. Merkel. I also thought that the cumulative system of evaluation was great. One could never cram for the cum exams in Organic since no topic was announced. This meant that you wouldn't know what to cram and hence it was a better measure of your overall comprehension. I always thought having a good night's rest so that you could think clearly was the best preparation.

# Remembrances of Ronald Evilia (PhD 1969)

**Degrees from Lehigh and Years for each: BA (1965); Ph.D (1969)**

**Years Attended: 1961 - 1969**

**Fields of specialization: Analytical**

**Dissertation mentor: A. James Diefenderfer**

*Specific questions ---*

1. **Who were the leading faculty in—**
    a) **Research - Kraihanzel**
    b) **Teaching – Sprague and Daen**
    c) **Other – Zettlemoyer -- he seemed to have the most funding**
2. **Estimate the number of grad students in your time _30___**
3. **Did you mentor any undergraduates? Names? No**
4. **How were you supported? Research assistantship and Lehigh fellowship. After sudden death of Velmer Fish, I was given quantitative analysis to teach in his place, so for a little while I simultaneously had both a research and a teaching assistantship.**
5. **Which professors had the largest research groups? I think that was my mentor, A. J. Diefenderfer, our group was 7 grad students my first year.**
6. **What was your impression of the LU undergrads? Smart & career oriented**
7. **What was your impression of the LU grad students? Not as smart as the best of the undergraduates but probably equal to the average undergrad. Hard working, motivated**
8. **How well equipped (instrumentation) was the dept? Specific hardware? The department had most of the common equipment necessary for chemical research at that time. While I was there the department got its first NMR, a Varian A60.**
9. **Why did you come to Lehigh? I liked the picture of the "marching Lehigh" that was in the catalogue I looked over while trying to decide on a college while in high school. This is actually true. I was pretty unfocused at that time, knew nothing about Lehigh or most other**

colleges and the picture of the band on the football field just caught my attention and imagination!

10. Have you stayed in touch with others from your time? Names? Contacts? Sadly the only classmate I kept in touch with, Tom Freund, passed away a couple of years ago.
11. Any remembrances you're willing to share: When I was a senior Jerry Daen and Jim Diefenderfer team taught a new course on spectroscopy developed with NSF funding. The idea was that Daen would lecture on the theory of the major spectroscopic techniques and Diefenderfer would lecture on the applications and uses of those spectroscopies. The course was a real challenge and by the end of the semester all the students were exhausted and a little scared. After we were seated to take the final, Jim Diefenderfer offered us the opportunity to skip the final and take whatever grade we had at that point. After they agreed to tell us what our current grades were, EVERYONE, including a couple of students getting D's opted to skip the final! I picked up a copy of the final on the way out and to this day am glad I opted out. For a number of years afterward, the course had a reputation as not having a final despite their warnings to the contrary. I don't think they ever made that offer again.

My freshman year I took chem. 4 and 5. One of the experiments involved boiling a mixture Cu and Ag salts in sulfuric acid down to SO3 fumes. We did these out on open benches in the large lab. I just can't imagine what it would be like to try and do that experiment today! Also, in the organic lab we used corks, not standard taper glassware. The first experiment involved learning how to soften up the corks and to drill the appropriate holes for the various syntheses we did. It was a different world then!

Ron Evilia, retired, Prof Emeritus, University of New Orleans

# Remembrances of James (Jim) Stuart (Ph.D. 1969)

Name: James (Jim) D. Stuart

Fields of specialization: analytical, Mentor: Prof. William E. Ohnesorge

*Specific questions* ---

1. Who were the leading faculty in—
    a) Research Dr. Ohnesorge and Dr. Heindel
    b) Teaching Dr. Fish (I believe who died too suddenly
    c) Other the faculty member that we in analytical chemistry could always talk to Dr. Fish in micro analytical chemistry
2. How were you supported? First year as an RA
3. second year as a T.A. for Dr. A. James Diefenderfer
4. For my last two years I returned to my undergraduate college, Lafayette College and held the rank of Instructor- where I taught Instrumental Methods of analysis for one semester to replace Prof. Joseph Sharma- This experience allowed me to have three job interviews and three academic job offers, clearly the best was teaching analytical chemistry at the University of Connecticut. For the graduate education at Lehigh I will always be grateful.
5. How well equipped (instrumentation) was the dept? Good but not really state of the art.
6. Why did you come to Lehigh? Because my major advisor, Prof. Ohnesorge left Univ.of Rhode Island for Lehigh and I choose to follow him.
7. Have you stayed in touch with others from your time? Contacts? No.
8. Any remembrances you're willing to share: I have stayed in contact with Prof. Heindel as we have run into each other a few times at meeting or have communicated. I will always thank Dr. Sturm as he allowed me to work on the his research gas chromatography, the first at the Chem Dept at Lehigh. Eventually my research expertise became chromatography and mass spectrometry.

Jim Stuart (ret. Professor – U. Conn)

# Remembrances of Thomas B. Garrett (Ph.D. 1970)

Name: Thomas B Garrett

Degrees from Lehigh and Years for each: PhD 1970

Years Attended: 1966 - 1970

Fields of specialization: Physical Chemistry, Mentor: Prof. Daniel Zeroka

*Specific questions* ---

1. Who were the leading faculty in—
    a) Research
    b) Teaching
    c) Other
2. Estimate the number of grad students in your time __10 in P Chem__
3. Did you mentor any undergraduates? None
4. How were you supported? Teaching assistantship and Fellowship (Horner Fellowship)
5. Which professors had the largest research groups? Professors Zettlemoyer and Heindel, as best I remember
6. What was your impression of the LU undergrads? Bright. Asked a lot of questions.
7. What was your impression of the LU grad students? Most seemed serious about their work and weren't just extending their stay in college.
8. How well equipped (instrumentation) was the dept? Specific hardware? Most of my work was done with paper, pencil, and computer. Access to the latter was very good, for its time.
9. Why did you come to Lehigh? Faculty reputation, alumnus encouragement
10. Have you stayed in touch with others from your time? No
11. Any remembrances you're willing to share: In general, the overall helpfulness and approachability of the chemistry and physics faculty is something that I recall.

# Remembrances of Alan R. Oyler (PhD 1973)

Name: Alan R. Oyler

Degrees from Lehigh and Years for each: Ph.D. (1973)

Years Attended: 1969-1973

Fields of specialization: Organic Chemistry

Dissertation mentor: Thomas E. Young

*Specific questions* --- [not able to answer some of the questions]

1. Who were the leading faculty in—
    a) Research
    b) Teaching
    c) Other
2. Estimate the number of grad students in your time _8-10 per yr___
3. Did you mentor any undergraduates? Names?
4. How were you supported? NSF Traineeship
5. Which professors had the largest research groups?
6. What was your impression of the LU undergrads?
7. What was your impression of the LU grad students?
8. How well equipped (instrumentation) was the dept? Specific hardware?
   There was an NMR with a pen that wouldn't write.
9. Why did you come to Lehigh? It was close to my future wife and recommended by my undergraduate Albright professor, Robert Rapp.
10. Have you stayed in touch with others from your time? Names? Contacts?
11. Any remembrances you're willing to share:
    I was using a lot of ether and one day Joe Nunzio said that he had a deal on ether for me. He said he found a new supply and the cost would only be a small fraction of what I had been paying. I failed to ask about the source of this supply. Some days later, I borrowed Ned Heindel's rotary evaporator (in an empty lab) to evaporate one of my ethereal solutions. While the evaporation was progressing, I ran upstairs to my lab to do something. When I returned, I found that an explosion had occurred and a fair portion of Ned's evaporator was missing. An investigation found that Joe's new ether supply was a ten-year-old drum in the basement of the chemistry building. A bomb squad was called in to remove it. Joe didn't have any special offers for me after that.

# Remembrances of Gary K. Smith (PhD 1978)

At Lehigh University, I worked under Dr Stephen Schaffer on the folding of bovine seminal RNase and earned the PhD in chemistry in 1978. After leaving Lehigh, I was a post-doctoral research fellow from 1978 – 1981 in the laboratory of Stephen J. Benkovic at The Pennsylvania State University. In his laboratory, I worked on avian glycineamide ribonucleotide transformylase (GAR TFase). I was able to demonstrate that the previously published and accepted enzyme mechanism and reaction cofactor were incorrect and established identity of true cofactor. We used this information to discover potent inhibitors of the enzyme as potential anticancer agents.

On June 27, 1981, I married Jane Gretsch in State College, PA. On that day I accepted an employment offer from Burroughs-Wellcome, RTP, NC. They hired me to continue some of the antifolate drug discovery work and to work on the biosynthetic pathway to another pteridine, tetrahydrobiopterin. The latter molecule is important in the biosynthesis of adrenaline and serotonin, and we were interested in determining if a regulator of the pathway could be a therapeutic. Our early work showed that the previously published and accepted biosynthetic pathway was incorrect. We showed that the tetrahydropteridine moiety formed from GTP without the need of an outside reducing agent via an internal redox reaction and were able to identify to true biosynthetic intermediates.

The antifolate work continued for 15 years with GAR TFase and thymidylate synthase (TS) as targets. A TS inhibitor, 1843U89, made it to the clinic and showed interesting responses, but the compound was sold to another company who did not develop it.

During this time, we were one of the early groups interested in chemotherapy induced apoptosis, an important mechanism of cell death. We showed that both GAR TFase and TS inhibitors kill cells via apoptotic mechanisms, but importantly, TS inhibitors were far more effective killers. GAR TFase inhibitors largely produced reversible cell stasis and limited kill. This observation led us and other groups to abandon pure GAR TFase inhibitors for cancer therapy since strong cell kill is critical in cancer.

Burroughs-Wellcome was purchased by Glaxo in 1995. I stayed with the new company, GlaxoWellcome, and continued work on apoptosis.

In 2001, GlaxoWellcome merged with SmithKlineBeecham to form GlaxoSmithKline. From 2003 to 2006, I was Co-Chair of Kinase Target Class Committee. In this international, cross division role, I directed, defended and was accountable for GSK world-wide kinase inhibitor research. This included development of the strategy, working with multiple therapeutic area leaders to discover and act on new kinase targets, appointing and leading GSK's international kinase expert core team, working with local scientists to initiate and execute new and ongoing kinase programs, and ensuring program progress within timelines. The programs within the kinase target class identified new kinase targets, hits, leads and drug candidates for a variety kinases and therapeutic areas.

In 2007, the company reorganized away from the target class model, and I was promoted to Director, Department of Screening and Compound Profiling. In this role, I led teams of biological assay experts to develop and run high throughput assays to discover and develop therapeutic agents targeting a wide variety of enzymes and receptors.

Throughout my career, I proposed, initiated, led, progressed, defended and (as warranted by science or strategy) terminated a number of research and discovery programs toward cancer, metabolic and muscle wasting disease therapeutics.

In 2013, I retired from GSK as a scientific leader in biochemistry and translational biology with 32 years of experience in R&D combined with extensive knowledge of drug discovery chemistry and biology and proven success in therapeutic target discovery followed by ligand discovery for target validation and lead development or target invalidation and termination.

My research interests include drug discovery and development, translational biology, kinases, proteases, other targets, antifolates, myostatin and signaling-based therapeutics.

Gary K. Smith
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Raleigh, NC 27608
919-787-6539

## Remembrances of KeriLyn C. Burrows (Ph.D. 1979)

Name: KeriLyn C. Burrows (Keri)

Degrees from Lehigh and Years for each: PhD 1979

Years Attended: 1972 – 1979 (actually left campus 1978)

Fields of specialization: Analytical (electrochemistry & environmental)

Dissertation mentor: Mike Hughes (initially Matt Hulbert)

*Specific questions* ---

1. Who were the leading faculty in—
    a) Research
    b) Teaching
    c) Other
2. Estimate the number of grad students in your time 25
3. Did you mentor any undergraduates? Names? Nope
4. How were you supported? TA, NWF fellowship (1 year), sponged off parents
5. Which professors had the largest research groups? Don't remember
6. What was your impression of the LU undergrads? The engineering freshmen were pretty inept in the lab!
7. What was your impression of the LU grad students? Serious, dedicated
8. How well equipped (instrumentation) was the dept? Specific hardware? Not bad for the times
9. Why did you come to Lehigh? Convenient -- the future I had planned out the first semester of my senior year at Muhlenberg fell apart, so going right for my doctorate seemed to be an easy solution.
10. Have you stayed in touch with others from your time? Names? Contacts? Not too many – Ned Heindel (of course!) and Natalie Foster
11. Any remembrances you're willing to share: I spent a year and a half down at The Wetlands Institute in Stone Harbor when Biology's Sid Herman was

the director. That was another great escape for me, and where I first learned the joys of birding. I lived at home in Catty and did not participate very much in campus life. Nonetheless, Lehigh gave me entry to almost a decade of college teaching (my first love).

# Remembrances of Henry T. Kalinoski (MS '81 PhD '84)

This remembrance covers my time at Lehigh from the fall of 1979 through the completion of my work there in December 1983. Thank you for the chance to recall this. My story covers a different, and I believe a unique, approach to graduate education and research that others might find interesting. My Lehigh education has certainly served me well throughout my career.

My Lehigh chemistry department experience began in August 1979 along with a class that included Doug Eadline, Michelle DeCrosta and André Sommer among others. We joined a department already comprised of individuals such as Tom Beidler, Joe Carnali, Dave Carrick, Natalie Foster, Joe Sohara, Brian Strohmeier, and the late Ed Schmauch. It was an interesting time as it seemed that things were changing in the department and in the university.

Perhaps as with others, I wasn't certain what I wanted to pursue as a graduate student. Therefore, things progressed in fits and starts and, after completing my time as a teaching assistant, I found project work with Mike Hughes. The project built on earlier work involving metal complexation constants of environmental materials and introduced me to aspects of column chromatography and atomic absorption spectroscopy. The work for me was an ideal blend of analytical chemistry with environmental science. Alas, things do not always proceed as hoped and planned. Dr Hughes left the department to pursue an opportunity in industry and I was without a project or an advisor. I had completed sufficient work to write a thesis for the Master's degree but wanted to complete the PhD.

It was at this time that the department brought on a new chairman. G. Doyle Daves, Jr. came to Lehigh from the Pacific Northwest and some of the changes I alluded to earlier began. The specific benefit for me was that Dr. Daves had an opportunity for a graduate student to carry on work he had on-going. The challenge was that the student had to leave South Mountain and travel to Portland, Oregon to address the lab work. Such an approach had not previously been pursued.

The work itself involved mass spectrometry and applications to metal-mediated organic synthesis being explored by Dr. Daves and his colleagues. So, I had an adventure to pursue an area of study that long held a fascination for me (mass spec) and an adventure to travel clear across the country to do so. I do not know how this arrangement was received by other faculty, staff and students in the Mudd Building but I was thrilled by the prospects.

It may be hard to understand in today's world but one of the greatest challenges to the arrangement was how to maintain proper communications. Supervision and collegial

interactions were possible as there was a good team at the Oregon Graduate Center (now part of the Oregon Health and Science University). But keeping up with what Dr. Daves was interested in and what I was to accomplish was no small task. I had to complete course work and exams. This was before distance learning or on-line courses. This was in the days before the Internet; there was no e-mail, no Skype, no video conferencing. Communications were by telephone, fax and US Mail. Phones were hard-wired, no cell phones, and people had to be at their desks to conduct a conversation. Times had to be scheduled and schedules maintained. The personal computer was not a common feature on everyone's desk, and the typewriter, not a word processor, was used to prepare correspondence. The University had a requirement that the final draft of one's dissertation be typewritten, not prepared using a word processor.

But the research work was fascinating and I learned a great deal about the capabilities of mass spectrometry. A new world was opening up about approaches to sample ionization that evolved into a wide new world of applications for the technique. Through our small efforts, an understanding of the potential to apply mass spectrometry to condensed-phase systems, not just to the gas phase, was glimpsed. Publication of a manuscript in the *Journal of the American Chemical Society* (JACS), among other publications, was evidence of the accomplishment.

My dissertation committee must have agreed with our efforts and I successfully defended in December of 1983. Along with Dr. Daves, the committee was comprised of Bill Ohnesorge, Chuck Kraihanzel, Jim Sturm and Doug Barofsky of the Oregon Graduate Center. I am indebted to these individuals for their contributions to my studies. I had the chance to pursue my Lehigh graduate education in a manner not previously utilized. The skills and experience of preparing clear, concise and informative correspondence served me well throughout my career. The fun and excitement of acquiring scientific knowledge remain with me.

I have a lot for which to be grateful, starting with my time at Lehigh. Since then, I followed an industrial R&D career with some of the world's largest consumer products companies, Unilever, Playtex, and L'Oréal, and with ingredient suppliers Firmenich and Ingredion. Almost all positions were in analytical chemistry, starting as a laboratory research scientist and ending up as a lab director and administrator. This has been a satisfying outcome for a reticent and somewhat confused young man starting at Lehigh a long time ago.

I learned a lot, met some great people, maintain some of those connections today and had a really good time. Thank you for reading through my story.

...Henry "Hank" Kalinoski

# Remembrances of Joseph Carnali (PhD 1984) for 75th History

Dear Dr. Heindel,

My graduate school experience with the Chemistry Department at Lehigh University pretty much began and ended with my Ph.D. advisor, Frederick M. Fowkes. As an undergraduate physics major at Lehigh, I was leaning towards going to graduate school in biophysics, then a rather new field. When I was a senior, I looked around for courses that might have something to do with biophysics and settled on Dr. Fowkes' course on colloid and surface chemistry. I really liked the course and he thought it was great that a physics student was actually taking it.

A year later, I was a graduate student at Penn State and came to the realization that there was too much biology in biophysics for my liking. I happened to write to Dr. Fowkes and he offered me a research assistantship in the area of tertiary oil recovery – a really hot area at the time. I started back at Lehigh in January 1979. I was lucky that I had taken most of the sophomore/junior chemistry courses for the biophysics preparations, and so was able to join right in with the other chemistry graduate students like Brian Strohmeier that spring and Andy Sommer, Doug Eadline, and Hank Kalinoski in the fall.

Other Mudd building inhabitants at the time who left a positive impression on me included Tom Beidler, Dave Carrick, Joe Sohara, and Ed Schmauck. And I valued my interactions with 5th floor staff members, faculty, and frequent visitors such as Dr. Ohnesorge, Joe Nunzio (I always knew he was on the floor when I heard strains of "Stranger in the Night"), Bob Pugh, and Bill Anderson, and with my good friends down in the Department office, Mary Ann Elgin and Dawne Kressler. I'll remind those colleagues still around about Friday Happy Hours at Your Mother's Bloomers and about our famous 5th floor hockey game that got us in such trouble with a certain 7th floor inorganic chemistry faculty member.

I spent most of 1979-1983 on the fifth floor of the Mudd building, though I also did some of my difficult experiments at the Western Electric facility in Princeton, NJ – through a contact with Dr. John Emerson initiated by Prof. Fowkes. My physical chemistry education was capably delivered by Professors Sturm and Zeroka, though I enjoyed my interactions with all of the faculty and maintained good friendships with the Physics Department as well.

My undergraduate advisor, Prof. Brent Benson, continued on to be on my thesis committee and provided a nice alternate viewpoint. After graduation, I did a post-doc at Lund University and then started at Unilever in the summer of 1985. I'm still there 30 years later, having worked on many different things, but always focusing on the relevant physical chemistry component of the problem. Actually my favorite work related thing is a course in colloid and surface science that I teach as an adjunct

professor at Stevens Institute of Technology in Hoboken, NJ. I think a lot about Dr. Fowkes the semesters I teach that course.

My wife Leslie and I have been living in Newtown, CT the last 10 years and have two grown daughters out in the working world.

Joe Carnali

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## The Remembrances of David P. Pursell (M.S. 1987)

I look back fondly on my Lehigh years (1985-1987, M.S. and M.A.), but also remember they were filled with hard work with great faculty and classmates. In coming to Lehigh, I took a break from my Army career to earn graduate degrees in chemistry and science education before joining the U.S. Military Academy at West Point faculty as a chemistry instructor. At Lehigh I studied primarily in the P-Chem area and did my research project in the lab of Henry Leidheiser, working on coatings for tin. I also did a masters research project in science education with Al Castaldi.

Ned Heindel was my overall advisor and I continued to work with him upon departure from Lehigh, at which time I taught general chemistry at West Point from 1987-1990. I then rejoined the field Army for 8 years of operational assignments and was fortunate to then be selected to complete Ph.D. studies at the University of Pennsylvania in preparation for a follow-on assignment at West Point. I earned my Ph.D. in chemical physics at Penn under Hai-Lung Dai, now provost at Temple University. I then joined the faculty at West Point for a second time and taught in several areas of chemistry before retiring from the Army in 2006.

After the Army, I became Executive Director of the Penn Chemistry Department. I left Penn in 2007 to help to help start a new public 4 year college in the University System of Georgia. I was the first Associate Dean of Science and Technology at Georgia Gwinnett College and currently am Professor of Chemistry. Jim Sturm and I still correspond about chemistry and I lament Lehigh changing the mascot from Engineers to Mountain Eagles!

Dave

**David P. Pursell, Ph.D.**
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## Remembrances of Robert Outten (PhD 1987)

**Name: Robert Outten**

**Degrees from Lehigh and Years for each: PhD 1987**

**Years Attended: September 1981 – February 1987**

**Fields of specialization: Organic Chemistry**

**Dissertation mentor: G. Doyle Daves, Jr.**

***Specific questions ---***

1. **Who were the leading faculty in—**
    a) **Research: Ned Heindel, Doyle Daves, Kamil Kier, Keith Schray, Jack Alhadeff, John Larsen, and Steve Regen**
    b) **Teaching: Thomas Young, Natalie Foster, Ned Heindel**
    c) **Other: Bill Anderson (Instrument guru extraordinaire)**
2. **Estimate the number of grad students in your time? 60 – this a guess**
3. **Did you mentor any undergraduates? Yes Names? Henrik Johnsson and Robert Huhn (both Summer Researchers from Sweden)**
4. **How were you supported? Teaching Assistant (General Chemistry) Fall 1981- Spring 1982, Althouse Graduate Fellowship Summer/Fall 1982- Fall 1986**
5. **Which professors had the largest research groups? Kamil Klier and Jack Alhadeff (that's a gut feeling no actual numbers being remembered)**
6. **What was your impression of the LU undergrads? Mixed. There were some very hard working talented students and**

there were some that were riding on their parents' abilities and resources, not appreciating the gift they were given.

7. What was your impression of the LU grad students? Hard working, friendly, cooperative, open to discussion and sharing ideas
8. How well equipped (instrumentation) was the dept? Rather well in my time. Specific hardware? Lots of HPLCs, H/C-NMR (don't remember the Hz), Solid State NMR (don't remember Hz) and mass spec.
9. Why did you come to Lehigh? Good reputation
10. Have you stayed in touch with others from your time? Yes Names? Pete Seoane, Marcian VanDort, Jane Cheng
11. Any remembrances you're willing to share:

Dr. Heindel coming in on the weekends (the ones I remember were usually near the end of the month) to work and he would take the graduate students that were in the labs to the Blue Anchor for lunch. Thank you for not letting us, those who were poor at budgeting expenses, starve at the end of the month. The science discussions over lunch were also very helpful.

Sorry, no photos. I did not own a camera at the time.

# Reminiscences of John Stuart (PhD 1993)

Name: John Stuart

Degrees from Lehigh and Years for each: 1993: Ph.D.

Years Attended: 1987-1993

Fields of specialization: Physical Organic

Dissertation mentor: John Larsen

*Specific questions ---*

1. Who were the leading faculty in—
    a) Research – Dr. Heindel, Dr. Larsen, Dr. Regan
    b) Teaching – Dr. Young
    c) Other
2. Estimate the number of grad students in your time _Started with about 15 each year and ca. 5 completed Ph.D.'s___
3. Did you mentor any undergraduates? Yes Names? Martin Chem
4. How were you supported? Teaching Assistant, Crompton and Knowles Fellowship
5. Which professors had the largest research groups? Larsen, Regan
6. What was your impression of the LU undergrads?
7. What was your impression of the LU grad students?
8. How well equipped (instrumentation) was the dept? Specific hardware? t NMR really great capabilities – the Bruker 500was being installed in my first year and a 300 was being installed as I left Lehigh
   Great improvements in Mass Spec capabilities while I was there the first benchtop GC/MS was added and the plasma desorption instrument was obtained.
9. Why did you come to Lehigh? Location, program
10. Have you stayed in touch with others from your time? Names? Contacts? Tom Eskay – it has been a while

11. Any remembrances you're willing to share:

Dr. Young was about to retire and several grad students went to him to ask if he would be willing to teach the Heterocyclic Class in his last semester – he was honored and very willing to teach the class.

Another Dr. Young memory – he was more than happy to discuss chemistry, as long as it was not the hour prior to a lecture, so he had time to go over his notes and prepare a 3X5 card with key points to reference if he got distracted or to verify pKa's – he never put an incorrect number on the board!

# Remembrances of Jean Lavelle (staff: 1956 – 1990's) and Joseph Lavelle (PhD 1968)

I'm responding to the specific questions you asked.

Ray Hoffman was an assistant who worked with Dr. R. R. Myers and moved with him to Kent State. The only thing else I can offer is that Ray and his wife were from Schnecksville and planned to return there.

There was only 1 technical staffer in the department in my time...a carpenter... Stevie Polak. He was a clean-cut man and a great carpenter who serviced well all of Chandler Ullman. Everyone liked Stevie. He was single and loved his mother with whom he lived. He died very unexpectedly of pancreatic cancer. We came in to work on a Monday morning and learned that Stevie had died. He was a good friend of Joe Nunzio.

I came to work at Lehigh in the fall of 1956 in the Ink Institute. I replaced a lovely chemist named Carolyn Moore. Her father was a minister in her home town, and Carolyn was the first person to get married in the Bethlehem Presbyterian Church on Center Street. At the time Zettlemoyer had a lot of technicians working in the printing ink group and on his many other projects which always included Dupont-sponsored science and other shorter projects such as for the for the U.S. Army and Navy.

Zettlemoyer's projects often included Dr. Myers and Dr. John Chessick as co-investigators. Chessick was involved in gas adsorption measurements especially for characterizing the surface chemistry of solids. For a while in the late 1960's Dr. Fowkes also worked with us. Zettlemoyer also had quite a few very good grad students and post docs who were funded by the ink industry, by graphic arts organizations, and by other companies with whom Z worked. In addition to a long list of secretaries who worked in the National Printing Ink Research Institute there were quite a few female and male technicians including Jo Gallagher, Bernie Dancho, and Connie Grund who worked there a long time. Connie married a graduate student, Tony Butto.

Jackie Fetsko, of course, was Zettlemoyer's right hand man. She kept the whole place on track whenever Z traveled. She was tough! The assistant director of NPIRI was Dr. William Schaeffer who came from Cabot Corp. He received his

PhD while working at Lehigh on polymer adsorption using a relatively new tool, at the time, ellipsometry. He was made Technical Director of the Graphic Arts Foundation ( GATF) in Pittsburgh which was a competitor to NPIRI. He died several years ago. Dr. Fortunato ("Nato") Micale tried to carry on some of Z's projects for a short time after Z's death but it wasn't the same without Dr. Z. Micale retired and is living in Kentucky. [The ink-related projects ceased shortly after Dr. Zettlemoyer died in January 1991.]

David Fairhurst was one of many post docs under Z in the 1960's , involved more, I think , in colloidal chemistry. He was here at the time with other post docs, Dr. Ernie Boucher and Dr. Phil Pendleton from England.

I was so very fortunate to work with Zettlemoyer and his brilliant colleagues who worked with him on so many interesting projects. I refer to this time as the Golden Years starting in the 1950's when so much funding was available for basic and applied research and ending in the 1990's . Of course, I also remember that Z taught us all to work hard!!!

My husband Joe graduated from Lehigh in 1968 while I worked there with a PhD in physical chemistry. Joe spent most of his career in research with Rohm and Haas. [Joe returned to the Department after retirement from Rohm and Haas and helped prepare lecture demonstrations for use in the Freshman chem course.]

Thanks,

Jean S. Lavelle
11 July 2014

# Remembrances of

# Chemistry Alumni

**(Solicited by Emeritus Professors**

**James E. Sturm and Daniel Zeroka)**

## Highlights of Responses to Questionnaire

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| Peter M. Jeffers | During his undergraduate years at Lehigh (B.A., 1961), Peter manifested high aptitude and versatility in science, athletics and even music. Besides being a star student, he was a strong performer on Lehigh's soccer and baseball teams and was given recognition. Peter stayed on for his Ph.D. degree (1964) under Prof. Jerome Daen on surface chemistry. Following two postdoctoral years at Cornell University with Prof. Simon Bauer on high-velocity chemical kinetics, Peter joined the faculty at SUNY Cortland and served there very effectively in teaching, research and administration for over 39 years. His research included attention to chemical behavior of industrially-used compounds of environmental concern. One of his general publications is "Handbook of Property Estimation Methods for Chemicals." He found it within his tremendous capacity in mid-life to excel in running marathon races in some of which he took first place. |
| Herbert H. Silber | Herbert worked his way to the Chemistry Faculty at San Jose State University; he brought in more than 10 million dollars in grant money at a non-PhD granting university. |
| James D. Lear | Jim Lear's attention to theory of chemistry manifested itself in his enrollment in the two 4-credit courses in mathematical physics given by the late Prof. Robert Folk. Jim used his perspective from these courses to solve a differential equation involved in his research on electronic excitation energy transfer dynamics. Publication of this solution led to recognition of his abilities in his career as a researcher in biophysical chemistry at the University of Pennsylvania . |
| John E. Minear | An explicit general appreciation of Jack Minear's study at Lehigh is the atmosphere of identification and solving problems of science. Jack recalls that the employment market even for PhDs was tight in the early 1970s. He found it necessary to learn new skills in product development and marketing of these products. His experience at Lehigh was well-suited to this adaptation and subsequent career. |
| Allan H. Laufer | As a result of the journal publication of his doctoral research, Allan Laufer was recruited to join the vacuum ultraviolet photochemistry group at the then NBS, now NIST. He had a very productive and well-recognized career there. |
| Margaret Kittek | Peggy was among the first 5 undergraduate women admitted to the College of Engineering in 1971; some reminiscences of growing up in Bethlehem and attending Lehigh as both an undergraduate and graduate student. Very thoughtful considerations of her time spent at Lehigh. |
| Lawrence A. Casper | Larry worked his way to be an Assistant Dean in the College of Engineering at the University of Wisconsin-Madison. |
| Gary S. Calabrese | Gary earned his Ph.D. in Inorganic Chemistry at MIT. He felt his undergraduate training prepared him well and put his beginning ability at equal to or better than other graduate students at MIT who came from more prestigious schools. Gary worked his way to Director of Research at |

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| Gary S. Calabrese (continued) | Corning. |
| John Texter | John earned a B.S. in Electrical Engineering and then an M.S. in Chemistry, M.S. in Mathematics and a Ph.D. in Chemistry in 1976 working under the supervision of Prof. Klier. After 2 postdoctoral appointments, he was a member of the research staff at Eastman Kodak Research Laboratories from 1978-1998 specializing in dispersion and emulsion technology. In 2002 he became a Professor of Polymer and Coatings at Eastern Michigan University. He provides some interesting reminiscences, in particular his humorous description of an incident involving the decomposition of a sample of $NI_3$. |
| Thomas B. Garrett | After earning his Ph.D. at Lehigh in 1970, Tom was on the research staff at Armstrong Cork (later renamed Armstrong World Industries) in Lancaster, PA. Tom comments that faculty in Chemistry and Physics were helpful and approachable. |
| Stephen J. Benkovic | Stephen did undergraduate research with Prof. Jerry Daen. Stephen earned a Ph.D. at Cornell University and accepted an appointment at Pennsylvania State University where he is now Evan Pugh Professor and Eberly Chair in Chemistry. |
| Joel M. Ressner | After his undergraduate degree at Lehigh, Joel earned an M.S. degree in England and returned to earn his Ph.D. under the supervision of Prof. Kraihanzel. He was appointed to the Chemistry Faculty at West Chester University where he continues today. He points out that at the time he was England he was surprised to learn how well the Chemistry Department Faculty were regarded by the Chemistry Faculty in England. He provides other reminiscences as well. |
| Charles M. Bartish | Charles studied at Lehigh (1969-1973) and earned a Ph.D. in Inorganic Chemistry in 1973 working under the supervision of Prof. Kraihanzel. He had a productive career at Air Products. He mentions that there was a trimodal distribution among the graduate students during his time of study. During his time at Lehigh, he felt that the NMR, mass spectrometer and the computing facilities were state of the art. |
| Abigail M. Oelker | Abby earned a B.S. in Chemical Engineering in 2003. She did undergraduate research with Prof. Messmer and Prof. Klier. She helped found the AXE Chemistry Fraternity at Lehigh. She earned a Ph.D. in Chemistry at Boston University having been influenced in a positive way by her research experience in the Chemistry Department. |
| Melissa Kistler Langston | Melissa earned an M.S. (2006) and Ph.D. in Chemistry (2009) under the supervision of Prof. Tianbo Liu. She reports on an incident involving the emergency showers in the hall in Sinclair Lab where there were no drains for the showers. |
| Richard Kellerman | After earning a B.S. in the UK, Richard came to Lehigh for graduate work based on contact with Prof. Zettlemoyer. He earned a Ph.D. degree with Prof. Leidheiser and did postdoctoral work with Prof. Klier. He was on the research staff of Xerox and later co-started a new company Nielson- |

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|---|---|
| | Kellerman in West-Chester, PA. |
| Dennis W. Hess | After earning a B.S. in Chemistry from Albright College, Dennis earned an M.S. in Chemistry (1970) with Prof. Lovejoy and Ph.D. in Chemistry (1973) with Prof. Fowkes. He worked his way to Chemical Engineering Faculties of several very prestigious universities: University of Minnesota, University of California (Berkeley), Lehigh University, and Georgia Institute of Technology. Dennis' current appointment at Georgia Tech is Professor and Thomas C. DeLoach, Jr. Chair. |
| Richard J. Miller | The dominant appreciation expressed by Dick Miller is that his graduate study at Lehigh prepared him well for his entire career as a physical chemistry faculty member at SUNY Cortland. He recognized high-quality teaching and the identification and stimulation of research ideas. His role also as a teaching assistant brought him into contact with Lehigh undergraduates whom he recognized as generally of quite high quality, consistent with Lehigh's reputation. |
| Arthur E. Waltking | As a son of a Lehigh alumnus, Art was quite disappointed at the admissions committee's assessment that his aptitude was not high enough for him "to be an engineer." Art responded that he had planned to pursue chemistry in the College of Arts and Sciences, not engineering. He was given conditional acceptance and was even required to take remedial courses in mathematics. Taking summer courses got him further along so that he could take elective courses, including nuclear and radiochemistry during his junior and senior years. This extra background made available career positions with food processing companies. One company hired him in recognition of his Lehigh B.A. degree and Art worked effectively for his whole career along with several scientists with PhD degrees. He has published widely in the trade and has even founded his own consulting firm. |
| Ronald D. Schaeffer | Ron Schaeffer is Chief Executive Officer of PhotoMachining, Inc. He has been involved in laser manufacture and materials processing for over 25 years, working in and starting small companies. He has over 150 publications, has written monthly web and print columns( currently writing a column for MicroManufacturing Magazine). He is on the Editorial Advisroy Board and is a frequent Blogger for Industrial Laser Solutions magazine. He is also a past member of the Board of Directors of the Laser Institute of America and is affiliated with the New England Board of Higher Education. Finally he is the author of the text book entitled, "Fundamentals of Laser Micromachining". He has a Ph.D. in Physical Chemistry from Lehigh University and did graduate work at the University of Paris. He is a US Army veteran of the 172$^{nd}$ Mountain Brigade and the 101$^{st}$ Airborne division. In his spare time he farms, collects antique pocket watches, plays guitar, and rides motorcycle. |
| Charles L. Cronan | Charles did his graduate research on surface chemistry with Professors Zettlemoyer and Leidheiser in Sinclair Laboratory. Among his memories related to sponsored research at Lehigh for Picatinny Arsenal to extend storage life of an explosive. He had no mishaps , but learned later how |

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|---|---|
| Charles L. Cronan (continued) | risky it was to handle the amounts involved. Upon completion of his Ph.D. in 1976, Charles joined the research staff of Miller Brewing Co., Milwaukee, WI. He used ESR to measure concentrations and free radicals to assess suitability of waste disposal. Charles was very productive in developing means related not only to brewing but also to other needs. Among his several patents is a method of dynamic surface tension measurement relates not only to beer suds formation but also found use in prenatal diagnosis of fetal lung development. In the mid-1990s, Charles formed his own consulting company, **Cronan Creative Solutions**, in which he continued his inventiveness with further patents. He also developed a way of monitoring heat transport through the walls of a building *en route* to choosing ways to conserve energy |
| James P. Wightman | B.S. Chemistry, Randolph-Macon College, 1955; Ph.D., Lehigh, 1960, Jim came to Lehigh in response to a visit and lecture by Dr. Harvey A. Neville and was encouraged by Prof. Herman Collier of Moravian College, both alumni of Randolph-Macon College. During his time at Lehigh as a T.A., Jim assessed very favorably the aptitudes of Lehigh undergraduates, at that time all male students. He observed a wider diversity among the graduate students. The most impressive teacher at that time was Prof. Robert West. Jim chose to do his M.S. and Ph.D. research on surface chemistry in Prof. A. C. Zettlemoyer's group. Prof. J. J. Chessick was Jim's mentor. Following a postdoctoral year at PA State University, Jim joined the faculty at VA Technical University. He performed very effectively there in both teaching and research from 1962-2001 with 161 technical publications and several awards. He was named Distinguished Professor at VA Technical University. Following formal retirement, Jim has given invited lectures on surface science to broader audiences. |
| Ira Brinn | Ira, a graduate student at Lehigh from Bucknell (1961), joined in the demonstrations by Lehigh students against the United States' involvement in the Vietnam War. He did so to the extent that was noticed by Chemistry Dept. faculty who, at a departmental meeting in early 1965, decided to discontinue Ira as a doctoral candidate. While teaching at a small college in Wheeling, WV, Ira saw the importance of further graduate study, was accepted at the Univ. of Pittsburgh, obtained his Ph.D. degree there and then had a postdoctoral year at Columbia Univ. He obtained a faculty position at Recife Univ. in Brazil and had most of his productive career at the Univ. of Rio de Janeiro. Some Lehigh faculty felt that the expulsion from Lehigh was done without appropriate warning. |

# Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: PETER JEFFERS

Degrees from Lehigh and Years for each: BA, 1957-61
PH.D, 1964

Years Attended: 1957-1964

Fields of specialization: PHYS. CHEM

Dissertation mentor: J. DAEN

*Specific questions ---*

1. Who were the leading faculty in—
   a) Research DAEN, STURM,
   b) Teaching " " , MYERS
   c) Other
2. Estimate the number of grad students in your time 30
3. Did you mentor any undergraduates? Names? NO
4. How were you supported? NSF FELLOWSHIP
5. Which professors had the largest research groups? ZETTLEMOYER
6. What was your impression of the LU undergrads? V. GOOD
7. What was your impression of the LU grad students? GOOD
8. How well equipped (instrumentation) was the dept? Specific hardware?
9. Why did you come to Lehigh? GOOD REPUTATION
10. Have you stayed in touch with others from your time? Names? Contacts? (SOME)
11. Any remembrances you're willing to share: (OVER)

Please e-return to <ndh0@lehigh.edu>

or mail Mr. James E. Sturm
2239 Wassergass Rd
Hellertown, PA 18055-1211

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Voice: 408-924-4800
Fax: 408-924-4815

www.sjsu.edu

January 7, 2011

Professor James E. Sturm
2239 Wassergass Road
Hellertown, PA 18055

Dear Jim:

Happy New Year. Thanks for your letter congratulating me on becoming an ACS Fellow. It was really nice to hear from you.

When I left Lehigh in 1964, I went to UC Davis and got my Ph.D. in 1967. While at Davis I met and married Kathleen, who was in a Master's Program in Social Work at UC Berkeley. We then spent my postdoc at the Royal Institute of Technology (KTH) in Stockholm, Sweden, supported via the Fulbright Program. Unable to get an academic job while in Europe, I then had a second postdoc at the University of Maryland College Park. My first academic appointment was at the University of Maryland Baltimore County (UMBC) starting in 1969. Even though I had over twenty publications and good teaching I was in a tenure fight there. I left to join the University of Texas at San Antonio (UTSA) and rose through the ranks to become a tenured Professor. The Chemistry Department was not a happy place then (and it still has some of the same problems 25 years later) and even though I had more than a million dollars in grant money I left in 1985, giving up rank and tenure to become an untenured Associate Professor at San Jose State University (at that time the Cal State System did not hire Full Professors nor did they hire anyone with tenure. Even the Provost came in without tenure.) I was told it would take four years to become promoted and tenured again, but I did it in one year. Coming here was my best academic decision I ever made.

My interests have been in kinetics, thermodynamics and spectroscopy of metal ion systems and I have over one hundred papers (mostly with undergraduates) with one more left in me. I have brought in more than ten million dollars in grant money here (we do not offer Ph.D. degrees). In addition to my research and teaching, I have been active with the national and local ACS; I have worked with high school teachers; and I have been involved with underrepresented minority students for over 30 years. In addition to loving what I do, I have received several awards: a Presidential Award for Mentoring Underrepresented Students from the White House; Outstanding Professor Award at SJSU; the Wang Award as the Outstanding California State University Faculty Member in the Sciences, Mathematics and Engineering; and two Local ACS Section Awards. For this year I am serving as the Acting Associate Dean of Science, an administrative position I never wanted nor sought. I

am looking forward to half retirement stating in August (I will be 70 then). We can do this for up to five years, collecting retirement, social security, half pay and full health benefits for life, a great deal.

I am still married to Kathleen and we have two children. Our eldest is Erik who is an Assistant US Attorney in Los Angeles and he is on a year's leave at the White House helping to set policy on intellectual property issues. Our daughter, Sarah, is an elementary school teacher who is married with three young boys. Sarah's family lives less than 5 miles from us and my wife babysits two days a week and continues to work three days a week (an easier job). Although I enjoyed my time at Lehigh, the years at Lehigh were tough for me because of the breakup of my family, but I survived the problems and continued to do better all the time. I am happy, both personally and professionally. As I look back and ask myself what was the turning point in my life back then, it started with the summer after my junior year of undergraduate research with Dr. Daen; my graduate research with you; and my first opportunity to be a teaching assistant while a master's student. I have tried to pay these opportunities back to other students. Thank you very much.

Sincerely,

Herb

Herbert B. Silber
Professor of Chemistry
hbsilber@science.sjsu.edu

Dr. James D. Lear
124 Kenilworth St.
Philadelphia, PA 19147

April 5, 2010

Dr. James E. Sturm
2239 Wassergas Rd.
Hellertown, PA 18055

Dear Jim;

It was so good to get your letter. You are certainly the most important person in my professional life. If not for your patience and faith in my not-so-obvious abilities, I would never have achieved anything approaching even the few things I've done in life. I wanted to make sure you knew that when considering your academic genealogy!

I hope this finds you well and enjoying the golden years of life. I'm still not fully retired; Penn has been good enough to allow me to keep my lab and office there and to work part time as I'm able. I underwent quadruple by-pass surgery last September and it's taken awhile to recover. So far, so good. The price paid for a reckless youth! More seriously, my wife Deborah has been fighting ovarian cancer for the last year and a half; two surgeries and seemingly endless chemotherapy, but things seem to be under control so far. Our daughter and two grandchildren live in New Mexico (Magdalena, an old mining town ~ 100 miles south of Albuquerque) and we're planning to drive out there in a few weeks and spend as much time there as we can. We have 140 acres of land out there that we planned to build on to retire to, but now that's uncertain. At least I can dress up like a rancher and cut wood and fix fences and run the dog out there. It's a really beautiful land once you get used to the sparsity of green.

Regarding your scientific genealogy, I think it's a terrific idea and I'd love to see it. I've had a few students myself during my time, mostly shared with more senior professors, but all of whom I'm proud and grateful for the experience. I might also mention that all that time I spent at duPont resulted in a few significant accomplishments: my private advice to management kept polychlorinated biphenyls out of childern's sleepware, my passing on a suggestion of Deborah's to do something about third world water purification developed into a successful program to provide simple nylon mesh water filters to Africa to eradicate Guinea worm disease, and I helped a young scientist there, Bill DeGrado (a friend of Steve Regen's and probably the second-most important person in my scientific life), launch a sucessful career in Protein Design.

All things considered, especially things family, it's been a rewarding, if somewhat turbulent life. But aren't they all? Again, thanks for your patience and encouragement during the formative years of my life.

Warmest regards,

Jim Lear

Questionaire for Lehigh Chem Dept's 150th Anniversary

Name:

John (Jack) Menear

Degrees from Lehigh:

Ph.D in Physical Chemistry, 1969

Years Attended:

1965-69

Fields of Specialization:

Physical chemistry

Dissertation Mentor:

Dr. Jim Sturm

Specific Questions:

1. Leading faculty in –

(a) research

Dr. Jim Sturm – physical chemistry
Dr. Albert Zettlemoyer (spelling ?) – printing ink/coatings
Dr. ___ Krayhanzle (spelling ?) – inorganic chemistry
Dr. ___ Fish – analytical chemistry
Dr. Frank Lovejoy - infrared spectroscopy
Dr. Ed Amstutz (spelling) – organic chemistry [department chairman]

(b) teaching

Dr. Robert(?) Sprague
Dr. Jim Sturm
Dr. Frank Lovejoy
Dr. Ed Amstutz

2. Number of grad students:

My memory is that I started with a group of 47 incoming grad students. But the number dropped off significantly after 2 years (to perhaps 10-12).

3. Mentoring undergraduates

As a teaching assistant, I always offered a review class before Dr. Sprague's freshman chemistry tests. I invited all undergraduates, even if they were not in my recitation groups.

I also did chemistry tutoring at a local private school.

4. Support

The first year or two was with a teaching assistantship. The final years were under an Atomic Energy Commission grant.

I also did tutoring and manual jobs near Bethlehem.

The remainder came from summer jobs in Arizona and California.

5. Professor with the largest research groups

Dr. Albert Zettlemoyer

6. Impression of the LU undergraduates

They were extremely bright. Many were from wealthy families.

The graduate students sometimes joked that "You could tell who the undergraduates were. They were the ones with the new cars."

7. Impression of the LU grad students

It was a widely diverse group. Backgrounds varied.

Nearly all were good ethical people, who wanted to do well.

It was a pleasure to be associated with them.

8. How well equipped was the department?

We were not highly equipped. Many of us built our own test rigs.

Perhaps the most sophisticated tool was a mass spectrometer. We also had access to visible and infrared spectroscopy.

9. Why Lehigh

I had choices, and chose Lehigh. It was my first preference.

Lehigh had a good reputation, and was close to my home. I had no second thoughts about the quality of education.

Lehigh offered me a teaching assistantship, which was important in 1965.

10. Have I stayed in touch?

Not very much. After graduation, I moved to the west coast, and slowly lost contact.

When I left in 1969, there was a recession for chemists. I had to pick up new capabilities in marketing and product development. This took me away from the core of my gradate work.

11. Remembrances

My time at Lehigh has served me well. My time there was a positive experience, and I will always remember it fondly.

The curriculum focused on how to solve problems. I use that skill every day.

I was very lucky to have Jim Sturm as my mentor.

Lehigh Chem Dept's 150th Anniversary

Name: Allan H. Laufer

Degrees from Lehigh and Years: Master of Science, 1958
Ph. D., 1962

Fields of Specialization: Physical chemistry, Vacuum-ultraviolet photochemistry

Dissertation mentor: Professor James E. Sturm

1. Leading faculty in:

a) Research – Professor James E. Sturm
Professor Albert Zettlemoyer (physical chemistry - surface chemistry)
Professor Earl Serfass – analytical chemistry
Professor Edward Amstutz – organic chemistry

b) Teaching – Professors James Sturm and J. Daen (both physical chemistry)

2. Number of graduate students – A guess would be about 30 – 40 in all fields of chemistry

3. Never mentored undergrad students although I was a Teaching Assistant (TA) in freshman chemistry for two years.

4. I believe that support for my research came through a grant to Professor Sturm from the then Atomic Energy Commision.

5. Professor Zettlemoyer's research group was probably the largest in the Department in those early years.

6. My experience with the Lehigh undergrads was limited to my experience as a TA. They seemed relatively well prepared for freshman chemistry, did the required work, studied and succeeded in learning the material. The students were primarily science or engineering students so chemistry was considered a "required" subject.

7. The grad students came from a wide variety of undergraduate colleges and universities and were quite serious about the efforts required to obtain a graduate degree. The work day began early in the morning for classes (some at 8 AM) and continued through the dinner hour. Most of us returned to the campus after dinner to continue until about 10 or 10:30 PM. In addition, working on the weekends was quite common!

8. The equipment in the department was quite adequate for my research effort. The major instrument that I used was a mass spectrometer which I had to maintain but it worked!

9. Lehigh was recommended to me by a college classmate who was a grad student at Lehigh.. So I applied!

10. I have maintained contact briefly with Sam Cozzens
3 Sail Maker Court
Salem, South Carolina 29676

More with William E. Tyler
1846 Crawfords Climb
Wintergreen, VA 22958

And most frequently with Robert Smerko
801 Key Highway #440
Baltimore, MD 21230

11.Several of us lived together in the same house before several of us got married. The comraderie among the students that developed in the department extended to social activities external to the school. Parties, camping trips, etc. made the school much more enjoyable.

Lehigh University Chemistry Department 150th Anniversary

Notes by
Margaret (Peggy) Kittek
BS in Chemistry 1975
MS in Chemistry 1986
Bethlehem, PA
August 9, 2014

I am a proud Lehigh University Department of Chemistry alumna.

I am a second generation American, born and raised in Bethlehem. My forefathers emigrated from Eastern Europe in the early 1900s in search of a better life. They labored in the steel mills of Bethlehem Steel, the silk mills, and garment and cigar factories. Lehigh stood on South Mountain as a beacon of hope for future generations.

From the time I could first walk, my father took me to Lehigh football games at Taylor field. Unable to afford tickets, would arrive when the box office closed and the gates were unattended. We were just in time to see the Marching 97 at halftime and the Engineers' second half.

Every year, during the evenings before the Lehigh Lafayette game, our entire family would pile in the station wagon and drive past Lehigh fraternities in the old mansions of Fountain Hill. We loved to see all the elaborate and brilliantly lit mechanical displays.

My father taught me to drive in the empty parking lots at Sayre Field, and on the twisty roads though Lehigh's South Mountain campus. Those were the same roads on which Roger Penske honed his racing skills.

Growing up, I was always bewildered by Lehigh. The great promise on my own South Mountain was out of reach to me. Alas, I was a girl, and Lehigh's undergraduate university all male. I was delighted my junior year of high school when Lehigh announced it would admit women. In the fall of 1971, I joined five other women in the Engineering College with over 1,000 men.

The Lehigh community and especially the Chemistry Department was always welcoming, supportive, and respectful. Sure, there were controversies over admission to the Marching 97 and use of Taylor Gym's weight rooms, but it was the best environment for a woman coming of age and advancing women's rights in the early 1970s.

When I first came to Chandler-Ullman Hall, the new ladies room was still under construction. We used the old ladies room, little more than a closet with slanted ceiling under the main staircase. When it was finished, the new ladies room was regarded by most coeds as the best on campus, and became a standard stop for all coeds on their marches up and down the hill, even if they had no classes in the building.

Chandler-Ullman Hall was known by most simply as "The Chemistry Building – that one with all the chimneys." It was magnificent. Most students believed they could not go from one side of the building to the other side without walking outside. Chemistry insiders knew the narrow dark stairway in the dusty supply closet off the stage of the main lecture theater. The path to the other wing was like the catacombs.

The main lecture theater was phenomenal. Entry was by an ornate metal staircase. The seating was steep. The light poured through enormous windows. In front of the lecture stage was a long demonstration lab bench. Behind was a wall of chalk boards. An array of vertically traveling boards was at center. During an organic chemistry lecture on enantiomers, Dr. Heindel threw up the center board to reveal a Playboy centerfold demonstrating mirror images. At the end of the lecture, most students remained in place for the next class, physical chemistry. The traveling chalk boards were back in order, concealing the centerfold. We waited anxiously for stern Dr. Lovejoy to appear and be surprised. Not missing a beat, dour Dr. Lovejoy strode in and tossed the center board up with flare, revealing the centerfold and giving shocked students a big "Gotcha!"

During an organic chemistry lab, I knocked over a beaker of ethanol which was ignited by a Bunsen burner. As two graduate teaching assistants struggled to lift the large fire extinguisher, Dr. Young calmly inverted a large beaker over the blaze, averting catastrophe.

Chandler's thick walls were filled with sand as fire retardant. Wise researches constructed tents over long term experiments as protection from the fallout of crumbling walls and ceilings. The hoods, ceilings and walls were splattered with evidence of experiments gone awry.

Dr. Fred Fowkes chaired the department with wisdom.

Administrative assistant Ms. Dawn Kressler strutted around the office, frequently announcing "We run a tight ship!"

Dr. James Sturm and Dr. Daniel Zeroka coached students through seemingly untenable physical chemistry with patience, persistence, and kindness.

Dr. Ned Heindel taught organic chemistry with flare. He was also a recognized expert in Lehigh Valley ghosts.

Dr. Young was always available and supportive.

The entire campus was wowed when Dr. Bob Rodgers, with sunglasses, long hair, and jeans, pulled into the parking lot in his red Lotus.

I was in awe when Dr. Lovejoy gave me a tour of his lab. We accessed the top floor via an outside metal staircase. Inside was the most impressive array of spectrometers, some of which he used to analyze signals from outer space.

Students gathered to study in a small conference room just off the front hall, sharing the CRC. Fellow classmates to be remembered include Judith Haneman for her infectious laugh and unending determination. Walter Lempert was genuine and freaky. Brilliant, he rarely took notes in class. During lectures, his only writings seemed to be scribbles of his own ideas expanding the topic at hand.

I earned a BS in Chemistry in 1975. During my senior year, under Dr. Ned Heindel, I synthesized mustard gas based organic chemicals proposed for cancer research.

I earned a MS in Chemistry in 1986, while working full time and having two children. Dr. Gary Simmons was my advisor. I studied backscattering factors in Auger spectroscopy.

I became a microscopist at Air Products and Chemicals. Decades earlier, I had seen my first electron microscope at Lehigh tour during a tour with my grade school Girl Scout troop. Amazing things happen.

I am retired.

My undergraduate degree was funded through need based scholarships, student loans, parent support, and summer jobs.

My graduate degree was funded by Air Products and Chemicals tuition reimbursement program.

Thank you Lehigh University Department of Chemistry! It has always been privilege for me a member of the Lehigh community.

# Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: Lawrence Casper

Degrees from Lehigh and Years for each: Ph. D. Chemistry,

Years Attended: 1974 - 1976

Fields of specialization: Physical / Analytical, Semiconductor processing (when at Honeywell Research, adv. materials

Dissertation mentor: Prof. Fred Fowkes

*Specific questions ---*

1. Who were the leading faculty in—
   a) Research — faculty at NPIRI / Sinclair labs
   b) Teaching
   c) Other
2. Estimate the number of grad students in your time 25
3. Did you mentor any undergraduates? Names? — No
4. How were you supported? TA 1 yr; RA 1 yr
5. Which professors had the largest research groups? — Zettlemoyer, Leidheiser.
6. What was your impression of the LU undergrads? — O.K.
7. What was your impression of the LU grad students? — Good
8. How well equipped (instrumentation) was the dept? Specific hardware? — Since lab had exceptional equipment and facilities, rest of Dept not so much
9. Why did you come to Lehigh?
10. Have you stayed in touch with others from your time? Names? Contacts?
11. Any remembrances you're willing to share:

I have not. Ran into Dan Dwyer who until recently was VP Research at U Montana in Missoula

The move from Chandler labs to Seeley-Mudd was a terrific change. I remember the old fume hood in Chandler raining rust particles on experiments!

Please e-return to <ndh0@lehigh.edu>

or mail to:

Mr. James E. Sturm
2239 Wassergass Rd
Hellertown, PA 18055-1211

RECEIVED
11-13-2014

(over)

November 6, 2014

Jim,

I enjoyed your letter wrt to Lehigh's Sesquicentennial.

I always remember you are from New Ulm, not far SW of Shakopee where our son and three our grandchildren live. Our daughter also lives in Minneapolis with the other two of our grandchildren. We spend a lot of time in the Twin Cities, about a 4 hour drive from Madison.

UW Madison has changed quite a bit, when I arrived in 1990 there had been little construction in years and probably looked pretty much the same as when you were there. But the last two decades have seen an enormous investment in new academic and research facilities, as well as private investment in new apartment and shopping/entertainment complexes surrounding the campus. Although Chemistry was in a different college I had many fruitful interactions with chemistry faculty over the years

As you may know, your Provost Pat Farrell came from the UW College of Engineering, I always thought that Lehigh attracted some great talent with Pat, and under the leadership of chemist Alice Gast you had quite a leadership team. I look forward to hearing who will lead Lehigh next.

The chancellor named me emeritus assistant dean last year when I retired after almost a quarter century at UW-Madison. My wife and I have been building a retirement cabin in the Rocky Mountains south of Glacier National Park, where we have started doing "citizen science" (this summer, surveys of the Common Loon). Our cabin is in the town of Seeley Lake, a lumber mill town in just west of the continental divide. Four decades ago I was in Seeley Mudd, today I am in Seeley mud.

Regards,

Lawrence (Larry) Casper
Emeritus Assistant Dean for Research
University of Wisconsin

122 Pyramid Loop
Seeley Lake, MT
&
7679 Westman Rd.
Middleton, WI

Larry

# Remembrances of Gary Calabrese (B.S. 1979)

11945 Jolley Way
Corning, NY 14830
December 3, 2014

James Sturm
2239 Wassergass Rd.
Hellertown, PA 18055

Jim,

So good to hear from you. Time does fly. First of all, I can forgive you for teaching at Lafayette if and only if you did not root for their football team when they played Lehigh. If you did, I can still forgive you anyway because you are helping do this interesting project for the department!

Also, I remember well taking a graduate level class in P-chem from you my senior year just to get better prepped for MIT. I can say the Lehigh undergraduate program prepared me well. I had no problems keeping up with all the "smart" kids from fancy schools like Harvard, Yale and elsewhere.

Now on to your questions...

B.S. Chemistry, 1979 (Lehigh) – attended 1975-1979 (yes, just 4 years)
Ph.D. Inorganic Chemistry, 1983 (MIT) – attended 1979-1983
Fields of specialization: Ph.D. was inorganic chemistry. Did organic and inorganic synthesis, surface functionalization, electrochemistry, and photochemistry at surfaces.
Dissertation mentor at MIT was Mark Wrighton, who gave a lecture at Lehigh in 1978 and interviewed me in Kraihanzel's office. I gave a chalk talk on Kraihanzel's board on the work I was doing trying to make some novel phosphine ligands. I applied to MIT and got accepted within 2 weeks of my application.

**Leading faculty at the time**
Research: If measured by publication output, Ned H. was the king at the time, competing with Zettlemoyer over in the EPI.
Teaching: My favorites: You, Schray, Ned, and Kraihanzel. They taught chemistry with humor, which made me learn it better.
**My guess on grad student population:** 10-15
**Undergraduate mentoring:** Several through campus tutoring program. I cannot remember names, but most of my tutoring was for freshman chemistry, calculus and physics.
**Largest research groups:** Ned H. and Schaffer.
**My impression of undergrads:** Solid.
**My impression of grad students:** They did not seem as sharp as us undergrads, at least in the couple classes I took with them, but they seemed to work hard in the lab.

**Quality of lab equipment:** Seemed OK to me for the undergraduate mission. Research equipment (NMR, mass spec., etc) seemed to match the needs of the faculty. Much better than liberal arts schools, but short of high-powered research universities.

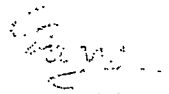
**My reason for coming to Lehigh:** Wanted a solid science & engineering oriented school not too far from my roots in NJ. I liked the campus and heard good things about the school. Most importantly, I knew graduates were getting good jobs!

**Have I stayed in touch with people from my time at Lehigh?** Sadly, not very much. Have been back once to give a departmental lecture around 2009 (organized by Klier) and got to see Schray, Kraihanzel and Zeroka then which was very nice.

**Memories:** Many humorous stories about organic molecules from Ned, including brominated compounds. Kraihanzel tucking his tie in and getting down and dirty in advanced undergrad lab with the students to get their reactions "cranking". Schray teaching about free radical chemistry and telling people to think of electrons as people. Having an ether fire in a hood in Kraihanzel's lab, putting it out quickly and having Kraihanzel walk in and just miss seeing it. Suspicious, he asked if anything was going on and I just said, "nope, everything is fine." Walking into Lovejoy's office to tell him I found an error in the Daniels and Alberty P-chem book that cost me hours in trying to solve a problem and him telling me, "you might be right, but I am sure they have bigger fish to fry than to worry about that." Zeroka's pseudo-derivation of the Schroedinger equation, which I thought was the neatest thing since sliced bread at the time. Listening to Perry Blazewicz (B.S. Chemistry, 1979) do outstanding impersonations of Lovejoy, Sprague, Kraihanzel, Klier and Ohnesorge, as well as some non-chemistry department professors. Sitting in the reading room which I believe was just outside of Ned's office and reading *Accounts of Chemical Research* and having Scray come up to me and say something like, "wow, and undergraduate reading *Accounts of Chemical Research*? Very impressive."

Well, that's about all I have. Hope this helps you in your project.

Best regards,



Gary Calabrese

# Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: John Texter

Degrees from Lehigh and Years for each: BSEE (1971), MS (1973, Chemsitry), MS (1976, Mathematics), PhD (1976, Chemistry)

Years Attended: 1967-1976

Fields of specialization: Electrical Engineering, Chemistry, Mathematics

Dissertation mentor: (PhD) Kamil Klier

*Specific questions* ---

1. Who were the leading faculty in—
    a) Research – I think it is hard to rank professors for their research; all of the regular chemistry dept professors did some research; assistant professors got the boot if they didn't do enough. The professors in Sinclair and Professor Manson in Cox Laboratory all did a lot of research because their appointments depended on it. Professors Klier and Simmons probably published the most out of that bunch. Fred Fowkes came in as Department Head, replacing Ed Amstutz, the year before I started as a grad student or the year of (1971).
    b) Teaching – As I remember all of the tenured and non-tenured professors taught courses if their appointments were in the Chemistry Department, and I do not recall anyone have a bad reputation as a teacher. Bob Sprague (Pop Sprague we used to call him behind his back) was perhaps the most widely beloved chemistry professor on campus, because he taught all of the freshman in the engineering college.
    c) Other – I spent many an enjoyable early evening at the Tally-Ho! Drinking beer with Bill Ohnesorge and various students and professors.

2. Estimate the number of grad students in your time: ~ 20?
3. Did you mentor any undergraduates? No
4. How were you supported? TA, Horner Fellowship, Buch Fellowship
5. Which professors had the largest research groups? Klier and Heindel
6. What was your impression of the LU undergrads? Fun loving nerds
7. What was your impression of the LU grad students? Nerds without fun
8. How well equipped (instrumentation) was the dept? Specific hardware? Very well equipped in some areas; not equipped in other areas. The NMR was low frequency, but typical for the times; mass spec – forget ti, but Sturm would help all he could; the Cary 14 was digitized and one could generate reels of paper punched tape when studying overtone line widths.
9. Why did you come to Lehigh? I was inspired by John J Karakash, and Lehigh gave me a Merit Scholarship that covered my undergraduate tuition.
10. Have you stayed in touch with others from your time? I have stayed in touch with Richard Kellerman, who after getting his PhD with Henry Leidheiser, postdoc'd with Kamil Kiier. Richard went to work for Xerox research in Webster, NY, than started Nielsen-Kellerman with Paul Nielsen (also from Xerox). The company moved to Chester, PA, and they sold the business a few years ago, so he and Elsie are retired.
11. Any remembrances you're willing to share:

Joe Nunzio ran the chemistry stockroom, and his office was a great place to congregate to waste time jawboning with fellow students and the occasional professor. Chuck Krahaenzl brought some nitrogen triiodide to class one morning (I had to take Chem302 because I did not major in chemistry and I had not taken inorganic chemistry) and placd it on the outer window ledge of the middle window of the classroom in Chandler, 2$^{nd}$ floor, opposite Nunzio's office. He tried to detonate the NI3 when class ended; he was using his car aerial type pointer, and everyone was tightly gathered around him, leaving an approximately 4-5 foot hemi-circle free of students around the inside of the window. He could not detonate the samples, so we all left and went to our next class. In late afternoon I remembered the samples, and I asked Joe Nunzio if I could borrow a push broom. He gave me one, and holding the broom handle just above the brush, and

standing on one of the seats (all bolted into the floor) as far away as I could, I proceeded to whack the biggest piece of NI3 still on the ledge. I whacked (nothing), then whacked again and KABOOOOOOOOOM!!! There was this thunderous sound and a cloud of purple smoke. I walked out with the broom being thankful to be alive, and watched Jim Sturm come running through the swinging doors separating the hallway along his office from the main stairwell area on the second floor wondering what had just happened. If we had gotten a similar explosion when Chuck tried whacking when it was too wet, I am sure broken bones would have come out of that classroom, because I have seen rooms empty of men in a fraction of a second given such a motivation! I think we got everyone out of their offices for a while, as word was passed that no one was hurt and that there was no damage. Anyway, this is the most outrageous thing that I will admit to in writing. Anything more incriminating will require my being plied with 18 year old scotch.

Perhaps not so exciting, I remember that Tom Young, our senior organic professor at the time, had a fairly high level of patience. He was lecturing in a small classroom in the back hallway of Chandler, second floor, and three-five of us grad students were "chatting" in the hallway. Tom came out into the hallway, and looked at us, and said, "I can't hear myself think!" He got his message across, and we respectfully dispersed.

I remember at one Chem Department Christmas party the students made a good joke at the expense of an untenured analytical assistant professor. During the festivities, one student remarked that they understood Professor X had just finished his first paper (as in publishing one from Lehigh); quickly, another student chimes in: "I understand he is going to start reading his second soon." It gave all of us a big belly laugh, and Professor X was present and took the joke very good naturedly.

I wish I could remember something embarrassing to say about Danny Zeroka, but I just cannot! Jim Sturm is one of the nicest and most agreeable people I have had the pleasure of knowing, and one day I dropped into his office to complain about how he had scored a qualifying question I had messed up.

After making my case he exuded empathy without giving in an inch, but proceeded to listen to my argumentation for over an hour, until I had no steam left and departed, having gotten everything I felt and could invent off of my chest. I then learned that the group of students standing outside his office and peering in, were the students he was supposed to have been teaching shortly after I first entered his office. I think one could say Jim Sturm is distractable!

Perhaps I high point of my graduate physical chemistry education was when we were taking a required physical chemistry course from Roland Lovejoy in a classroom way back in Chandler, that is in the section just south of the freshman chemistry lab on the second floor of the east wing of Chandler, also where he and Danny Zeroka had their offices. Roland explained to us one day that Gerhard Herzberg was married to an infrared spectroscopist, and Roland mentioned "you can imagine what they talked about over breakfast." One of the students quipped: "Good morning Gerhard, how's your rigid rotor"? Well, even Roland Lovejoy turned purple in the face over that one, and it is safe to say that levity was not an everyday occurrence in Roland's lectures. I think Glen Zoski could confirm that this actually happened.

I wish everyone a happy 150$^{th}$ anniversary!

Please e-return to <dz00@lehigh.edu>

# Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: Thomas B Garrett

Degrees from Lehigh and Years for each: PhD 1970

Years Attended: 1966 - 1970

Fields of specialization: Physical Chemistry

Dissertation mentor: Prof. Daniel Zeroka

*Specific questions* ---

1. Who were the leading faculty in—
    a) Research
    b) Teaching
    c) Other
2. Estimate the number of grad students in your time __10 in P Chem__
3. Did you mentor any undergraduates? None
4. How were you supported? Teaching assistantship and Fellowship (Roy Horner Fellowship??)
5. Which professors had the largest research groups? Professors Zettlemoyer and Heindel, as best I remember
6. What was your impression of the LU undergrads? Bright. Asked a lot of questions.
7. What was your impression of the LU grad students? Most seemed serious about their work and weren't just extending their stay in college.
8. How well equipped (instrumentation) was the dept? Specific hardware? Most of my work was done with paper, pencil, and computer. Access to the latter was very good, for its time.
9. Why did you come to Lehigh? Faculty reputation, alumnus encouragement
10. Have you stayed in touch with others from your time? No

11. Any remembrances you're willing to share: In general, the overall helpfulness and approachability of the chemistry and physics faculty is something that I recall.

Please e-return to <dz00@lehigh.edu>

# Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: Stephen Benkovic

Degrees from Lehigh and Years for each:BS Chem/AB Engl Lit

Years Attended:1955/1960

Fields of specialization: Physical Chemistry/Biochemistry

Dissertation mentor:Jerome Daen

*Specific questions* ---

1. Who were the leading faculty in—
    a) Research
    b) Teaching Amstutz,Young, Daen, Surfass,
    c) Other
2. Estimate the number of grad students in your time ____Not in the graduate program, had little or no contact..
3. Did you mentor any undergraduates? Names?
4. How were you supported?
5. Which professors had the largest research groups?
6. What was your impression of the LU undergrads? Very Good
7. What was your impression of the LU grad students?
8. How well equipped (instrumentation) was the dept? Specific hardware? Good
9. Why did you come to Lehigh? For Chem Eng
10. Have you stayed in touch with others from your time? Names? Contacts?
11. Any remembrances you're willing to share:
12. My first graduate student Keith Schray became a Professor at Lehigh..

# Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: Joel M. Ressner

Degrees from Lehigh and Years for each: BS 1971

PhD 1978

Years Attended: 1967 – 1971; 1972 - 1978

Fields of specialization: Organometallic Chemistry

Dissertation mentor: CSK

*Specific questions* ---

1. Who were the leading faculty in—
    a) Research – Ned Heindel and the researchers in the Printing Ink Institute, which was located in the basement of the Ullman wing at the time.
    b) Teaching - CSK, Ned Heindel, Bill Ohnesorge
    c) Other
2. Estimate the number of grad students in your time _30___
3. Did you mentor any undergraduates? Names? Several, but I can't remember their names. My memory is really slipping. The name Rich Davenport sticks in my mind, however.
4. How were you supported? I was supported as a TA during my first year as a grad student, and through a combination of a fellowship and part-time TA work during the rest of my grad student career. I also worked part time at Northampton Area Community College and at Lafayette.
5. Which professors had the largest research groups? If you exclude the "Inkies", I seem to remember that Ned had a larger research group than anyone else in the early 1970's.
6. What was your impression of the LU undergrads? Go-getters, mostly, although there were a large contingent (mostly in the frats) who came to

Lehigh for the beer and the fun. Many of the guys (it was all male then) who started in the Class of 1971 did not last to graduation).

7. What was your impression of the LU grad students? Some were excellent, some were marginal. Some of those employed as TA's did not want to be in front of a class and let you know it. There is some irony here: Dana Guyresek (I've probably misspelled her name) hated my guts and told me that I'd NEVER be a chemist; she did not make it to the PhD program whereas I did and have carved out a pretty nice career here at WCU.
8. How well equipped (instrumentation) was the dept? Specific hardware? Lehigh was very poorly equipped in those days; for example, the ONE GC that we had available for analytical lab was not functioning, and thus I never experienced GC until I was working for my master's degree in England. The 60 MHz nmr (the department's only nmr) had a probe that was epoxied together by CSK because Lehigh's chemistry department could not afford the cost of repairs. Much of the equipment we did have was second rate during my undergraduate years; this improved during my graduate years at Lehigh. I particularly remember some of the truly ancient equipment in Dr. Lovejoy's lab – I think (but I'm not sure) that he had a Raman instrument that ran on a mercury lamp – laser Raman hadn't been invented yet. We had a double-beam infrared instrument that had to have the chart drive gears changed if you wanted to expand a region of the spectrum. I have to say that when I bring my students to look at Lehigh as a potential grad school and we take the tour I am particularly impressed not only by how "instrument-rich" the department has become but by a willingness to maintain the instruments and the environment – house nitrogen (dry), for example, would have been useful for maintaining instruments during a humid summer.
9. Why did you come to Lehigh? There were several reasons that I chose Lehigh for my BS over other schools – first and foremost is that my parents put a geographical limitation on the distance they would allow me to go away from home to attend college. Within that distance Lehigh's BS chemistry program stood out as well structured. Another factor was that

unlike many institutions in the late 1960's, Lehigh did not have compulsory worship attendance.

During my master's career overseas I found out that many of Lehigh's faculty were well regarded by the faculty at the University of Sussex; that fact, plus my familiarity with the University, faculty, and environment lead me to come back to Lehigh for my PhD.

10. Have you stayed in touch with others from your time? Names? Contacts?

My classmate, John Waud (BS 71) went to Penn for his master's degree and, like me, came back to Lehigh for his PhD (in clinical chemistry). John recently retired from the Rochester Institute of Technology.

11. Any remembrances you're willing to share:

Lots of late nights in the Mart Library.

Keith Schray instituting the "Mutual of Organic Insurance Company" to pool funds to replace broken organic lab equipment. Keith arrived at Lehigh un my junior year, I seem to remember, so I never got the "insurance policy". "Mutual of Organic" went out of business pretty rapidly.

Teaching "Advanced Chemical Experimentation" with CSK – the lab was open all day, 5 days a week, while students came and went to work on their projects (most of which were organometallic preps). This was an excellent experience for the students and an excellent experience for me, giving me a pretty good look at what a faculty member had to do to successfully conduct an advanced lab or a research project. I also gained experience in some arcane procedures, such as running reactions in anhydrous liquid nitrogen, which have been useful in both my research and teaching here at West Chester University.

Sharing a lab with Charlie Bartish, who was finishing up his PhD with CSK, in the "new" (Ullman) wing of Chandler.

I have great memories of the Christmas banquets and the skits the chem majors did satirizing the faculty and Lehigh in general. My senior year we made a film, which I think Tom Ortolano took with him when he left.

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# Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: Charles M. Bartish

Degrees from Lehigh and Years for each: PhD in 1973

Years Attended: 1969 -- 1973

Fields of specialization: Inorganic / organometallic chemistry

Dissertation mentor: Charles S. Kraihanzel

*Specific questions* ---

1. Who were the leading faculty in—
    a) Research Fowkes, Klier, Heindel, Kraihanzel, Zettlemoyer
    b) Teaching Sprague, Heindel, Kraihanzel
    c) Other
2. Estimate the number of grad students in your time. I recall about 10 new students each year, with about 35 or so total
3. Did you mentor any undergraduates? Names? None
4. How were you supported? I had an NSF fellowship as primary support with a part time teaching assistance ship
5. Which professors had the largest research groups? Fowkes, Heindel, Zettlemoyer
6. What was your impression of the LU undergrads? The undergrads were generally a very sharp group of students. They provided ongoing stimulation in recitation classes and performed well in several shared graduate / undergraduate classes.
7. What was your impression of the LU grad students? We had a tri-modal distribution of students. The top 10% were very good and went on to first class professional jobs, mostly in industry. However, there were more than a few guys who lingered on for six to eight years and detracted from the overall reputation of the department.

8. How well equipped (instrumentation) was the dept? Specific hardware? Our NMR, mass spectroscopy, and computing facilities were state of the art. After tutoring from Kraihanzel and Sturm, we had free run and use of the equipment and often ran experiments late at night under specialized conditions. Of course, the "price tag" was to provide some basic maintenance and training for new grad students and advanced undergrads. I needed advanced infrared spectroscopy capability and was able to connect with Bethlehem Steel's Homer labs to use their facilities.
9. Why did you come to Lehigh? Lehigh was on my short graduate school list partially because of the time. I am a Lehigh Valley native, it was 1969, I was to marry that year, and the Vietnam War was an issue. There were advantages to staying close to home. When I interviewed at Lehigh prior to graduation from Villanova, I recall vividly my discussions with Kraihanzel. As a result of that discussion I decided I wanted to work with him. I started research with him the beginning of my second semester.
10. Have you stayed in touch with others from your time? Names? Contacts? We stay in touch with John Conville and Jim Davis.
11. Any remembrances you're willing to share:

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# Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: *Abigail Oelker*

Degrees from Lehigh and Years for each: *B.S. Chemical Engineering (2003)*

Years Attended: *1998-2003*

Fields of specialization: *Chemical Engineering, minor in Russian*

Dissertation mentor:

*Specific questions ---*

1. Who were the leading faculty in—
    a) Research: *Prof Messmer*
    b) Teaching: *Prof Schray, Prof Foster, Dr. Berk*
    c) Other: *I would like to propose the following categories and awardees: most entertaining professor to work for - Prof Klier; best pchem lab professor - Prof Zeroka; best dancer - Prof Heindel.*
2. Estimate the number of grad students in your time *25?*
3. Did you mentor any undergraduates? Names?
4. How were you supported? *Govt grants, federal + private loans, federal work study, Thomas R. Komline scholarship*
5. Which professors had the largest research groups?
6. What was your impression of the LU undergrads?
7. What was your impression of the LU grad students?
8. How well equipped (instrumentation) was the dept? Specific hardware?
9. Why did you come to Lehigh? *It seemed like a good idea at the time. Fortunately, it was.*
10. Have you stayed in touch with others from your time? Names? Contacts? *Linda Sung (formerly Wu), Sarah Muse, Jeremy Eberhardt, Nicholas Castle, Daniell Rowles, Heather Thomson*
11. Any remembrances you're willing to share:

*My favorite Lehigh Chemistry memories typically involve AXE, the chemistry fraternity, and especially Gamma Omicron, the Lehigh AXE chapter I helped found with friends. My AXE brothers and I spent many hours planning service and social events and meeting brothers from chapters across the US with our trusted faculty advisor, Prof Schray, often by our sides.*

*Lehigh Chemistry made such a good impression on me that I went on to get a Ph.D. in chemistry. This is partially thanks to Prof Klier, who gave me a research job between college and grad school. This job was about 40% research and 60% chatting with Prof Klier about every topic under the sun. Another main driver in my decision to go to grad school for chemistry was Prof Zeroka's pchem lab - I really enjoyed the experiments and lab reports. I always use the experimental design, logical reasoning, and technical writing skills gained from pchem lab and other Lehigh Chemistry classes in my everyday work.*

*I still have keys to Mudd - you should probably change the locks if you haven't already!*

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# Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: Melissa Kistler Langston

Degrees from Lehigh and Years for each: 2006 – MS, 2009 - PhD

Years Attended: 2004-2009

Fields of specialization: Analytical

Dissertation mentor: Dr. Tianbo Liu

*Specific questions* ---

1. Who were the leading faculty in—
    a) Research – Drs. Flowers, Liu, Heindel, Regen, Koel, Klier
    b) Teaching – Drs. Schray, Roberts, Zeroka, Miller, Berk, Foster
    c) Other
2. Estimate the number of grad students in your time _20___
3. Did you mentor any undergraduates? Names? Yes – Anish Bhatt, Komal Patel
4. How were you supported? TA, RA, Morrison Fellowship
5. Which professors had the largest research groups? Flowers, Regen
6. What was your impression of the LU undergrads?
   Undergrads were kind and respectful. The undergrads that I mentored were hard working and very helpful.
7. What was your impression of the LU grad students?
   Hardworking, dedicated, overall an eclectic group
8. How well equipped (instrumentation) was the dept? Specific hardware?
   Well equipped. I spent the majority of my time working with the Laser Light Scattering Spectrophotometer for dynamic light scattering and static light scattering studies of my samples.
9. Why did you come to Lehigh?

In 2003, I inherited a house in Kutztown. Lehigh was the closest school to offer a PhD in chemistry. Fortunately, the campus was beautiful and the chemistry department was outstanding.

10. Have you stayed in touch with others from your time? Names? Contacts?

    Paul Rearden
    Jimmy Devery
    Joe Teprovich
    Danielle Ringhoff
    Cecilia Giovarelli
    Ryan Fealy

11. Any remembrances you're willing to share:

    During my first summer at Lehigh, the second floor hallway of the Sinclair Building was painted. I left the lab on the second floor to go to the department office in Mudd. As I walked through the courtyard between Mudd and Sinclair, I saw the painters were on their break. I entered Sinclair and climbed the stairs to the second floor. As I opened the door to the hallway I saw a giant puddle of water on the floor and the two post-docs in group laughing like little school girls outside of room 210. They pointed to the emergency shower overhead and asked me if I knew what is was. I said "That's the emergency shower. Its for emergencies," noting that they were both dry and not in need of the shower. I stepped over the puddle that was now running down the hallway and went to my desk. To clean up the water, the post-docs took the painters' drop cloths. When the painters returned from break there was some very creative language that could be heard from the hallway and anyone walking through the hallway was questioned as to how their cloths got wet.

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## Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: Richard Kellerman

Degrees from Lehigh and Years for each: PhD 1971

Years Attended: 1967 - 72

RECEIVED
06-18-2014

Fields of specialization: P. CHEM. SURFACES

Dissertation mentor: ~~KAH~~ HENRY LEDHEISER

*Specific questions ---*

1. Who were the leading faculty in—
   a) Research KAMIL KLIER
   b) Teaching " "
   c) Other
2. Estimate the number of grad students in your time 10
3. Did you mentor any undergraduates? Names? NO
4. How were you supported? R.A,
5. Which professors had the largest research groups? AL ZETTLEMOYER
6. What was your impression of the LU undergrads? PARALLEL UNIVERSE
7. What was your impression of the LU grad students? ECLECTIC
8. How well equipped (instrumentation) was the dept? Specific hardware? MARGINAL
9. Why did you come to Lehigh? UK CONTACT WITH AL ZETTLEMOYER
10. Have you stayed in touch with others from your time? Names? Contacts? JOHN TEXTER
11. Any remembrances you're willing to share:

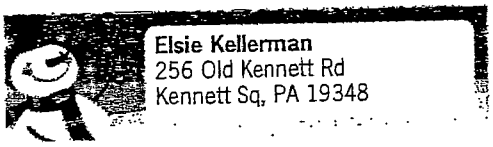
Notice outside Jim Sturm's office over sight:
"Close Easily - David Faucet"
Utter a complete failure to comprehend Stat. Mech. Now regret this.

Please e-return to <dz00@lehigh.edu>

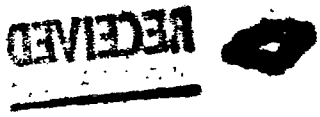
Say Hi to Jim!

Rich

(over)
for address



**Elsie Kellerman**
256 Old Kennett Rd
Kennett Sq, PA 19348



# Questionnaire for Lehigh Chem Dept's 150th Anniversary

Name: Dennis W. Hess

Degrees from Lehigh and Years for each: M.S., 1970; Ph.D., 1973

Years Attended: 1968-1973

Fields of specialization: Physical Chemistry (spectroscopy, solid state materials)

Dissertation mentor: M.S., Roland Lovejoy; Ph.D., Fred Fowkes

*Specific questions* ---

1. Who were the leading faculty in—
    a) Research: Fowkes, Heindel, Klier Leidheiser, Zettlemoyer
    b) Teaching: Heindel, Kraihanzel, Sprague, Zeroka
    c) Other
2. Estimate the number of grad students in your time __70__
3. Did you mentor any undergraduates? Names? No
4. How were you supported? Initially TA; subsequently NSF grant
5. Which professors had the largest research groups? Zettlemoyer, Leidheiser
6. What was your impression of the LU undergrads? Capable, motivated
7. What was your impression of the LU grad students? Capable, motivated; most from local geographical area (within 150 miles radius)
8. How well equipped (instrumentation) was the dept? Specific hardware? Department not particularly well-equipped, although there was new instrumentation that arrived during my time there (XPS). Despite the moderate availability in Chemistry, most facilities that I needed existed around campus and were accessible.
9. Why did you come to Lehigh? I wanted to stay in the vicinity of where I grew-up, and Lehigh had a good chemistry department, especially in physical chemistry.

10. Have you stayed in touch with others from your time? Names? Contacts?

    No

11. Any remembrances you're willing to share:

Please e-return to <dz00@lehigh.edu>

RICHARD MILLER
1316 EAST SHORE DRIVE
ITHACA, NY 14850

Telephone & Facsimile: 607 277-0250
e-mail: millerr@cortland.edu

March 21, 2015

Prof. (Emeritus) James E. Sturm
2239 Wassergass Rd.
Hellertown, PA 18055

Dear Jim,

I was surprised and delighted to see your name in the return address spot on your envelope. Did you get my address from Peter Jeffers? The gap in time for my reply is because your letter was forwarded to me in the Virgin Islands, our winter escape. It is good to hear from you. I haven't heard a peep from Lehigh U., not an alumni note, an announcement of anything or even a request for money since my graduation ceremony in the Fall of 1964. I guess that they consider former grad students as ex-employees, not alumni. I have been back from time to time, most recently for the Bach Festival two years ago. The place looked pretty lush and prosperous.

Things have been going well for me. When we retired, my wife and I built a house in Ithaca, a move to the big city, on Cayuga Lake. Ithaca is rated among the top college towns and retirement spots in lots of publications and although we like it a lot we escape winters (the last two have been brutal) in St.. John in the US Virgin Islands.

Your questionnaire is included. If any results are published concerning the Chemistry Dept. I'd love to get a copy.

Sincerely,

Dick Miller

Dick Miller

**Questionaire for Lehigh Chem Dept's 150th Anniversary**

Name: Richard Miller

Degrees from Lehigh and Years for each: Ph.D 1964

Years Attended: Sept '59 to 1964

Fields of specialization: Physical chemistry

Dissertation mentor: Jerry Daen

Specific questions ---

1. Who were the leadin faculty in ---
   a) Research – J. Daen had the most interesting problems
   b) Teaching – Profs Daen, Sprague, Diefenderfer
   c) Other – Bob Sprague was an inspiration that led me to college teaching
2. Estimate the number of grad students in your time 65
3. Did you mentor any undergraduates? Names? no
4. How were you supported? Teaching Assistantships, Union Carbide fellows
5. Which professors had the largest research groups? Zettlemoyer
6. What was your impression of the LU undergrads?
   Smart aggressive. If they thought a T.A. was hesitant or unknowledgeable, they would pile on. I thought it was fun.
7. What was your impression of the LU grad students?
   In general, pretty good, from a range of undergrad program
8. How well equipped (instrumentation) was the Dept.? I really don't remember With the exception of 2 oscilloscopes, I put together what I needed
   Specific hardware?
   I got everything I needed.
9. Why did you come to Lehigh? 1. reputation in Science & engineering
   2. They accepted me.
   3. my undergrad advisors said "we never sent anyone there; try it & let us know.
   4. When I first saw South Bethlehem (& smelled the steel mill) I almost went home & to RPI

I built an automatically recording analytical balance as part of a surface film pressure-area apparatus and learned a lot about practical electronics and about equipment design and construction in general. I was introduced to glassblowing in a P-chem lab, and have used (and taught!) it ever since.

DR. RICHARD MILLER
1316 EAST SHORE DR.
ITHACA, NY 14850

**Questionaire for Lehigh Chem Dept's 150th Anniversary**

Name: ARTHUR ERNEST WALTHING

Degrees from Lehigh and Years for each: BA 1959

Years Attended: 1955 - 1959

Fields of specialization: ANALYTICAL + RADIATION

Dissertation mentor:

Specific questions --- FOR MASTER'S RESEARCH JAMES STURM

1. Who were the leadin faculty in ---
   a) Research –
   b) Teaching –
   c) Other –

2. Estimate the number of grad students in your time
3. Did you mentor any undergraduates? Names?

4. How were you supported?
5. Which professors had the largest research groups?
6. What was your impression of the LU undergrads?

7. What was your impression of the LU grad students?

8. How well equipped (instrumentation) was the Dept.?

   Specific hardware?

9. Why did you come to Lehigh?

SUGGESTED BY ONE OF MY FATHER'S ASSOCIATES WHO WAS AN ALUMNUS

**Reminiscences of James P. Chovan (PhD 1980)**

Name: James P. Chovan

Degrees from Lehigh and Years for each: MS/Chemistry 1977
PhD Biochemistry 1980

Years Attended: 1975-80

Fields of specialization: Biochemistry

Dissertation mentor: Stephen Schaffer

1. Who were the leading faculty in—
    a) Research N. Heindel, S. Schaffer, K. Schray
    b) Teaching N. Heindel, S. Schaffer, K. Schray, J. Merkel, R. Sprague
    c) Others J. Sturm, T. Young
2. Estimate the number of grad students in your time _30___
3. Did you mentor any undergraduates? Names? No
4. How were you supported? TA and then RA
5. Which professors had the largest research groups? N. Heindel, S. Schaffer, K. Schray
6. What was your impression of the LU undergrads? Generally good
7. What was your impression of the LU grad students? Generally good
8. How well equipped (instrumentation) was the dept? Specific hardware? Adequate but could have been more current
9. Why did you come to Lehigh?
   Lehigh had the courses and, eventually, research that interested me.
10. Have you stayed in touch with others from your time? Names? Contacts?
    No contacts except for professors S. Schaffer, N. Heindel, and K. Schray, and a fellow grad student, Jay Kramer (10132 Community Lane, Fairfax Station, VA 22039-2529
11. Any remembrances you're willing to share: Overnight naps in the break room for long studies; frequent visits to the hoagie shop on 4th Street

Dr. Charles L. Cronan
4239 N. Larkin St.
Shorewood, WI 53211-1558

James Sturm
2239 Wassergass Road
Hellertown, PA 18055

Jan 5, 2015

Hi Jim,

The book, "Sturm's Reflections" is a very foggy memory, that was indeed many years ago. The book is displayed, now, on a web site, page by page. What is interesting is the P Chem on page 184, "MAY XXVI, THE ATTRACTIVE POWER OF BODIES" with a lecture on gravitation and surface chemistry (capillary rise). And this was back in 1807!!

I am retired but I have about 4 inventive ideas I have been working on.

a. Back in 1980, when we bought our house, it had a oil-fired boiler (hot water, radiator heat system) about 30 years old. I decided to monitor the energy consumption and now I have a working Building Heat Capacitometer. Calibrates your home or business physically measure the energy needed to maintain the temperature setting on your thermostat, based upon the outdoor temperature. Linear down to -20F in my application for winter. There is some confusion in summer for A/C because we have a home that is about 80% brick. If the sun is out in summer (not as much effect in winter) the bricks are heated and continue to heat the house even on a cool night. When we lived for a year in the UK (post doc) that was the heat system used in our flat: bricks heated overnight at a lower rate and heat emitted during the day. Anyway, this could be a great smartphone app, but I have no idea of how to market that. I could use the retirement funds, my primary IRA was destroyed in 2008/9 and never recovered. We are looking for a nice underpass on the interstate for an upcoming domicile.

b. I actually have a medical diagnostic that uses a surface tension device I invented. I got a patent for this, now public domain (everybody doing dynamic surface tension uses it). There was an excellent paper published showing the power of my device to study surfactants. I hired a chromatography scientist to help me in my Foam Scientist period. When he ran a separation of beer foam through an LC column, and collected 50 drops in each sample, I noticed that the volume in the tubes varied. The most minimum volume I guessed was the tube with ethanol, had it tested and it proved true. Great way to search for surfactants in a mixture if there is a means to separate the components. Most biologically active components are surface active because of the lock and key functionality. Beer foam is due to barley lipid transfer protein (denatured) enzyme which strongly reacts with hops for lasting foam.

The diagnostic is for Fetal Lung Maturity (detection of Respiratory Distress Syndrome, RDS) which I worked on during my retirement. Measuring amniotic fluid dynamic drop surface tension I can rank (real samples at the U. of Utah showed this) samples exactly as the current method ($200K) AND eliminate the False Positives, unborn children who are thought to have RDS if born tomorrow, but they are actually healthy. It was submitted to

NIH, I was encouraged to resubmit, and then my help dropped out (Dave Fairhurst) because his investors wanted them to get back to what they invested in. My method even only uses a $2K pump and I made one that uses no moving parts and fits in a drawer for remote or poor prenatal care.

I need a pulmonary neonatologist to help me – none will.

And the sensor was used in a biotech project to manufacture the anti-freeze-peptide of winter flounder by genetic engineering of yeast. This was done for Kraft.

c. How about a bottle of Glacial Gladiator, a super-cooled beer that when poured has 10%v/v slush ice. True – I am the only person in the world that knows how to super cool beer. And that will die with me. Ice Princess for women. No additives needed.


d. I also sold an Electronic Nose. Company was importing rice flour and occasionally a bag smelled bad. His employees tested this fine powder by sniffing. My tin oxide sensor worked. I have also now combined 4 sensors into one to determine what would be the best sensor to use for any application. Two for better discrimination.

More ideas not described. All will die with me, I fear.

I also worked with ESR for shelf life stability, a few original ideas there as well. Have a report on file by the North Carolina board that follows emissions, saving Miller's can plant. And another hot project that increased the production of bottles by 10% that Owens Brockway could not fix.

And then at about 22 years, Miller turned on me. The same thing happened to Tin Ho Chiu at Becton Dickenson. They moved him out to a hallway outside of a restroom. I was subject to not writing reports on imaginary projects, so I went to EEO complaint that was accepted by the State (only 10% are) but it never came to court – the Director of R&D quit, and my supervisor who managed 8 people was demoted - no people anymore.

This came after 20 years of service. I did my best work I think with ESR and discovered that one malting company was supplying malt that resulted in 10x the free radicals of its competitor. They then accused me of plagiarizing the report! I told them if they show me what I plagiarized I would quit, not retire (my lab books were filled with the data). And then they fired the malting company using my data, that they claimed was faked. I retired in 2002, and in 2008 I asked if I could publish the malt oxidation study – their attorneys jumped on me saying it was a trade secret and they would ruin me financially (happened that year anyway) if I breathed a word of it (the report they disbelieved). Those last 2 years were hell.

I have another story "How I almost blew up the Lehigh Sinclair Laboratories". My first project was to coat silica particles with the plastic explosive RDX in order to determine water adsorption properties for improved stability. This stuff was highly electrostatic. I had no safety training from Picatinny Arsenal on handling this stuff and was sent about 200g in a glass jar. There were two other explosives as well. About a month after I had been using it a rep from Picatinny Arsenal came to talk with me. We had lunch at the faculty cafeteria, and he asked me about sample handling. I explained that I weighed the samples out and mentioned that they were jumpy particles.
He: "How do you remove the sample from the container?"
Me: "With a spatula."
He: (a little concerned) "What kind of spatula?"
Me: "I have a metal spatula."
He: (jumping up and practically screaming) "What? You have to use a wooden spatula!"

That is how the Sinclair Laboratory was nearly destroyed (and at least one grad student torn apart) within 2 years of its opening. RDX is usually set off by electrical charges.

I have a daughter who is a microbiologist in Madison. She designs diagnostic kits for rare enzymes and proteins. Her company is competing for the Ebola diagnostic, but she is working on something else (they do NOT use the virus).

And we have a Grandson who will, be a year old later this month.

You can copy this to Dan Zeroka – he might be amused.

My career at Miller was great for the first 22 years. Lots of fun. Incidentally, I am one of 9 authors of a paper to be published about drop volume surface tension, this month I believe. The method from paragraph B above. No money, unfortunately.

I always loved your puns. I do that as well, and so does my daughter. She is amazed that she is sometimes the only listener that chuckles.

Chuck Cronan
4239 N Larkin St
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ccronan@mixcom.com

VirginiaTech
College of Science

James P. Wightman
Alumni Distinguished Professor Emeritus
1300 Westover Drive
Blacksburg, Virginia 24060
(540) 230-1268
wightman@vt.edu

March 17, 2015

Professor James E. Sturm
2239 Wassergass Rd
Hellertown PA 18055

Dear Jim,

What a surprise to receive your kind letter. We are both looking at 55 years since we first met at Lehigh. Where did the years go? I think I attended the Colloid Symposium at Lehigh in 1970 but I know I didn't give a paper. However, my students gave 4 papers at the 1980 Colloid Symposium at Lehigh. I'm pretty sure we talked briefly at either one or both of those meetings. In any case, I have missed your puns and laughs over the years. Your children were raised with no TV in the house! I have kept in touch with some of the students from the 1955-1960 period including Bob [now deceased] & Flo Walck; Sam & Peg Cozens; Bill Tyler; Al Laufer; Y. K. Lui; Luke Lin; Noubar Tcheurekdjian.

I have enclosed the questionnaire you sent. Thank you for your kind comments about myself. I cannot imagine a more satisfying career than teaching/research at Virginia Tech. I have enclosed a brief summary of my professional years. I retired in 2000 and was retained as a Visiting Professor for 4 more years helping fill some teaching spots. Then I packed up my office and moved home. I brought the 52 MS/PhD theses/dissertations home with me and after another 5 years, I took them to the recycle bin. I left with tears in my eyes.

Your interest in watches was also interesting to me especially your dad's RR watch and the watch with the LVRR logo on the dial. One of my former M.S. students from Rural Retreat VA [now living in San Francisco] is actively involved in restoring the railroad depot in Rural Retreat. His grandfather was the station master there. There are 2 B&W photographs of his grandfather, one waving a lantern at the Rural Retreat Depot, taken by O. Winston Link, a famous railroad B&W photographer of steam engines. The photographs are displayed in the OWL Museum in Roanoke VA.

You were "smack on" with knowing what the "P" in my name stands for. When the conversation turns to Charleston SC, people sometimes ask if I am related to the Pinckneys' of Charleston. My answer most times is "no" but as Paul Harvey often said , "and now for the rest of the story". My great-great-great grandfather came ashore in Charleston from England in about 1776 [nice time to come to America] and the next 2 generations of Wightmans were born in Charleston.

Juanita joins me in wishing blessings to you and your family.

Jim

jim wightman
1300 westover dr
blacksburg va 24060
540.750.9815 [cell]
540.230.7105 [Juanita cell]

**Questionaire for Lehigh Chem Dept's 150th Anniversary**

Name: James P. Wightman

Degrees from Lehigh and Years for each: M.S.-1958; Ph.D.-1960

Years Attended: 1955-1960

Fields of specialization: surface chemistry

Dissertation mentor: J.J. Chessick (A.C. Zettlemoyer)

Specific questions ---

1. Who were the leadin faculty in ---
   a) Research – A.C. Zettlemoyer
   b) Teaching – Bob West
   c) Other –
2. Estimate the number of grad students in your time 40
3. Did you mentor any undergraduates? Names? No
4. How were you supported? teaching assistantship/research assistantship
5. Which professors had the largest research groups? Zettlemoyer
6. What was your impression of the LU undergrads?

   well prepared

7. What was your impression of the LU grad students?

   diverse*/ hard workers /

8. How well equipped (instrumentation) was the Dept.? OK for my work

   Specific hardware? interferometer/calorimeter

9. Why did you come to Lehigh? Dr. Harvey Neville & Dr. Herman Collier (also a RMC ~~grad~~ alumnus)

Dr. Neville gave a talk at Randolph-Macon and encouraged me to apply to Lehigh U. Dr. Neville was himself an alumnus of Randolph-Macon College.

* men & women & international

## Biographical Sketch

## James P. Wightman

Dr. James P. (Jim) Wightman is Alumni Distinguished Professor Emeritus of Chemistry at Virginia Tech. A native of Ashland, Virginia he received his B. S. degree in chemistry from Randolph-Macon College and his Ph.D. degree in chemistry from Lehigh University. He was a postdoctoral associate at Penn State prior to coming to Virginia Tech in 1962. He was a visiting professor at the University of Bristol (U.K.) during the 1975-76 academic year. Dr. Wightman was named an Alumni Distinguished Professor at Virginia Tech in 1987.

He received the Wine Award for outstanding teaching at Virginia Tech in 1972 and a NASA Public Service Award in 1986 for contributions to adhesion science. He was the 1991 recipient of the ASTM D14 Adhesives Age Award and received a Distinguished Alumni Award from Randolph-Macon College. He was awarded the Adhesive and Sealant Council Award for 1993. He was named Virginia's Outstanding Scientist for 1994. He received the Sporn Award for teaching introductory subjects at Virginia Tech in 1995 and the Alan F. Clifford Faculty Service Award in chemistry in 1998. He was the recipient of the 2001 SCHEV Outstanding Faculty Award for the Commonwealth of Virginia. He is co-author of 161 technical publications in surface chemistry and adhesion science. He is a frequent speaker at Virginia Tech alumni chapters across the country.

March 2015

**Questionaire for Lehigh Chem Dept's 150th Anniversary**

Name: IRA M. BRIHN

Degrees from Lehigh and Years for each: M.S. 1965 (ATTENDED 1961-1965)

Years Attended: 1961 - 1965

Fields of specialization: RADIOCHEMISTRY (PHYSICAL CHEM.)

Dissertation mentor: PROF. JAMES STURM

Specific questions ---

1. Who were the leadin faculty in ---
   a) Research – A. C. ZETTLEMOYER
   b) Teaching – J. DAEN
   c) Other –

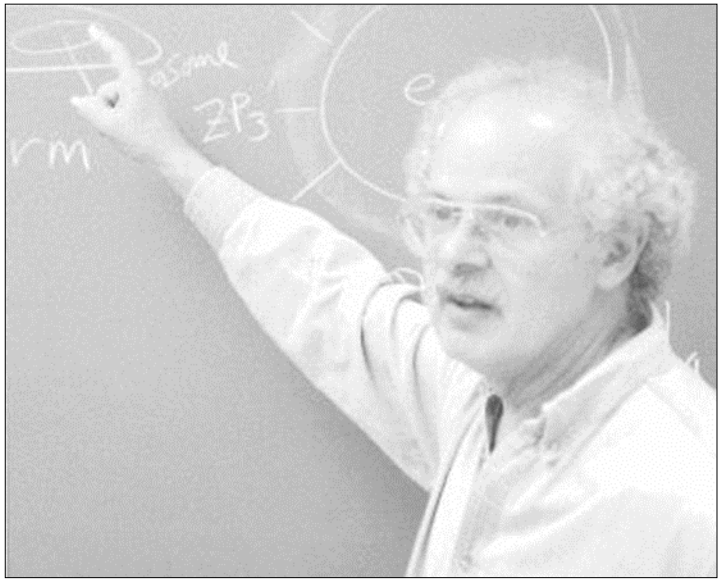
2. Estimate the number of grad students in your time ~30
3. Did you mentor any undergraduates? Names? NO
4. How were you supported? { FIRST YEAR: T ASST. / LATER: RES. ASST.
5. Which professors had the largest research groups? A.C. ZETTLEMOYER
6. What was your impression of the LU undergrads?
   GENERALLY POSITIVE
7. What was your impression of the LU grad students?
   - WIDE RANGE OF CAPACITY
   - GENERALLY FRIENDLY
8. How well equipped (instrumentation) was the Dept.? 50 YR. AGO, THERE WAS NOT A GREAT DEAL AVAILABLE ON THE MARKET. LEHIGH HAD "A BIT" MORE THAN MY UNDERGRAD SCHOOL (BUCKNELL) BUT LESS THAN U. PITT. OR COLUMBIA
   Specific hardware? I USED A G-M COUNTER BUT SCINT. COUNTERS WERE KNOWN
9. Why did you come to Lehigh? DON'T RECALL

10. I'VE KEPT IN TOUCH WITH LY OHNMACHT.

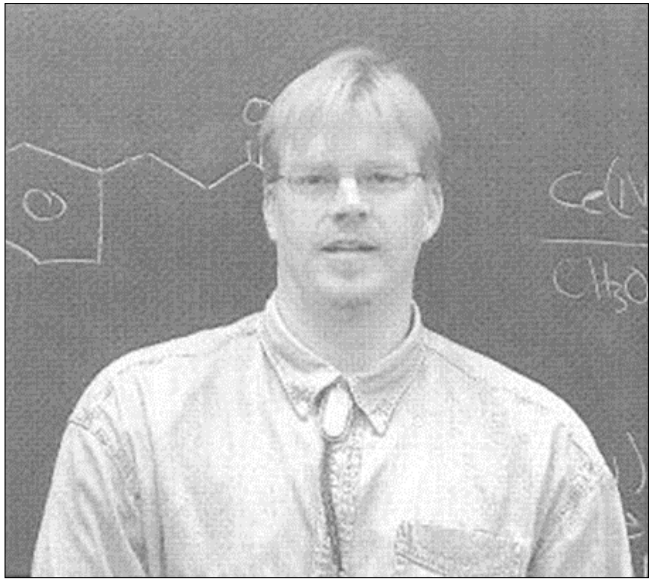
11. REMEMBRANCES: I WAS KICKED OUT OF PRD PROGRAM. WHY??? 

# 75-Years of Department History

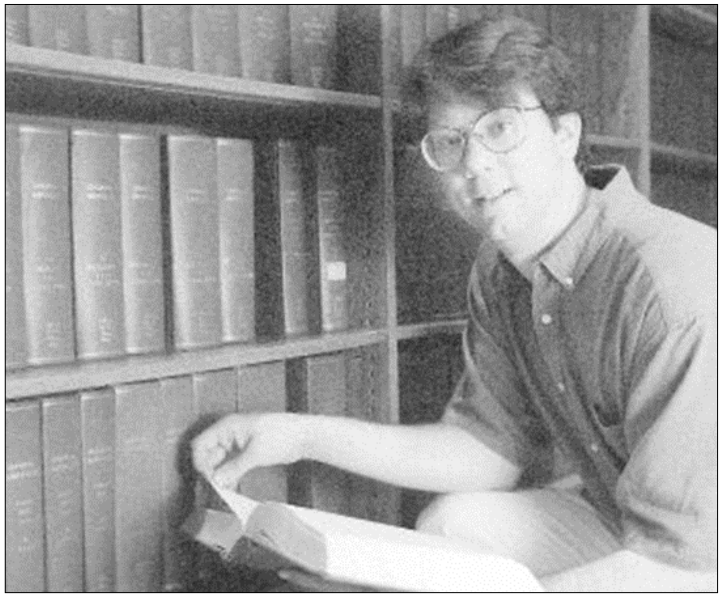
*Remembered in Photos of Faculty, Staff and Events.*



Professor Jack Alhadeff (1998)



Professor Robert Flowers (2007)



Professor Gregory Ferguson checks a reference in *Chemical Abstracts* before e-searching and SciFinder became available (1997)

Professor Natalie Foster at her favorite NMR (1995)


Twenty-seven undergraduates from sixteen colleges and universities participated in a joint NSF-industry sponsored summer research program 1988.

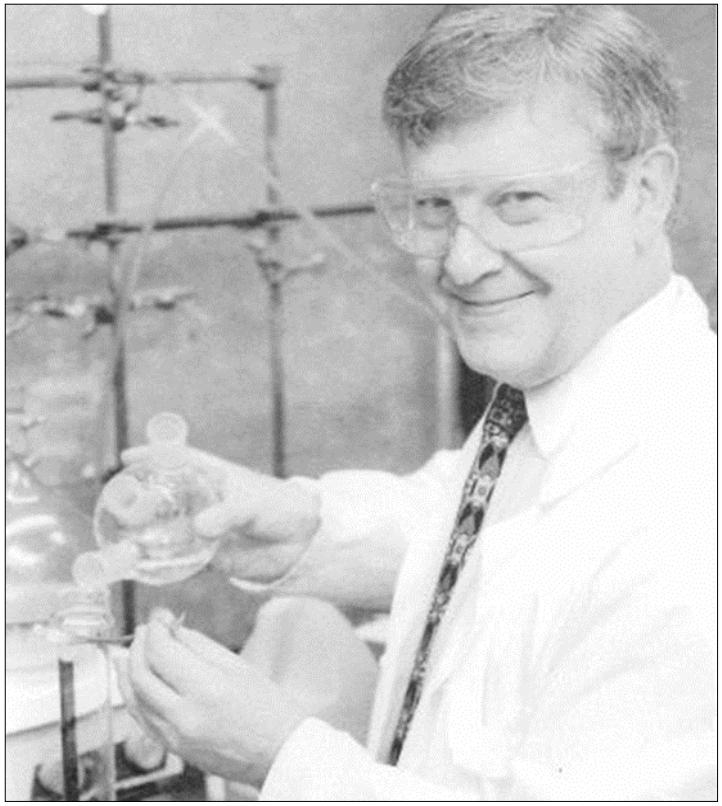
With substantial support from industry matching NSF grants, the department hosted 20 to 35 undergraduates each summer for two decades.

Graduate student, Beverly G. Pestel (D.A. 1983) chats with Chairman Frederick Fowkes at the New Student Reception picnic. (1981)

Using satellite links, Lehigh brought together speakers and students from three locations, including Sweden, for an interactive two-day seminar on Radioactive Pharmaceutical Chemistry. (1994)


Richard Conley (PhD 1974) introduces Terry Rathman, guest lecturer from Lithium Corporation on “Handling Organometallics in Bulk” in satellite distance education course on Process Chemistry. (2004)

Conley, a corporate process chemist for BMS and for J&J created the course while on-leave at his alma mater.



Professor Ned D. Heindel bottles a freshly distilled compound. (1988)

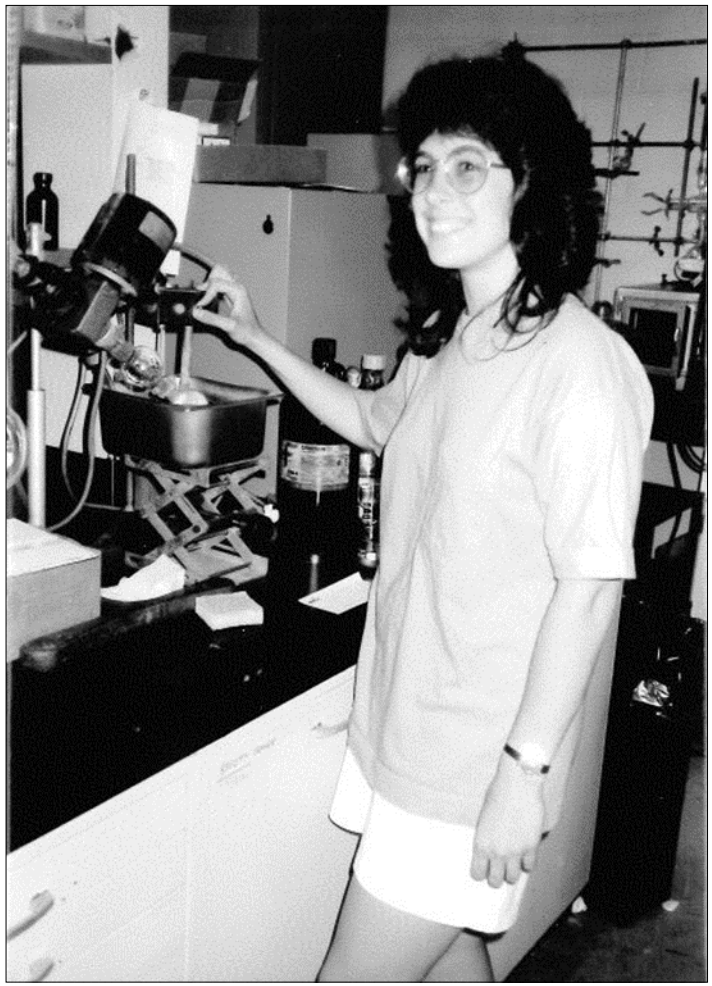
Professors Keith J. Schray and Natalie Foster confer about grading results and where to draw the lines. (1986)

Bryan P. Pitkin, senior satellite technician in the Distance Education program, prepares the transmitter in Iacocca Hall to broadcast an advanced organic class to fifteen corporate receiving sites. (1997)

Graduate students Mark Plucinsky (Ph.D. 1986), left of the analyzer and R. Sam Niedbala (Ph.D. 1986), right of the analyzer learn hospital chemistry in the department's M.S. clinical chemistry internship at the Lehigh Valley Hospital Center. Preceptors Dr. John Salvanti (far left) and Dr. Gerald Clement (far right), served as mentors in the program. (1984)

Chemical assay kit used by an A.C. major while a Lehigh student and subsequently as an assayer in the silver camps of Colorado. (1884)

Chairman Kamil Klier attends a committee meeting. (1994)



Graduate student Stephanie (Engel) Kardos (M.S. 1995) flashes off solvent from a newly synthesized compound.

Chairman G. Doyle Daves in his office located in Mudd Building. (1984)

Professors Natalie Foster and Kamil Klier in animated discussion during a department Christmas party. (1991)

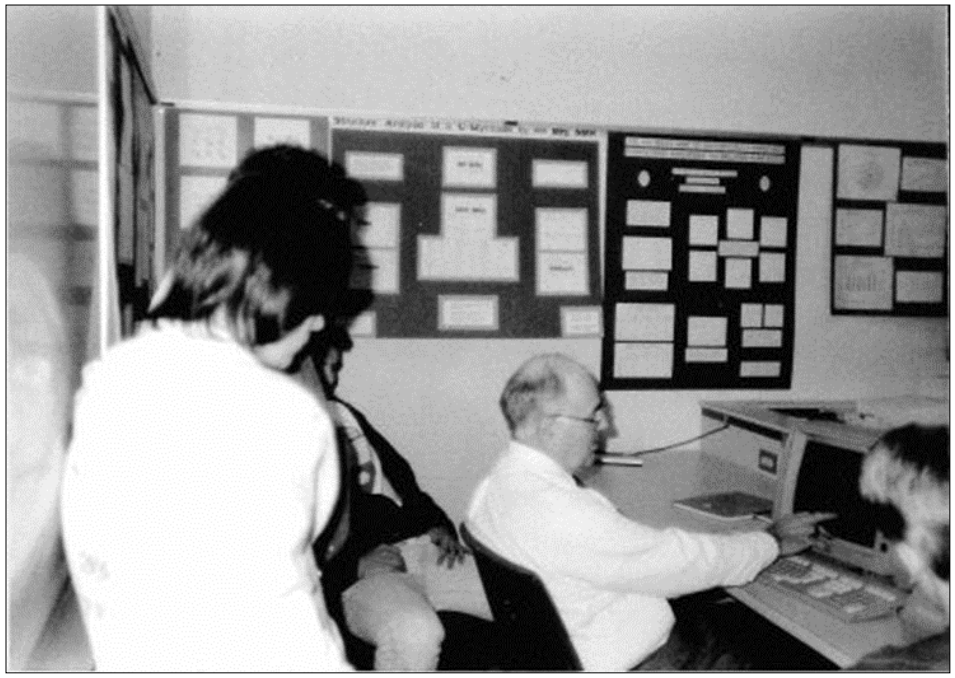
Department staff (left to right) Mary Ann Elgin and Mary Murphy chat with graduate student Deborah Hokien now a professor of biochemistry at Marywood College. (1993)

Chairmen (left to right) Frederick M. Fowkes (1968-1981), Henry Leidheiser, Jr. (1988-1989) and G. Doyle Daves (1981-1988 and 2002-2003) in the chair's office. (1988)

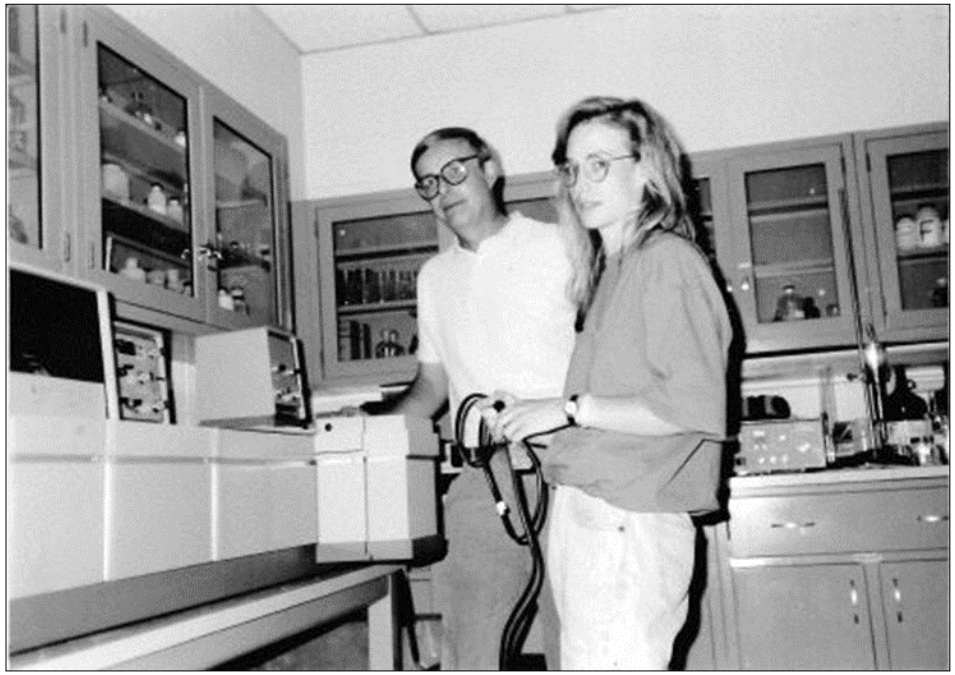

Summer undergraduate program. (1989)

Many graduate students have served as research mentors to undergraduates. Richard A. Conley (Ph.D. 1974) and John R. Gaughan (B.S. 1974) leave their Chandler-Ullmann laboratory. (1972)


Professor Ned Heindel mounts a poster on Lehigh's distance education program in chemistry at the IUPAC meeting on global education. (1993)



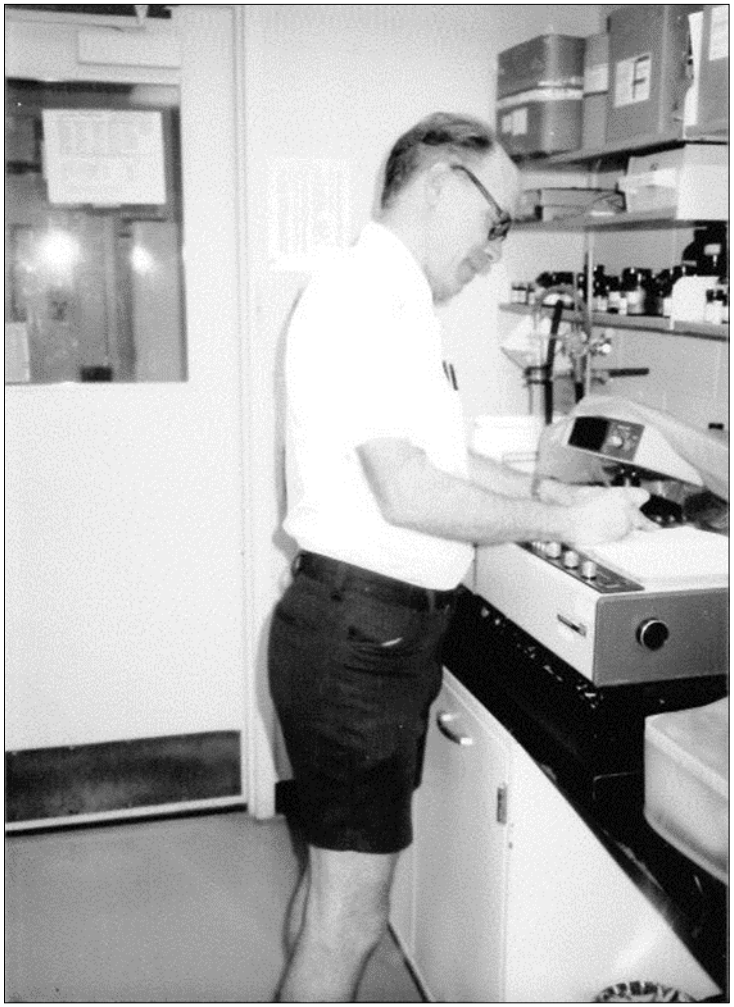
Professor Charles Kraihanzel illustrates a molecular docking process on a computer during open house on National Chemistry Day. (1987)



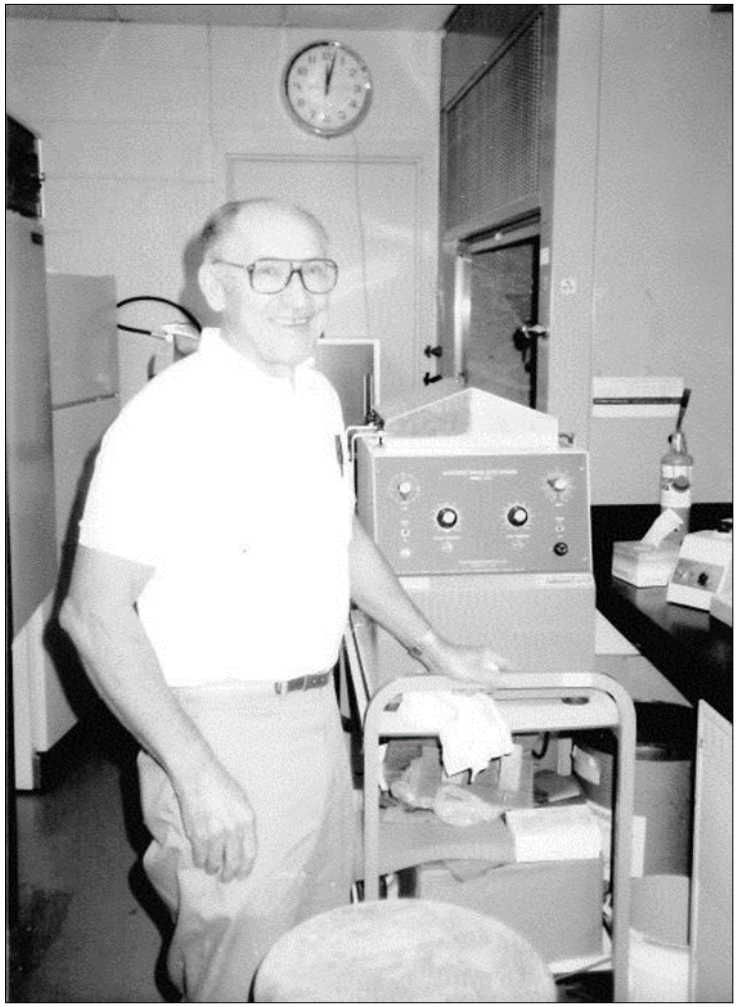
Dieruff High School chemistry teacher, Wayne Bilder and his daughter, Donna, Penn State undergraduate, participated in the summer undergraduate research program. (1989)

Senior Research Scientist, C. Jeffrey Lacey and Michele Jetter (Ph.D. 1989) pose in their research lab.

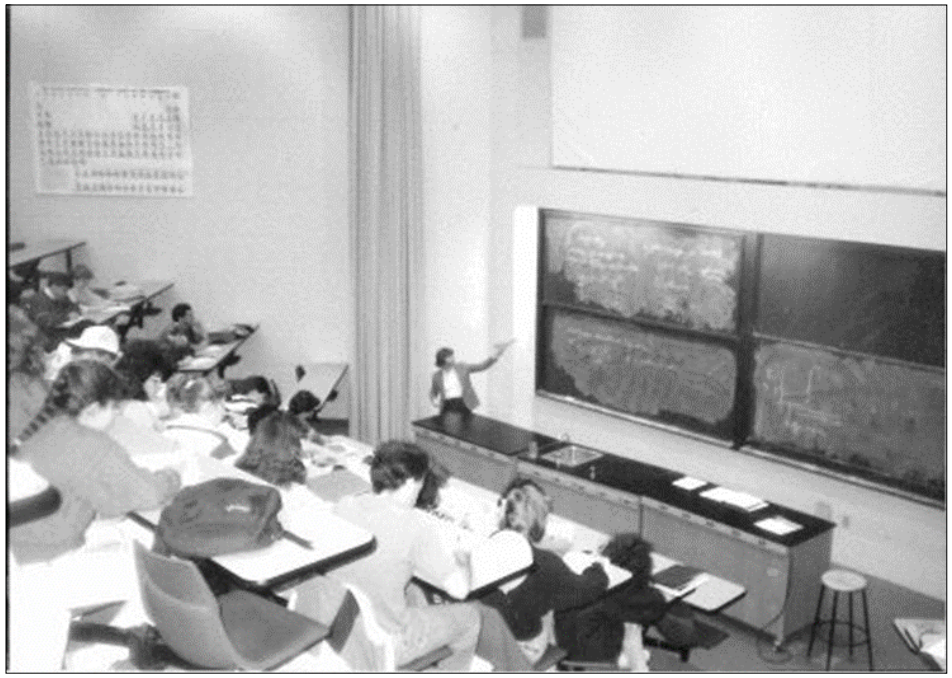
Students, (left to right) Joanna Parker (visiting graduate student from Hahnemann University), Michael Frey (Ph.D. 1995), and Helen Huiri Zhao (Ph.D. 1990) enter biological testing results on an early computer. (1987)



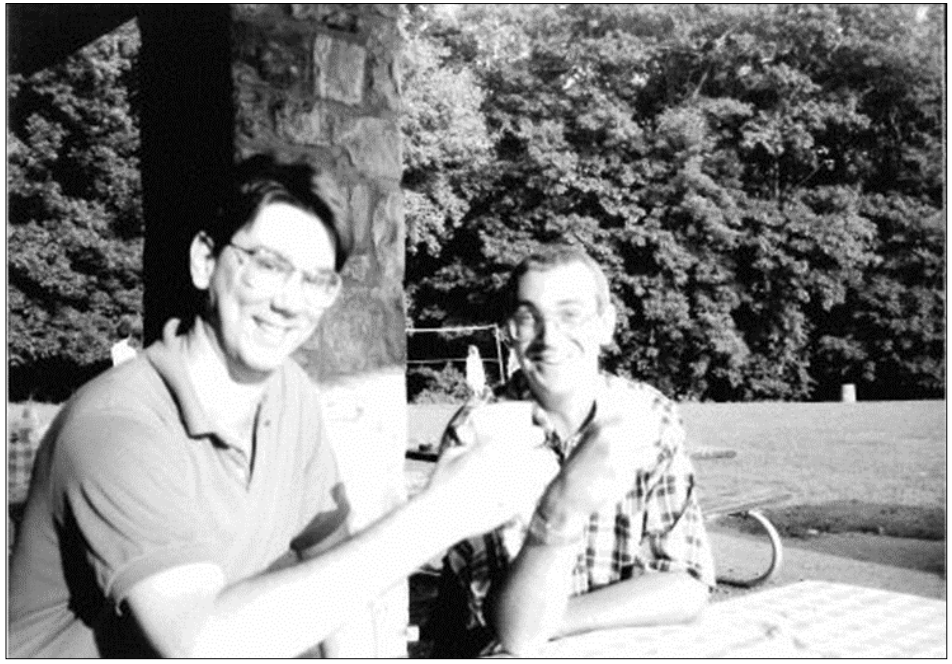
Professor Keith J. Schray prepares to scan a sample. (1982)



Professor Joseph Merkel at work in his laboratory. (1982)



Professor Natalie Foster instructs a general chemistry class in Neville Auditorium. (1979)



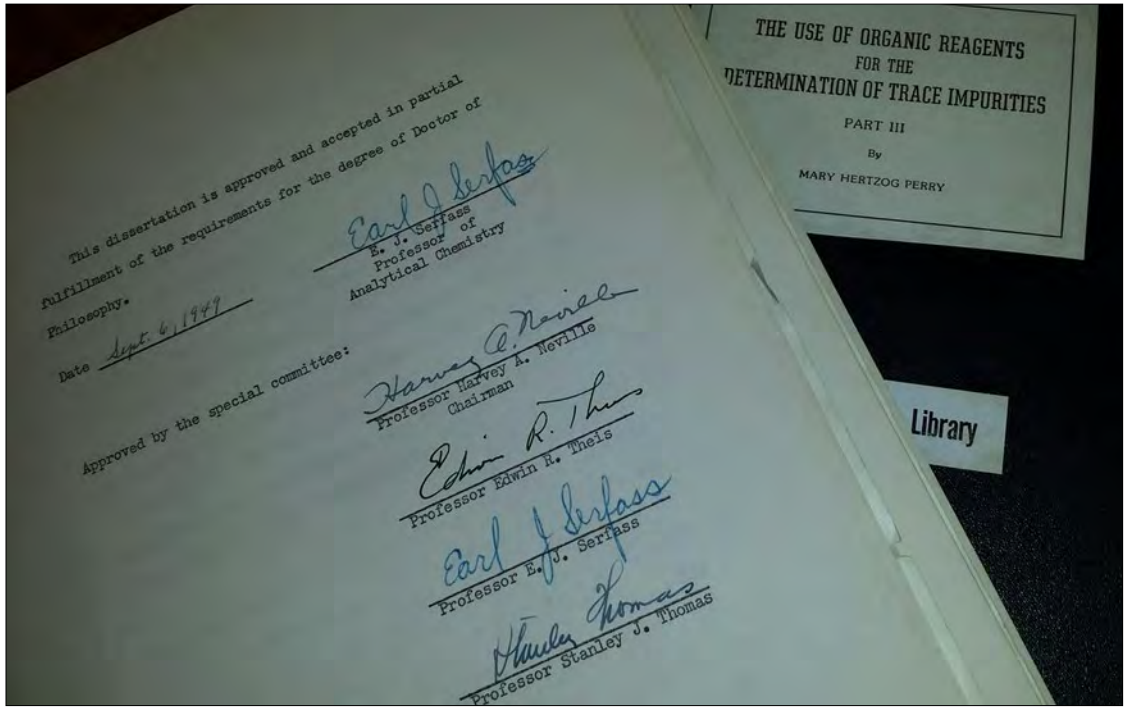
Professors Gregory Ferguson and John Benbow enjoy hamburgers at the welcoming picnic for new graduate students. (1995)

# CHEMISTRY DEPARTMENT

In December 1990 it took two photos to capture the faculty, grad students and staff in Neville Auditorium. Professor Albert C. Zettlemoyer (front left) appears in both pictures. Al, who had been part of the department for 58 years since he began as an undergraduate in 1932, was in failing health but he struggled to come in from home for the photo shoot. He passed away a month after the photographs were taken.

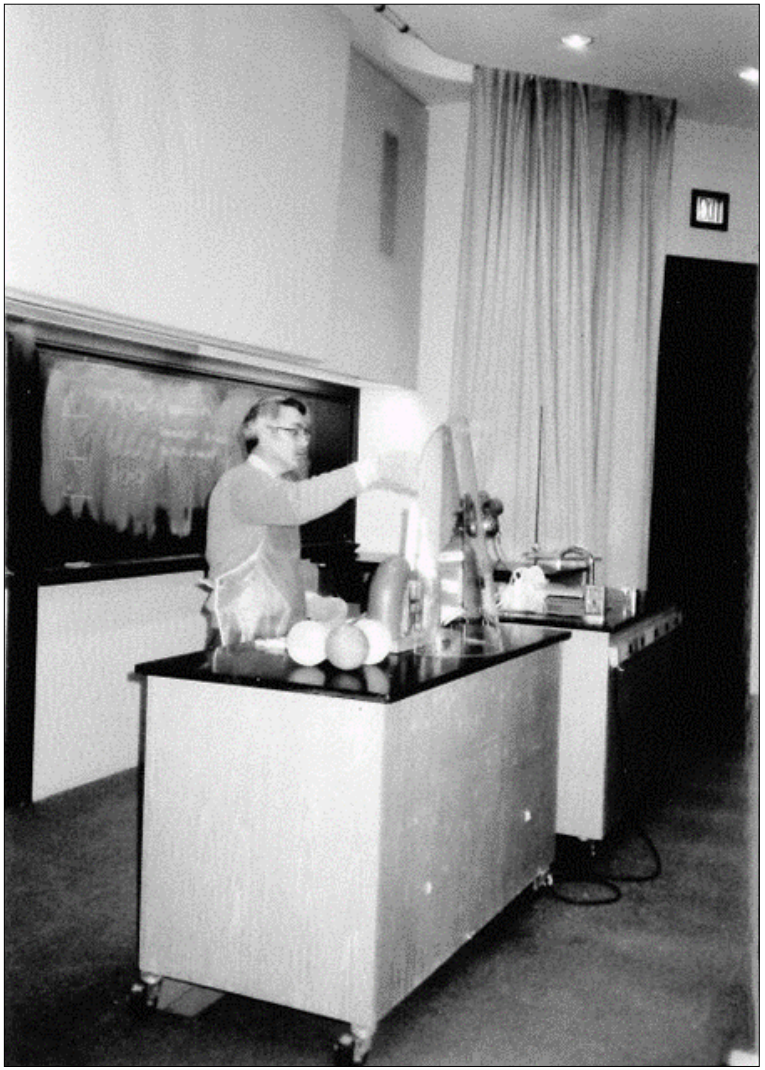
Graduate student, Jack R. Reid (Ph.D. 1973) supervises high school student Diane (Boschelli) Harris (B.S. 1977) during a summer high school research program. (1973)

Jay E. Rowe (Ph.D. 1973) washes up at the end of a busy day in his Chandler-Ullmann laboratory.

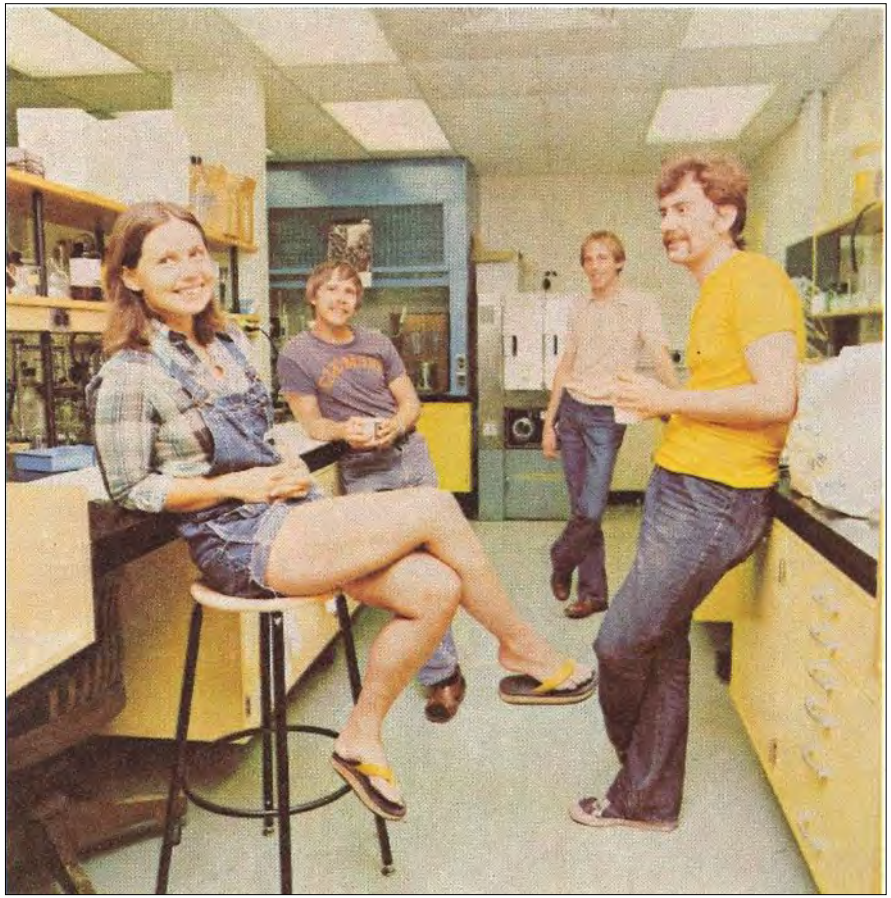



The Ph.D. thesis of Mary Hertzog Perry (1949), the department's first female doctoral graduate, was in analytical development of new assay methods for trace metals in electrochemical plating baths. Senior research professors, Neville, Serfass, Thomas and Theis, were all on her committee. Mary was seven months pregnant when she defended her thesis and missed receiving her diploma on Founder's Day as she was in labor at St. Luke's Hospital.

Professors Natalie Foster, Keith J. Schray, and John Larsen enjoy a party moment with Provost Nelson Markley. (1998)



Professor Daniel Zeroka wows campus visitors with a lecture demonstration on National Chemistry Day. (1987)



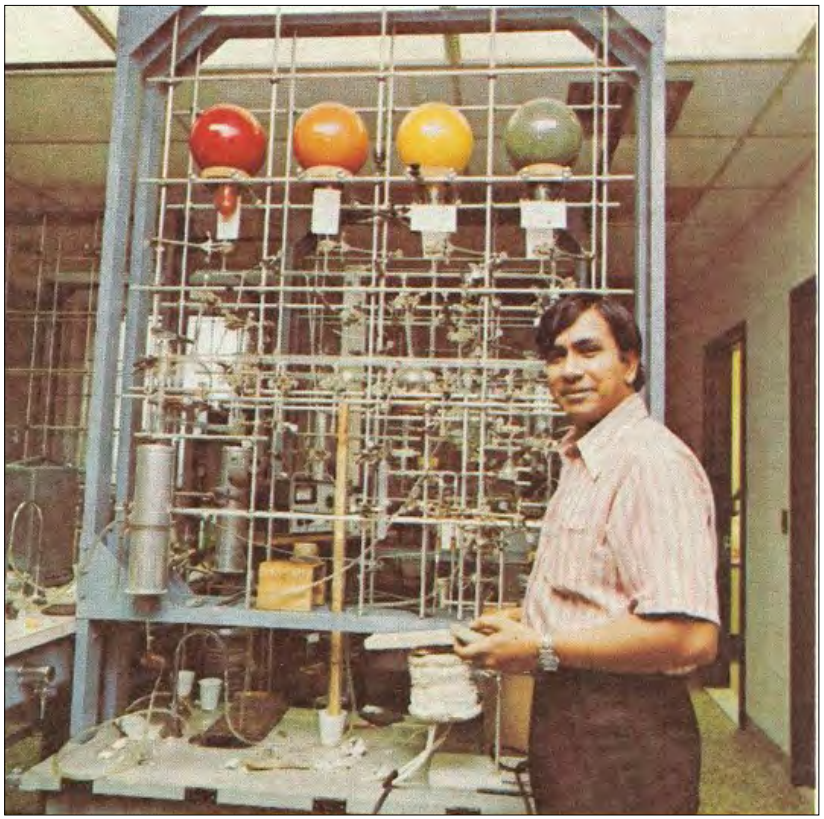
Pausing for coffee in the new biochem lab are Julie Russ (M.S. 1977), James P. Chovan (Ph.D. 1980), Gary K. Smith (Ph.D. 1978) and Elliott C. Kulakowski (Ph.D. 1980). (1976)

Graduate students (left to right) George Barringer (Ph.D. 1979) and Mark Brindle attach a microprocessor to an instrument. (1977)

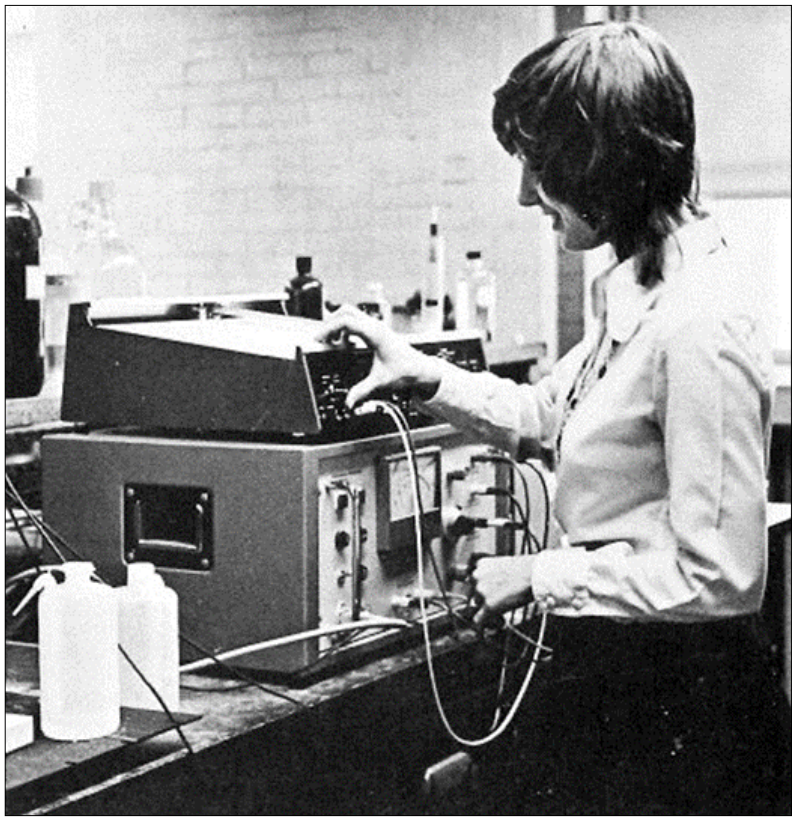
Ronald Eva (M.S. 1978) and George Barringer (Ph.D. 1979) chat in the courtyard behind the newly opened Seeley G. Mudd Building. (1976)

Albert C. Zettlemoyer, Professor of Chemistry, Institute Director, Center Director, Vice-President for Research, and Provost

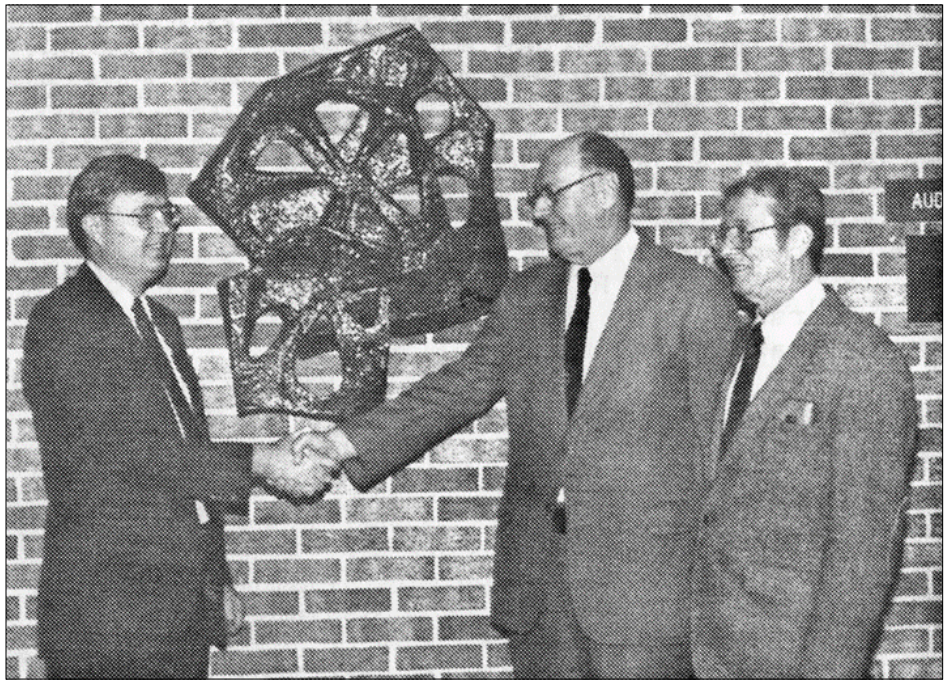
Professor Natalie Foster (DA 1977, Ph.D. 1982) teaches organic chemistry in Whitaker Auditorium to students enrolled in Lehigh's six-year B.S-M.D. programs. (1977)



Chemical Engineering graduate student, Mohammed Siddiq, carries out his thesis research work in the gas absorption lab in Sinclair. (1976)

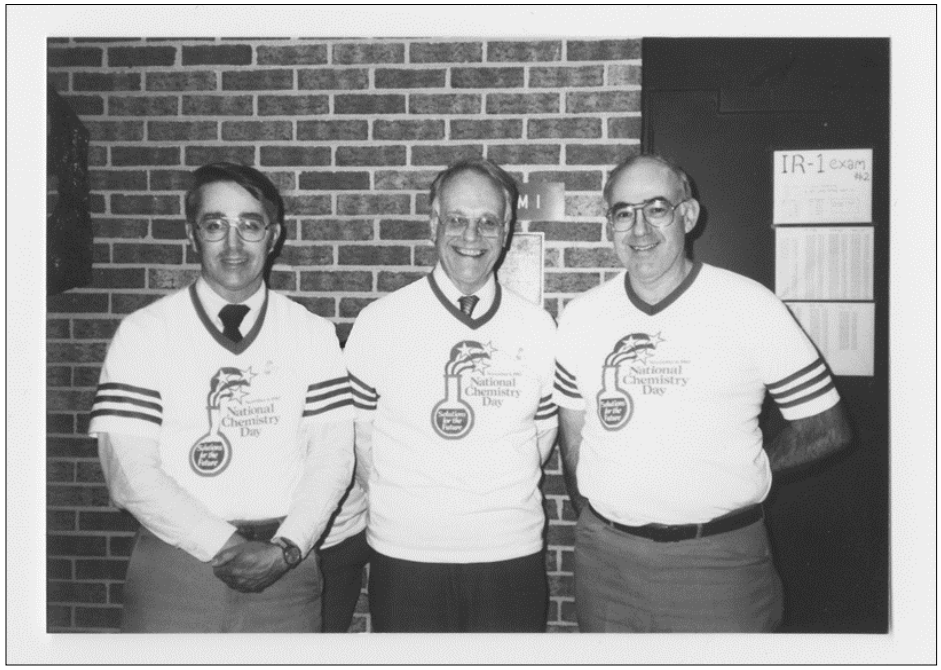


Louise (Snyder) Shive (MS-Chem 1973, Ed.D. 2005) at work on her analytical project in Chandler-Ullmann Hall.



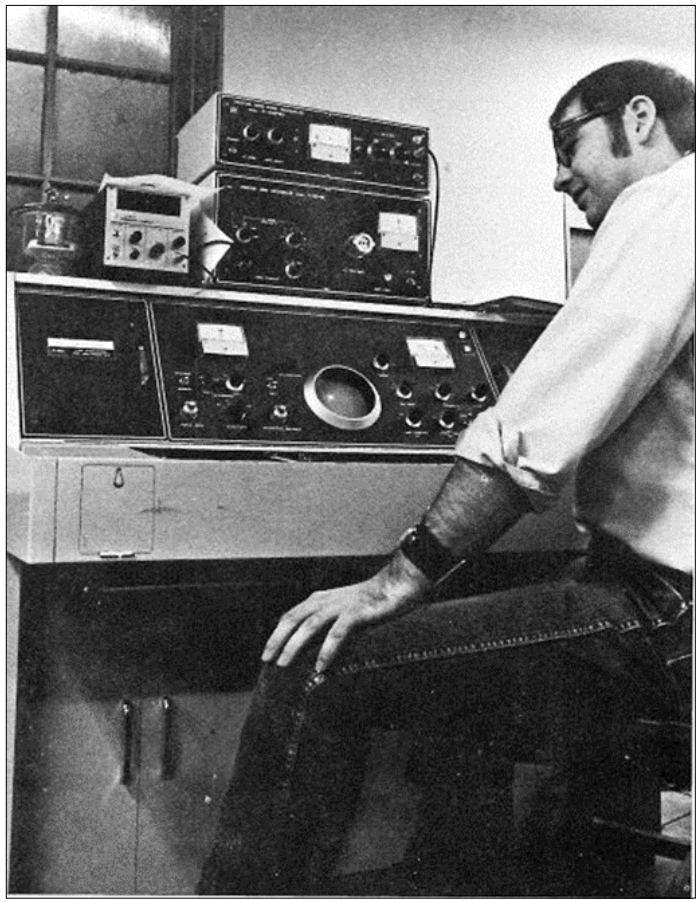
At a ceremony held in December 1986 in Neville Hall lobby, Chairman G. Doyle Daves (left) receives the gift of a bronze artistic rendering of a molecule (2,2-diphenylcyclopentanone) laboriously synthesized by two Lehigh Ph.D. graduates in 1949-50. The molecule was a critical intermediate in the pathway to a new anti-opiate drug designed by Assistant Professor Nelson Roy Easton .

The donor of the bronze molecule, Stuart S. Kulp, Chairman of Chemistry at Moravian College and Professor Thomas E. Young, friend of Dr. Easton, are shown center and right respectively. The story of the molecule appears in the Organic Chemistry section of this history.

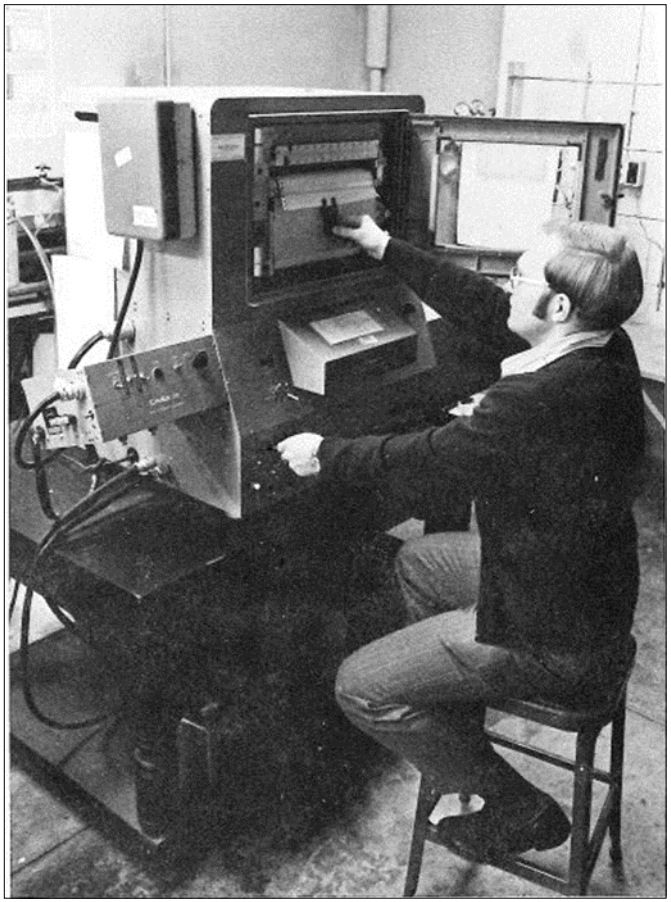



(left to right) Professor Daniel Zeroka, Senior Scientist Thomas Lloyd and Professor Charles S. Kraihanzel welcomed visiting students during the National Chemistry Day open house. (1987)

Departmental stockroom manager, Joe Nunzio chats with Professor Keith J. Schray at a departmental social gathering. (1992)

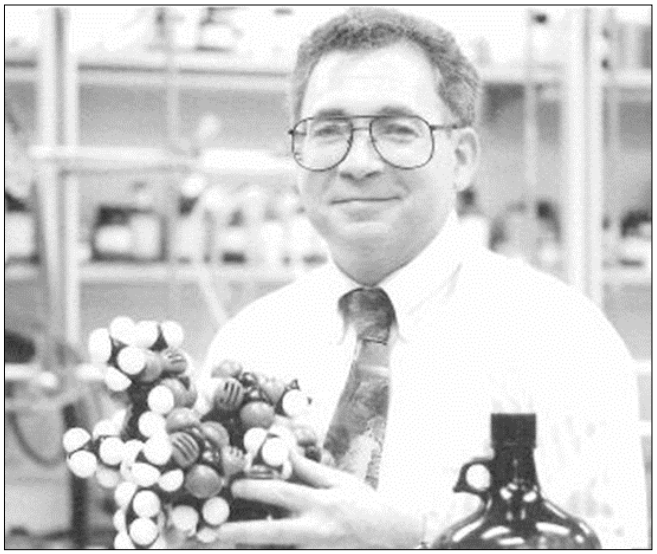


The Hitachi Perkin-Elmer R20A NMR was a “bear” to keep in tune but to several dozen grad students between 1972 and 1981 it did yield critical data for their dissertations.



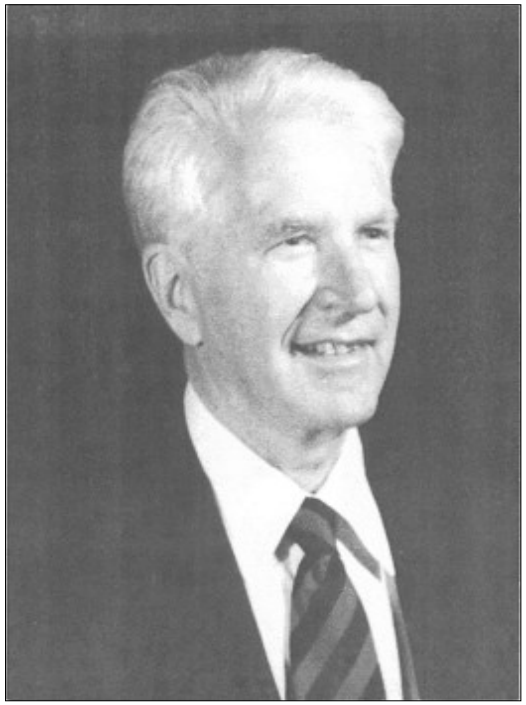
Rodger E. Burg (Ph.D. 1976) makes use of the Cary UV-VIS Spectrophotometer for his thesis work. (1973)

Bonnie A. Martinez (Ph.D. 2002)

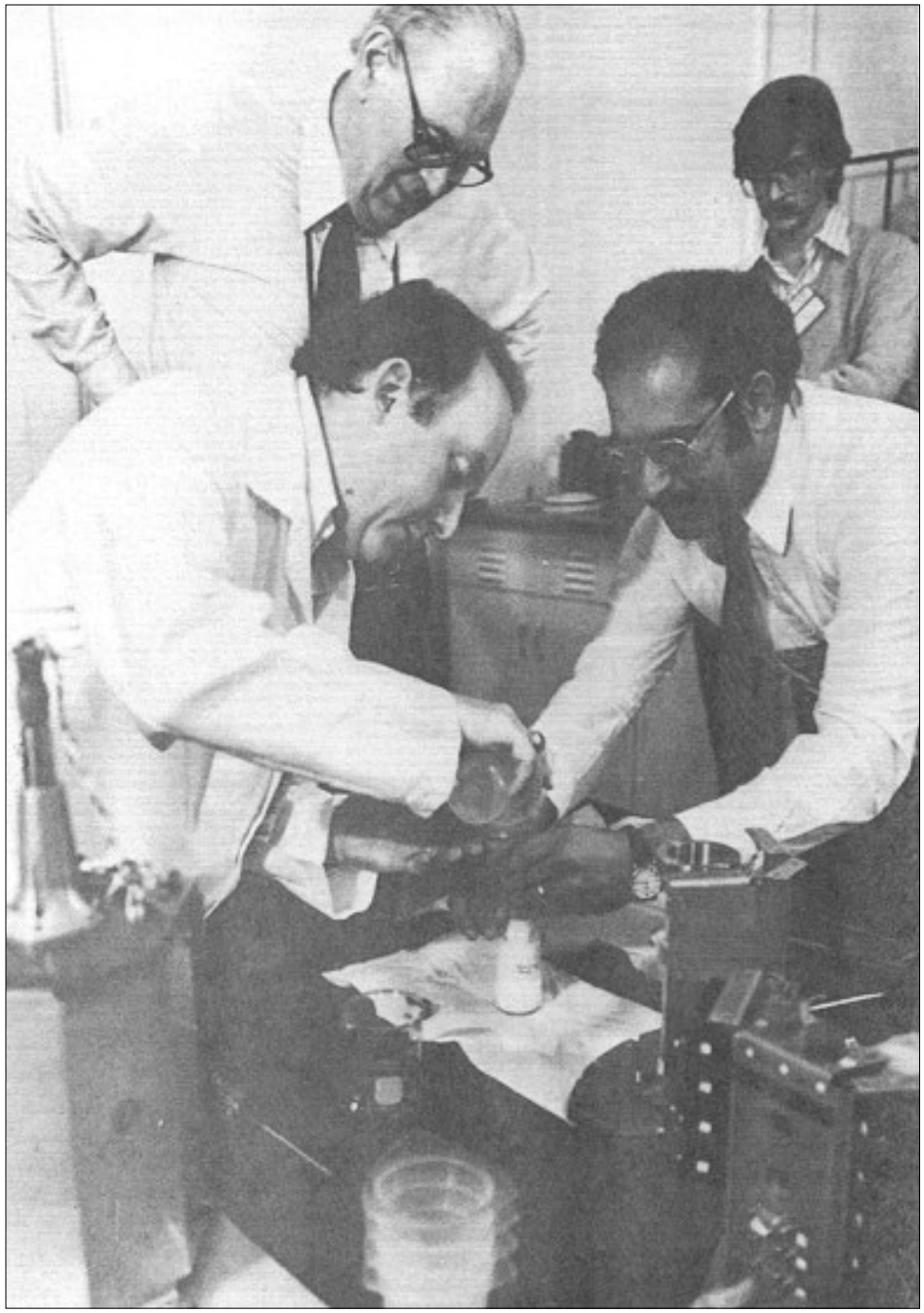


Professor Steven Regen

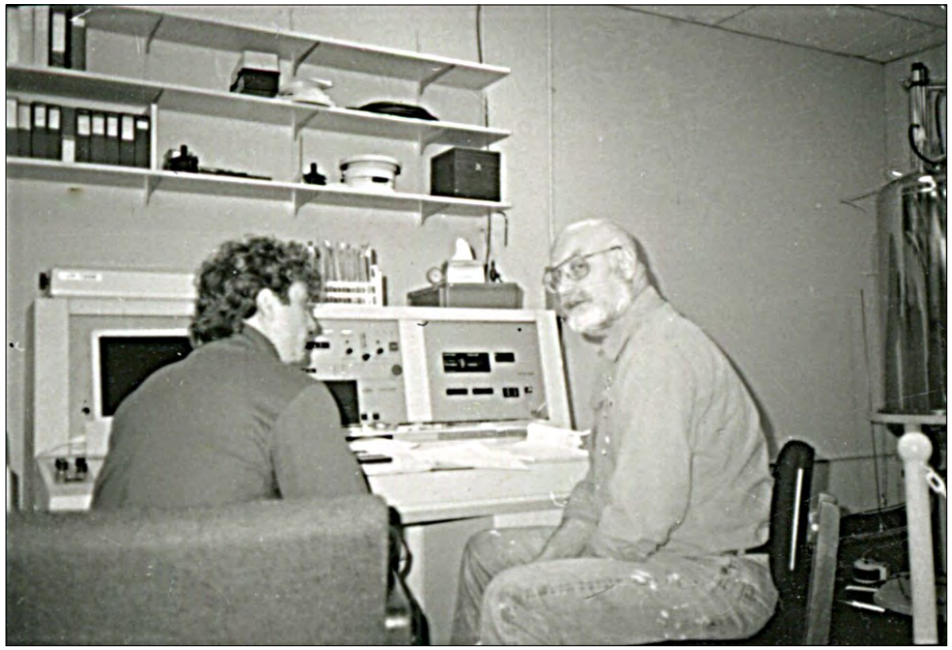
Reeti (Katoch) Rouse (Ph.D. 2001)



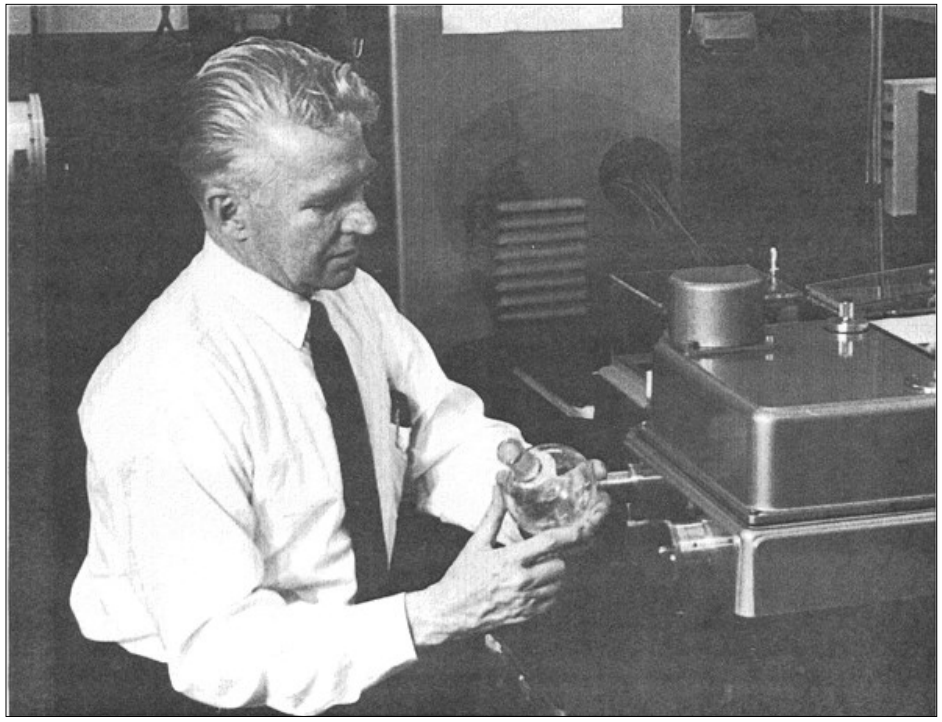
Chairman and Professor Frederick M. Fowkes



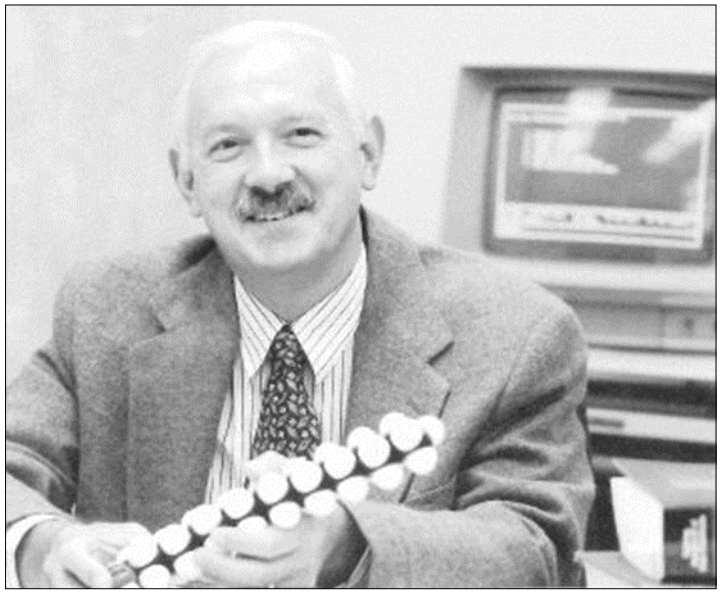
Professor of Chemistry John W. Vanderhoff (upper left) and Professor of Chemical Engineering Mohamed El-Aasser (lower right) assist in prepare a pre-polymerization reaction for initiation in special micro-gravity aboard the Columbia and Challenger spacecraft. The experiment was designed to test if a narrower range of particle size distribution would result if the latex emulsion polymerization were triggered in zero gravity. The answer was "yes." The results were published in a series of papers in 1986 – 1989 under Vanderhoff's and El-Aasser's authorship. Professor of Chemistry Fortunato ("Nato") Micale was also involved in the project.



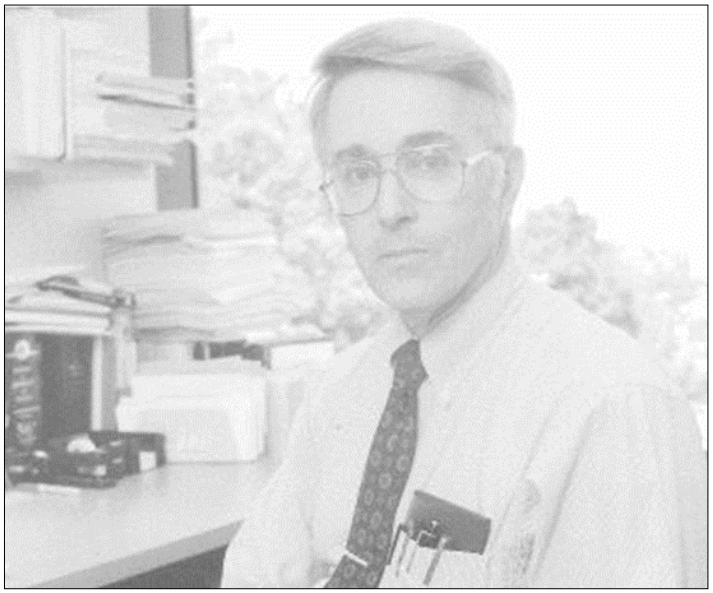
Graduate student, Pat Wernett and Departmental Spectroscopist, William Anderson, discuss an NMR experiment. (1989)



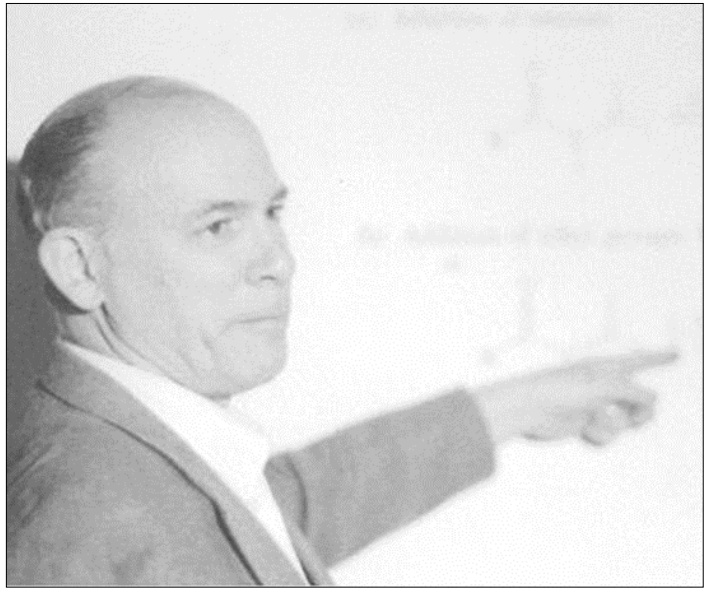
Professor Fredrick M. Fowkes at work in his laboratory. (1980)



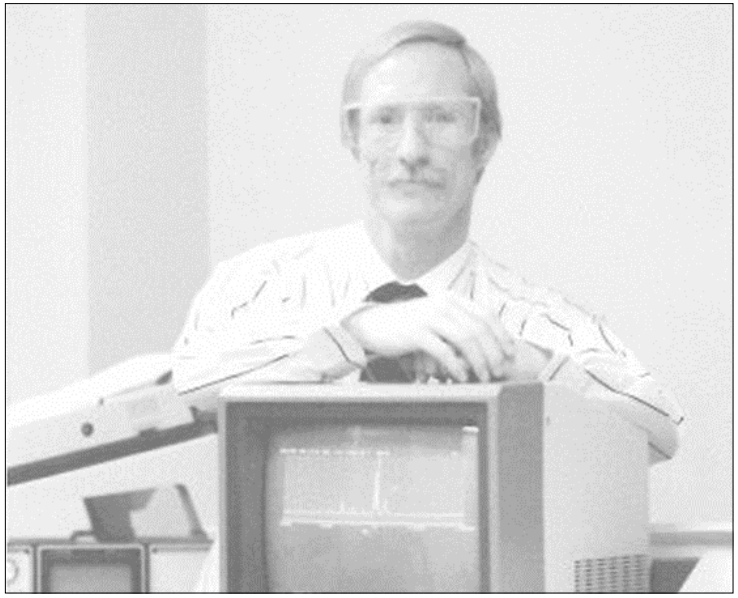
Professor Gary Simmons talks about the surface properties of highly lipophilic polymethylene compounds.



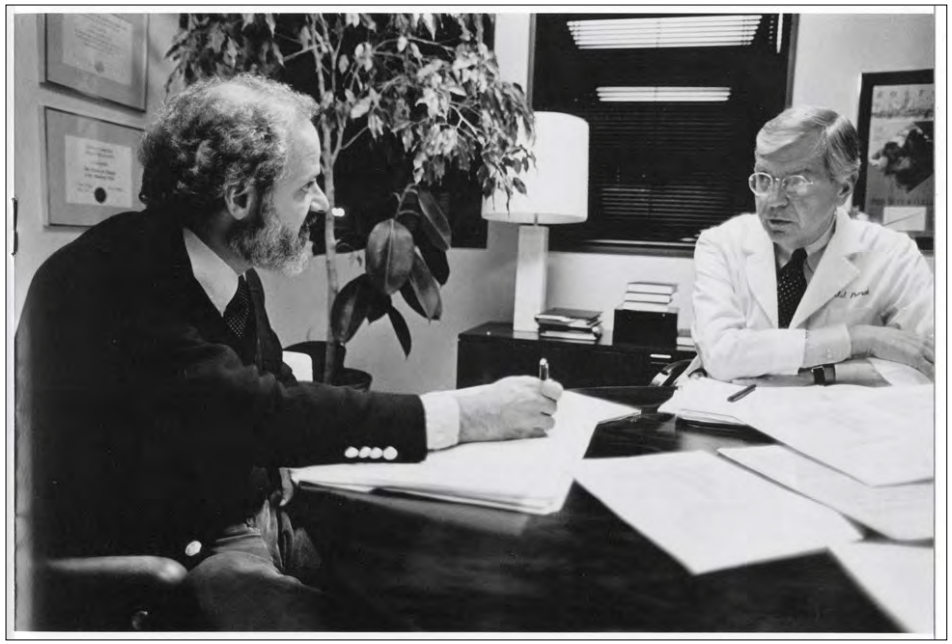
Professor Daniel Zeroka



Professor Keith J. Schray makes a point about carbonyl chemistry.



Professor James Roberts



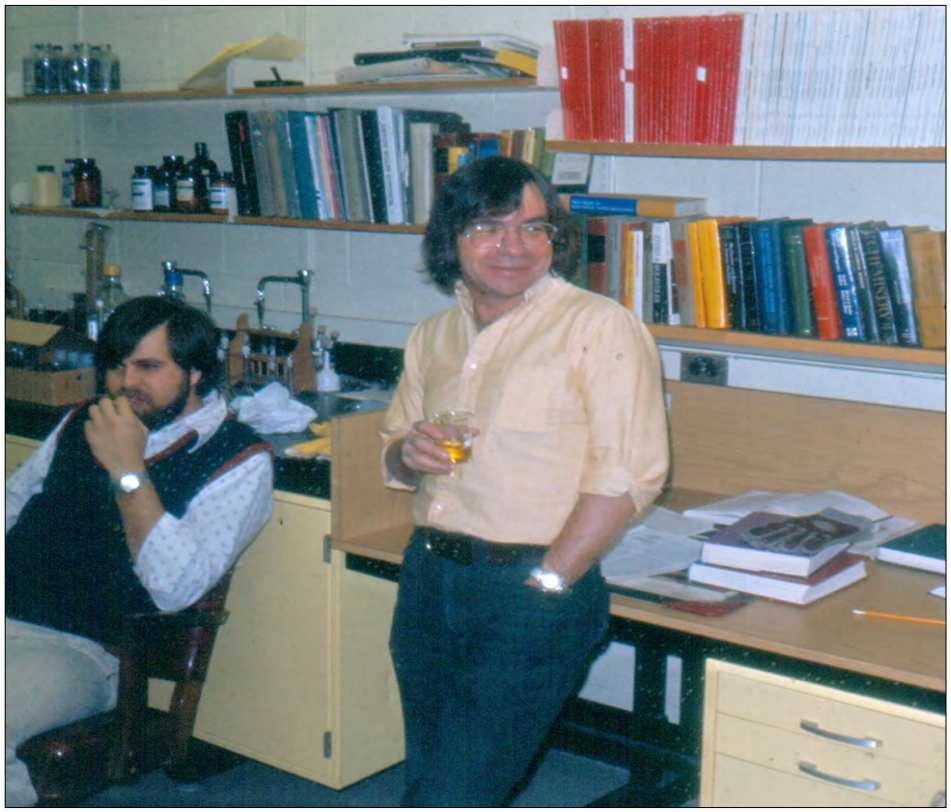
Professor Jack Alhadeff (left) and Joseph J. Prorok, M.D., of the Lehigh Valley Hospital Center, meet to discuss joint research and education programs. (1986)

Biochemistry graduate student John J. Spaltro (Ph.D. 1985) at work in his research lab. (1983)

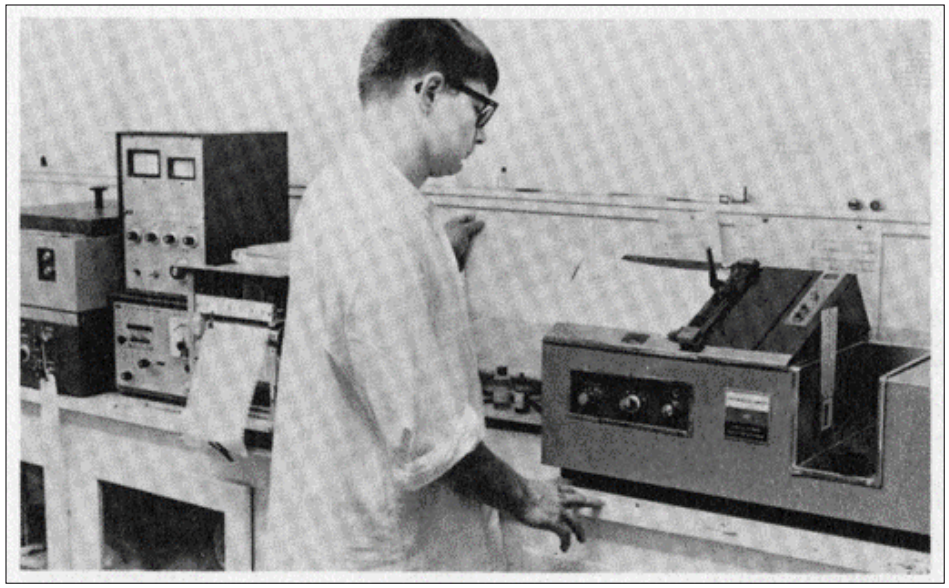
In the Chandler-Ullmann vivarium, Professor Thomas Cheng shows biochemistry graduate student, Patricia Pietrobon (Ph.D. 1983) how to inject an antigen into a rabbit ear. (1981)


Graduate student Tibor Sipos (Ph.D. 1968) runs an electrophoretic separation in the department's biochemistry laboratories, then located in Williams Hall. (1966)

Sally M. Lemke, research associate, and husband, Thomas F. Lemke (PhD 1968) operate the Perkin Elmer R21 Infrared Spectrometer and the Beckman DK-2A UV-Vis Spectrometer in the core instrumentation laboratory in Chandler-Ullmann Hall in 1966.



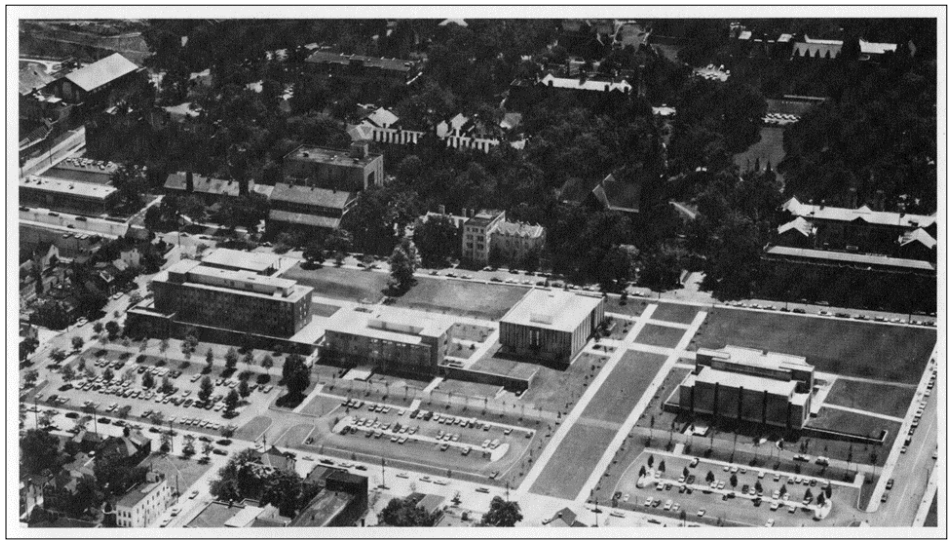
Graduate student Dennis M. Todd, left, (Ph.D. 1978) and his faculty mentor, Professor William E. Ohnesorge relax in their laboratory. (1976)



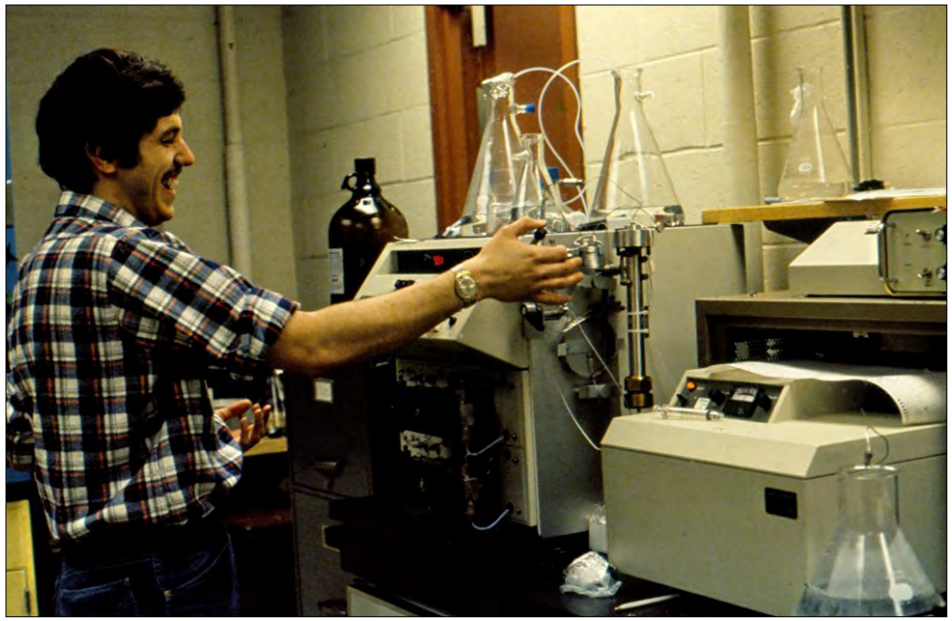
Lee A. Schaeffer (B.S. 1965, Ph.D. 1972) obtains an infrared spectrum in his Chandler-Ullmann research laboratory. (1966)

The chemistry office staff, (l to r) Rosemary Makosky, Elsie Hamel and Mary Ann Elgin. (1988)

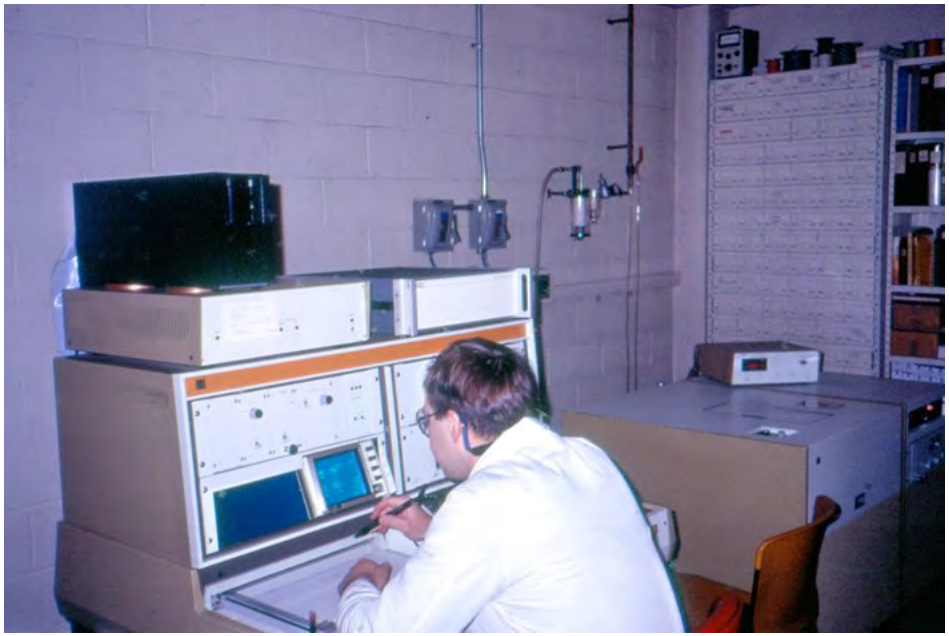

March 26, 1994, Lehigh President Peter Likins (right) and chemistry professor Ned D. Heindel (left) unveil a bronze plaque designating the Chandler Chemistry Laboratory as a National Historic Chemical Landmark. The distinction, granted by the American Chemical Society's Historic Landmarks program, points to the prize-winner architecture of the building which achieved global state-of-the-art distinction in 1885. The plaque is on display in the lobby of Chandler-Ullmann Hall.



As part of Lehigh's controversial expansion north of Packer Avenue – an event which required displacement of several blocks of blue collar homes – an aerial view shows the completed Whitaker Laboratory, Sinclair Hall, Maginnes Hall and MART Library and two vacant lots awaiting the construction of Seeley G. Mudd Laboratory and Neville Auditorium. Both of the latter structures were completed three years later. (1972)

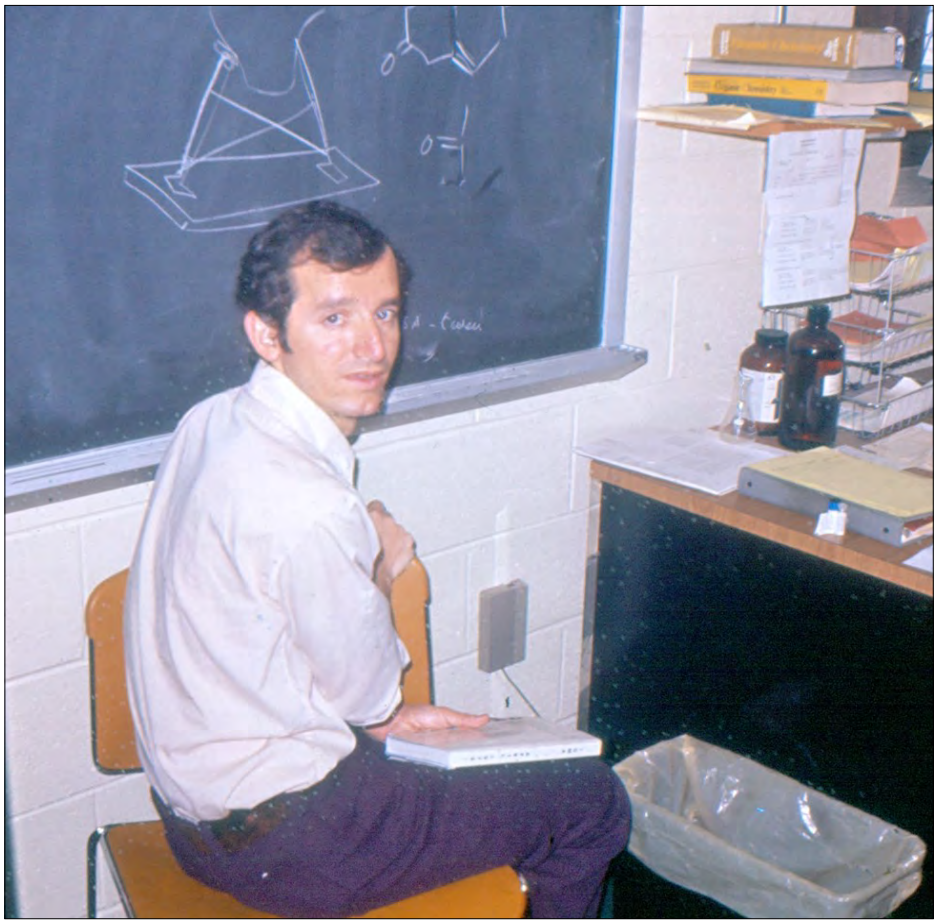


Robert A. Outten (Ph.D. 1987) expresses joy that his finicky HPLC with prep column is working well.



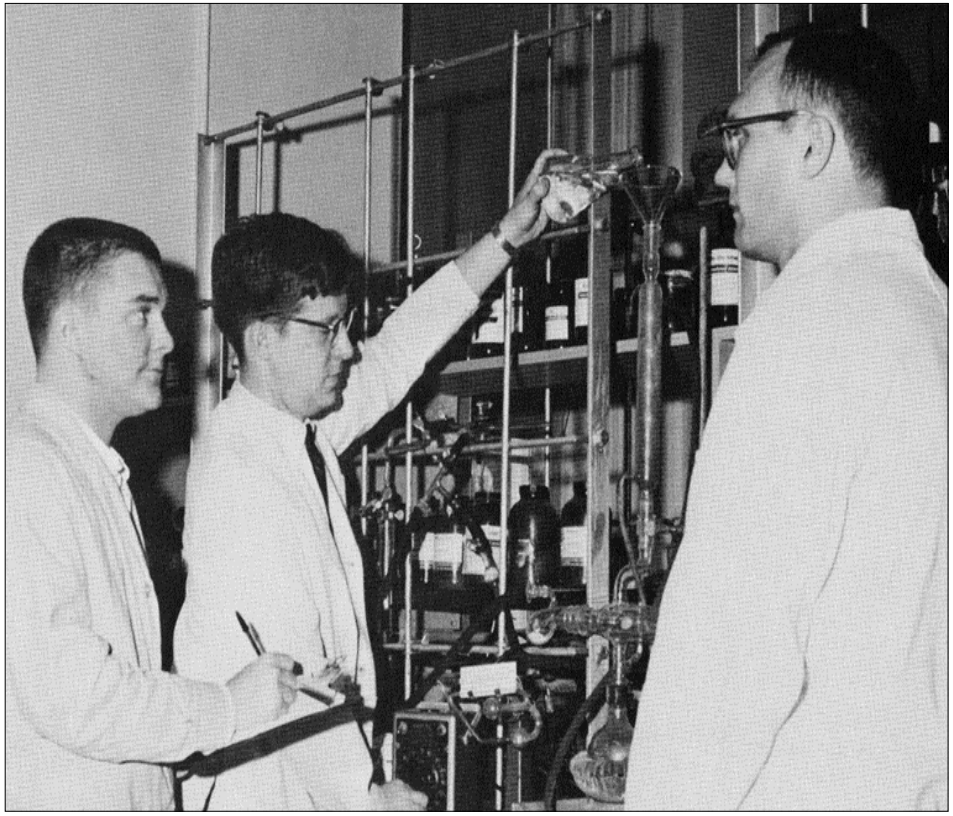
A graduate student runs an NMR spectrum on the department's JEOL FX90Q. (1982)

Victor R. Risch (B.S .1972, Ph.D. 1976) prepares a radiopharmaceutical in the Department's Radiochem Lab. (1974)



Throughout the 1970's the department provided doctoral education to South American students committed to serving as faculty in their home country. Seven students from the Universidad De Antioquia, including Guillermo L. Palcio (Ph.D. 1978), came to Lehigh for advanced study. Here he discusses a synthesis problem in the office of his doctoral advisor, Professor Keith J. Schray. (1976)

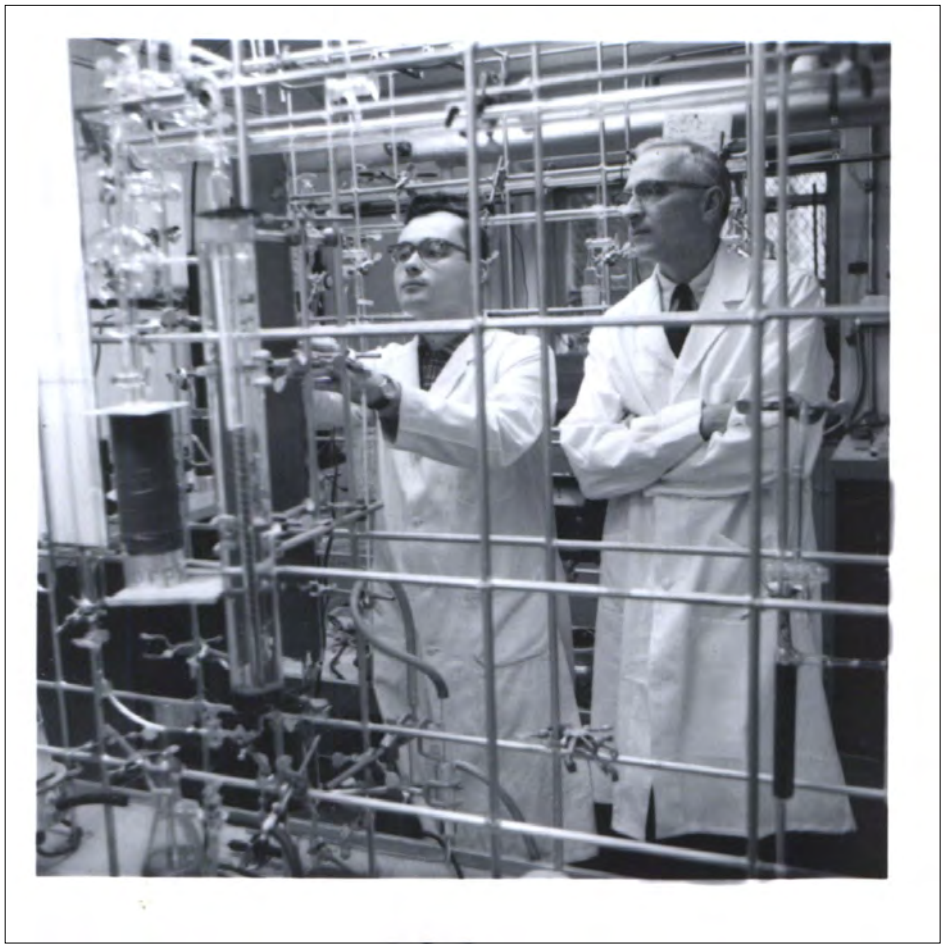
Professor Thomas C. Cheng instructs his graduate students in techniques to maintain aquatic parasites in culture. (1970) Cheng's Institute for Pathobiology (ceased 1980) and its successor, the Center for Health Sciences, were housed on the ground floor of Chandler-Ullmann Laboratory from 1968 to 1987.



Post-doctoral associate, Cyrus J. Ohnmacht (Ph.D. 1966) (right), watches while Professor Ned D. Heindel illustrates the proper way to pour solvent into an Aberhalden drying pistol and graduate student James M. Molnar (Ph.D. 1971) (left) takes notes on the complicated procedure. (1968)

As a demonstration Professor Earl Serfass burns a ribbon of magnesium. Serfass served as Department chair from 1952 to 1959. Where are his safety glasses?

James E. Sturm, physical chemistry professor, served the department from 1956 to 1995



Professor Edward D. Amstutz helps graduate student Morris Anschel (Ph.D. 1967) set up a vac-line.

Lehigh President Harvey A. Neville (1962) enjoys dinner with trustees. Neville was chair of the Chemistry Department from 1938-1952.

2015 Department of Chemistry Faculty

Top Row (left to right): Dr. Andy Ho, Dr. David Vicic, Dr. Robert Flowers, Dr. Heather Jaeger, Dr. Ned Heindel, Dr. Rebecca Miller, Dr. Greg Ferguson

Bottom Row (left to Right:): Dr. Xiaoji Xu, Dr. James Roberts, Dr. Steve Regen, Dr. Dmitri Vezenov, Dr. Mark Chen, Dr. Suzanne Fernandez

Not Pictured: Dr. Jebrell Glover, Dr. Kai Landskron, Dr. David Moore, Dr. Marcos Pires, Dr. Damien Thévenin

1940 Department of Chemistry Faculty

Top Row (left to right): J.H. Steele, R.D. Billinger, J.G. Smull, H.A. Smith, E.D. Amstuts, W.A McGrath, C.H. Reichardt, N.S. Levenson, J.C. Hertz, E.J. Serfass, F.J. Fornoff

Second Row (left to right): H.V. Anderson, W.W. Ewing, A.A. Diefenderfer, H.A. Neville, H.W. Ullmann, G.C. Beck, C.W. Simmons

On Floor (left to right): E. Heins, P.T.W. Strub, R.F. Schultz, T.N. Kaslehurst

| | |
|---|---|
| History 334 | American Urban History from 1880 to Present |
| Government 352 | Civil Rights |
| Social Relations 320 | Urban Ethnology |
| Social Relations 312 | Interpersonal Behavior in Small Groups |

## Dissertation/Research

The Dissertation Research requirement is fulfilled in two discrete parts: a. a project in chemical education and b. an externship in industrial chemistry. The student's committee will provide guidance and supervision in the selection and completion of both of these requirements.

The project in chemical education may consist, for example, of an in-depth analysis of the "two-track" chemical teaching programs in the two-year colleges, the development of a new or improved laboratory experiment series, the creating and evaluation of a standardized examination battery, or the development and teaching of a new chemistry course.

## Industrial Externship

Since approximately half of the graduates of two-year colleges obtain industrial employment as laboratory technicians, it is important for the D.A. candidate to develop an appreciation of the way industry utilizes the chemistry graduate at A.A. and B.S. levels. This "externship" can be fulfilled by summer or regular employment in a chemically related research and development laboratory. In the event that industrial employment would not be available or would be exceedingly inconvenient for the D.A. candidate, this requirement may be fulfilled by extensive on-site visits and by interviews with laboratory group leaders, production and plant managers, and industrial personnel supervisors. It is the intention of this requirement that the doctor of arts candidate obtain an appreciation for the field of industrial chemical employment. To that end, the candidate will be required to submit a written report summarizing his or her industrial externship experience.

## Concerning Lehigh

The university's primary academic and residential campus consists of two-hundred acres on South Mountain, overlooking the attractive and historic City of Bethlehem. There are approximately one-hundred buildings on this campus, including the new seven-story Seeley G. Mudd Chemistry Complex, ready for use in fall, 1975. The chemistry tower has been specially designed to provide for good ventilation of individual laboratories. The adjoining Sinclair Laboratory, an attractive contemporary structure, also is a center for chemistry research. Both buildings are located a few steps away from the recently constructed Mart Science and Engineering Library, containing some 100,000 volumes. An additional 550,000 volumes are housed in Linderman Library, a short distance from the chemistry centers.

Lehigh is widely known for the beauty of its wooded campus. In addition to rare plant specimens on the lower campus, students enjoy the nature preserve located high on top of the mountain. On the other side of the mountain is Lehigh's 600-acre Saucon Valley campus, featuring athletic facilities. The university's newly built Saucon Married and Graduate Students apartment complex is located on this campus.

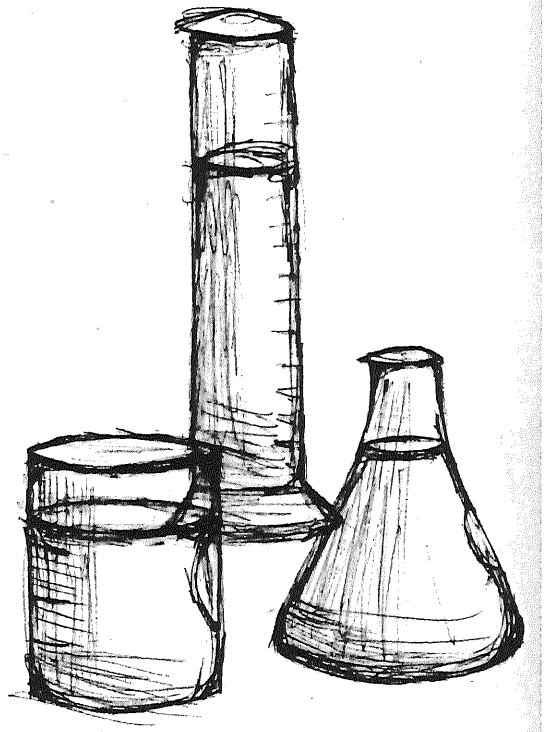
The university is private, nondenominational and coeducational. There are 2,000 persons enrolled in the Graduate School and the School of Education. There are some 4,000 undergraduates enrolled in the three colleges, including the College of Engineering and Physical Sciences, the College of Arts and Science, and the College of Business and Economics. The university employs some 1,450 persons, and among tenured faculty, approximately 85 percent hold the doctorate.

Prospective doctor of arts candidates are cordially invited to visit the campus and to confer with chemistry department representatives.

## Where to Write

For applications and information contact: Chairman, Department of Chemistry, Lehigh University, Bethlehem, Pa. 18015. The 300-page catalog will be sent to you upon request.

# Doctor of Arts in Chemistry



College Teachers for the Future
Lehigh University
Bethlehem, Pennsylvania

## The D.A. Degree in Chemistry

Lehigh University offers the degree of doctor of arts (D.A.) in the fields of chemistry, business and economics, government and psychology for those who wish to prepare for a career in college teaching. The focus of the degree is preparation for instructional positions in two-year and four-year colleges with emphasis on a broadly based, coursework background in chemistry. Admission standards are equal to those for Ph.D. programs, and the D.A. programs have been developed in accordance with guidelines of the Council of Graduate Schools.

## General Requirements

The requirements for the D.A. degree parallel those for the Ph.D. with the following exceptions: 1. a broader distribution of graduate courses in the field; 2. a minor area of study for those students wishing bidisciplinary preparation for two-year college teaching; 3. coursework and training in interpersonal awareness; 4. a supervised internship in college teaching, and 5. a project appropriate to college teaching in the field instead of a dissertation.

The program in chemistry has been prepared in consultation with supervisors of doctors of arts programs in chemistry at major universities and by reference to the guidelines established by both the Carnegie Foundation and the Council of Graduate Schools.

## Graduate Work in Chemistry

The student is expected to complete the same graduate core courses required of Ph.D. candidates in each of the following major disciplines of chemistry:

Analytical Chemistry (Chem 332)
Inorganic Chemistry (Chem 307)
Organic Chemistry (Chem 358)
Physical Chemistry (Chem 445)

The student can select any major area of chemical concentration and will then complete a minimum of two additional graduate courses (above the core course) in that field, two semesters of experimental research at the master's degree level, and two credits of graduate seminar in that major field. In addition, the research, coursework, seminars and thesis requirements for the M.S. in chemistry will be fulfilled.

One inherent part of being an effective chemistry teacher is an appreciation for experimental chemical research. Thus, although the candidate is not expected to pursue the in-depth experimental projects required of Ph.D. students, he or she is expected to gain some understanding of the difficulties, instrumental tools, approaches, laboratory equipment, frustrations and exhilarations of laboratory science by undertaking an experimental master's-level program. Students enrolling in the D.A. program with a completed master's degree which included a research component may be excused from this aspect of the D.A. requirement by petition to the D.A. Advisory Committee.

The student will also select a minor area of concentration in chemistry and complete any two additional graduate courses (above the core course) in that field. Since chemistry teachers in two- and four-year colleges occasionally teach science subjects in areas outside of chemistry (e.g., earth science, biology, chemistry or physics), the D.A. in Chemistry curriculum permits an outside-of-chemistry minor so long as the courses to be taken represent advanced-level work in that area. These minors would normally be a minimum of three or four courses in the nonchemical science approved by the student's D.A. Advisory Committee.

The examinations consist of the regular Ph.D. Qualifying Examinations in both the major and minor areas of study. In addition, the candidate is expected to compose a research proposal in some area of chemical education. Ph.D. candidates normally pass a comprehensive graduate qualifying examination in their subdiscipline of chemistry taken in the second year of fulltime graduate study. The D.A. candidate is asked to take two such exams (in major and minor fields) before the completion of three years of graduate work.

Because the D.A. degree is intended to develop greater breadth in the student than does the traditional Ph.D. degree, broader coursework and a broader examination system are employed. Also, since chemical educators are often concerned with preparing proposals to foundations and federal agencies for financial support of new teaching instrumentation, new laboratory acquisitions, and new educational equipment, D.A. candidates are asked to master the technique of writing and justifying educationally oriented proposals.

### Apprentice Teaching (six semester hours credit)

Apprentice teaching is taken on a fulltime basis for at least one semester under the critical supervision of the master teacher.

### Seminar in Chemical Education Problems
(one credit, but can be repeated three times)

This seminar is staffed and instructed by senior faculty from Lehigh University and the surrounding liberal arts colleges of the Lehigh Valley. This seminar will focus on the unique problems of teaching chemistry in state colleges, private church-related liberal arts colleges, two-year university extension schools, and community colleges. Subjects to be treated include Keller Plan instruction, contract grading, auto-tutorial methods, programmed instruction, film-strip laboratory briefings, standardized examinations, and demonstration experiments.

### Sensitivity Core (nine to 12 semester hours credit)

A series of sensitivity courses is designed to acquaint the student with the philosophy of education and the problems of minorities and to develop interpersonal awareness. Some possible selections are:

| | |
|---|---|
| Education 393 | Instructional Media |
| Education 400 | Psychological Foundations of Education |
| Education 407 | Philosophical Foundations of Education |
| Education 409 | The Two-Year College |
| Psychology 411 | Interpersonal Awareness |
| Social Relations 361 | Social Conflicts |

*Michigan State University Printing*

# THE DOCTOR OF ARTS DEGREE:

## A Degree for College Teachers

*Prepared by representatives of the following D.A. degree granting institutions:*

Atlanta University
Ball State University
Carnegie-Mellon University
Catholic University
Idaho State University
Illinois State University
Lehigh University
Middle Tennessee State University
University of Illinois-Chicago Circle
University of Miami
University of Mississippi
University of North Dakota
University of Northern Colorado

February 28, 1980

**Institutional Representatives:**

H. Dale Abadie
Associate Dean, Graduate School
University of Mississippi

Robert C. Aden
Dean, Institutional Research and Planning;
Acting Graduate Dean
Middle Tennessee State University

Arnold Burkart
Coordinator, Graduate Programs in Music
Ball State University

John Dossey, Director
Program in Mathematics
Illinois State University

Irwin Feinstein
Department of Mathematics
University of Illinois–Chicago Circle

John Harris
Middle Tennessee State University

Jo Anne K. Hecker
Associate Dean, Graduate School;
Director, Doctor of Arts Programs
University of Miami

Thomas Howard
Professor of History
University of North Dakota

A. William Johnson
Dean of the Graduate School
University of North Dakota

Steven L. Jordan
Professor of Mathematics
University of Illinois–Chicago Circle

Eugene R. Kennedy, Dean
School of Arts and Science
Catholic University

Ivo E. Lindauer
Assistant Dean
College of Education and Arts and Sciences
Univeristy of Northern Colorado

David C. Miller
Coordinator of D.A. Programs
University of Illinois–Chicago Circle

Irving F. Miller
Dean, Graduate College
University of Illinois–Chicago Circle

Anthony N. Penna, Director
Carnegie-Mellon Education Center
Carnegie Mellon University

Arthur Reynolds
Dean of the Graduate School
University of Northern Colorado

Lawrence H. Rice
Graduate Dean
Idaho State University

Erwin Steinberg
Department of English
Carnegie-Mellon University

Robert D. Stout
Dean of the Graduate School
Lehigh University

David Wheeler
Dean of the Graduate School
Ball State University

Charles A. White
Dean of the Graduate School
Illinois State University

Alfred Young
School of Arts and Sciences
Atlanta University

**Others:**

Paul L. Dressel
Professor of University Research
Michigan State University

Roy P. Peterson
Associate Director for Academic Affairs
Illinois State Board of Higher Education

*Appreciation is expressed to the Carnegie Corporation and specifically to Dr. Alden Dunham for financial assistance making possible the several discussions leading to this statement.*

## The Doctor of Arts Degree

1. Purpose of the Doctor of Arts degree

   1.1 The Doctor of Arts degree is a content-based degree designed especially to

   a) prepare individuals for a career in college teaching and in the substantive disciplines, especially at the undergraduate level; and

   b) educate individuals who can and do engage in scholarly research relating to course content, the improvement of teaching, or to the development and revision of the curriculums or programs in their substantive discipline.

   This statement emphasizes the D.A. as a professional degree for college teachers and emphasizes the existence and importance of research directed to the improvement of the content, processes, and materials used in teaching. Substantive research in a discipline is not irrelevant to those concerns.

   The offering of the D.A. for purposes other than those stated above is not only inappropriate, but may also inhibit the achievement of widespread understanding and acceptance of the purposes and character of the D.A.

2. The substantive or disciplinary component of the D.A. should

   2.1 be sufficiently broad to provide a background for teaching or development of undergraduate offerings of a discipline while avoiding such broad coverage and consequent superficiality that the quality and depth of the program are lessened;

   2.2 be provided in courses and seminars appropriate for doctoral study;

   2.3 include consideration of the relationship of advanced scholarship and research to undergraduate instruction;

   2.4 use a problem or theme approach to give unity and coherence to any degree program which is based upon two or more disciplines;

   2.5 provide the instruction and experience in using the modes and methods of inquiry that characterize a discipline.

3. The professional component of the D.A. should include:

   3.1 one or more courses or seminars that deal with problems of teaching and learning, course development, evaluation, liberal education at the undergraduate level. Such courses should be planned to include such topics as development of higher education in the U.S.A., conceptions of the role and character of higher education, human learning, and characteristics and problems of college students and of the professoriate.

   3.2 one or more courses or seminars focused on instructional and curricular problems and practices in a discipline or group of closely related disciplines (e.g., natural sciences or social sciences).

   3.3 a supervised internship that, depending upon prior experience and performance, may have one or more phases of increasing responsibility. The final phase of the internship should provide an opportunity for creative and scholarly effort in course development, teaching and assessment. The internship may provide the focus of the dissertation or culminative paper and final oral. If the internship and dissertation are combined, scholarly insight into the discipline as well as into the problems of teaching should be evident. The internship experience (and any dissertation or paper based upon it) should usually develop out of the previous studies described in 2 and 3.1 and 3.2.

   3.4 A dissertation or an integrative or culminative paper demonstrating the ability of the degree recipient to perform in a professional manner implied by the nature of the degree. It should provide for the use or development of research skills in the discipline and also involve some aspects related to teaching preparation of instructional materials, developing or evaluating courses, or developing and using instructional media in the discipline may also be appropriate projects.

4. The staffing of the D.A. professional offerings and the staffing of D.A. doctoral committees should recognize that the doctoral program of a prospective D.A. may often involve courses and activities

transcending the immediate discipline that determines the major portion of the program. Faculty members with appropriate experience and competency should be sought to teach such courses and serve on committees regardless of departmental or disciplinary affiliations.

5. The coordination of the courses and requirements composing the professional component of the D.A. should be a shared responsibility of the departments offering the D.A., the graduate school, and the individuals teaching those courses. A committee chaired by the graduate dean or his designate has frequently been found to be an effective way to handle this matter.

6. Experience with D.A. candidates to date indicates that they demonstrate a high degree of variability in experiences, education, and length of service. Most of them have been involved in teaching assignemnts in community colleges or liberal arts colleges and have completed D.A. requirements while on leave or by a combination of full- and part-time study. These circumstances dictate a degree of flexibility in planning individual programs that is inconsistent with rigid specifications of core professional courses, site and length of internships, and residence requirements. Suggested or recommended electives provide the opportunity for individuals to round out either the professional or the substantive component of the degree.

   The requirement of a dissertation (or equivalent) and a final examination are widely regarded as desirable to bring the D.A. program to a definitive close (see 3.4).

Although credits and time serving are inadequate indicators of program quality and individual accomplishment, there should be some clear statement and an accompanying rationale for allocation of credits to the various D.A. program components.

The following model may serve as a guide to the planning of D.A. programs, with the expectation that justified variations resulting from individual, disciplinary, and institutional differences and commitments will be the practice rather than the exception. The model assumes a total of 90 semester credit hours—a full three years of study, including the master's and doctor's levels. Institutions that have not customarily assigned credit hours to internships or dissertations may exhibit a similar pattern but indicate a different credit hour total.

| | |
|---|---|
| Substantive courses and credits in the discipline and related fields | 55 semester hours |
| Professional core (all D.A.'s) | 9 semester hours |
| Professional courses in discipline | 6 semester hours |
| Internship ) Dissertation) or equivalent | 20 semester hours |
| Total requirement | 90 semester hours |

For some persons, interdisciplinary D.A.'s may be desirable. Whether or not programs of sound quality can be developed depends both upon the individual and the institution. The strength of the relevant disciplines, not only as disciplines, but in relation to the program focus, is essential. Only individuals whose prior education and experience permit a sound combination of breadth and depth should be permitted to develop such programs. It may be desirable to have a special committee appointed by the graduate dean to develop a general structure or set of guidelines for interdisciplinary programs and to review and approve or reject specific interdisciplinary program proposals.

# M.S. and Ph.D.
# PROGRAM IN PHYSIOLOGICAL CHEMISTRY
# AT
# LEHIGH UNIVERSITY

The graduate program in Physiological Chemistry is an interdisciplinary one aimed at preparing individuals interested in a career in biomedical research, teaching, or administration, or in some aspect of public health. Students enrolled in this program may have majored in biology, chemistry, animal science, entomology, veterinary science, pharmacy, or some other area of the life sciences. All students participating in this program are enrolled in the Department of Chemistry and are provided research space in one of the laboratories of the Center for Health Sciences.

Current research interests of the faculty include:

MEDICINAL CHEMISTRY

NUCLEAR MEDICINE

EXPERIMENTAL PATHOBIOLOGY

EXPERIMENTAL PARASITOLOGY

IMMUNOLOGY

TOXICOLOGY

MEDICAL AND PUBLIC HEALTH ECOLOGY

Financial support is available on a competitive basis in the form of research assistantships and fellowships.

For further information write:

**Dr. Thomas C. Cheng, Director**
**Center for Health Sciences**
**Building No. 17**
**Lehigh University**
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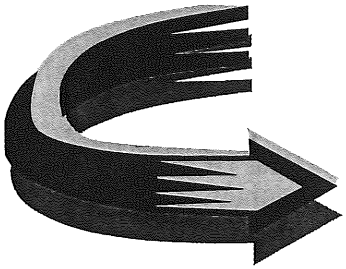

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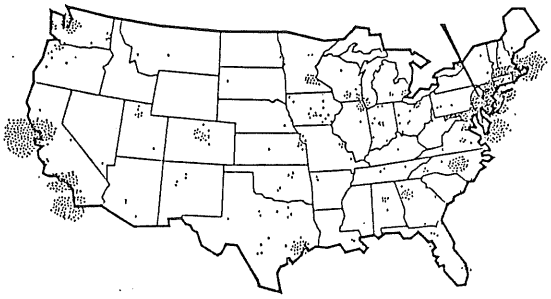

To learn more about the Center, contact:


**Dr. Neal Simon**, *Director*, or
**Dr. Daniel Lima**, *Deputy Director*,
phone (215) 758-5426
fax (215) 758-5851


# CENTER FOR MOLECULAR BIOSCIENCE AND BIOTECHNOLOGY

LEHIGH UNIVERSITY

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Fostering cooperative research and training between the university and industry.

Bringing flexibility, ingenuity and problem solving skills to the private sector.

## *Lehigh's Tradition of Close University/Industry Partnerships*

The Center for Molecular Bioscience and Biotechnology (CMBB), established in 1986, blends faculty expertise in molecular and cellular biology, biochemistry and health sciences, biochemical engineering, and environmental sciences to solve problems in areas of applied biological sciences—the new biotechnology.

Forty percent of Lehigh University's external research support comes directly from industry (ten times the national average for universities). Many firms with close ties to Lehigh have become industry leaders, in part because of the help they received from the university.

Located on the spacious and scenic Mountaintop Campus we have integrated biotechnology-related faculty, graduate students, and professional staff into contiguous research, teaching, and office space —a total of 45,000 square feet.

The result has been a synergistic mix of 26 faculty members, 80 graduate students, and 15 research scientists and engineers working side-by-side, sharing technical perspectives, laboratories, equipment, and classrooms.

## *Vehicles for Success... CMBB/Industry Partners*

The CMBB's objective is to promote interdisciplinary research among its 26 participating faculty members and numerous research scientists and engineers. We encourage direct participation from private industry through the following vehicles:

- ***Industrial Liaison Membership.*** Membership serves as an introduction to CMBB expertise and facilities. Often this first step leads to more extensive collaboration between your company and CMBB scientists and engineers of your choosing.
- ***Industry-Funded Projects.*** These contract R&D projects are negotiated through the CMBB to accomplish a specific study or task. Feasibility studies, product development, process scale-up and optimization, and toll manufacturing are some of the types of projects that CMBB routinely accomplishes.
- ***Consortium Projects.*** You may need a more comprehensive R&D approach involving several CMBB scientists and engineers—from basic scientific understanding to technology transfer. Because we are an interdisciplinary center, with core facilities, our staff can propose an integral R&D program managed by a consortium of biologists, biochemists, and biochemical engineers.

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Our laboratories contain an impressive collection of state-of-the-art equipment. Access to these instruments and facilities can provide companies—small or large—with a cost-effective alternative to acquiring specialized and expensive instruments for high risk R&D or short-term projects. A partial list of facilities includes:

Fermentation laboratory and pilot plant
Molecular biology laboratories
Mammalian cell culture laboratories

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  - Raman FT
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*Hormone receptors and reproductive cell biology*

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*Lysosomal glycosidases and complex carbohydrates in animals*

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*Development, structural and functional, of Drosophila; molecular genetics*

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Chemical & Engineering NEWS

# Lehigh: One University's Approach To Rejuvenating U.S. Industry

Wil Lepkowski

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# Lehigh: One University's Approach To Rejuvenating U.S. Industry

## Industry-funded centers and institutes and strong regional roots give Lehigh formula for applying academic research to upgrading industry, economy

**Wil Lepkowski,** C&EN Washington

Asa Packer, the 19th century railroad magnate and dedicated but modest capitalist, probably would wax proud today to look down from his place in the Elysium onto Bethlehem, Pa., and view his dream of 127 years ago. Lehigh University is no tall hog among the country's research universities, but it does appear to have something to say about the university's role in the technological changes now enveloping the U.S. in this postindustrial, information-intensive era.

What likely would please Packer today would be the type of university Lehigh plans on becoming: mainspring in the technological revitalization of a regional economy. It is slowly acquiring national attention as it incorporates its high-tech faculty talents into the economic challenges that face the country.

Lehigh feels that enough intellectual challenge lies toward regional revitalization that it need not go big time. Yet at the same time, the school is far from parochial. Some of its departments—materials, robotics, microelectronics, chemistry—enjoy international reputations. The difference is that although faculty members compete well among peers, Lehigh seems comfortable in its identification with the region in this postindustrial era.

The place literally bristles with interdepartmental institutes and centers—information and computer sciences, marine and environmental studies, social research, surface and coating research, emulsion polymers, fracture and solid mechanics, robotics, biotechnology, ink research, thermo-fluid engineering—and thus a faculty willing to cross disciplinary boundaries to communicate with one another. That intellectual cross hatching is most responsible for the financially enriching relationships Lehigh has developed with more than 100 companies around the country.

Moreover, it is trying to integrate its technological strengths into the other educational functions of the university—through new programs and courses in the management of technology in the business school and through the development of a new institute for international technology transfer. It already has a thriving science, technology, and society program that brings the leavening of the liberal arts to issues involving science and technology.

And yet it remains rooted in two ways: to its region, the Lehigh Valley, and to the basic liberal arts idea of the university. And it has a president in Peter Likins who seems to understand the integrated social and economic circuit that loops together knowledge, university, region, and economy.

Likins was sworn in as the eleventh Lehigh president two years ago, succeeding Deming Lewis, who in his 17 years worked to raise Lehigh up from its reputation as merely an undergraduate engineering school to a respected research university. Now its next phase is to use its technological strengths to create what Likins hopes will be balanced excellence among all the departments, and at the same time the high-tech heart of the regional economy.

Likins appears comfortable in this basic regional relationship. "A Lehigh presidency," he says, "differs from other university presidencies in that you have a community leadership responsibility. That means, for example, that in planning your horizons and making efforts to look down the road, you're guided primarily by your concerns for your institution, but fundamentally for your total community. You're looking out for the cultural vitality of your whole community. When you think in terms of the economic vitality of the Lehigh Valley, you think fundamentally of Lehigh's role in supporting it."

Local development officials rejoiced last year, when, thanks largely to Lehigh's strong microelectronics faculty, AT&T decided to locate its new telecommunications research center in the valley's Whitehall Township, near Allentown. The new center joins AT&T Technology Systems' (formerly Western Electric) manufacturing plant where the 256-kilobyte RAM chip was developed and is now being manufactured.

### Lehigh at a glance

**Enrollment:** Undergraduate, 4400; total graduate, 1900; science and engineering graduate, 850

**Tuition:** $8000 per academic year

**Budget:** $82 million

**Endowment:** $102.5 million (market value)

**Gifts and grants:** $15 million

**Other funding:** Ben Franklin Partnership funding, state, $2.9 million; private, $8.5 million

**R&D spending:** $8.3 million

C&EN staff photos

*Likins: responsibility to community*

Lehigh heads a group of universities that under a Pennsylvania state plan is aiming to revitalize through advanced technology the northeastern part of the state. The plan is known as the Ben Franklin Partnership, and it is now entering its third ambitious year.

Some people remark that Lehigh has no business getting involved in job building for an economically distressed state, but the majority say that universities today have no choice but to embed themselves in their regional economies. And it has that historical tie with industry that seems natural to exploit for broader goals.

*Bolton: help industries be competitive*

Lehigh appears to pack a lot of clout for such a small school. According to National Science Foundation tables, it ranks only 140th among universities in federal research funding (with $6.5 million), its research budget totaling $8.3 million in the 1982-83 fiscal year. But it has an alumni group so enthusiastic that fully 56% of it contributes to its annual fund drives, ranking third behind Dartmouth and Princeton. Its endowment has grown to about $100 million from $60 million five years ago. And fully 20% of its research funding comes from private industry.

It is clear from talking to several department heads that Lehigh has carefully marketed its faculty capabilities to industry. And it continues to perfect its techniques. One example is the materials liaison program, whereby the members of the materials institute faculty visit industrial laboratories and help out with problems there in exchange for graduate student support from those companies.

"These liaison programs," says John Chen, chairman of the chemical engineering department, "are relatively inexpensive to the companies but provide a fine forum that leads to bigger programs on defined subjects. So we market, but it's very clear here that the most successful marketing is done by the individual scientists."

Another approach is the consortium. "Because we're small," says Chen, "we tend to encourage this approach. We have an interdepartmental clustering of effort. Whenever we find a few common interests, we tend to cluster them. This permits us to have a critical mass of faculty in a subject area. The net result at Lehigh is a bundle of centers and institutes around which companies are invited to become consortium members."

One center, in process modeling and control, has as members Du Pont, Exxon Chemical, Rohm & Haas, Air Products & Chemicals, and Tennessee Eastman. Cost per company is $50,000 a year, and Chen says the center is looking for about five more companies to join in. The money goes for both faculty salary and graduate student support.

A third approach is the "friend" arrangement organized on the department level. This takes many forms, including direct financial support, the lending of company engineers to work with students, or providing internship programs for the students.

So the university over the years has established community bonds with its industrial cohorts and has no hesitation in brandishing its sense roots as part of the Lehigh Valley. And that would appear to make it thoroughly postindustrial.

Ernest A. Lynton, professor of public affairs at the University of Massachusetts' Boston campus, has been studying the changing role of universities in the postindustrial era. Lynton says that the technical needs in the world absorb knowledge quickly and that universities, as producers of that knowledge, need to pick up the tempo. He says it isn't enough to add more money to R&D or to expand science and engineering faculties. "We need more pervasive structural changes to accommodate the new missions," he says. "New knowledge and new technology must be absorbed into the fabric of our economy and become part both of manufacturing and service industry before they can have an appreciable impact.

"These goals cannot be pursued merely by fiddling with the curriculum and adding a few courses here and there. Universities must make a determined attempt to achieve greater internal coherence and interconnectedness of the curriculum and, at the same time, relate it more effectively with the outside world," he says. What Lynton argues for is some new university structures that would preserve and enhance the disciplines but develop a "second stream" of cross-disciplinary outreach activities. What he terms "new" appears to be de rigeur at Lehigh.

Chemistry department chairman Doyle Daves has been at Lehigh only two years, but he says it didn't take him long to capture the spirit of the place, finding it immediately applicable to his department's key role in the scheme.

"Chemistry," says Daves, "is really the science that lies under the high-tech areas, whether they are microelectronics, materials, or biotechnology. All are chemistry-based sciences. Lehigh at this point is really structurally placed for the kind of emphasis coming, in that we've had emphasis on interdisciplinary research teams for years. We are experienced at building the kinds of groups coming from all over the country. I don't know of any other small university that has so much experience with the combination of focused and interdisciplinary fields."

Students, too, benefit. Daves says exposure to thinking across disciplines cannot help but improve students' chances of finding better jobs after graduation.

Daves says the chemistry department forms the core of institutes or centers for materials, surface coatings, health sciences, and polymers. "Not all of these are written into the Ben Franklin program, but we expect them to be deeply involved in those projects."

Pennsylvania is a smokestack state, not known for its high-tech companies. The hope is that the universities can superimpose their high-tech R&D know-how onto Pennsylvania's industrial base, which is the whole point of the Ben Franklin program.

Under it, Lehigh is in charge of the so-called Northeast Tier (NET) grouping of counties and serves as that region's Advanced Technology Center. University City Science Center in Philadelphia has the southeast, Pennsylvania State University the central part of the state, and Carnegie-Mellon and the University of Pittsburgh, the western section.

Under the Ben Franklin program the aim is to pull together the state's academic, labor, government, and industrial sectors into consortia to upgrade old industries and bring new ones to the state. The process involves establishing advanced technology centers in each of the four regions of the state, for which the state legislature appropriated $10 million for the first year. Lehigh received $2.9 million and got another $8.4 million from outside sources.

**Federal sources dominate R&D funding**

| $ Thousands | |
|---|---|
| U.S. government | $6494 |
| Defense Department | 2183 |
| National Science Foundation | 2095 |
| Energy Department | 920 |
| National Aeronautics & Space Administration | 345 |
| Health & Human Services Department | 257 |
| Transportation Department | 181 |
| Nuclear Regulatory Commission | 176 |
| Justice Department | 127 |
| Agriculture Department | 75 |
| Commerce Department | 72 |
| National Academy of Sciences | 61 |
| National Endowment for Humanities | 2 |
| Private corporations | 1487 |
| State government | 181 |
| Foundations | 144 |
| Local government | 18 |
| TOTAL | $8324 |

Note: Figures for 1982–83 academic year.

Lehigh's center focuses on its four major technological strengths: computer-aided design and manufacturing, microelectronics, biotechnology, and materials. Most of the energies for now will be applied to the computer area, because that field spans almost all industries aiming toward higher productivity.

Lehigh has interdepartmental institutes in all of them. It's the Advanced Technology Center's job, then, to bring in the Lehigh faculty for R&D activities, for teaching and training people in the fields or entering them, and helping them with business and management advice when they wish to start a new company. That's one of the reasons Lehigh's Advanced Technology Center works with the older Small Business Development Center, which, under John Bonge, runs a variety of projects designed to help, through financial and management advice, entrepreneurs get started in business. Thus, the Advanced Technology Center provides office, or "incubator," space for companies just getting started.

"Our first priority," says its executive director, Michael G. Bolton, "is to help the existing industries be competitive. That's why we call our program advanced technology, not high technology. We think the biggest users are going to be the traditional firms."

One example of how Bolton sees Lehigh's role locally: "Last week I was at Bucknell in Lewisburg and discovered that the major proportion of wire rope makers were all within a 50-mile radius of Lewisburg. So we immediately asked ourselves, How can the elements of the community work together to make our wire rope manufacturers the world leaders in wire rope technology?"

Another example is the series of cooperative projects between the computer-aided design and manufacturing laboratories in the department of mechanical engineering and McDonnell Douglas Automation, Data General, five community colleges in the NET region, and Lehigh's ongoing group of computer-related industrial partners. The key philosophy lies in the concept of networking, keeping the information and the human contacts flowing between knowledge and user.

Bolton sees the Ben Franklin initiative as a modern day reworking of the concept known as pride and knowledge of place, whereby a region focuses on its own resources as a base for its growth. "The Japanese," he says, "have a strategy called settlements. You identify the resources in your region that can contribute to the economic development of that region. In that sense, not a week goes by when I don't find something about northeast Pennsylvania that could contribute to our strategy."

If Bolton knows where he wants to go with the program, the faculty is still getting used to it. "We're trying to get a feeling for what this Ben Franklin animal is," says Chen, whose chemical engineering department has heavy involvement in the program. "It is new. It clearly has potential for added financial resources. So in this sense it has a lure. The state's declared interest is valid. We're learning and making the rules as we go along. But there is a potential danger in such an activity. We have to be careful that we're not dazzled by the potential for financial support and in the pro-

cess lose our concerns for the teaching and scientific value."

"The fact that we went headlong into the Ben Franklin program," adds Joseph Goldstein, vice president for research, "is the feeling that we knew how to deal with industry. But still, it's a delicate relationship. We produce students and education, and they want jobs. The state has to realize, too, that if it wants help from the university, it has to help the university. That means we can't be merely a dispenser of money but have to involve ourselves in the activity, by research projects, investment in equipment to build centers of excellence and in training aspects which are really teaching aspects. And we're glad to share in the public relations that naturally comes with this."

One of Lehigh's missing links is a business school involvement in the management of technology, a field in which only a handful of universities can boast expertise, or even interest. But last September it moved to fill the vacuum by appointing Alden S. Bean to the Keenan Chair for Management and Technology.

Bean, formerly head of policy studies at the National Science Foundation, says he finds it "delightful" that the university has long felt so comfortable in its relations with industry. Bean is hoping to develop a research and teaching program in technology and management through another one of those Lehigh centers. He says he hopes to get 10 to 20 companies as sponsors within the year.

The new center would incorporate into the teaching and training program what today only appears as a trend in management thinking: that managers need to know more about the nature of the technology they are administering.

"Most people tend to treat business as a homogeneous set of activities," Bean says. "But research results coming out say that it isn't so. Deep understanding of the technological foundations of the economy and business are as fundamental to industry as the management structure of a company."

Lehigh isn't the first school to think in those terms. Others, in fact—Stanford, MIT's Sloan School, Claremont College, Case Western Reserve, and Northwestern—have had programs of that sort going for years.

But his approach does resonate with the more advanced thinking today, that in an era of fast technological obsolescence—product marketability is said to turn over every five years as opposed to the 10 or 15 in the preceding era—generalized management principles just don't apply across the board. A manager needs continuous input from the world of technological ideas. One cannot be trained only in management and expect to run a technologically intensive company effectively.

"If you're in the manufacture of industrial chemical intermediates, your management problems are different from those of agricultural chemicals or packaged foods. This means that large corporations in multiple lines have to establish practices that are different than if they were in a single line of business," Bean says.

"So I'm interested in the linkage between technological choices that are made at the R&D level and the strategic choices that are made at the corporate level. The risks and the management problems associated with innovation are different depending on the different lines of businesses."

Nor is Lehigh ignoring some serious looks at the human face of these oncoming technologies. Like many research universities, Lehigh has developed a multidepartmental science, technology, and society program that explores the social ramifications of the technological revolution. And even this effort is grounded in the issues facing the Lehigh Valley. The program is headed by historian Steven L. Goldman, who later this month is hosting a conference on the impact of new technologies on the economic and social development of eastern Pennsylvania. "We're asking," says Stephen H. Cutcliffe, a professor in the program, "what the region can do to plan so that the changes ahead can be as acceptable to as many people as possible."

What this all appears to add up to is the development of a university that, in the words of Likins, "covers the ground." And in what appear to be possibly rough economic times ahead, Likins fears, it will be the technical schools that will need to cover, or protect, the all-important liberal arts.

"Look at the balance of trade, look at our deficits," he says. "These are terribly dangerous times for the national economy. Under these pressures there is a tendency in any society to invest limited funds toward short-term paybacks. And liberal education, as a long-term payback, is low on anybody's list. I'm fearful that education, broadly considered, will have a hard time getting support at a time when all things are judged by economic measures."

Accordingly, Likins sees that high tech and the money it attracts is going to be needed to help fund the strengthening of the liberal arts on his campus. And he is developing a plan to see that it happens. "It's ironic," he says. "The liberal arts, in their role as the transmitting and interpreting agents of new knowledge, have been technology's main critics. Yet it will take the wealth technology attracts to financially protect them in their difficult times."

Lehigh obviously isn't the country's only postindustrial university. And maybe it isn't even the best of the ilk; for even educational fashions change. But as a case study of a popular concept, it does seem worth taking a look at. Lehigh seems to stick to the basics—or put another way, seems to know where home is. □

**Engineering tops fields of federal R&D spending**

| $ Thousands | |
|---|---|
| Engineering | $3592 |
| Chemistry | 1189 |
| Other physical sciences | 266 |
| Math/computer sciences | 397 |
| Life sciences | 218 |
| Environmental sciences | 213 |
| Social sciences | 190 |
| Psychology | 15 |
| Other sciences | 367 |
| TOTAL | $6447 |