Chemical Engineering 2001

Consider the second step of ionization:

\[ \text{the equilibrium concentration of } \text{C}_2\text{O}_4^{2-} \text{ in mol/L, } T = \text{equ}\]

\[ \text{H}_2\text{O}_4^{2-} \stackrel{(aq)}{=} \text{H}^+(aq) + \text{C}_2\text{O}_4^{2-} \]

0.054

0.054 + y

\(10^{-3} \text{ mol/L} \)

\(= 6.1 \times 10^{-5} \)

In the previous problem, we wrote:

\(= 6.1 \times 10^{-5} \)

\[ \text{H}_2\text{O}_4^{2-} - y = 0.054 \]

To substitute them in the equation, which reduces to:

\[ y = 6.1 \times 10^{-5} M \]

At equilibrium, therefore...
Dear Alumni,

This year 2000 has proved to be both a challenging and an exciting year.

A major challenge of the department has been the finances largely due to the addition of the new faculty, perhaps the most important investment for our future. The good news is that with the Chemical Engineering Campaign we have raised $870,000 for undergraduate scholarships and graduate fellowships. We are most grateful to our alumni who have generously contributed to this campaign. We also hope that those who have not yet contributed will help us reach the goal of $1,000,000 before the end of the year. I hope you all realize that the major challenge that the University faces is a relatively low endowment compared to other competing schools, making it difficult to provide financial aid to our undergraduate students. The major challenge we face as a department is that the cost of graduate students at Carnegie Mellon is now among the highest in the nation, making it difficult for new faculty to develop their academic careers. We trust our alumni, through their generous pledges, will help us to overcome these financial challenges.

Among the exciting developments this year, Neil Donahue from Harvard has joined our department as an Assistant Professor with a joint appointment in the Chemistry Department. The research area of Neil, which is atmospheric chemistry, will greatly strengthen our envirochemical engineering area, and complement the vigorous efforts of Spyros Pandis who in fact has recently obtained a $3.5 million grant from EPA to establish the Supersite for Pittsburgh Particular Matter to study the air quality in Western Pennsylvania. Another important development has been the formation of the Center for Complex Fluids Engineering, which involves about one-third of our faculty. A major goal of this center will be to develop novel experimental and theoretical techniques for the synthesis and characterization of nanomaterials for pharmaceutical processing. Descriptions of these two new centers in the department can be found in this issue.

We are very pleased to inform you that Larry Biegler has been recognized with the 2000 Computing in Chemical Engineering Award from AIChE for his contributions to process optimization. Also, two of our undergraduates, Scott Shell who went to Princeton, and Michael McElroy, who went to Harvard, have received NSF graduate fellowships. In the case of Scott, he also received a prestigious Herz fellowship. Mike McElroy obtained his Master of Chemical Engineering degree together with his B.S. degree. Our seniors who went to industry did very well and obtained an average salary of $50,729. (See inside newsletter for job statistics).

Finally, I hope you will enjoy reading this newsletter. We have added a new section where we want to highlight some of our distinguished alumni. I very much hope you will be in touch with Carnegie Mellon, and especially the Chemical Engineering Department.

Ignacio Grossmann
Welcome Assistant Professor Neil Donahue. Chemical Engineering’s newest faculty member. Professor Donahue comes to Carnegie Mellon from Harvard University, where he was a Post-doc and Research Scientist in the Chemistry Department. He received his Ph.D. in 1991 from the Massachusetts Institute of Technology in Meteorology. His office is in Doherty Hall room 1106.

Professor Larry Biegler has been selected as the recipient of the 2000 Computing in Chemical Engineering Award from the CAST Division of AIChE. Larry received the award at the Annual Meeting in Los Angeles, on November 14. Aside from receiving a check, he gave an after dinner speech on that date. The award is in recognition to Larry’s outstanding contributions in process optimization and Process Systems Engineering.

Spyros Pandis received the Kenneth T. Whitby Award at the Annual Conference of the American Association for Aerosol Research. This is a very prestigious award that recognizes outstanding technical contributions to aerosol science and technology by a young scientist.

Professor Mike Domach was elected to be a Fellow of American Institute of Medical and Biological Engineering. Mike was also elected to the Editorial Board of Biotechnology, the co-Recipient of Patent 6008010, issued 12/99 entitled “Method and Apparatus for Holding Cells,” and he was invited to give a lecture at Merck entitled “NMR Methods for Process Analysis.”

Professor Ignacio Grossmann, was elected to the National Academy of Engineering for leadership in mixed integer programming (MINLP) model formulation and solution for process design and operation. Ignacio is recognized as an outstanding educator and scholar. He focuses his research in the areas of process synthesis, energy integration, process flexibility, planning, and scheduling of batch and continuous processes, and mixed-integer and logic-based optimization. He has authored more than 170 papers, several monographs or design case studies, and the textbook Systematic Methods of Chemical Process Design. Ignacio has graduated 26 PhD and 3 MS students.

Professor Ignacio Grossmann was awarded the 2000 Outstanding Technical Achievement Award in the category of Academic Research at the Hispanic Engineering National Achievement Awards Conference (HEENAC) that took place in El Paso, Texas, on October 21.

Professor Myung Jhon, was featured in the Fall 2000 issue of the Carnegie Mellon Magazine, in an article titled, “Hourglass Model Broadens Undergraduate Education.” Specifically, Professor Jhon wants his students to apply knowledge from other areas of engineering when they solve problems in fluid mechanics.

Professor Todd Przybycien was featured in the Fall 2000 issue of the Carnegie Mellon Magazine for being named head of the new Biomedical and Health Engineering Program in the College of Engineering.

Professor Lynn Walker received the Kun Li Award for Excellence in Education at the 2000 Commencement ceremony.
Faculty in the News

EPA Supersite: Spyros Pandis

The Pittsburgh Atmospheric Particular Matter Supersite Program
Airborne particulate matter (PM) continues to pose serious health risks for susceptible members of the U.S. population and for sensitive ecosystems. Design of cost-effective PM control strategies is limited by the lack of understanding of the PM-health effects links which is exacerbated by a paucity of physiological data, the difficulty of establishing the PM-source-receptor relationships, and finally the limitations of existing instrumentation for PM measurements. The Environmental Protection Agency and the Department of Energy have awarded Professor Spyros Pandis (ChE/EPP), Cliff Davidson (CEE/EPP), and Alien Robinson (ME/EPP) $6.8 million for a comprehensive multidisciplinary study in the Pittsburgh region, which will address the above issues. The study will include investigators from twelve universities, three national laboratories, and two private companies. The field study part of the program is scheduled to start in May 2001 and will last for eighteen months.

The objectives of the Pittsburgh Supersite Program are:
- to characterize atmospheric PM (size, surface, and volume distribution, chemical composition as a function of size and on a single particle basis, morphology, and temporal and spatial variability) in the Pittsburgh region
- to quantify the impact of the various sources (transportation, powerplants, biogenic, etc.) to the PM concentrations in the area;
- to develop and evaluate the next generation of atmospheric aerosol monitoring techniques (single particle measurements continuous composition measurements, ultrafine aerosol measurements, improved organic component characterization, etc.)
- elucidate the links between PM characteristics and their health impacts;
- quantify the relationship between indoor and outdoor concentrations;
- and quantify the responses of PM characteristics to changes in emissions to support regulation development.

More information about the program can be found in http://homer.cheme.cmu.edu

CFE Center: Lee White

Center for Complex Fluids Engineering
There is a history of excellence in colloid and polymer science at CMU. A multidisciplinary group of faculty from CIT and MCS has been performing collaborative research as part of the Colloids, Polymers and Surfaces (CPS) program for a quarter of a century. Recently, the desirability of block funding to enable effective response to the problems of complex fluids engineering in industry has become increasingly apparent. In order to present our case for such funding in the strongest light, the faculty involved have sought recognition as a cohesive research group from the College of Engineering. As of August 30 this year the Center for Complex Fluids Engineering was officially established as a CIT center. The Center director is Prof. Lee White (ChE.) with Prof. Steve Garoff (Physics) and Dr. Annette Jacobson (ChE) as deputy directors.

Complex fluids, which include polymeric and surfactant solutions as well as colloidal suspensions are of universal industrial importance due to their unique mechanical properties, their capacity to solubilize and transport materials and their internal microstructures. In large-scale operations, due to economics and optimization concerns, the simultaneous interaction of polymer, particle, and surfactant plays a key role in the process efficiency and product quality. Complex fluids engineering is a synergy of scientific knowledge bases and, in the absence of that cross-disciplinary interaction, has been historically restricted to the Edisonian approach for want of a rational basis for formulation. As a recognized research center with the requisite cross-disciplinary skills, the group will actively target block funding and industrial consortia. Ongoing initiatives focus on three areas: block funding for an NSF center, block funding for graduate training grants and a industrial consortium focusing on complex fluids problems in pharmaceutical processing. The educational arm of the Center for Complex Fluids Engineering will continue to be the Colloids Polymers and Surfaces Program.
Tom McConomy
Tom McConomy, co-chair of the department's Advisory Board, received his bachelor's degree in chemical engineering from Carnegie Mellon. Tom is former chairman of the board of Calgon Carbon Corporation. He is also a life trustee and former chairman of the Board of Trustees of Carnegie Mellon. He has held several positions at Calgon Carbon Corporation. In 1988, he was vice-president and general manager. Earlier, he was manager Calgon Interamerican in Caracas, Venezuela; for twelve years he served as President and CEO of the corporation. He was with Calgon Carbon on its predecessor companies from 1955 to 1994 and again from 1998 to 1999. He has contributed to technical publications and given technical papers to various conferences on industrial water treatment. Tom is also a director of Equitable Resources, Inc., Greater Pittsburgh Chamber of Commerce, Pittsburgh Regional Alliance, and Southwestern Pennsylvania Corporation.

Stan Morris
Stan Morris, co-chair of the department's Advisory Board, received a bachelor's degree in chemical engineering from Carnegie Mellon and master's and doctor's degrees in chemical engineering from Lehigh University. Stan is corporate vice president of Technology at Air Products and Chemicals, Inc. Previously, he was vice president of Technology for Air Products' Gases and Equipment Group, and earlier, vice president of Technology and Business Development for Chemicals. He has been vice president of the Corporate Science and Technology Center, general manager for the Technical Diversification Department and vice president of Engineering Technology for International Coal Refining Company, an Air Products joint venture. Stan is a member of the American Institute of Chemical Engineers, American Chemical Society, Industrial Research Institute (IRI), and Sigma Xi, a national research honor society. He is co-chair of the Chemical Engineering Visiting Committee at Lehigh University and also serves on the board of directors for the IRI and Community Services for Children in the Lehigh Valley.

Carol Dudley
Carol Dudley received her bachelor's degree in Chemical Engineering from the department and participates on our advisory board. Carol is the Business Vice President for Chlor-Alkali Assets at Dow Chemical. In this role, she leads the Chlor-Alkali Business Management Team, is a member of the Board of Directors for the Chlorine Institute and stewards the production of over 15 billion pounds of chlorine per year. Previously, Carol was the Operations Director for Chlor-Alkali Assets and Site Manager for the Oyster Creek Division in Freeport, Texas. She has also held the role as the Global R&D Director for the Epoxy Products and Intermediates Business. In this role, she had overall management responsibility for Research and Development in North America, Latin America, Europe and the Pacific regions.

Marco Duran
Marco A. Duran is the Head for Computational Sciences in ExxonMobil Research and Engineering Company. Computational Sciences is a “child of the Exxon and Mobil merger, since this function did not exist before in either company”. Marco's section is based in Clinton, New Jersey where he has been since 1988 when he joined Exxon Corporate Research Laboratories. From 1986 to 1988, Marco was a Professor at the Universidad Autonoma Metropolitana in Iztapalapa, Mexico City. Marco graduated from Carnegie Mellon in 1984 with a Ph.D. in Chemical Engineering. Marco's work at ExxonMobil, and before at Exxon, has always been in Applied Mathematics, Modeling, and Computing, for Optimization purposes. Throughout all these years, Marco has successfully demonstrated the value of Optimization in the oil business; he has been amply recognized internally for this. Marco's current job is to define, structure, and build the new Computational Sciences section. The section is in the hiring mode, and Marco is looking for excellent professionals with the right skills in Computational Sciences and large-scale Optimization Algorithms.

Paul McKenzie
Paul McKenzie, chair of CIT's Leadership Council and member of CIT's Advisory Board, obtained his BS degree from the University of Pennsylvania in 1987 and his Ph.D. degree from Carnegie Mellon in 1992. He is currently the Director of Pilot Plant Operations in the Pharmaceutical Research Institute of Bristol-Myers Squibb. He joined BMS in December 1998 from Merck & Company. At Merck, he was involved in process development of both the drug and the final formulation (i.e., tablet, capsule, etc.). This gave him a broad perspective of drug development process. He says the best project he has worked on to date is Crixivan, which is for HIV. It was a tremendous project for him since the science and teamwork was top shelf and as important, it had a tremendous impact on the lives of many people throughout the world.

Scott Whalen
Scott Whalen is a native Pittsburgher. He graduated in 1981 with a BS in Chemical Engineering and Economics, with an option in Colloids, Polymers, and Surfaces. Scott joined Procter & Gamble in Product Development in June 1981. His current position is Director of Product Development with global responsibility for the Company's Oral Care products such as Crest toothpaste and toothbrushes. Also responsible for research and development recruiting at Carnegie Mellon and currently sits on the External Advisory Panel for the Colloids, Polymers, and Surfaces program at CMU. Scott is a frequent visitor to Carnegie Mellon where he recruits engineering students and gives seminars to undergraduates about career paths in Chemical Engineering. He and his wife have three children, Kristin (14), Patrick (11), and Collin (6), and they live in Cincinnati, Ohio.
**Department News**

**Advisory Board Meeting**

The University requires each department to have an advisory meeting every 4 years in order to evaluate its academic and research programs. The department had its advisory board meeting on April 24-25, 2000. The department is most grateful to the following members of the board for their valuable advice.

- **Professor J. Larry Dudo**
  Pennsylvania State University
- **Mrs. Carol M. Dudley**
  The Dow Chemical Corporation
- **Dr. James Ebel**
  Procter & Gamble Company
- **Dr. Leonard Gerlowski**
  Shell Chemical Company
- **Professor Eduardo D. Glandt**
  University of Pennsylvania
- **Dr. George Hill**
  The Lubrizol Corporation
- **Dr. Michael Kosinski**
  Merck & Company
- **Mr. Thomas A. McCormy, Chair**
  Calgon Carbon Corporation
- **Dr. Stanley Morris, Co-chair**
  Air Products & Chemicals, Inc.
- **Mr. E. Kears Pollock**
  PPG Industries, Inc.
- **Professor G.V. Reklaitis**
  Purdue University
- **Professor Stanley I. Sandler**
  University of Delaware
- **Professor Michael L. Shuler**
  Cornell University
- **Dr. Jeffrey J. Sirola**
  Eastman Chemical Company
- **Dr. Klaus Sommer**
  Bayer Corporation
- **Professor Arnold Stancell**
  Georgia Institute of Technology
- **Dr. James Trainham**
  Dupont
- **D: Lynn Yanyo**
  Lord Corporation

**Chem E Student Job Placements**

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<th>Ph.Ds to Companies:</th>
<th>Laminar Software</th>
<th>McKinsey</th>
<th>Merck</th>
<th>Mitsubishi Chemicals</th>
<th>Rhodia</th>
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<td>Bayer (2)</td>
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<td>Dash Optimization</td>
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<td>ExxonMobil</td>
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<td>Immunex</td>
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<tr>
<td>Institute Defense Analysis</td>
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**Average Salary**

- **High** $85,000
- **Low** $68,000

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<th>Ph.Ds to Faculty:</th>
<th>Jae Woo Lee CCNY</th>
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<tbody>
<tr>
<td>Ph.Ds to Postdocs:</td>
<td>Aachen (J. Lee), Delaware (M. Buelow), Rhodia (M. Sun), Rice, Stanford</td>
</tr>
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</table>

**Master in Chemical Engineering:**

- Dow Chemical
- INTEL
- Pfizer

**Average Salary** $62,000/yr

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**New Award Established**

The Kun Li Award has been established in the Department of Chemical Engineering in order to recognize every year, a faculty member who has demonstrated excellence in teaching. The senior class selects the award recipient. Students are asked to select the faculty member who in their opinion has had the greatest impact in terms of education during their four years at Carnegie Mellon. The Award was established to promote excellence in teaching in chemical engineering. The award has also been established to recognize Emeritus Professor Kun Li who taught in the department from 1962 to 1988. Professor Li was an outstanding teacher and mentor, who showed exceptional dedication in his work. He had very high standards in his courses and always challenged students to think and to be creative in the solution of chemical engineering problems. The Department of Chemical Engineering is committed to excellence in education and research, and is very excited with the establishment of the Kun Li Award. The department is grateful to The Coca-Cola Company and to Professor Herb Toor for providing financial support for this award. **This year's recipient, Professor Lynn Walker**

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**Staff News**

**Congratulations to Ken Meyer, Chemical Engineering's Machine Shop Foreman and an alumnus of Carnegie Mellon.**

His article entitled, “The Miracle of Everyday Objects,” appeared in the Fall 1999 Carnegie Mellon Magazine. The article was one of four finalists in the Association of Educational Publishers feature articles category. Judges selected honored stories from 1,300 entries nationwide.

**Congratulations to Toni McIlvane for winning the 2000 Andy Award in the Enthusiasm category.**

President Jared Cohon and Provost Mark Kamlet presented the awards in recognition to staff for their contributions at the annual Andy Awards Program. The four categories are Citizenship, Dedication, Enthusiasm, and Innovation.

**Provost Mark Kamlet, Toni McIlvane and President Jared Cohon**
Department News

The 22nd Annual Chemical Engineering Symposium

The Chemical Engineering Graduate Student Association held the 22nd Annual ChEGSA Symposium on October 12th and 13th at Carnegie Mellon University. This year’s keynote speaker was Professor Klavs F. Jensen from Massachusetts Institute of Technology. Professor Jensen is the Lammot du Pont Professor of Chemical Engineering and Professor of Materials Science and Engineering at MIT. His address titled “Microchemical Systems: A New Approach to Chemical Synthesis” was well received by the Symposium audience consisting of industrial guests, faculty and graduate students.

As always, the ChEGSA Symposium would not be possible without the generous contribution from industry. The Department of Chemical Engineering and ChEGSA are grateful for this support.

The 2000 Symposium Winners

The 2000 Geoffrey D. Parfitt Memorial Award was presented to William C. Rooney for his talk entitled “Nonlinear Confidence Regions for Design Under Uncertainty.”

The Symposium Awards were presented to Susara A. van den Heever, “A Lagrangean Decomposition Approach for the Design and Planning of Offshore Hydrocarbon Field Infrastructures with Complex Economic Objectives,” and

Aravind R. Asthagiri, “Thermal Roughening of Naturally Chiral Metal Surfaces.”

The Honorable Mentions were given to Jennifer R. Jackson, “A Disjunctive Programming Approach for the Design of Reactive Distillation Columns,” and

Timothy D. Power, “Handedness in Single-Crystal Metal Surfaces.”

The 2000 Sponsors include:

Air Products and Chemicals, Inc.
Aspen Technology, Inc.
Bayer Corporation
BOC Gases
Bristol-Myers Squibb Company
The Dow Chemical Company
Elf Aquitaine
ExxonMobil Corporation
Intel Corporation
The Lubrizol Corporation
Merck & Company, Inc.
Mitsubishi Chemical Corporation
PPG Industries, Inc.
Procter & Gamble
Reference Metals Company, Inc.
Union Carbide

The 2000 Contributors include:

Johnson & Johnson
Simulation Sciences, Inc.
Graduate Student News

Congratulations to Stephanie Butler Velegol for receiving a Selected Professions Fellowship from the American Association for University Women. This fellowship is for women who are in the final year of writing their dissertation.

Recent Graduate News

Congratulations to Jae Woo Lee, was selected as a Humboldt Research Fellow by Alexander Von Humboldt Foundation.

Congratulations to Ganesh Vedantham, who won the Peterson Award from the BioT Division of the American Chemical Society for best student oral presentation at the 2000 Annual Meeting in San Francisco. Ganesh was awarded the W.H. Peterson Award for his talk "Protein Structural Integrity Loss During Continuous Infusion." Life Technologies, Inc. sponsors the award which consists of a cash award, a commemorative plaque and a $250 catalog credit from Life Technologies (GIBCO/BRL) for the awardee's research groups. Dr. Vedantham finished his Ph.D. in the Przybysz group in April 2000 and is currently employed as Associate Staff Scientist at Immunex, Inc. in Seattle, WA.

Undergraduate Student News

Undergraduate Scholarships

Chemical Engineering Alumni Scholarships, which have been possible with the generous contributions of our alumni to the Chemical Engineering campaign, were awarded to five undergraduates. The scholarships will be available to the following students until their senior year, provided they stay in the chemical engineering program and keep a GPA of 3.5 or higher: Brian Baker, Anthony Balducci, Jordan Green, Kevin Hughes and Earl Osman Solis.

Congratulations to Senior Raymond Ip who was awarded by the Delta Epsilon Iota National Scholarship Fund, the top prize in the annual "Search for Excellence" competition. The public award program "seeks to identify leading scholars whose character and community involvement exemplify the principles of Dedication, Enthusiasm, and Initiative." In addition to maintaining a perfect 4.0 grade point average while earning degrees in both Chemical Engineering and Psychology, Raymond has focused his extracurricular attention to participating in numerous outreach activities and strengthening the university's community service commitment as a whole. He founded both the First-Year Service Initiative program, and the Bridge to Independence volunteer program serving transitional housing for single mothers. He spearheaded the campus Community Service Task Force, helped establish a Habitat for Humanity chapter at CMU, and has held leadership positions in Circle K, Doctors of Carnegie (a pre-med organization), and a local tutoring program.

Undergraduate Job Placements

| Average salary (2000): $50,729 | 
| High: $56,000 | Low: $40,850 |
| Companies: | McMaster Car | Merck |
| Air Products and Chem. | Motorola |
| Andersen Consulting | MPR Assoc. |
| Cytec | Procter & Gamble (5) |
| DOE | Raytheon |
| Dow | Samsung |
| GEON | Syngi |
| Honeywell | Valspar Corp. |
| Intel (2) | |
| J&L Steel | |
| Johnson & Johnson | |
| Graduate schools (2000): | Pittsburgh |
| Carnegie Mellon | Princeton (2) |

Senior Banquet

The senior Banquet has been a tradition in the department over the years. Thanks to the leadership of Professor Lynn Walker, that event is once again an annual event that the seniors organize and is anticipated by faculty & staff!
Undergraduate Student News

ABET Review

On November 6 & 7, 2000, the Accreditation Board for Engineering and Technology (ABET) committee reviewed CIT/ChemE. The Secretary of Education of the United States Department of Education lists ABET as the nationally recognized agency responsible for accreditation of educational programs leading to degrees in engineering. To attain this recognition, ABET must include as part of the accrediting process an institutional or program self-study and an on-site review by a visiting team. The self-study is expected to be a qualitative assessment of the strengths and limitations of the institution or program, including the achievement of institutional and program objectives, and should involve broad and appropriate constituent groups in its preparation and process. Institutions are required to have educational objectives and to employ outcomes assessment techniques to determine the degree to which program goals and objectives are being attained. The assessment, in tur, is used in an ongoing process of improving student learning through enhancements to the program. The Program Self-Study Report, which was prepared by Myung Jhon and Rob Hilton, provided essential input for the evaluation team as part of the overall accreditation process. We are happy to report that the ABET evaluator, Professor John Hudson from the University of Virginia, gave high marks and has recommended accreditation of our program.

CMU Program shows girls there’s a future in science and engineering

Carnegie Mellon University held its sixth annual Engineering Your Future program. The six-day program is aimed at encouraging incoming female high school freshmen to consider a career in engineering. Biomedical Engineering Associate Director Hilda Diamond founded the program. “There aren’t enough women in engineering. I felt this would be a good thing for girls because it’s harder to get girls to participate” in engineering programs, said Diamond, adviser to the Society of Women Engineers. In an introduction by chemical engineering senior lecturer Annette Jacobson, they learned that polymers — substances with large molecules that are made of smaller, repeating units — are present in everything from shampoo and bicycles to balloons and bubble gum. In an undergraduate lab, the 55 girls also got a chance to try simple chemical experiments of their own. The experiments are a large component of the program, taking half of each day’s two-hour session. Students who remain interested in science and engineering can return in subsequent years for more advanced offerings. (This article appeared in the July 11 edition of the Post-Gazette).

National Chemistry Week Celebration

The department’s students and faculty participated in “Kitchen Chemistry,” the topic of this year’s celebration, and provided hands-on polymer experiments to more than 800 children, teachers and parents, demonstrating the usefulness of polymers in food chemistry.

PISCES Program

Reid Patterson provides his insight into the PISCES program benefits. One of the most significant points he could make about the PISCES program was that he learned more than he expected. “As we all know there is a part of life that cannot be taught in the classroom. The PISCES program offers one of those pieces that are missing. Throughout the program I of course learned more about chemical engineering and the different disciplines that the field has to offer, but I also learned what really goes on behind the stock quote and security gate. Industry is much different than academia and that is probably the most important lesson that I have learned. Many students are not sure of their likes and dislikes and what fields they will be successful in. Summer internships just cannot give you that type of feel for what there is. This program has helped me to find out these things for myself so when the time comes I will know how to evaluate companies not just to ‘get a job’, but to find a career. With this program my ‘career search’ will likely be just as time consuming and nerve-racking, but the confidence in my abilities and what I want and have to offer will enable me to go out and find what I want and what is best for me. Each graduating student has his or her own life and path to take. Are you ready for yours? PISCES has definitely made me ready for mine.”
Chemical Car Race
By Prof. Gary Powers

Remember how the freshmen MechEs made mouse-trap cars and tossed eggs in those energy absorbing holders and the ECs made those circuits and robots and the Civs made the balsa wood bridges? What did freshmen Chemical Engineers do? We made mass balances! Is this fair? Obviously NO! Now we all know that building and optimizing a chemical plant could involve potentially hazardous chemicals, expensive analytical equipment, etc. and should stop us from having some fun. Right? NO way!

This semester the intro to Chemical Engineering class is making Mass Balances! (still need the fundamentals) and forming teams to build a chemical car. The goal is to build a car that will travel via controlled chemical means a distance between 50-100 feet carrying a load from 0 to 500 grams (the distance and load specified shortly before the contest). The winner is closest to the finish line with additional points for style (safety, efficiency, environmentally sound chemistry, cool looking, robust, reliable, neat drive mechanism, etc.). The students are teamed with senior ChemE advisors to assist with safety evaluation, etc.

The teams selected the chemistry, propulsion mechanism, platform, etc. and have performed experimental and theoretical studies. Mr. Matt Cline, Undergraduate Lab Director, assisted with the selection and procurement of parts and the machining of components.

The chemistry has ranged from the classic vinegar + baking soda to peroxide decomposition, urea reactions with bleach, and the still not safe enough nitrogen triiodide decomposition. Several hundred reactions were proposed, evaluated for safety and capability and tested in the laboratory in our calorimeter.

The propulsion mechanisms have included free jets of vapor and liquid, pistons with rack and pinion drives, liquid and vapor jets on vaned drive wheels, and single acting piston engines adapted from air powered cars.

The senior advisors are helping with the car teams and are developing a series of home problems that will carry the chemical car forward into our courses on Thermodynamics, Fluid Mechanics, Math Modeling, Heat and Mass Transfer, Control and Kinetics.

I haven't had this much fun in a long time in the intro course. The students are very capable and are learning about numerous practical issues associated with planning and performing experimental work.

They are reading on their own and consulting with others about the mechanisms of these reactions, how to control the reaction rate, how to estimate and control the maximum pressure that can be generated by these reactions and how to assemble pipe and fittings that will allow for the delayed mixing of these reagents. Some have discovered that these reactions can sometimes take off and produce large amounts of gases before you can get the top back on the reaction vessel! Of course, we are very careful to wear good PPE and work in a safe manner.

More news on the winners, technologies utilized, and humorous control mechanisms in our next newsletter. Stay tuned.

Race winners pictured left to right: Paul Chung, Beth Newton, Sara Schrass and Tatiana Uschakov
The following papers were presented by our faculty and graduate students at the AIChE annual meeting in Los Angeles, November 12-17, 2000.

J. L. Anderson, H. Kasumi, Paul J. Sides and Yuri E. Solomentsev, "Thermocapillary Flow and Aggregation of Bubbles on a Solid Wall."


L.T. Biegler and N. Arora, "Redescending Estimators for Data Reconciliation and Parameter Estimation."

L.T. Biegler and R. Bartlett, "New Object-Oriented, Active-Set Approaches to SQP for Large-Scale Process Optimization."

L.T. Biegler and A. Waechter, "An Interior Point Algorithm for Large-Scale Nonlinear Optimization with Applications in Dynamic Optimization."

L.T. Biegler and D. Alkaya, "Use of Parallel Processing in Existing Model and Optimizer Coupling for Simultaneous Flowsheet Optimization."

L.T. Biegler and G. Itie, "Constraint Aggregation for Large-scale NLP Algorithms."

L.T. Biegler, D. Glasser (Univ. of Witwatersrand), B. Hausberger (Univ. of Witwatersrand), D. Hildebrandt (Univ. of Witwatersrand), and W.C. Rooney, "Application of the Iso-State Algorithm for Finding the Attainable Region for an Ammonia Synthesis System."

M.M. Domach, I.E. Grossmann, S. Lee and C. Phalakornkule, "Recursive MILP Model for Computational Analysis of Multiple Flux Distributions in Metabolic Networks."

A.J. Gellman, J.S. Ko and C. Mancinelli, "Oxidation and Friction Studies of AlPdMn Quasicrystals and its Approximate A448x442Mn 10."

A.J. Gellman and R. Lei, "Humidity Effects on PFPE Lubricant Bonding to a-ChIx Overcoats." A.J. Gellman, J. Horvath, T. Power and D.S. Sholl, "Enantiospecific Properties of Chiral Single-Crystal Surfaces."

A.J. Gellman and K. Paterba, "Vapor Phase Deposition of High Mass Lubricants."


I.E. Grossmann and J. Jackson, "Optimal Retrofit of Process Networks."


I.E. Grossmann and I. Harjunkoski, "A Decompositional Strategy for Optimizing Large-Scale Scheduling Problems in the Steel Making Industry."

I.E. Grossmann and M. Jhon, "International Exchange Program at Crnezegic Mellon University."

I.E. Grossmann and J. Bakesubramanian, "Scheduling to Minimize the Expected Completion Time in Flowshops with Uncertain Processing Times."


S. Taun and W. Hoffmester, "Sectional and Overall Reachable Products in Systems with S-shaped Distillation Curves."

M. Jhon and S. Vinay, "Fluid Flow Using Smoothed Particle Hydrodynamics."

M. Jhon, Xiaoming Ma (Seagate Tech.), D. Phillips and S. Vinay, "Simulation of Ultra-Thin Lubricant Film Dynamics."


M. Pandis and T. Raymond, "Organic Aerosols as Cloud Condensation Nuclei."


D. Prieve, R. Dagastine and L. R. White, "Direct Force Measurement Between a Glass Surface and an Oil Droplet Using AFM."

D. Prieve and P. O'Diachi, "Depletion Attraction Induced by Clay Platelets."


T. Przybycien and A. Wilcox, "The Development of Quartz Crystal Microgravimetry for Probing Protein Aggregation Behavior in Bioprocessing Environments."


D. Sholl, T. Bowen, J. Falconer (Univ. of Colorado), R. Noble (Univ. of Colorado) and A. Skoulidas, "Comparing Theory and Experiment for Light Gas Permeation Through Silicate Membranes."

S. Sholl and A. Asthagiri, "Multiscale Modeling of Thermal Roughening of Nanostructured Metal Surfaces."

R.J. Sides, G. Fedder, J. Garrett and M. Patton, "Visualization of an NMR on a Chip in CMOS-Based MEMS."

L. Walker and M. Truong, "Structure and Rheology of Mixtures of Wormlike Micelles and Nonionic Polymers."


B.E. Ydstie and D. Coffey, "Distillation Stability Using Passivity and Thermodynamics."

B.E. Ydstie, J. Hillard and Y. Jiao (PG Ind.), "Robust Adaptive Control With Unknown Disturbances."


Session Chairpersons

Andrew Gellman, Fundamentals of the Mechanical and Tribological Properties of Surfaces.

Spyros Pandis, Heterogeneous and Homogenous Atmospheric Chemistry.

Todd Przybycien, Focus on Viral Vaccines & Gene Therapy.

James Schneider, Poster Session: Fundamental Research in Interfacial Phenomena.

James Schneider, *Fundamental Research in Interfacial Phenomena I, II, III* 

David Sholl, Theory and Simulation at the Mesoscale.
Special Lectures

The 2000 Herbert L. Toor Chemical Industry Lectureship

The 2000 Herbert L. Toor Chemical Industry Lectureship was held on Thursday, September 14, 2000, from 4:30-5:30 p.m. in the Singleton Room. E. Kearns Pollock, Former Executive Vice President of PPG Industries spoke on "Descartes Before the Fish."

Pictured left, guest speaker, E. Kearns Pollock. Right, CIT Dean John Anderson, Herbert L. Toor, E. Kearns Pollock and Department Head, Ignacio Grossmann at the reception.

2000 Distinguished Research Lecture

On April 11, Professor George Stephanopoulos, Department of Chemical Engineering, Massachusetts Institute of Technology, presented the 2000 Distinguished Research Lecture, which is sponsored by Lubrizol Corporation. His talk was titled, "Perspectives on the Synthesis of Plant-Wide Control Structures."

Bayer Lecture Series in Process Systems Engineering

The Department of Chemical Engineering at Carnegie Mellon has established the Bayer Lecture Series in Process Systems Engineering to recognize the contribution of Bayer Corporation for establishing the Bayer Chair for Chemical Engineering in 1980 and for providing an additional $500,000 endowment of that chair in 1998.

The Bayer Lecture Series has as a major goal to present state-of-the-art research in work in the area of Process Systems Engineering, an area of great strength and long tradition in the Department of Chemical Engineering. The lectures are given by speakers of international recognition. The objective is to strengthen the links between Bayer Corporation and Carnegie Mellon by stimulating research ideas, which have the potential of having significant impact on industry. Professor Lorenz T. Bieger, the current holder of the Bayer Chair at Carnegie Mellon, was the first speaker of this series of lectures. This year Professor Costas C. Pantelides of Imperial College presented "Opportunities and Challenges in Multiscale Process Modeling" on November 20, 2000.
At the end of each academic year, we survey the graduating class to obtain an idea of student satisfaction, look for perceived weaknesses and strengths and guide curriculum changes. Overall, we are pleased with the responses from our students. In most areas, students are positive about the education received here at CMU. The students feel that they are well prepared to work in teams, apply basic engineering skill and analyze problems. Students were also satisfied with most of the programs and opportunities available to them through departmental efforts. We are working to improve in several areas including exposing our students to contemporary and global issues and increasing faculty/student interactions.

The table below outlines student response this year to the ABET 2000 criteria. These are the skills that our students are required to develop during their stay at CMU as stated by ABET.

<table>
<thead>
<tr>
<th>Skill or Ability</th>
<th>Poor</th>
<th>Satis.</th>
<th>Strong</th>
<th>2000*</th>
<th>1999</th>
<th>1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to apply knowledge of mathematics, science and engineering</td>
<td>0</td>
<td>7</td>
<td>27</td>
<td>4.59</td>
<td>4.18</td>
<td>4.37</td>
</tr>
<tr>
<td>Ability to design experiments and analyze and interpret data</td>
<td>1</td>
<td>15</td>
<td>18</td>
<td>4.00</td>
<td>4.38</td>
<td>4.00</td>
</tr>
<tr>
<td>Ability to design a chemical process</td>
<td>2</td>
<td>17</td>
<td>15</td>
<td>3.76</td>
<td>3.21</td>
<td>3.74</td>
</tr>
<tr>
<td>Ability to identify, formulate and solve engineering problems</td>
<td>0</td>
<td>12</td>
<td>21</td>
<td>4.27</td>
<td>3.92</td>
<td>3.74</td>
</tr>
<tr>
<td>Ability to use techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>0</td>
<td>13</td>
<td>21</td>
<td>4.24</td>
<td>3.77</td>
<td>4.11</td>
</tr>
<tr>
<td>Ability to function on multidisciplinary teams</td>
<td>1</td>
<td>7</td>
<td>26</td>
<td>4.47</td>
<td>4.28</td>
<td>4.58</td>
</tr>
<tr>
<td>Understanding of professional and ethical responsibility</td>
<td>2</td>
<td>18</td>
<td>14</td>
<td>3.71</td>
<td>3.82</td>
<td>3.68</td>
</tr>
<tr>
<td>An ability to communicate effectively</td>
<td>0</td>
<td>10</td>
<td>24</td>
<td>4.41</td>
<td>4.00</td>
<td>3.89</td>
</tr>
<tr>
<td>Broad education necessary to understand Enq. Solutions in global/societal context</td>
<td>1</td>
<td>15</td>
<td>18</td>
<td>4.00</td>
<td>3.56</td>
<td>3.37</td>
</tr>
<tr>
<td>A recognition of the need and ability to engage in life-long learning</td>
<td>0</td>
<td>8</td>
<td>26</td>
<td>4.53</td>
<td>4.21</td>
<td>4.26</td>
</tr>
<tr>
<td>A knowledge of contemporary issues</td>
<td>6</td>
<td>21</td>
<td>7</td>
<td>3.06</td>
<td>2.84</td>
<td>3.00</td>
</tr>
</tbody>
</table>

(*) The "Overall Rating" was determined by a weighted "FCE-style" average of the responses ("poor"=1, "satisfactory"=3 and "strong"=5).
Meredith Welsh shares her experience as an exchange student at Aachen University during her junior year.

According to her, as a CMU student living in Germany, Meredith had opportunities and experiences rarely afforded most American Students. Living in Europe and coping with everyday tasks in a foreign language is both challenging and rewarding, and dealing with the bureaucracy of a different society makes each day a learning experience. RWTH is a internationally renowned technical university, and many of the professors are know throughout Europe. The German educational system allows students a great deal of freedom to tailor their course of study, and students are expected to use sources outside of class to supplement their education.

In addition, opportunities to add to her education abroad in other ways abounded. While really submerged in the culture, she learned a new way of thinking and found that there are other points of view on international problems and issues that had never before occurred to her. Living with other German students also helped Meredith to learn the language quickly and easily. Because Aachen is such a large university and attracts students from all over the world, Meredith made many good friends whose backgrounds are vastly different from her own. She even got to learn some Swedish. Furthermore, the very central location of Aachen allowed her the opportunity to travel all over Europe. The historic significance of Aachen encouraged her to develop an interest in European history.

The exchange taught her how to be successful in a new and unfamiliar environment, allowed her to be truly independent both socially and academically, and really broadened her perspective on the world. Meredith believes that living overseas and taking classes in Germany has given her abilities sought after in the job market and will make her more employable in the future. Not to mention, it was one of the best years of her life.

2000 Graduation
The Campaign for Chemical Engineering

Our most sincere thanks to the many alumni and friends who have contributed to this important campaign. We are pleased to announce that, with your generous gifts and pledges, we have raised nearly $870,000 towards our $1 million goal for fellowships, scholarships, and general department funds. With your continued support, we expect to reach this important milestone by December 31. Thank you for your current and future generosity.

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