

the Test Tube

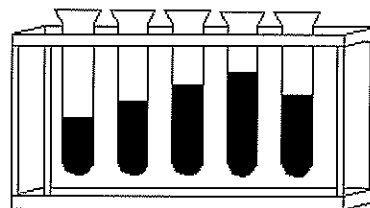
Newsletter 2000 (#17)

The Department of Chemistry and Biochemistry

Texas Tech University

Lubbock, Tx

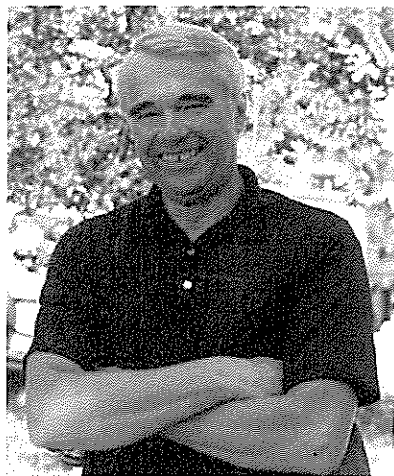
Editor: Dominick J. Casadonte, Jr..



A Chemist's Chemist: Wilse Robinson 1924-2000

by Ed Quitevis

[Editor's Note: Dr. Wilse Robinson, our Welch Professor of Chemistry, passed away on September 7th as the result of a stroke. The department held a memorial service on September 15th. Reproduced below is the text of the eulogy which physical chemist Ed Quitevis delivered]



For over 43 years, Wilse was a prolific researcher in physical chemistry and chemical physics, having published 287 papers. Over half of these papers were written while at Texas Tech. He was widely recognized

as one of the leading figures in physical chemistry. His presence on our faculty helped to raise the stature of Texas Tech University in the field of chemistry. When chemists around the world are asked to list the most distinguished chemists at Texas Tech, the majority, without hesitation, put Wilse near the top of that list. He and his coworkers have brought fundamental understanding through both innovative experiments and insightful theory to some of the most important problems in molecular structure, electronic energy relaxation in molecules, crystal spectroscopy, reaction dynamics in liquids, and more recently, the structure and properties of liquid water. His work in these areas has led to new molecular phenomena that have spawned the active research of scientists.

Born in Kansas City, Missouri on July 27, 1924, he attended schools in Kansas City and Clearwater, Florida. After serving in the U.S. Navy during World War II, he enrolled at the Georgia Institute of Technology, earning a BS in 1947 and an MS in 1949, all in chemistry. He then went on to gradu-

ate school at the University of Iowa and received a PhD in 1952. As a graduate student without a research advisor, Wilse expanded Casimirs well-known theory of nuclear quadrupole interactions in diatomic molecules to two nuclear quadrupoles interacting with states of an asymmetric rotor molecule. While in graduate school he met Ellen Johnson, whom he married on June 5, 1950 in Cedar Rapids, Iowa.

In 1954, after two years as a Research Fellow at the University of Rochester, He received his first faculty appointment as an Assistant Professor at Johns Hopkins University. At Johns Hopkins, he was the first to successfully develop techniques for detecting electronic spectra of isolated molecules and free radicals trapped in crystalline inert gases at liquid helium temperature.

In 1959, he moved to Caltech as an Associate Professor. Two years later he was promoted to Professor of Physical Chemistry. At Caltech, Wilse and his group were engaged in some *(continued on next page)*

A Chemist's Chemist (cont.)

of the most exciting research in physical chemistry and chemical physics. The Caltech years were highlighted by landmark theoretical and experimental work on radiationless loss of excited state electronic energy in molecular aggregates. The 1962 and 1963 *Journal of Chemical Physics* papers by Robinson and Frosch are considered to be key papers in radiationless transition theory. This work for which he is widely known has had and continues to have a profound impact not only in photochemistry and photobiology, but also in other fields. His explanation of the very large deuterium isotope effect on triplet-singlet transitions in benzene and naphthalene represents one of the earliest successes of this theory. A key feature in the theory is the dependence on the Franck-Condon factor. This factor is a crucial component in the theory of charge-transfer reactions later developed by Marcus at Caltech. Marcus eventually won the Nobel Prize in chemistry in 1992 for this work on charge transfer. Wilse and his group at Caltech developed experimental and conceptual techniques to further our understanding of triplet states, excitation energy transfer and photosynthesis, and exciton phenomena in organic crystals and biological systems. At Caltech, he was also one of the first chemists to use lasers in his research.

In 1975, Wilse left Caltech to become Chairman in the Department of Physical Chemistry at the University of Melbourne in Australia. His group in Australia was one the first university groups to publish papers in the emerging field of picosecond spectroscopy. Although he was at the University of Melbourne for only a year, it was productive time, resulting in 13 papers. An important paper was the clarification of the rotational diffusion of 'sticky' molecules, which confirmed Einstein's earlier ideas of Brownian motion.

In 1976, he returned to the United

States to become the Robert A. Welch Professor at Texas Tech University. Continuing the use of ultrafast lasers, Wilse and his group attacked some of the most important problems in the liquid state. In the early 1980's, Wilse and his group carried out picosecond spectroscopic studies of the hydrated electron and proton. They showed experimentally the importance of H_9O_4^+ in weak acid chemistry, and the role of solvent attachment to solute molecules in rotational diffusion in liquids.

To gain a better understanding of liquids, Wilse and his group tapped the power of molecular dynamics simulations. Earlier, at Caltech, Wilse had used molecular dynamics simulations to study the structure and dynamics of argon clusters. The two papers from this work are still heavily cited in the field of vapor phase homogeneous nucleation. At Texas Tech, Wilse began to rely heavily on molecular dynamics simulations to solve a variety of problems, including salt solutions, isomerization reactions, liquids in high electric fields, and in confined geometries such as between parallel plates. In a series of extensive computational studies, Wilse and his co-workers showed that non-Maxwellian velocity distributions in equilibrated systems could occur under certain conditions. Although controversial at the time, these results now appear to be in agreement with recent studies of chaotic dynamics in real systems.

In addition to computer simulations, Wilse and his group at Texas Tech developed analytical models to understand chemical reactions such as isomerization in liquids. In particular, they showed that the rate of activated barrier crossing obeys certain scaling laws. These scaling laws allow us to understand the behavior of many different reactions with just a few parameters. The significance of this work is reflected by fact that it was published in *Physical Review Letters*, the premier journal in the physical sciences for rapid publication of

work that is deemed to be very important.

For the past sixteen years, Wilse and his coworkers endeavored to understand the most important liquid known to humankind, water. To quote the Caltech's eminent inorganic chemist, Harry Gray, "When the dust settles, and someday it surely will, Wilse Robinson will be recognized as the scientist whose work led to a fundamental understanding of the properties of this amazing substance."

Although water has been extensively studied, incredibly, it is still not completely understood. From 1994 until his time of his death, he published over 40 papers, more than half concerned with the topic of water. In addition, he wrote a book with Zhu, Singh, and Evans, entitled, *Water in Biology, Chemistry and Physics*. The book gives comprehensive (2028 references!) and lucid discussions of water from experimental, computational, and theoretical perspectives. Robinson's most important contribution to date on the problem of water has been to come up with a two-state or mixture model which explains all the anomalous properties of water, including the famous density maximum where the density as a function of temperature has a maximum at 4°C. Using this model, Wilse and his group have shown that this anomaly, as well as other properties of water, arises from outer-neighbor structural transformations. He showed in a *Physical Review Letters* publication that a simple one-dimensional analytical model could reproduce the density maximum. They also showed that the model and the "thermal offset" effect provide a quantitative explanation for the pressure and temperature dependences of the properties of liquid H_2O and D_2O . The significance of this work is that none of the other current models are able to reproduce the density and other properties of water over a wide range of conditions of temperature and pressure. In a *Biophysical Journal* paper published last year, (continued on next page)

A Chemist's Chemist (cont.)

Wilse and his group showed that the curvature in the total free energy function for protein unfolding can be attributed to the steep change with temperature of the proportions of ice-Ih-type and ice-II-type bonding in the liquid. This behavior, which leads to cold and heat denaturation, had never before been explained.

In recognition for his breakthrough ideas on the water problem he was asked to give the leadoff lecture at the 1996 Faraday Discussions meeting in London, "Hydration Processes in Biological and Macromolecular Systems." Further acknowledgment of the significance of his model is reflected in short accounts in the March 2, 1996 issue of *New Scientist* and the April, 1996 issue of *Physics Today*. He was invited to speak on his water research last year at the 218th National ACS Meeting in New Orleans and this year at the Gordon Conference on Water in New Hampshire.

He loved doing science and passionately tackled each problem. His scientific standards were high. In most of his scientific advances, he strove first to obtain a physical understanding of the problem. These advances have had wide ranging impact in many areas of science and technology because they provide a deep understanding of fundamental molecular phenomena that underlie chemistry, physics, and biology. His contributions also include the training of many students and postdoctoral coworkers, many of whom have gone on to become outstanding researchers in physical chemistry and chemical physics. He was not afraid to propose ideas that differed from the mainstream thought. However, more often than not, he was ahead of the rest in terms of understanding the problem. We lost a great scientist with his death. He will be greatly missed.



The Chair Conformation by Dr. Richard Bartsch

This has been a momentous year for Texas Tech University and for the Department of Chemistry and Biochemistry. In August, Dr. David J. Schmidly became the 13th President of Texas Tech University. Dr. Schmidly, who was our Vice President for Graduate Studies and Technology Transfer and Dean of the Graduate School, was selected from a finalist field of two external candidates and one internal candidate by Chancellor Montford and the Board of Regents following a nationwide search. In other exciting news, Texas Tech University has recently been placed in the highest category as a Doctoral Research-Intensive University by the Carnegie Foundation.

Within the past year, we have come a long way toward meeting the Welch Challenge to raise \$500,000 in matching money which will increase the endowment for the Welch Chair in Chemistry from one million to two million dollars. Pledges and gifts totalling \$382,350 have been received. We express our appreciation to: The Don Kay Clay Cash Family Foundation of Salt Lake City and The CH Foundation of Lubbock for donations of \$200,000 and \$100,000, respectively; John and Charles Blitz, G. Wilse Robinson and L. O'Brien Thompson for donations of \$20,000-\$25,000; Robert Carnahan, John Loudermilk, W. Robert Laughlin and Kathleen Bellah for donations of \$1,500-\$5,000; and Tracey Kriauciunas, Michael Smith, Ferril C. Smith, K. T. Dockay, and Paul J. Dobrowolski for donations of \$50-\$500. We hope that other donors will come forward, so we can reach the final objective by December 31, 2000.

The Henry J. Shine Lecture Series was inaugurated in 1999 by Clayton Heathcock, who is Professor of Chemistry at the University of California, Berkeley, and former Editor

for the *Journal of Organic Chemistry*. The 2000 Shine lecture was given by Dr. Peter Dervan, Bren Professor of Organic Chemistry at the California Institute of Technology.

Our NMR capabilities received a major boost with the installation of a 500 MHz Varian NMR spectrometer this year. A new departmental Thermoquest GC/MS instrument is scheduled to arrive shortly.

Congratulations to Dominick Casadonte for recognition of his instructional efforts at the University and national levels. In addition to the TTU President's Excellence in Teaching Award, his receipt of the International Professor of the Year Award from Alpha Phi sorority was announced in a half-page advertisement in the *Chronicle of Higher Education*.

The Student Affiliates of the American Chemical Society was awarded Commendable ratings at the national level both in 1999 and 2000. The South Plains Local Section of the American Chemical Society received a national CHEMLUMINARY award from the American Chemical Society in 1999 for "Best Activity with Student Affiliates". As part of the ACS Phoenix Awards for 2000 the ACS/ACS-SA received an Honorable Mention for the "Most Imaginative Periodic Table Display".

Interviews will begin shortly for junior faculty in the areas of chemical education, organic chemistry and theoretical chemistry. We're excited with the prospect of bringing three new faculty members into our department for Fall Semester 2001.

Despite all of this good news, we are all deeply saddened by the recent death of G. Wilse Robinson, the second Welch Professor of Chemistry at Texas Tech University. We have lost an excellent researcher, colleague and friend. The Robinson Lecture Series is being established to recognize Wilse's many contributions to our department and the University. A commemorative issue of the *Journal of* (continued on page 5)

Chemistry Magic - TTU Style

ACS Local Section, ACS-SA Win National Awards

by Carrie Bates and Lisa Walters

The South Plains Local Section of the American Chemical Society and the TTU American Chemical Society Student Affiliate received national recognition from the American Chemical Society during the 1999-2000 academic year for their activities in 1998-1999.

In August of 1999 the ACS local section received the American Chemical Society's CHEMLUMINARY Award for "Best Activity with Student Affiliates" for a "chemical magic show" which the ACS-SA group put on in collaboration with Dr. Casadonte at the Buckner Children's Home (a home for at-risk youth) in Lubbock. The festivities were part of National Chemistry Week (do you participate? If not, its never too late. Contact your local ACS section...).



Dr. Casadonte Striking a Wizardly Pose at the Buckner Children's Home

The ACS Student Affiliate group was quite busy during the 1999-2000 school year with a variety of other activities. One of the premiere events this year was their participation in the Conference for the Advancement of Science Teaching (CAST) in October. As part of the conference, the Student Affiliates presented a workshop entitled "From the Pantry to the Classroom" in which the attendees were taught how to do meaningful chemistry demonstrations using household

items such as soda, laundry detergent, and various foods. In order to help support this event the Student Affiliates applied for and received, with full funding, an *Innovative Activities Grant* from the ACS.

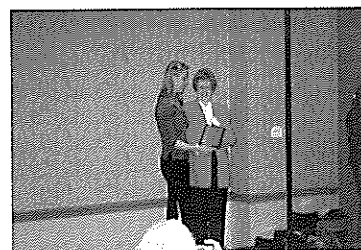
In addition to the aforementioned National Chemistry Week activities, in 1999 the ACS-SA spent three days in the University Center promoting chemistry by giving out cupcakes (arranged in the form of the periodic table) for playing the Wheel of Chemistry (similar to Wheel of Fortune). The puzzles that were to be solved were all related in some way to chemistry. Through this activity ACS-SA was able to show people that chemistry can be fun, entertaining, and not intimidating. The local ACS/ACS-SA received an ACS honorable mention in the Phoenix Award competition again this year, this time in the category "Most Imaginative Periodic Table Display" for the edible "Periodic Table of Cupcakes".

Amongst all the activity of the fall, the Student Affiliates were also able to participate in Student Organizations Day and University Day, which promoted the Department of Chemistry and Biochemistry and their organization. In addition, they were able to participate in the Regional ACS Meeting in El Paso.

In the spring of 2000 the ACS-SA chapter participated in the National ACS Meeting that was held in San Francisco. They had a station at the ChemDemo Exchange, an event for Student Affiliate chapters to show off and share their household chemical demos with other chapters. Their booth was a big hit—it featured the amazing burning money (only one dollar bill was harmed in the presentation of this demo), the mystifying disappearing water (only one volunteer got wet), and make-your-own

sticky icky gak. They also stumped some people with some truly cheesy Chemistry riddles (Q: What do you do when you find a dead chemist? A: Barium). The other ACS-SA chapters, from as far away as Puerto Rico) gave them lots of good ideas for new demos to try in the future, like edible warts and flying rockets powered by alkalizer. The chapter also picked up an award for Commendable Achievements in the 1998-1999 and 1999-2000 school years. Last year they received Honorable Mention, which is the category just below Commendable, and they are hoping that with their efforts at the National Convention and other events this year, that they will receive the Outstanding award next time (the category above Commendable). Stayed tuned next year. The chapter extends its gratitude to the people and organizations who made the trip to San Francisco possible: TTU President Haragan, Dean Winer, Provost Burns, Department Chair Bartsch, and Dow Chemical Company.

For the 2000-2001 academic year the ACS-SA has applied for and received two grants from the Education Division of the ACS. The first is from the Community Interaction-Student Affiliates (CISA) program, where they were only one of 14 projects funded nationally. The major goal of the (*continued on next page*)



Lisa Walters Receiving the 1999 ACS-SA Commendable Achievement Award in San Francisco

CISA program is to give children, especially minority students, a chance to succeed in science. Support from this grant will allow the ACS-SA to continue and expand their "Kids and Chemistry" program promoting science and chemistry with a lively demonstration show.

The second grant is from the Innovative Activity Grant (IAG) program, where they were only one of 18 successful grantees nationally. This funding will be used to support a new "Professional Life Skills" seminar series, organized in conjunction with Dr. Karlene Hoo in the TTU Chemical Engineering Department. It is designed to cover many early career questions not covered in the Science/Engineering classroom, and brings in speakers from industry and business to address topics ranging from interview skills to financial planning to dual career families, etc. The series is off to a great start so far, with more than 50 students attending.

Officers 1999-2000

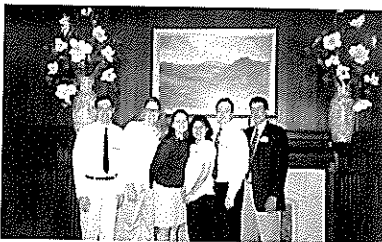
President: Carrie Bates (Fall, 1999)
 Lisa Walter (President, Spring 2000)
 Vice President: Miranda Wilkins
 Treasurer: Sandra Flores
 Sectary: Michelle Magallanez
 Activities Coordinator: Martin Pflanz, VIII

Officers 2000-2001

President: Sandra Flores
 Vice President: Larry Shaw
 Treasurer: Melissa Patton
 Sectary: Martin Ziska
 Activities Coordinator: Jessica Patton



The Old: Some of the 1999 ACS-SA officers with their Commendable Affiliate plaque. From left to right, Michelle Magallanez, Lisa Walter, Miranda Wilkins, Sandra Flores, and advisor Dr. Greg Gellene.



And the New: The 2000-01 ACS-SA Officers. From left to right, Martin Ziska, Jessica Patton, Melissa Patton, Sandra Flores, Larry Shaw, and Dr. Greg Gellene.

The Chair Conformation (cont.)

Chemical Physics will appear next year.

Finally, we would like to thank Celanese Corporation for its continuing financial support of departmental activities.

Sincerely yours,
 Richard A. Bartsch, Chair

What's Been Going On? Staff Role Call

Like everyone, our staff often go through life-changing experiences during the course of the year. Some of these changes mean that we must say goodbye to valued members of our family, and some changes are of a more pleasant sort. On the pleasant side, Cheryl Starkey has become Cheryl Blasingame by marriage and Kelly Diaz has become a mom again for the third time in September. On the other hand, our business manager for the past two years, Steve Bain, has moved to another job one campus. Ms. Yesenia Sanchez joined us in that capacity in early August. Yesenia comes to us after having experience as the Academic Program Assistant for the TTU Institute of Environmental and Human Health at the Reese Center.

In continuing with our practice of keeping you up-to-date in case you happen to be in the neighborhood and want to stop by and be able to call all the staff by their first names, here is the current staff list for the year:

Justo Adame, Stores Supervisor

Cheryl Blasingame, Secretary III
 Martha Jane Bradley, Secretary II
 Kelly D. Diaz, Secretary II
 Jennifer Dunfield, Administrative Secretary

Bill Good, Analytical Instrumentation Specialist

James Hildebrand, Manager, Chemistry Building Operations
 Duane C. Hinds, Technician IV
 Priscilla Jones, Clerical Specialist II
 Melissa Martinez, Clerical Spec. III

David Wayne Purkiss, Spectroscopy Technologist
 LaQuetta Purkiss, Prep Lab Chemist

Yesenia Sanchez, Business Manager

Noah H. Solis, Technician II

Jim Stephens, Glass Shop Supervisor

Kenneth W. Taylor, Laboratory Sales Clerk

Jerry A. Walton, Technician IV



"Where the Buck Stops". Cheryl Blasingame (Formerly Cheryl Starkey), Our Front Office Secretary,

Who's "v" (That's c/λ of Course!) On The Faculty?

We are in that rare state where there are no new faculty to report this year. Next year, however, we hope to report the addition of three faculty to our ranks, in chemical education, organic chemistry, and theoretical chemistry ("Now, let's begin by imagining a spherically symmetrical chemist...").

Faculty News and Notes

Richard A. Bartsch and his co-workers presented five papers in the Symposium on Calixarene Molecules for Separations at the 217th National ACS Meeting in Anaheim. Dr. Bartsch presented seminars entitled "New Proton-Ionizable Ligands for Metal Ion Separations" at Argonne National Laboratory, Iowa State University, Texas Christian University, and Southern Methodist University.

During 1999, Dr. Richard A. Bartsch graduated his 32nd (Robert E. Hanes, Jr.), 33rd (Nazar S. A. Elkarim) and 34th (Martin J. Campbell) Ph.D. students from the Department of Chemistry and Biochemistry at Texas Tech University. Also, Dr. Bartsch had his 300th paper accepted for publication.

Dominick Casadonte spent the spring semester 2000 in Chambéry, France as a Fulbright Senior Scholar. He studied the effects of ultrasonic pulses in environmental contaminant degradation.

Purnendu (Sandy) Dasgupta says that he has been "measuring air pollution here, there and everywhere". Last year his measurements took him to Atlanta, and this year he was in Houston.

David Knaff was an invited symposium speaker at the International Botanical Congress in St. Louis in August and gave seminars at Case Western Reserve U., Texas A&M U., U. of Pennsylvania, Rutgers U. and Roche Central Research.

The Biotechnology Institute has been re-organized and renamed as the TTU Center for Biotechnology and Genomics, effective 9/1/99. Dr. Knaff has just begun a 5-year term as co-director of the new Center (Prof. Randy Allen, from Biological Sciences, is the other co-Director). Among its other

activities, the Center has opened a second core facility, dedicated to high-throughput DNA sequencing and characterization.

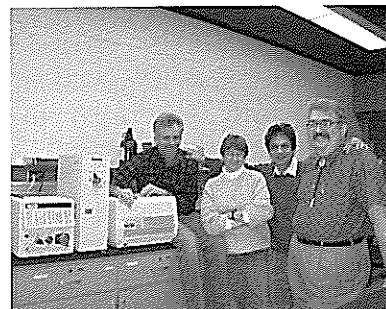
Dr. Knaff was also selected to be one of two TTU faculty representatives on the Texas Research Universities Forum (TRUF). TRUF represents a joint effort by faculty and research administrators at TTU, UT Austin, Texas A&M and the University of Houston, to persuade the state legislature and administration to increase support for research and graduate education at the four universities.

Mark Porter was elected as Chair-Elect of the South Plains Local section of the ACS in 1999, and assumed responsibilities as the Chair in 2000. He was recognized as the Outstanding Professor of the Year by Alpha Epsilon Delta (the pre-med honor society) and received second place honors in the University Daily's Reader's Choice Awards as Best Professor. Mark will be taking over coordination of the Welch Summer Scholars Program from Dennis Shelly in the summer of 2001.

Henry Shine presented an invited paper at the ACS symposium on free radical and electron transfer chemistry in San Francisco in March.

A 1990 Ph.D. student with Dr. Shine who is now a professor and erstwhile Dean of the Dept. of Chemistry Education at Chonnam National U, Korea, spent about 9 months recently at TTU on sabbatical leave. While at TTU, he discovered that cycloalkenes will form mono-adducts (1:1) as well as the better known bis-adducts (1:2) in reaction with thianthrene cation radical. He was able to isolate the adduct of cyclooctene and verify its nature with its X-ray crystal structure. The results were recently published in the *Journal of Organic Chemistry*. Henry's former postdoc Bo Liu has moved to Toronto, Canada. Joining Henry in his place is Dr. Ding Quan Qian, from Nankai U., China.

Bruce Whittlesey and his wife Charlotte are the proud parents of their second child, William, born on August 9, 1999. Mom, dad, and baby are doing well.



The Analytical Division (from left to right: Drs. Bornhop, Korzeniewski, Dasgupta, Shelly) Showing Just How Instrumental They Are to Our Department...

We're in the Money: New Grant and Monetary Support

Richard A. Bartsch received a three-year, \$315,000 grant from the Office of Basic Energy Sciences of the U.S. Department of Energy to investigate "New Proton-Ionizable, Calixarene-Based Ligands for Selective Metal Ion Separations." Dr. Bartsch also received a one-year, \$70,000 grant from the PG Research Foundation to study "Applications of Sonochemistry in Organic Synthesis". He also was awarded a two-year, \$85,000 grant from the Texas Higher Education Coordinating Board - Advanced Research Program to examine "Applications of Ionic Liquids in Chemical Separations."

Sandy Dasgupta received the following grants: "Low Wavelength Synchronous Fluorescence Measurements on a Chip" from DARPA for \$255,000 for 2000-20004; "Atmospheric Characterization of the Houston Supersite 2000" from the EPA for \$300,000 for 2000-2003; "Basic Research in Ionic Analysis" from

Dionex Corp for \$50,000 for 1999-2000; "Fast Process Titrator" from the Center for Process Analytical Chemistry, University of Washington for \$60,000 for the year 2000; "Real Time Field Monitoring of Airborne Cr(VI), Arsenic, Benzene and Trichloroethylene in Water" from the USAF/SERDP program for \$188,785 for 1999-2000; "Determination of Refractive Index of Crude Oil" from USDOE/New Mexico Institute of Technology for \$65,590 from 1999-2000

David Knaff received a new 3-year grant for \$300,00 from the U.S. Dept. of Energy.

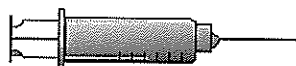
Guigen Li received a Welch grant of \$135,000 for 2000-2003 and an NIH grant of \$106,000 (also for 2000-2003).

Paul Paré has received a number of grants recently, including: "Mechanisms of Flavonoid Free-Radical Scavenging", The Robert A. Welch Foundation, \$135,000 for 2000-2003; "Plant Carbon Allocation and Partitioning of Metabolites in a Closed Growth Facility" through NASA, \$376,813 (in collaboration with three other TTU researchers) for 2000-2001; "Translocation of Herbivore Elicitors and Induction of Plant Volatile Emissions" from the USDA-NRI program, \$199,000 for 2000-2003; "Mechanism of Regulation for Tea Flavonoids: Enzymatic Oxidation and Their Antioxidant Action from the NATO Science Program, \$12,000 for 2001.

Ed Quitevis received a Texas Higher Education Coordinating Board ARP Grant entitled "Vibrational Dynamics of Microconfined Liquids" for \$118,358 for two years, as well as a grant from the Robert A. Welch Foundation entitled "Femtosecond Non-linear Laser Spectroscopy of Liquids" for \$135,000 for three years.

The Welch Matching Fund Donors

have been mentioned in the Chair's letter. Thank you so much for your generous support!



Products in High Yield: Alumni News

KEITH ALEXANDER (BS 1984) is the Division President for Palm Harbor Homes. He and his wife, Michele Pappas Alexander, have three children.

DAVID BABB (PHD Bartsch 1985) is a Research Leader in the Polyolefins Division of The Dow Chemical Company in Freeport, Texas.

HAROLD BRANNAN (BA 1953) is the President of South Texas Radiology and Chief of Staff at Nix Hospital.

CHARLES M. BALDWIN (PHD 1970) is the Hammons Professor of Pre-Medical Studies in the Department of Chemistry of Union University in Jackson, Tennessee

DOUGLAS BOATMAN (PHD 1990) is a Project Leader at Molecumetics in Bellvue, Washington.

LARRY BRATTON (MS 1989) is a Senior Associate Scientist at Parke-Davis Pharmaceutical Research Division in Ann Arbor, Michigan.

VICTOR CASON (MS 1986) is a Senior Project Manager for GZA GeoEnvironmental, Inc. in Dallas.

BONG RAE CHO (PHD 1980) is Professor in the Dept. of Chemistry of Korea University in Seoul, Korea.

HYUNHO CHO (PHD 1993) has taken a new job in Mergers and Acquisitions at Sithe Energies (headquar-

tered in New York). He will be located in Seoul, Korea.

JAMES COLLIER (MS 1996) is a Research Associate with Roche Bioscience in Palo Alto, California.

ROBIN L. COOPER (BS 1983) wrote: "All that chemistry is finally paying off when one has to teach it in physiology courses. Since 1996 I have been an Assistant Professor in Biology at the University of Kentucky."

ALAN CROFT (PHD 1983) is a R&D Leader at The Dow Chemical Company in Freeport, Texas.

RAYMOND CUNNINGHAM (PHD 1988) is a Senior Product Specialist at Chevron Chemical Company LLC in Houston, Texas.

PAUL J. DOBROWOLSKI (MS 1982) continues to work at Pharmacia and Upjohn in Kalamazoo, Michigan as a medicinal chemist.

CONNIE DUNN (PHD 1995) is Technical Director for the Chemistry Division of the Institute of Environment, Safety Occupational Health Risk Analysis at Brooks Air Force Base in San Antonio, Texas.

NAZAR ELKARIM (PHD 1999) is working as analytical chemist for Northern Lipids, Inc. in Vancouver, British Columbia, Canada.

AMI C. FOSTER (BS 1995) wrote that she married Jerry Chris Kurklin (BS 1996 Agronomy; MS 1997 Agriculture) in April 1999. She expects to receive her MD from UT Houston in June 2000 and is anxiously awaiting "The Match" in March 2000 for residency in Family Practice. She plans to return to West Texas or another rural underserved area to practice when her residency is completed.

RONNIE E. FOSTER (BS 1965; MS 1966) retired September 30, 1999 af-

ter thirty-three years with Rohm & Hass, his only job after leaving Tech in 1966.

EVELYN E. GENTRY (aka, BETH LANEY) (PHD 1994) is a Project Manager in Science Applications for International Corporation (SAIC) in San Antonio, Texas.

GAYLE GLENN (BA 1982) was elected president of the Southwestern Society of Orthodontists in September. She has been in orthodontic practice for 15 years.

KEVIN GRAY (PHD 1988) has become a research group leader at Diversa, Inc. (a San Diego biotech firm).

LUFENG GUAN (PHD 1994) is a Senior Scientist, Chemistry at Cytovia in San Diego, California.

ERIN (BS 1990; MS 1996) and JOHNNY HALLMAN (BS 1982; MS 1988, PHD 1991) are now living near Austin, TX and working for Samsung.

ROBERT HANES (PHD 1999) is a Postdoctoral Fellow in the Department of Chemistry of the University of Texas, Austin.

MATTHEW HANKINS (PHD 1994) is a Senior Member of the Technical Staff at Sandia National Laboratories in Albuquerque, New Mexico.

JACK HENRY (BA 1960) is a Professor of Orthopaedic Surgery for the Texas Tech Medical School.

GWISUK HEO (PHD 1983) is a Principal Research Chemist at Korea Research Institute of Standards and Science in Taejon, South Korea.

J. DOUGLAS HUDSON (BA 1958) became the first physician in Austin to be certified by the American Board of Sleep Medicine.

HONG SIK HWANG (PHD 1996) is a Research Chemist at the National Center for Agricultural Utilization Research of U.S. Department of Agriculture in Peoria, Illinois.

SHERYL IVY (MS 1996) is a Scientific Fellow II with SIDDCO in Tucson, Arizona.

OSCAR B. JACKSON, JR (BA 1967) is using his chemistry knowledge once again at his Middle Creek Ranch and Vineyard near Johnson City, TX.

YOUNGCHAN JANG (PHD 1995) is a Researcher with Kumho Chemical Laboratories in Yusejong Taejon, South Korea.

RUSSELL JOHNSON (MS 1999) is a Scientific Fellow 2 at SIDDCO in Tucson, Arizona.

PEDRO JURI (PHD 1979) is Vice President for Quality Assurance and Compliance with McNeil Consumer Healthcare in Fort Washington, Pennsylvania.

JEFFREY KAHL (PHD 1997) is a Research Scientist with X-ceptor Therapeutics in San Diego, CA.

SANG KANG (PHD 1993) is a Senior Scientist with Cognis Corporation in Cincinnati, Ohio.

KIM KEHOE (MS 1997) is currently in her second year of medical school at UT-Galveston. She is working in the anesthesiology department and is also a 2LT in the Army reserves.

SANG WOONG KIM (PHD 1993) works at LG Biotech Research Institute in Taejon, South Korea.

YOUNG SOO KIM (PHD 1993) is an Assistant Professor in the Department of Industrial Chemistry of Dankook University in Choongnam, South Korea.

JONG SEUNG KIM (PHD 1993) is an Associate Professor in the Department of Chemistry of Konyang University in Nonsan, South Korea.

JOHN KNOBELOCH (MS 1992) is an Organic Chemist with Eli Lilly & Company in Indianapolis, Indiana.

JONG CHAN LEE (PHD 1992) is Associate Professor in the Department of Chemistry of Chung-Ang University in Seoul, South Korea.

YUNG LUI (PHD 1983) is a Transfer Project Manager for Texas Instruments in Dallas, TX.

JIANPING LU (PHD 1997) is a Software Engineer for Multi-Media Communications, Inc. in Bethesda, Maryland.

ZUANGCONG LU (MS 1990) is Vice President of Great Western Inorganics in Arvada, Colorado.

TORI IRLBECK MARNELL (BA 1992) completed her residency training at Texas Tech University Health Sciences Center and began practice as a family practice physician in Tulia, Texas in September.

JAMES C. MCGRAW (BA 1955) is a Past President of the Washington State Dental Association; Past President of the American Association of Endodontists; Past Vice-President of the American Dental Association. In March 2000 he was the recipient of The Cooledge Award, the American Association of Endodontists' (Dental Speciality) highest award.

NANCY K. MCGUIRE (BS, 1978) works at the ACS Headquarters in Washington, DC as the Associate Editor for Chemical Innovation magazine (formerly CHEMTECH).

DALE MORRIS (BS 1970) is the Environmental Manager for Williams Refining LCC.

MICHAEL MCPHERSON (BS 1992) married Marianne Murfee on May 29, 1999. He works for University Medical Center and she is employed by Lubbock Independent School District.

MICHAEL MOSHER (PHD 1993) is an Assistant Professor in the Department of Chemistry at the University of Nebraska, Kearney.

NABEEL NABULSI (MS 1984) is a Postdoctoral Fellow at the M.D. Anderson Cancer Center in Houston.

BART NEFF (PHD 1997) works in the Analytical Sciences division at Dow Chemical in Freeport, TX.

JAMES NOBLE (BS 1957) retired in June as a biochemistry research assistant in biomedical research from the University of Texas at Tyler.

NIHAL OBEYESEKERE (PHD 1989) is a Senior Scientist, Corrosion at Champion Technologies, Inc. in Houston.

TRACY BRYANS PHILLIPS (BS 1992, MS 1995) is employed by Northrop Grumman. She says that making sure that our airplane sections are built out of quality materials is her major responsibility. "Dr. Dasgupta's hard nosed analytical training (standardization torture) was an immense benefit that to this day I value. Also, Dr. Quitevis might find it funny that I finally have unlimited access to all those sol-gel, silicate ceramic references that were secured under military lock and key."

MICHAEL PUGIA (PHD 1986) is the Senior Manager for New Products in the Diagnostics Business Group of Bayer Corporation in Elkhart, Indiana.

HONG QIN, (M.S. 1994) has become a research technician at Roche Vitamins in Nutley, NJ.

LEAH REIGLE (BITALAC) (MS 1991) is a Staff Chemist for Merck and Company in Rahway, New Jersey.

THOMAS ROBISON (PHD 1991) is a Technical Staff Member at Los Alamos National Laboratory in Los Alamos, New Mexico.

MRINAL ROHIT PARANJPE (MS 1996) is the Assistant Manager-Quality Assurance for Fresenius Mafatial Medicals Ltd. in Pune, India.

ARCHITA SENGUPTA (MS 1996) is a graduate student at UC Santa Cruz. She received the 1999 Marilyn C. Davis Memorial Scholarship Development Award at UCSC. She received the Ph.D. degree in June, 2000.

BYUNGKI SON (PHD 1985) is a Director for the Dyestuffs Research Center of LG Chemical Ltd. in Ulju-Gun, South Korea.

CHRISTOPHER STETSON (PHD 1995) is a Research Scientist in the Point of Care Diagnostics Division of Bayer Corporation in Elkhart, Indiana.

LOUIS STEWART (MS 1984) is the Minister, Christian Education for the Mt. Olive Missionary Baptist Church in Fort Worth.

JAMES D. SWEET (PHD 1998) writes that he finished on the USS Essex in April and he and Stacey will be moving to Crete, Greece for a year to complete his Navy job.

KEN M. TALKINGTON (BA 1961) was one of three distinguished alumni honored by Texas Tech on November 5, 1999.

LOKMAN TORUN (MS 1994) is a Graduate Assistant in the Department of Chemistry of Purdue University in West Lafayette, Indiana.

MARTY UTTERBACK (PHD 1992) is the Commercial Development for

Uniqema in Sugar Land, Texas.

LINDSAY WALKER (BS 1997) is pursuing her MBA at Texas Tech and has received a fellowship to work in the Texas Tech Medical School.

T. JOHN WARD (BA 1964) has been named as the United States District Judge for the Eastern District of Texas.

JOHN WHITE (PHD 1993) holds Adjunct Instructor positions in the Departments of Chemistry of Temple College in Temple, Texas and the University of Mary Hardin-Baylor in Belton, Texas.

MICHAEL R. WILSON (BS 1997) received his commission as a naval officer in 1999.

JAMES H. VAN TASSEL (MS 1957;PHD 1959) retired from NCR in 1991. He and his wife Mary Lou live in Dayton, OH where he keeps current with technology with memberships on various councils and boards.

IL-WOO YANG (PHD 1981) is Professor of Chemistry and Dean of the Natural Science Division of Korea Military Academy in Seoul, South Korea.

MINJOONG YOON (PHD 1981) is Professor of Chemistry at Chungnam National University in Taejon, South Korea.

QIANG ZHANG (MS 1999) is a Senior Research Assistant with Pharmacoopia, Inc. in Monmouth Junction, New Jersey.

QIANG ZHAO (PHD 1995) is a Senior Process Engineer in the Dielectric Etch Division of Applied Materials in Sunnyvale, California.

LONGGUI ZHONG (MS 1997) is the Materials Development Lab Manager at the corporate headquarters of Acadia Polymers.



Scholarships and Awards

It is a pleasure to acknowledge the generous support of our scholarship programs by Phillips Petroleum Company and the Celanese Chemical Division of Hoechst in 1998. Such contributions allow us to recognize and encourage our excellent undergraduates. In addition to our industrial supporters, funds for scholarships are available from the interest generated by the endowment given to the department many years ago by Dr. and Mrs. Joe Dennis and Joe Goodwin. Interest from funds established in memory of our late colleague Walter J. Chesnavich, is used to fund awards for the outstanding physical chemistry student for the year. These scholarships are awarded at the annual chemistry and biochemistry banquet, co-sponsored by the South Plains Local Section of The American Chemical Society.

Walter J. Chesnavich Memorial Award

Jacob Kelly

Jeannette and Joe Dennis Scholarships

Stephen Hagedorn
Jason Redler
Jennifer Lacina

Robert Goodwin Scholarships

April Nesbit
Kyle Hume
Holly Goebel

Phillips Petroleum Scholarships

Nader Dehghan

Celanese Scholarships

Richard Walulu
Bruce McHam

ACS-SA Scholarship

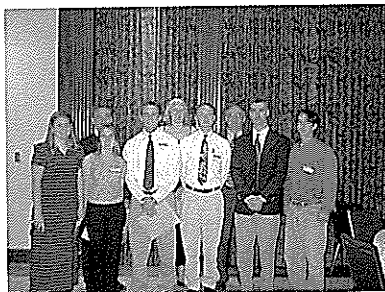
Michelle Magallenez

Julie Marshal, a doctoral student who works with David Nes, has received a graduate student ARCS Award.

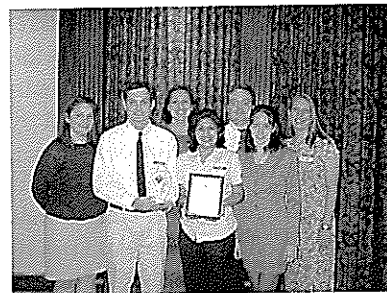
Marty Campbell, former Ph.D. student of Richard Bartsch and current Visiting Assistant Professor at TTU, won the 1999 Song Prize for best Ph.D. thesis for his work entitled "Synthesis of Mono- and Dibenzocrown Ethers with Fluorinated or Chromogenic Substituents". The Song Prize carries with it a \$650 cash award.



Cupcakes, Anyone?: Carrie Bates (l) and Lisa Walters pose with the award-winning Periodic Table of Cupcakes. The edible display was featured during National Chemistry Week in 1999.



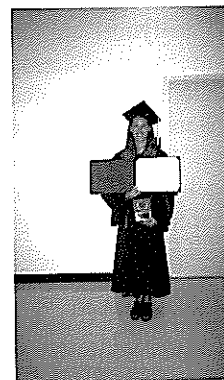
Chemistry Banquet Award Winners Pose with Dr. Bartsch. Front Row: Jennifer Lacina, Holly Goebel, Kyle Hulme, Bruce McHam, Jason Redler, Jacob Kelly. Back Row: Stephen Hagedorn, April Nesbit, Dr. Bartsch



Some of the old and new ACS-SA officers pose with their national awards. From left to right, Melissa Patton, Martin Ziska, Michelle Magallenez (the ACS-SA Scholarship Winner), Sandra Flores, Larry Shaw, Miranda Wilkins, and Lisa Walter.



Carrie Bates Displays her Most Recent Award (Her Diploma) next to the ACS-SA awards which she helped to bring to Texas Tech during her presidency of the ACS-SA in 1999.



4.0 Student: Keeli Hanzelka, a spring, 2000 graduate, completed her undergraduate career as a cell and molecular biology major and chemistry minor with a perfect 4.0 average. Keeli is currently a first year medical student at UT Galveston.

Transition States

• Graduations

Bachelor of Arts in Chemistry

August 1999
Keith Adam Fitzgerald

May 2000
Heather Dann Howard
Audra Michelle McAteer

Bachelor of Science in Chemistry

August 1999
Denise Renee Butler
Misty Brooke Scribner

December 1999
Carrie Lee Bates
Matt Dustin Findley
John Douglas Goodgion

May 2000
Timothy James Drake
Stephen Quinn Lee
Regina Diane Sandoval
Randy Martinez Tercero

Bachelor of Arts in Biochemistry

August 1999
Robert Michael Shirley
Phat Linh Tran

May 2000
Roy Tate Hendley
David Shawn Laney
Jason Bradley Lentz
Hao Li
Wendy Jo Niswonger
Michelle Lea Peters
Brent Buchanan Philips
Amy Catherine Sorrells
Tien Thuy Vo
Karri Renee Frazier Wheeler



Bachelor of Science in Biochemistry

August 1999
Andrea Kamini Sanchara
Marsha Kay Spivey

May 2000
Doris Arkaifie
Carrie Leane Gembler
Timothy Stephen Goebel
Christopher Thomas Horner
Tracy Brooke Kubena
Brandon Dean Novicke
Lisa Caroline Walter
Miranda Renae Wilkins

Master's Degree in Chemistry

August 1999
Wenxu Zhou (Biochemistry-Dr. Nes)
"Studies on the Purification and Characterization of the (S)-Adenosyl-L-Methionine Sterol Methyl Transferase from *Arabidopsis thaliana*"

December 1999
Christina Leigh Childers (Analytical-Dr. Korzeniewski) "Formaldehyde Yields from Methanol Electrochemical Oxidation on Platinum and Supported Catalysts"

May 2000
Brian Michael De Borja (Analytical-Dr. Dasgupta) "Ion Chromatographic Determination of Acidity"

Sofia Galanis (Analytical-Dr. Dasgupta) "Flow-Based Automatic Analysis Systems"

Sivakumar Jambunathan (Analytical-Dr. Dasgupta) "Measurement of Hexavalent Chromium in Leather by Colorimetric Methods"

Ph.D. Degree in Chemistry

August 1999
Nazar Saied Elkarim (Analytical-Dr. Bartsch) "Metal Ion Complexation by Acyclic and Cyclic Multidentate Ligands"

Susan Kay Thomas (Biochemistry-Dr. Makhatadze) "Rules of Helix Termination by the C-Capping Box: Calorimetric and Spectroscopic Studies"

December 1999
Martin James Campbell (Organic-Dr. Bartsch) "Synthesis of Mono- and Dibenzocrown Ethers with Fluorinated or Chromogenic Substituents"

CORRECTION

XIN LI (PHD 1999) Dr. Li's dissertation title in the previous edition of The Test Tube was incorrectly listed. The correct title should be "Expressing Higher Plant Nitrite Reductase."

• Promotions

James Harman was reappointed as Associate Chair of the Department of Chemistry and Biochemistry.

Allan Headley has become the new Associate Dean of the Graduate School.

Carol Korzeniewski was promoted from Assistant to Associate Professor in Sept. 1999.

Mark Porter became our General Chemistry Laboratory Coordinator in 1999. Mark was recently promoted from Instructor to Lecturer with acceptance of the Coordinator position.

Henry Shine has been designated Horn Professor Emeritus by the TTU Board of Regents. He had previously been deemed a Research Professor by the Board.

Bruce Whittlesey has assumed the position of Assistant Dean of the College of Arts and Sciences.



• Faculty Leaving TTU

Gayle Nicoll has left the faculty along with her husband Alex to take positions at the University of Nebraska in Omaha and Lincoln and to spend more time with their baby Serena.

• Deaths

JOHNNY BILL DELASHAW (BS 1954) died March 16, 1997

WADE J. HARTRICK (BA 1929) died on December 24, 1998.

POLLY TILTON died on May 29, 2000. She is described in her obituary in the *Avalanche-Journal* as having taught biology at TTU for 40+ years. But, Henry Shine recollects that when he came to TTU in 1954 she was teaching freshman chem. She shared an office with Patricia Fain, our first chemistry PhD, next to his office. He remembers Polly for the day-long stream of students that came to her office for help.



• New Beginnings

Emeritus Prof. Joe Dennis and Mrs. Dennis moved to Kerrville at the end of May after over 60 years in Lubbock. Dr. Dennis, who was in a nursing home in Lubbock, entered one in Kerrville, with Mrs. Dennis living nearby. They have a daughter living in Kerrville and another in nearby San Antonio. Dr. Dennis was head of the TTU Chemistry Dept. for 17 years and chair for two. He was the one who began putting it on a research path. He came to Texas Technological College in 1938, finished his Ph.D. in biochemistry from UT Galveston in 1942 while teaching at Tech. He became head in 1950 and hired Henry Shine, in 1954, among other faculty.

Letters and Symbols

May 31, 2000

Dear Former Colleagues and New Friends:

Your gracious gift and letter of appreciation to us touched our hearts and brought back many happy memories.

The book was new to us, and most timely. Joe especially enjoyed seeing the symbols of the elements as they appear on the building as HELIBECNOF (Hope I got it right). Dr. Craig introduced Joe to this way of pronouncing that, and Joe has always remembered it (ask Dr. Shine about that).

We treasure our years with you - former colleagues, and we wish each of you newer department members increasing success in your field, and that you will bring increasing recognition to the Texas Tech Department of Chemistry and Biochemistry.

Thank you for your thoughtfulness. May God bless each of you.

Sincerely,
Joe and Jeanette Dennis

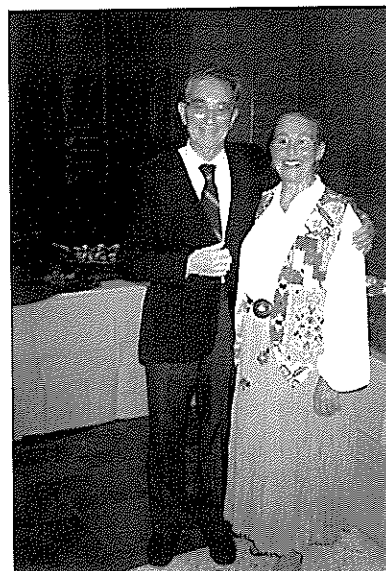
Nov. 2, 1999

Dear Prof. Shine:

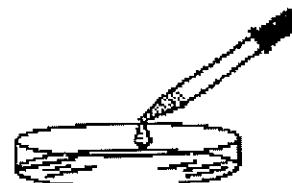
I was thrilled to get the announcement of the Shine Lectures. Not only was it the first bit of mail I have gotten from the school in the 40 years since I graduated but it was wonderful to see your name honored. While the brief bio was interesting, it did not mention a very important fact of your career. No mention of students or the motivation you provided. The human side is one of prime importance to those of us who have long since forgotten our graduate organic classes. Thank you.

I hope this letter finds you and your family well. Mary Lou and I live in Dayton, where we retired from NCR in 1991. I still keep current with technology with memberships on various councils and boards. I hear from MacPherson at Christmas, but that is it.

Best Wishes,
Jim (Dr. James J. Van Tassel)



Henry and Sellie Shine relax after the 1999 Inaugural Shine Lecture.

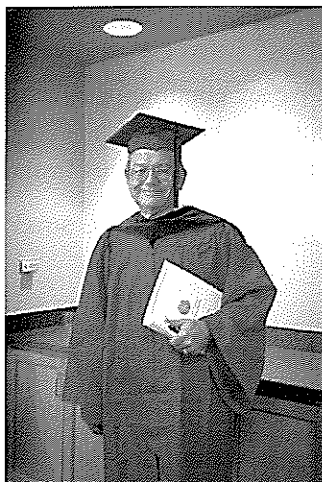


Contact Us By E-Mail!

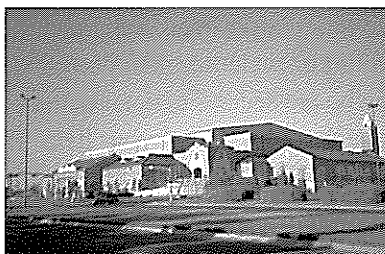
In this electronic day and age it seems that everyone is E-mailing, faxing, and cellular phoning everyone else. So, in our attempt to stay at the forefront of technology (its in our name, after all!), we would like to invite you to send us an E-mail message. These can be changes of address, articles you would like to include in the next *Test Tube*, whatever. Send your E-mail comments to:

dcasadon@ttacs.ttu.edu

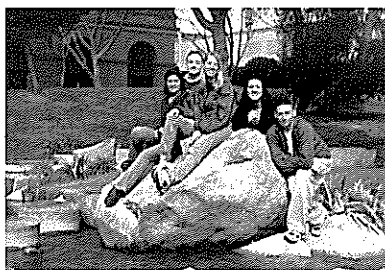
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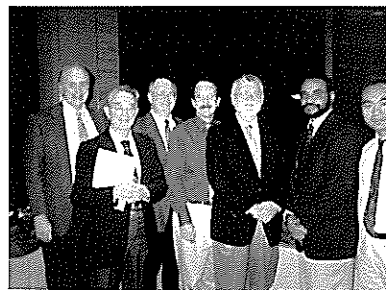
Better Late Than Never: Dr. Charles M. Baldwin, Ph.D., 1970, with Henry Shine, now Hammons Professor of Pre-Medical Studies and Department Chair in the Chemistry Department at Union College in Jackson, TN. The class of '70 was unable to graduate in the coliseum due to the tornado which ravaged Lubbock only a few day earlier. They had a graduation ceremony with the August, 2000 graduates in the United Spirit Arena.



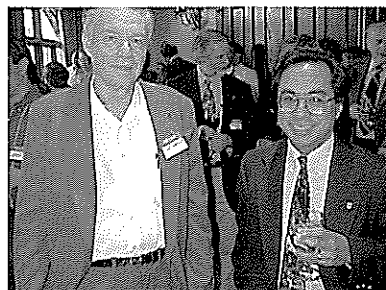
Spirit Anyone? In late 1998 the United Spirit Arena (abbreviated USA, fittingly enough) opened its doors. The first concert featured Elton John playing to a crowd which sold out in two hours.



California Dreamin': Members of the ACS-SA take some time off in San Francisco during the ACS national meeting. L to R, Sandra Flore, Larry Shaw, Lisa Walter, Michelle Magellanez, Martin Pflanz VIII



Shine On, Henry!: Members of the Organic Chermistry Division pose with Henry Shine and Clayton Heathcock, the Inaugural Henry Shine Lecturer. From l to r, John Marx, Henry Shine, Dick Bartsch, David Birney, Clayton Heathcock, Allan Headley, and Guigen Li.



Just Like in the Old Days: Emeritus Professor Joe Adamcik and Professor Ed Quitevis get caught up during the 2000 Chemistry Awards Banquet.



Undergraduates at Kids & Chemistry workshop (left) and ChemDemos (above) enjoy learning simple experiments to use in public outreach programs.



It's Magic: Martin Pflanz VIII illustrates the Amazing Ability of Sodium Polyacrylate to soak up water at the San Francisco ACS meeting. This picture was featured in *Chemical and Engineering News*, the ACS trade journal.



Dr. Dr. Walkup: Dr. Robert Walkup, former faculty member, graduated this year from the TTU medical school. Pictured here with members of his research groups who came back for a surprise celebration. Dr. Walkup is continuing with a residency in Family Practice at TTUHSC.

The Coinage Metals

Our department is, more than ever, dependent upon non-state sources of funding in the form of endowments and personal donations. The continued success of and improvement in our department depends upon the establishment of a stable endowment-based foundation. Would you please consider helping us in this crucial endeavor? Contributions in any amount would be welcome. As you can see from this issue, we are well on our way to establishing a class of students who are second to none in the country. We are continuing to raise money for the Welch Chair Endowment match and we need your help. Please consider helping Chemistry and Biochemistry at TTU as it strives to be one of the premier teaching and research departments in the United States and the world.

Donation Response Form

Enclosed please find a check, made out to "The Department of Chemistry & Biochemistry - TTU", "Welch Chair Endowment Matching Fund" on the memo line, in the amount of \$ _____.

My employer participates in a matching program for donations by employees.

Please contact _____ at _____

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Name:

Degree and Graduation Year

Address (or enclose "Information Update Form"):

E-mail Address:

**Please return to: Dominick J. Casadonte, Jr., Dept. of Chemistry & Biochemistry
Texas Tech University, Lubbock, TX 79409-1061**

Dear Family, We Are Fine, How Are You?

Please let us hear from you, whether it be a quick “hello,” a lengthy epistle, or a cool note to correct my errors about you! It would be a tremendous help to us if you could help us update our information about you and that, in turn, would help you to be better informed about what’s going on here at Tech. Please, at least, fill out the form below and send to the *TestTube* editor.

Information Update for TTU Chemistry and Biochemistry Alumni File

Name _____
Last First Middle Maiden Name

TTU Degree (Circle all that apply): BA BS MS PhD Postdoc

Year(s) of Degree(s) _____
(please give name of research advisor for graduate & postdoc positions, and school, if not TTU)

Address: _____

E-mail Address: _____

_____ Check here if this address is different from the one printed on your issue of the *TestTube*,

Employer: _____ **Position:** _____

Business Address: _____

Comments, Corrections, News (photos are welcome!):

Please return to: Dominick J. Casadonte, Jr., Dept. of Chemistry & Biochemistry
Texas Tech University, Lubbock, TX 79409-1061

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Biochemistry
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Lubbock, Texas 79409-1061

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