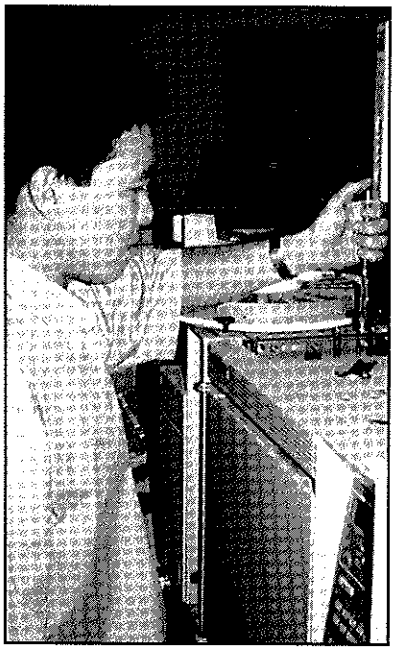

EIH

1997 Annual Report of the Environmental Institute of Houston

The University of Houston Clear Lake and The University of Houston Houston, Texas

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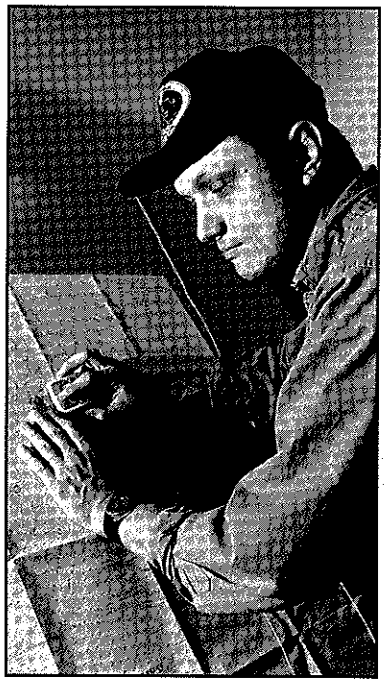

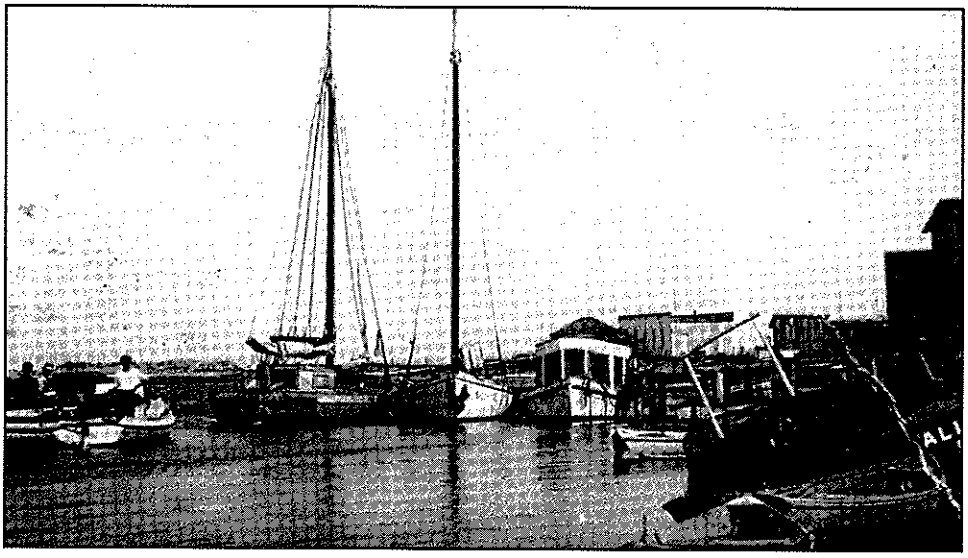

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March 1998

The roadway to the University of Houston Clear Lake bridging the bayou and introducing students, faculty, and visitors to a natural environment and nature preserve. UH Clear Lake is within three miles of NASA and an easy drive to the Kemah shrimping docks.

Outdoor classes in February at the University of Houston, five miles from metropolitan Houston at the Ezekiel Cullen Family Fountain within sight of biology and chemistry laboratories.

Cover photos

***Top Left*—Dat Tran, a baccalaureate student in chemistry and environmental science, assists Dr. Sam Chen in the analysis of pesticides in vegetables. Here he is shown working on a spinach sample. (*See page 6.*)**

***Top Right*—Aerial photographs (used by classroom students K-12 to study geography), in a project under the direction of Prof. Joan Maier, UHCL. (*See page 20.*)**

***Center*—Kenneth McVay, research assistant in the laboratory of Dr. Theron Sage, devotes his effort to quantifying suspended sediments in Galveston Bay. With a B.A. in mathematics, McVay is pursuing his master's in physical science at the University of Houston Clear Lake. (*See page 25.*)**

***Bottom Left*—Seabrook, Texas, 1908; courtesy of the Chapman/Christy family. (*See page 17.*)**

***Bottom Right*—Texas fisherman, 1914; courtesy of the Ellis family. (*See page 17.*)**

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University of Houston Clear Lake
University of Houston
Houston, Texas

Principal Investigators

Dr. John Ramsey, associate professor of curriculum and instruction, shown at the sculptured waterfall east of the School of Education Building.

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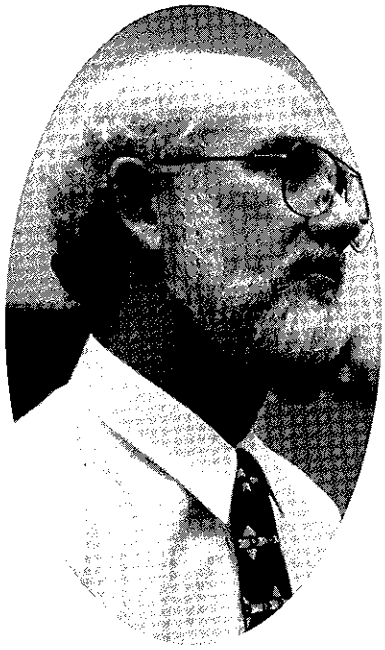
EIH Director's Message • Dr. Jim Lester

1997 FOR EIH WAS THE year of environmental education (EE, for the initiated). The focal point was a conference hosted by EIH in April titled "A Question of Balance: Building Blocks for Environmental Education in Texas." The organization and impact of the conference are described on page 12. The conference became the first step in the process for environmental education reform in Texas. The Texas Natural Resource Conservation Commission received a grant from the National Environmental Education Advancement Project for a statewide planning effort termed EE2000, which included the conference. EIH is administering the grant and supporting the EE2000 project.

EE2000 has an impressively diverse group of participants working on guidelines, infrastructure, and R&D for EE. Concomitantly, the Environmental Regulation Committee of the Texas House of Representatives is engaged in an interim study of EE materials produced with Texas funds. I believe these efforts will spark a metamorphosis and growth of environmental education in Texas.

The major environmental event for the country was the Kyoto conference on the Global Climate Change Convention. The juxtaposition of our environmental education efforts and the global climate change debate in our media was instructive. It is clear that most journalists and policy makers need some education about climate change. Accounts of the debate did not emphasize the inevitability of climate change or set the current temperature rise in a paleoclimatic context. It may be true that human contributions to global warming are less than contributions attributed to natural processes, but that understanding does not mean there is nothing to worry about, nor does it suggest that no policy is needed. Obviously, the people who wrote the press releases and articles were not trained in EE. Good environmental educators use accepted science and teach how to think about the issue, not what to think.

One reason for enhancing EE is the cost of learning lessons about the environment from mistakes. Mistakes can be very expensive in terms of lost or damaged



Dr. Jim Lester, Director

resources and natural beauty. Perhaps that explains why so many of the projects described in this annual report are studies of the historical record. Melosi and Radcliff examined the records of people who personify the development of conservationism in Houston. Few and Fustes cataloged the records of land use change in Northern Galveston Co. Weeks and Gallaway compiled information on historical management of an important living resource, shrimp. Lawrence is analyzing the chemical records held in clamshells to tell him about the frequency of past hurricanes.

Some of us are skeptics about "common knowledge" or "everyone knows that. . . ." Those skeptics develop research projects to understand what is really transpiring on select environmental issues. Allison and Durand examined correlates of compliance failure by water treatment facilities. What affects the effluent quality more—influent quality, facility management, or technology employed? Robinson, Cameron, and Bryant studied the impact of habitat fragmentation in coastal wetlands. Wetland protection is strong, and acreage is increasing, but are the gaps in distribution preventing improvement of habitat quality? Various models are available to simulate the movement of pollutants in soil. Do they reflect the actual process in our Gulf Coast gumbo? Capuano, Bunge, Krauszer, Snyder, and Hyeong concluded that the soil is less important than the holes, crayfish holes that is. Gossett took a careful look at what has really been the record of the Darth Vaders in government agencies for property takings related to water rights. Sater wants to determine if amphibians are disappearing from some regions because acid rain conditions disrupt embryonic neural development.

Several of our grants went to projects that disseminated knowledge about environmental pedagogy. Jones developed activities to teach school children about the principles of reducing, reusing, and recycling nonconsumable goods. Maier and Sanders worked on a new delivery system for geographical information to middle-school children. Ramsey teamed with the Texas Parks and Wildlife Department to create an alliance of schools putting their explorations of their local environment on the World Wide Web.

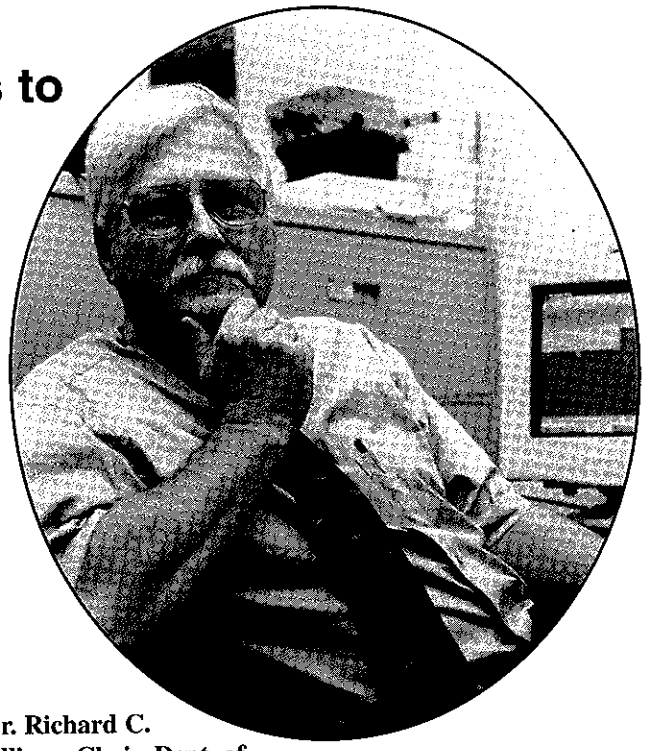
Academia has always been accused of harboring dreamers, for whom I believe no apologies are due. Some dreamers will elaborate on tomorrow's realities. The 1997 EIH projects included a vision by May and Talley of what a sustainable community would look like in Houston's East End. Investigators worked on concepts of pollution prevention through 1) better catalysis of chlorinated hydrocarbons, by Richardson, and 2) better energy efficiency from new coatings for lighting, by Hoffman. Roberts took an experimental gamble that she would find viruses capable of extending the life of sewers and storm drains by attacking bacteria responsible for corrosion.

Sometimes we just cannot resist applying a technology that fascinates us to a problem it was not designed to solve. Chen is using light-activated semiconductors to study decomposition of herbicides. Sage and McVay are using satellite images to measure the load of dirt in the waters of Galveston Bay.

In 1997, several colleagues in environmental studies departed UH. One of our 1997 projects commemorated the work of retiring Professor Jim Symons through a symposium on water disinfection by-prod-

(Continued on page 4.)

Contributions of Management Practices to the Prevention of Water Pollution



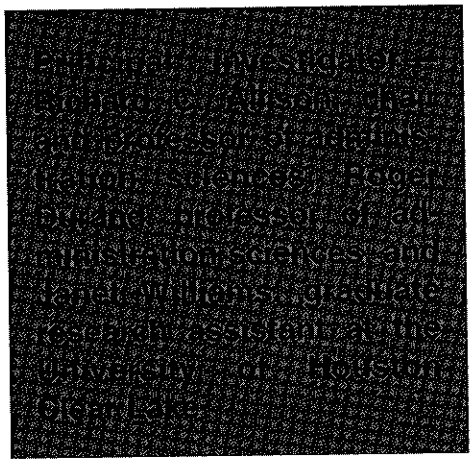
Dr. Richard C. Allison, Chair, Dept. of Administrative Science, School of Business and Public Administration

A SAMPLE OF WATER DISTRICTS WAS selected from the population of water districts in Texas. The sampling plan afforded control over a set of variables hypothesized to be important to wastewater permit violations (*e.g.*, climate, rainfall, *etc.*).

Longitudinal data on wastewater permit violations were gathered on the sampling of districts. A cooperative relationship was developed with the staff of the Texas Natural Resource Conservation Commission (TNRCC). TNRCC assisted the investigators with gathering longitudinal data on a set of 125 water districts in southeast Texas. The data gathered consisted of evidence on wastewater permit violations for a seven-year period.

A survey instrument intended to measure management variables was developed with the assistance of the Association of Water Board Directors of Texas (AWBD). This instrument is now being tested on the directors and staff of the Clear Lake City Water Authority.

Arrangements for the administering of the survey to the 125 districts included in the sample (see above) have been completed. The survey will be administered in the fall in order to ensure a high response rate.



Principal Investigator — Richard C. Allison, chair, and professor of administrative sciences; Roger Duncan, professor of administrative sciences; and Janet Williams, graduate research assistant at the University of Houston-Clear Lake.

Director's Message

(Continued from page 3.)

ucts. Professor Symons has demonstrated his environmental preference by moving to Florida. Dr. Guy Cameron also changed his environment in 1997 by accepting the chairmanship of the biology department at the University of Cincinnati. His departure was commemorated by a gathering at the UH Coastal Center where Dr. Cameron and students have developed personal relationships with untold numbers of small mammals.

Despite El Niño and other potentially catastrophic environmental phenomena, I forecast smooth sailing for EIH. The Houston public knows environmental quality is valuable. The institute has a role in many of the important processes that will protect and improve our environmental quality. The better we perform, the more opportunities we will be offered. It is a blessing that we can improve the environment but a curse that we cannot effect faultless conditions.

Contaminant Transport and Bioremediation in Shallow Fluvial-Deltaic Sediments, Common Hosts for Chemical Contamination along the U. S. Gulf Coast

We have found that vertical migration in the thick layers of clay-rich sediments commonly deposited in fluvial-deltaic depositional systems appears to be controlled by macropores rather than micropores. Micropores are the pores that make up the matrix permeability of the bulk sediment. In contrast, macropores are the larger scale features such as fractures, root holes, and crayfish burrows.

We have focused our efforts this year on two major aspects of this problem: (1) field methods for the evaluation of the hydraulic conductivity of these sediments and (2) the contribution of crayfish burrows to the permeability of surface sediments and their importance to the increase in infiltration of surface runoff.

We have confirmed that the measurement of the sediment hydraulic conductivity by laboratory permeameter tests underestimates the *in-situ* vertical and horizontal hydraulic conductivity of the clay-rich portions of fluvial deltaic sediments by one to four orders of magnitude.[1,2] This finding is important because hydraulic conductivities determined from permeameter tests are commonly used to predict contaminant transport in fluvial-deltaic systems, and data are needed to make decisions regarding remediation of contaminated portions of these sediments.

Our testing included the comparison of hydraulic conductivities determined from multiwell and multilevel pumping tests and dye tracer tests (horizontal migration only) with those determined from the permeameter tests. As part of our future work to quantify vertical migration we have plans to inject a tracer and follow its vertical migration with our array of five piezometer nests that range in depth from 3 to 25 meters.

As part of our study to determine the contribution of crayfish burrows to the vertical hydraulic conductivity of surface sediments, we have conducted modified pumping tests on the burrows and employed a dye tracer test. The pumping tests have shown that drawdown in the burrows results in drawdown in wells screened at depths of 3 m. The dye test showed that dye applied to four neighboring burrows infiltrated within one month into the underlying sediments to a depth of 3 m and a distance of 15 m down the hydraulic gradient. These results strongly

Dr. Regina Capuano studying output from a chromatograph sampling.

suggest that there is significant hydraulic communication between the burrows and the subsurface. This is significant because the generally very low vertical hydraulic conductivity of clay soils is thought to retard the vertical infiltration of a chemical spill on the ground surface. Our results, however, suggest that in the vicinity of crayfish burrows infiltrate rates will be faster than expected. We will have more information on how much faster, when the interpretation of the data is completed.

References

[1]R. M. Capuano and R. Z. Jan. "*In-situ* Hydraulic Conductivity of Clay and Silty-Clay Fluvial-Deltaic Sediments," *Ground Water* 34.3 (1996): 545-51.

[2]R. M. Capuano. "Permeameter Tests of the Silty Clay from the Fluvial-Deltaic Beaumont Formation can Underestimate Hydraulic Conductivity," *Bulletin* Houston Geological Soc. 39.10 (1997): 8.

Principal Investigator: Regina M. Capuano, Associate Professor of Geoscience; George Bunch, research assistant; Scott Krausen, research assistant; Fred Snyder, research assistant; and Kisson Liyanto, research assistant, at the University of Houston

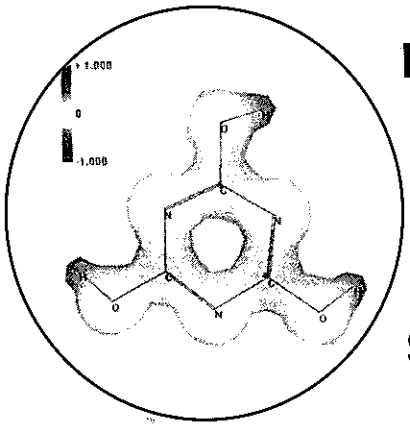
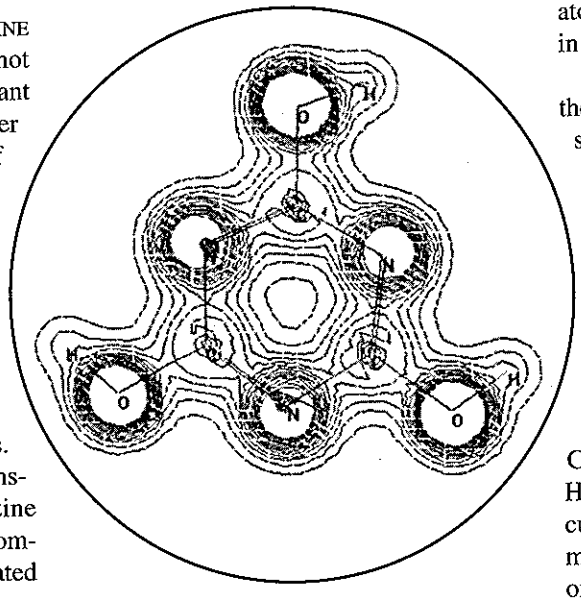


Photo-Decomposition of Triazine Herbicides in Water with Light-Activated Semiconductors

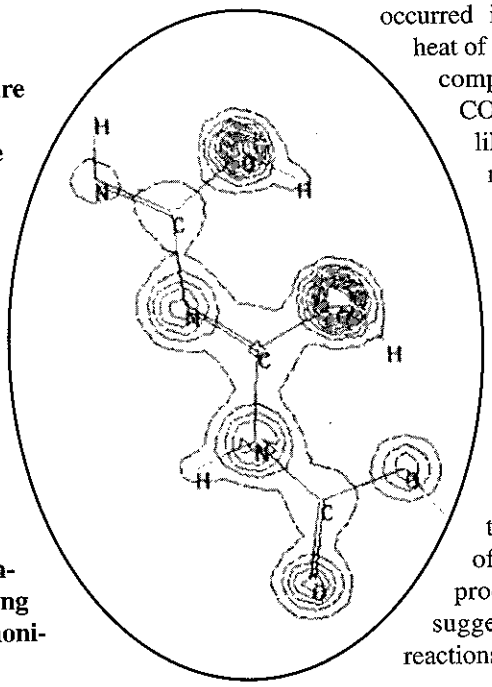
THE FATE OF WIDELY USED TRIAZINE herbicides in natural waters is not fully understood but very important in the prevention and control of water pollution. The photo-decomposition of triazine herbicides atrazine, cyanazine, propazine, and simazine in water in the presence of the light-activated semiconductor anatase (TiO_2) was studied using several techniques. Gas chromatography-mass spectrometry (GC-MS) study revealed the gradual oxidation of the ethyl, isopropyl, and cyano groups of the parent molecules. All four triazine herbicides were transformed to diethyldiisopropyl atrazine when the aqueous solutions of these compounds were illuminated with simulated sunlight and catalyzed by TiO_2.

UV absorbance was taken before and after exposure to simulated sunlight. The absence of UV absorbance after photolysis experiments suggested complete decomposition of the molecules. Without the catalyst anatase, however, atrazine was photolyzed to dichloroatrazine, which was then degraded slowly in water. The observed degradation pattern seemed to support a hydroxyl free radical reaction mechanism, in which light-activated hydroxyl free radicals migrated from the surface of TiO_2 particles and abstracted hydrogen atoms from the target molecules, resulting in gradual oxidation of the compounds.



Upper left—Figure 1. Chemical structure of cyanuric acid and the 3D mapped isosurface plot of its electrostatic potential.

Above—Figure 2. Cyanuric acid structure and the 2D contour plot of its total charge density. The molecule is not stable in water and can be hydrolyzed.



Right—Figure 3. Possible chemical structure of a reaction intermediate of cyanuric acid after hydrolysis in water. This structure is not stable and will decompose further, producing carbon dioxide, ammonium, and water.

The physical chemical properties of these herbicides and their photo-decomposition products were important in predicting and understanding their reaction and fate in the environment. Properties such as heat of formation were never experimentally measured for a number of reasons. Computer molecular modeling of the decomposition process was performed using well-known computational chemistry software packages, CHEM3D from Cambridgesoft and Hyperchem from Hypercube. The geometry of all the molecules was optimized and the energy minimized prior to any calculations. The heat of formation (ΔH_f) for the parent and daughter molecules was computed using AM1 (Austin Model 1), a popular semi-empirical quantum mechanical method.

Since the photolysis process occurred in water, aqueous heat of formation was also computed using the COSMO (Conductor-like Screen Model) routine included in MOPAC 93.

If we utilize the results (Table 1) and assume that the undetected inorganic products are carbon dioxide and water, the calculated heat of reaction (ΔH) for each of the degradation products is negative, suggesting exothermic reactions. Since $\Delta G = \Delta H$ -

Principal Investigator — Sam Chen, Assistant Professor of Environmental Science, and Dat Tran, undergraduate student at the University of Houston Clear Lake

$T\Delta S$ and the ΔS is most likely to be positive, the ΔG is smaller than zero, indicating a thermodynamically favorable reaction. Ammeline, ammelide, and cyanuric acid were suggested as final decomposition products by other researchers, so the heats of formation for these molecules are included in Table 1. The electrostatic potential and total charge density for cyanuric acid are presented in Figs. 1 and 2, these plots indicate an unstable structure. In an aqueous environment, cyanuric acid is hydrolyzed and the heterocyclic ring is then broken. The intermediate product, shown in Fig. 3, is not stable enough to be isolated experimentally but can be computer-modeled. It will undergo rapid decomposition to give carbon dioxide, ammonium, and water, leading to a complete decomposition. This sequence of reactions is illustrated in Fig. 4.

Overall, this study successfully demonstrated the feasibility of modeling chemical reactions of compounds of environmental importance using computational chemistry.

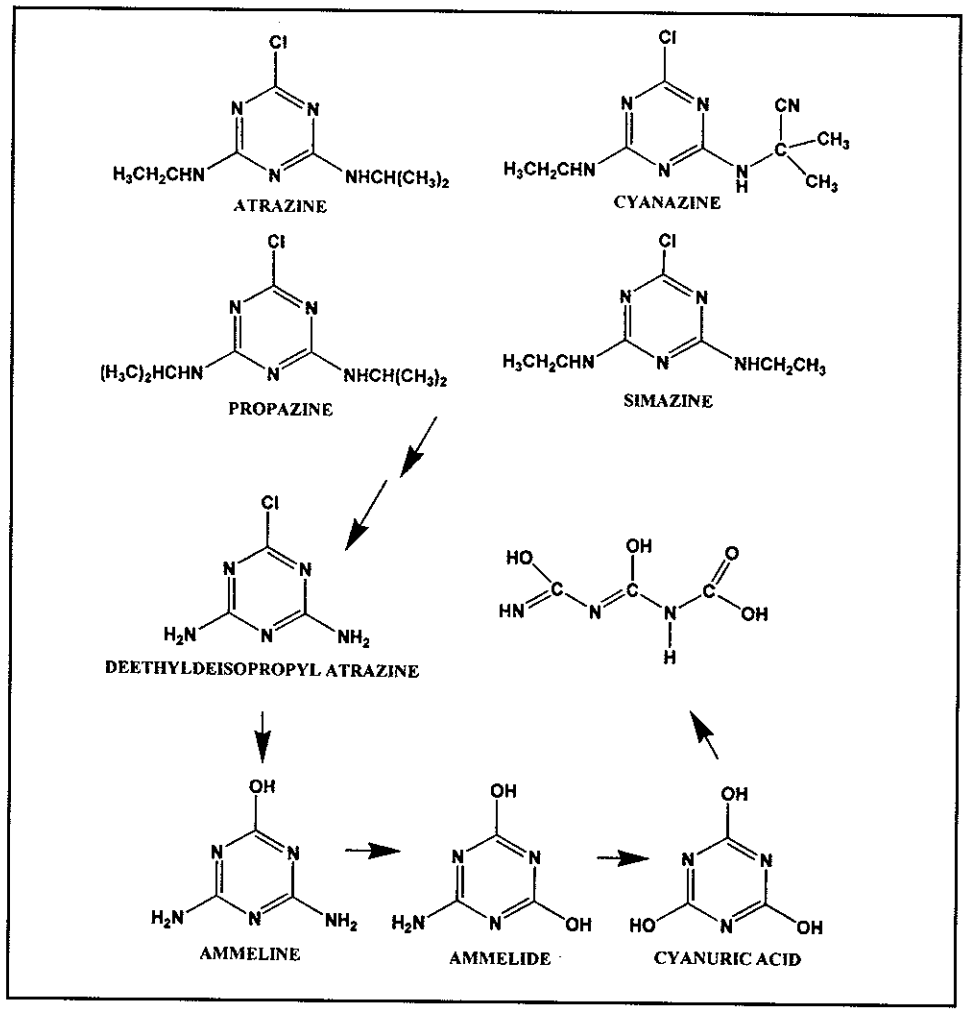


Figure 4. Proposed reaction sequence for the photodecomposition of triazine herbicides atrazine, cyanazine, propazine, and simazine.

Table 1. Heat of formation (ΔH_f) of triazine herbicides and their photo-decomposition products as calculated with AM1 method and the COSMO routine.

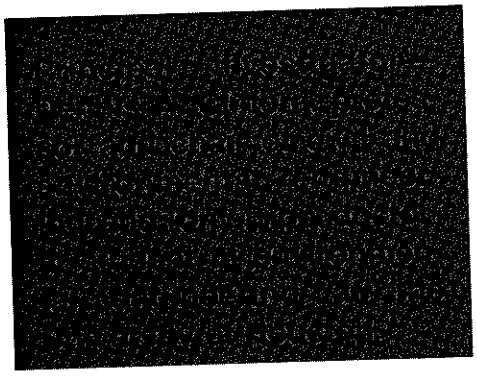
Compounds	Formula	ΔH_f In Vacuo kcal/mole	ΔH_f In Water kcal/mole
Atrazine	$C_8H_{14}N_5Cl_1$	46.9	30.4
Deethyl atrazine	$C_6H_{10}N_5Cl_1$	49.8	30.4
Deisopropyl atrazine	$C_5H_8N_5Cl_1$	53.8	33.6
Deethyldeisopropyl atrazine	$C_3H_4N_5Cl_1$	56.8	33.5
N-Acetyl atrazine	$C_8H_{12}N_5O_1Cl_1$	19.5	-5.7
Dechloro atrazine	$C_8H_{15}N_5$	50.7	33.2
Ammeline	$C_3H_5N_5O_1$	21.7	-5.2
Ammelide	$C_3H_4N_4O_2$	-20.2	-46.3
Cyanuric acid	$C_3H_3N_3O_3$	-60.3	-86.1
(Opened hydrated cyanuric acid)	$C_3H_5N_3O_4$	-122.8	-154.5
Cyanazine	$C_9H_{13}N_6Cl_1$	86.9	67.8
Propazine	$C_9H_{16}N_5Cl_1$	42.8	27.1
Dechloro propazine	$C_9H_{17}N_5$	46.6	30.6
Simazine	$C_7H_{12}N_5Cl_1$	50.6	34.6
Dechloro simazine	$C_7H_{13}N_5$	54.3	37.0

Disinfection By-Products Symposium—History, State-of-the-Art, and Research Needs

THE YEAR 1997 MARKED THE 25TH anniversary of the water supply industry's concern with disinfection by-products (DBPs) and it also marked the retirement of Dr. James M. Symons, University of Houston Cullen Distinguished Professor of Environmental Engineering. The intersection of these two events prompted the Department of Civil and Environmental Engineering to organize a technical symposium to critically evaluate what is known about DBPs at this milestone and to plan the future direction of research, as well as to honor Professor Symons.

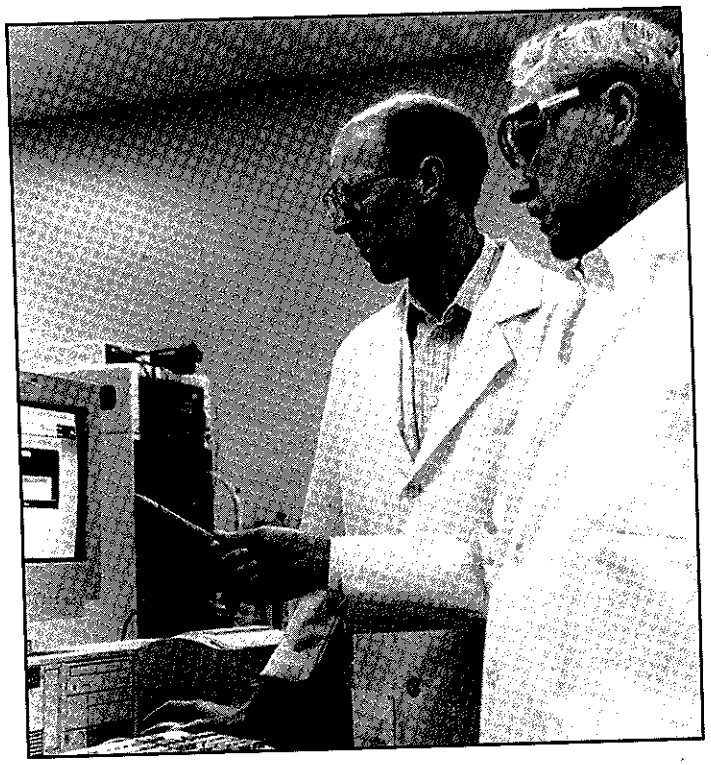
The symposium, which brought major recognition to the University of Houston, was funded by the Environmental Institute of Houston (EIH), the Civil and Environmental Engineering Department (CEE), the Cullen College of Engineering (CCE), and the U. S. Environmental Protection Agency (USEPA). Additional sponsorship was provided by the American Academy of Environmental Engineers (AAEE) and the Texas Section of the American Water Works Association (AWWA). The technical meeting and banquet were held on the University of Houston campus, March 20 and 21, 1997.

The one-and-one-half-day symposium brought together 20 national and international experts who presented papers on various aspects of the DBP problem. The speakers and their co-authors are also contributing manuscripts to a book on DBPs to be published by the American Water Works Association. In addition to the formal presentations, nine posters detailing the findings of significant current research were displayed at the meeting.



Twenty of the best-known national and international experts in each aspect of the Disinfection By-Products problem were contacted and asked to serve as speakers at the meeting. All agreed to participate in the landmark symposium honoring Professor Symons.

Once the speakers were committed, the meeting was widely advertised. Advertising was sent out using selected mailing lists of the American Water Works Association, the American Water Works Research Foundation, the State Health Department Laboratories, the UH Environmental Engineering Program, the Association of Environmental Engineering Professors, and friends of Dr. Symons and the other civil and environmental engineering faculty.



Prof. Dennis Clifford (front) shown working with Tony Tripp (back), doctoral student in environmental engineering, on an ion exchange technique useful in the purification of drinking water. Clifford served as chair of the March 1998 symposium at the University of Houston on disinfection by-products (DBPs), in cooperation with industrial sponsors, the AAEE, AWWA, and the EPA.

In addition, the symposium was advertised on the UH CEE Web Page and the AEEP Web Page and in a variety of newsletters including the American Water Works Association Mainstream, the Texas Section AWWA Newsletter, and the MIT CEE Newsletter. Numerous e-mails and faxes were sent announcing the meeting to close friends and associates. Probably, no one in the field of Disinfection By-Product Research was missed.

Attendance at the technical symposium was about 200, including engineers, scientists, and technologists who came to a "landmark meeting." Attendees came from throughout the United States, and from Israel, France, Canada and the UK. By all reports, the symposium and banquet were a huge success, both technically and socially. Reports from those attending the symposium included statements like "outstanding," "excellent talks, all of them," "the best technical meeting I have ever attended."

The attendance at the Symposium Banquet honoring Cullen Distinguished Professor James M. Symons and his family was about 225 including family, friends, and symposium attendees.

Each symposium speaker is providing a chapter for a state-of-the-art monograph updating all the research on the subject of disinfection by-products in drinking water. The hard-cover volume will be published in 1998 by the American Water Works Association. The editor of the book is Professor Philip Singer of the University of North Carolina, the preeminent researcher in the disinfection by-products field.

Environmental Changes

Effect of Habitat Fragmentation on Demographic and Genetic Structure of Natural Populations: A Metapopulation Analysis

THE EFFECT OF HABITAT FRAGMENTATION on populations is a major concern for resource managers and conservation biologists. Most scientific studies of fragmentation have focused on forest habitats and bird populations. The few studies with mammals have focused on the impact of fragmentation of grasslands and forests. In the interest of seeking a new, broader understanding of the effects of fragmentation, the purpose of this project was to understand the effect of fragmentation of coastal salt marsh on the population dynamics of the dominant small mammal, the marsh rice rat (*Oryzomys palustris*).

Progress

We identified six potentially linked habitat fragments in a bayou system entering Galveston Bay and areas to be used as controls. After obtaining permission from the owners, we conducted a three-month-long pilot study to finalize tagging techniques and establish trapping grids. To finalize our experimental design, we performed power analyses to confirm that our experimental method could detect the differences between habitats forecast by the pilot studies, and we evaluated the effect of grid-size on estimation of 30 different demographic parameters. In response to these pilot analyses, plot size was set and the study was expanded to include two mammal species, the marsh rice rat and the cotton rat (*Sigmodon hispidus*) because both rodents use marsh and upland in different season.

Accomplishments this year include collecting field data. In addition, in response to the power analysis, our experimental design was modified to emphasize sampling an increased number of areas. Consequently, our experiments were linked with the work of graduate student Beth Kruchek (studying the use of marsh *vs.* upland habitats by small mammals) to increase the number of plots sampled for both studies. Thus, in addition to the marsh trapping each month, adjacent areas of upland were trapped at selected sites. We will use all the sites for the habitat fragmentation study (Table 1) and Kruchek will use plots with adjacent uplands (S, H; Table 1).

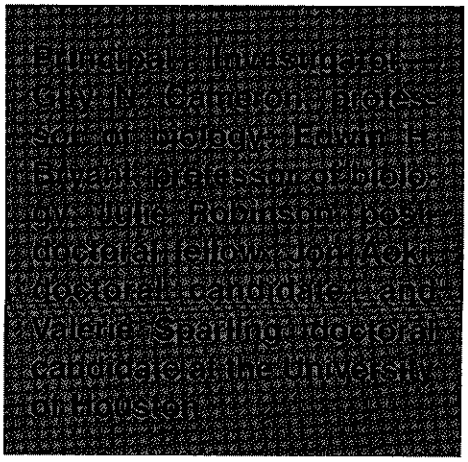
Salt marshes are habitats characterized by fluctuating conditions. Heavy rains and coastal flooding hindered the beginning of field work and data could not be obtained from all sites. Capture/recapture methods require three consecutive days of trapping, and these were sometimes precluded when the entire site was under water. Thus, through November 1997, we will have a total of 12-13 months of data depending on the way data analysis techniques are used to allow for missing values (Table 1).

Radios used in previous studies were returned for remanufacture to conduct pilot telemetry studies. The remanufactured radio was not suitable for use on rice rats because it was too large. Redesigned radios were ordered and received in late June 1997.

The finalized field research program began in August 1996 and terminated in November 1997. At that time, researchers analyzed the demographic effects of fragmentation. As part of her master's thesis, Kruchek is analyzing the importance of the upland/wetland interface for small mammals. Valerie Sparling, who joined the team in October 1996, is studying movements of small mammals in response to habitat fragmentation as part of her dissertation research.

Table 1. Successfully completed trapping sessions. *X* indicates complete data obtained, *O* indicates data is suspect due to influence of severe flooding, blank indicates trapping could not be conducted. *P* = Pierce Marsh, *B* = Brazoria, *S* = State Park, *H* = Highland Bayou, *J* = Jamaica Beach.

		Unfragmented Sites						Fragmented Sites					
Month	#	P1	P2	B1	B2	S1	S2	H1	H2	H3	H4	J1	J2
Oct 96		X				O	O						
Nov	1	X	X	X	O	X	X	X	X				
Dec	2	X	X			X	X	X	X			X	X
Jan 97	3	X	X	X	X	X	X	X	X	X	X	X	X
Feb	4	X	X	X	X	X	X	X	X	X	X	X	X
Mar	5	X	X	X	X	X	X	X	X	X	X	X	X
Apr	6	O	O	X	X	X	X	X	X	O	O	X	X
May	7	X	X	X	X	X	X	X	X	X	X	X	X
Jun	8	X	X	X	X	X	X	X	X	X	X	X	X
Jul	9	X	X	X	X	X	X	X	X	X	X	X	X
Aug	10	X	X	X	X	X	X	X	X	X	X	X	X



Changed Environment of Northern Galveston County: A Synthesis of the Historic, Geographical, Topographical, Demographic, Industrial and Archaeological Data Pertaining to Environmental Change, From 1800 to the Present, in the Land Between Clear Creek and Dickinson Bayou

Dickinson Bayou, 1915-1918. Courtesy of the Broussard Collection.

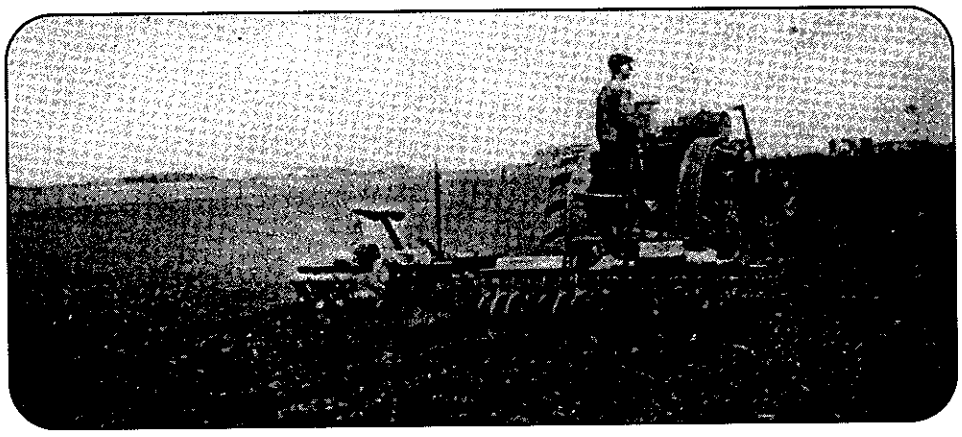
IN 1997, THE STUDY AREA INCLUDED THE land between Clear Creek and Dickinson Bayou. The objectives of the inquiry were to document the types of resources that brought people to the area, how they exploited those resources, and how this exploitation altered the land and its resources. Longtime residents were interviewed.

Cheap and available land and jobs relating to the exploitation of this land seem to have been what brought most people to north Galveston County. Cheap and available land still brings people to residential communities that cover the area, but many immigrants no longer make their living exploiting the land. Of the 13 persons surveyed about their or their family's immigration to the area, four came to ranch or work on ranches, and six came to farm or work on farms. Three families had dairy farms, and one came with the railroad. Three families had members who came with the army and stayed on. One person's family came to work in the oil fields, and three came to work in construction. Two came because they found the area a desirable place to live and raise children.

The information obtained in the interviews could not document any significant environmental changes in the area prior to the arrival of settlers in the early- to mid-1800s but significant changes have occurred since then. The changes discussed in the interviews appear to have resulted from four broad movements of large scale land use.

The earliest movement was ranching, which began a series of changes to the environment that accelerated with successive phases. The second movement was farming. The shift from ranching to farming was slow and overlapping but the impact of farming appears to be more significant. Farming brought the clearing and plowing of land, irrigation, the introduction of nonnative crops and, eventually, the use of chemical fertilizers and pesticides. The third major land use movement was oil exploration and the petrochemical industry which came to the area beginning in the 1930s and became a major employer after World War II. It offered full-time year-round employment to residents of the study area but was also viewed by those interviewed as a destructive element to the environment. The fourth major land use movement in the area was the arrival of NASA at the northern boundary of the study area. The introduction of a new highly educated and skilled work force increased the demand for housing and improved services. The local population became aware of the increased expectations of the new immigrants.

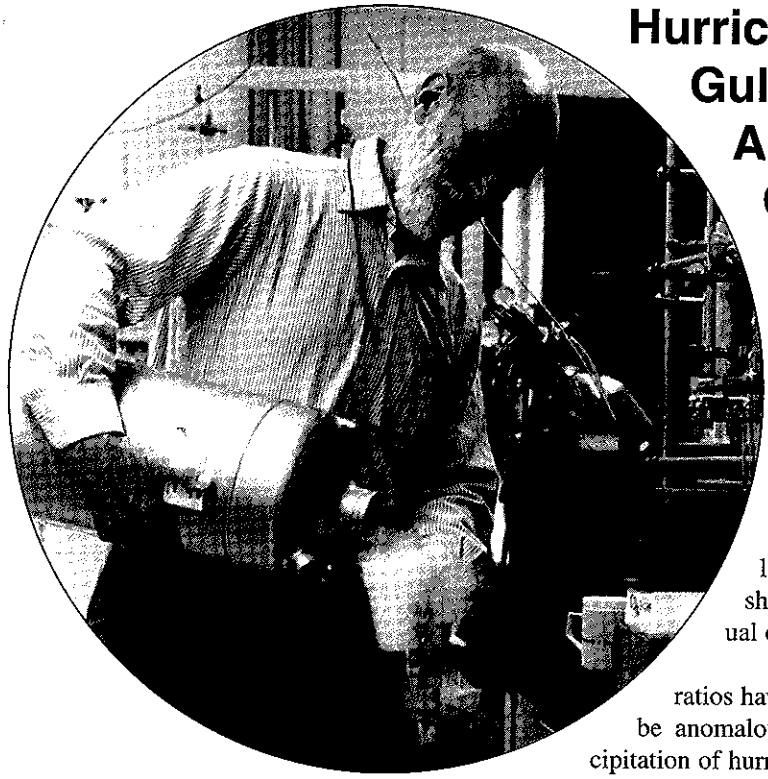
The study area's natural resources, the development of industrial/employment centers adjacent to the study area, and the increase in transportation resources helped create the conditions that led to the growth of the original settlements into the major suburban developments we encounter today.



Rice Farming in Friendswood. Courtesy of the Eignus Collection.

Principal Investigator: Jean Lee, another associate professor of archaeology, and Karen F. Hustes, research associate, at the University of Houston-Clear Lake

Hurricanes of the Past along the Gulf Coast from Isotopic Analysis of Clam and Ostracode Shells



Low stable isotope anomalies that exist in rains from hurricanes are recorded in annual growth layers of clam shells and individual ostracode shells. Oxygen isotope ratios have been shown to be anomalously low in precipitation of hurricanes and tropical storms.[1] In regions where rainfall from these storms was heavy, the isotope ratios of surface waters were also found to be low for a few weeks. Calculations show that this anomalously low isotope signal should be transferred to the annual layers of the clam shells and individual ostracode shells.[2]

The first objective of the proposed studies was to discover these negative isotope spikes in a clam shell from a living clam known to have lived through a tropical cyclone event.

The second objective was to discover where ostracodes could be found in shallow fresh water bodies along the Texas coast so that cores might be taken to discover isotopic spikes in a stratigraphic sequence of ostracode shells in the sediments.

The long-term objective of the studies is to reconstruct hurricane activity in the historic past so that risk potential can be assigned to coastal areas of the Gulf of Mexico and to measure hurricane activity in the geologic past so that better models of paleoclimate can be constructed.

Results

A new laboratory technique was developed for analyzing small amounts of carbonate powder from drill holes along growth layers of clam shells. This technique included methods for the extraction of carbon dioxide gas from small amounts of powder and introduction of the samples into our mass spectrometer for isotopic analysis. Success in the methodology was demonstrated by the analysis of a set of isotopic standards.

Preliminary isotopic analyses of a shell from a clam that lived through the summer of 1989 when two tropical storms dumped large amounts of isotopically depleted water in Highland Bayou were completed. About 15 mm of the shell growth length was analyzed without finding the hypothesized isotopic spike. More analyses along the length of the shell will be required to complete the search.

Samples of water and sediments were gathered from small ponds at the Houston Coastal Center to search for ostracodes present during the hurricane season. The intent was to discover which species might form shells shortly after the passage of a hurricane. The species, *Cypridopsis vidua* (O. F. Muller, 1776), was identified and juveniles were found to be common, indicating that shell growth does take place during the hurricane season.

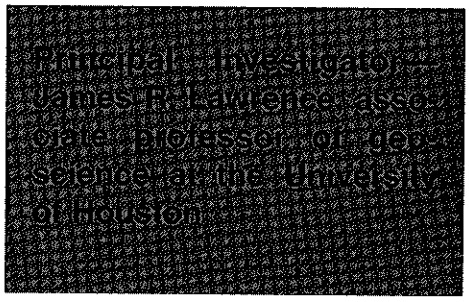
Contacts were made with Dr. Ken Brown of Louisiana State University, a biologist specializing in fresh water clams of the Texas coast. He has agreed to take us to localities in Louisiana where freshwater clams that survived Hurricane Andrew can be found. These will be used for additional isotopic analyses.

References

[1]J. R. Lawrence and S. D. Gedzelman. "Low Stable Isotope Ratios of Tropical Cyclone Rains," *Geophys. Res. Lett.* 23 (1996): 527-30.

[2]J. R. Lawrence. "Isotopic Spikes from Tropical Cyclones in Surface Waters: Opportunities in Hydrology and Paleoclimatology," *Chem. Geol.* (In press.)

Photo—Dr. Lawrence utilizes carbon dioxide gas in a new sampling technique for isotopic analysis.



Control Agent to Prevent Microbial Corrosion of Concrete

CURRENT EXPERIMENTS HAVE BEEN conducted to obtain initial evidence in support of the use of phage as a biological control agent to prevent microbially induced concrete corrosion. The experiments were designed to isolate and cultivate phage from natural sources and to prove that this phage could be used as a biological control agent.

Two procedures were used to isolate phage. Cultures of *Thiobacillus* sp. were obtained from the American Type Tissue Collection (ATTC). These cultures were exposed to 10, 20, 30 sec of UV light exposure in order to induce any prophage they might be carrying. UV light exposure was also carried out on an acidophilic sulfur oxidizing organism isolated from Houston sewers.

Raw sewage collected from Houston sewers (1-L) was filtered through a 0.2 mm membrane filter to remove all particles except phage.

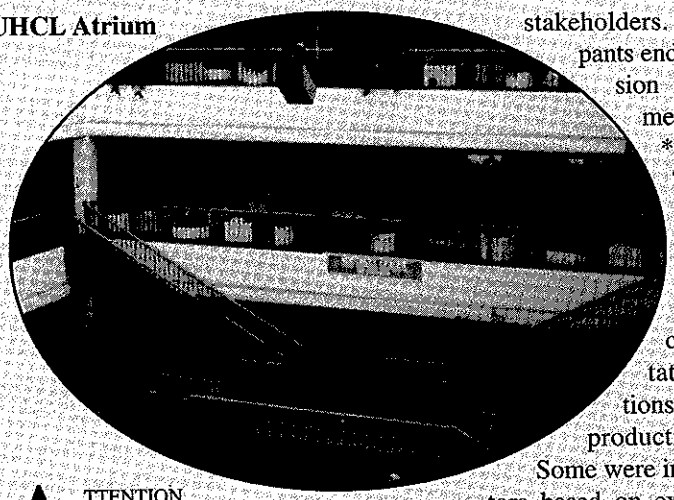
Solutions obtained after the isolation procedures were used whole or diluted to test for the presence of phage. Cultures of the Houston isolate, *T. novellus*, *T. intermedius*, and *T. neapolitanus* were grown to mid-log phase and then spiked with the solutions expected to contain phage particles. The effect of the phage on the cultures was observed by monitoring absorbance at 440 nm. If the phage were lytic, a reduction in turbidity of the test samples as compared to the controls would have occurred.

Experiments conducted twice in the time period produced no definitive results. Some cultures are spontaneously losing turbidity; we plan to do further experiments to determine whether this is due to phage or some other phenomenon.

Principal Investigator: Deborah L. Roberts, ASAS Lab Manager, Department of Civil and Environmental Engineering at the University of Houston

EIH Hosts an Environmental Education Conference for Texas

UHCL Atrium



ATTENTION TO ENVIRONMENTAL EDUCATION (EE) has increased nationwide. Diverse viewpoints have formed over the years and a variety of relationships, positive and negative, have developed among stakeholders. In April 1997, EIH hosted a statewide conference on environmental education entitled "Environmental Education in Texas." The conference brought together EE stakeholders to discuss the need for education on environmental issues and voluntary EE guidelines for educators. It generated controversy exemplified by a Sierra Club press release and was covered by the *Houston Chronicle* and the *Washington Post*.

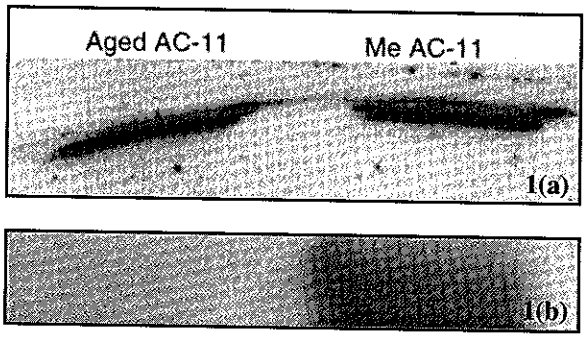
From the conference and related controversy, we have inferred the following:

* EE is of great interest to a large number of private and public organizations, corporations and individuals. The content and methods of EE are of concern, especially to those in the private sector.
* Corporations support open discussions about EE. Some environmental groups support open debate and some do not. Significant differences exist between non-governmental organizations (NGO) which emphasize education and those which emphasize advocacy.
* The North American Association for Environmental Education's standards of EE were, in general, accepted by all stakeholders. Conference participants endorsed "informed decision making" as a fundamental outcome of EE.
* The delivery of EE in Texas' schools will be a negotiated process.

EIH coordinated the conference with support by a steering committee of representatives from organizations with histories of EE production or sponsorship. Some were invited to represent sectors based on expressions of personal interest in EE. Potential speakers were identified based upon a plan to obtain diversity by stakeholder group and geographic area. The agenda was diverse. It contained speakers from the Audubon Society and Exxon, from Houston and El Paso. Some speakers were concerned about "being set up" for criticism from opposing viewpoints. Every precaution was taken to ensure fair representation of every perspective. Funding obtained from agencies and corporations led to criticism that the organizers were biased toward the corporate view. Controversy was not unexpected because our inclusive consensus approach usually builds trust from debates among disagreeing stakeholders.

The conference ended with workshop sessions on techniques for achieving a balance in materials, teacher training, and student learning. There was consensus that EE should be a fundamental component of K-12 education. but the pathway to reach factually correct and balanced EE was not clear. One of our hopes was recognition by the Legislature. The Environmental Regulation Committee of the Texas House is conducting an interim study on environmental education materials produced with public funds. Many of the attendees are currently engaged in a statewide effort called EE2000 to develop a plan for achieving goals discussed at the conference.

Effect of Environmental pH on Ionic Signals Mediating Early Neural Development in Amphibians

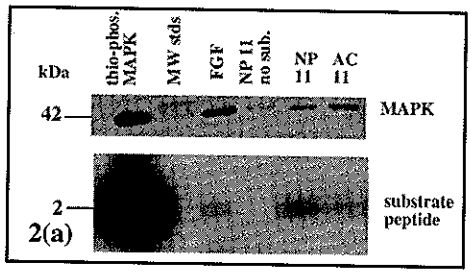


As the global decline in amphibian populations over the last decade suggests, amphibians serve as highly sensitive bio-indicators of changing environmental conditions. Amphibian embryos may be particularly sensitive to decreased environmental pH associated with acid precipitation, because the formation of the nervous system is initiated by signals that include an intracellular alkalinization of the future neural ectoderm cells. This alkalinization leads to the phosphorylation of MAP kinase, a key signalling component involved in many aspects of cellular communication.

The goal of this project was to determine whether decreased environmental pH could disrupt the initiation of neural development in the amphibian *Xenopus laevis* by assessing neural gene expression and the activation of MAP kinase in embryos subjected to decreased environmental pH. We were unable to identify a value for environmental pH that was comparable to that of acid precipitation in eastern Texas that would permit the survival of embryos removed from their protective jelly. Our studies of MAP kinase activation and neural development at normal environmental pH values indicate, however, that the alkalinization-dependent activation of MAP kinase plays a key role in the initiation of neural development *in vivo*.

MAP kinase activity was elevated in alkalinized ectoderm relative to untreated uninduced ectoderm at the same stage. Ectodermal MAP kinase activity increases during neural specification *in vivo*, as well. Moreover, at the midgastrula stage, MAP kinase activity is five-fold higher in newly induced neural ectoderm or ectoderm overexpressing the neural inducer noggin than in uninduced ectoderm at the same stage.

The relationship between MAP kinase activity and the anteroposterior axis of the embryonic nervous system was investigated by treating uninduced ectoderm with increasing concentrations of basic Fibroblast Growth Factor (bFGF), which activates the MAP kinase signalling pathway.



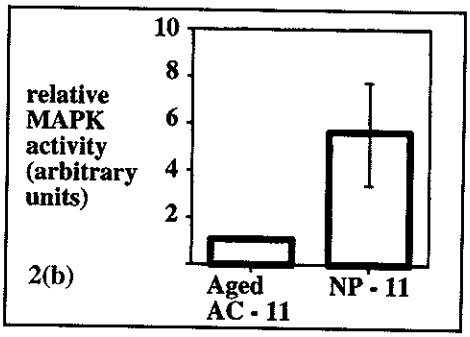


Figure 1. Comparison of MAPK activity in uninduced and alkalinized ectoderm at st. 11. MAP kinase activity was assayed, using the EGF receptor peptide as a substrate, and proteins were separated on a 24 percent gel. The gel was probed with anti-MAPK antibody to estimate the total amount of MAPK present in each reaction (a). The lower half was autoradiographed to visualize phosphorylated EGF receptor peptide (b). The difference in MAPK activity between the samples can be assessed by comparing the ratio of phosphorylated EGF receptor to the amount of MAPK. MAPK activity is approximately 4-6-fold higher in alkalinized ectoderm than in aged uninduced ectoderm.

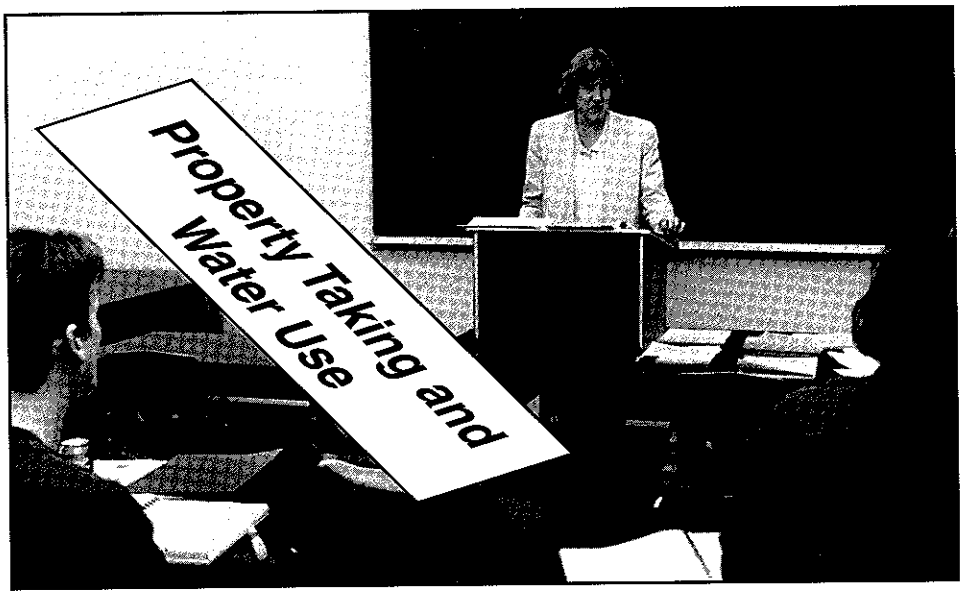
Figure 2. MAPK activity is higher in newly induced neural ectoderm than in uninduced ectoderm at the same stage. (a) MAPK activity in neural ectoderm isolated at mid-gastrula (st. 11) (NP-11) and in animal cap ectoderm isolated at mid-blastula (st. 8)(AC-11) and aged in culture until st. 11. Assay was performed using the Xnf7 peptide as a substrate; controls included thio-phosphorylated MAPK and mid-blastula animal cap ectoderm treated with 100 ng/ml bFGF. (NP-no sub., neural ectoderm without substrate. MW stds, molecular weight standards.) The 42 kDa band represents the amount of MAPK protein, and the 2 kDa band reveals the amount of phosphorylated substrate. A ratio of the 2 band intensities provides a relative measure of MAPK activity. (b) Relative MAPK activity is over 5-fold higher in the neural ectoderm than in uninduced ectoderm at the same stage. (Mean ± S.E.E., n = 3 experiments).

MAP kinase activity and neural-specific gene expression were assayed in the treated ectoderm. Increasing levels of MAP kinase activity are correlated with increasingly posterior positions within the neural ectoderm.

Additional experiments assessed whether MAP kinase is required for the establishment of neural fate in the developing embryo. First, MAP kinase activation was blocked by treatment with the highly specific pharmacological agent PD 98059. Isolates of uninduced ectoderm were treat-

(Continued on page 22.)

Principal Investigator
Arthur K. Sater, assistant professor of biology
Sonali Patil, graduate research assistant, and
Pedro Ordaz, graduate research assistant at the University of Houston



MANY EXISTING DAMS, CANALS, and other water management structures were constructed years ago for multiple purposes, such as flood control, water supply, recreation, and power generation. Over time, the relative priorities among these different uses may have changed significantly. For example, a reservoir built primarily for flood control and power generation may be used today primarily for water supply and recreation. As circumstances and operating procedures change, there can be legal ramifications if property owners can show they have been damaged by operational changes and management decisions which affect their property.

How water resources are used or managed can give rise to claims of property rights, and of the "taking" of these rights by entities that control or use the water resources. The "Takings Clause" of the 5th Amendment of the U. S. Constitution applies when property is appropriated by a government entity. Many states have state constitutional provisions or recently enacted statutes which provide for compensation when property value is reduced by governmental activity. The interrelationship between water management priorities is varied and complex, with many legal implications.

This project involved legal and factual research in libraries, electronic databases, on the Internet, and in the files of agencies, law firms, and individuals. Research also included follow-up requests for additional information, as appropriate. Michael Lillibridge, a student at the University of Houston Law Center, assisted with the research.

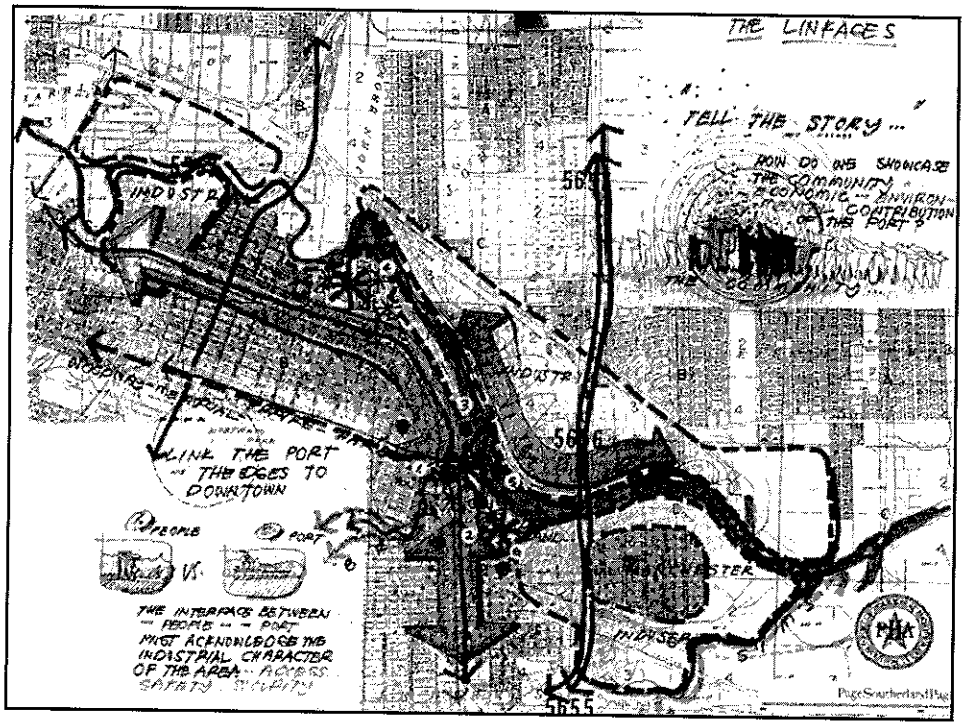
Federal and state court cases involving "takings" claims and water management issues were located and analyzed. While the scope of the research was national, statutes and case studies from Texas were developed in more depth.

The Texas Private Real Property Rights Preservation Act, passed by the Texas Legislature in 1995, became the subject of a journal article. Presentations and papers for professional conferences used case studies from Texas as examples of the types of disputes that can arise in the water use context and the development of various approaches toward resolving these issues.

Principal Investigator: Lisa B. Gossett, assistant professor of environmental management, and Michael Lillibridge, research assistant at the University of Houston Law Center

Prof. Lisa Gossett, assistant professor in the School of Business and Public Administration, engages students in discussion of the process of environmental permitting. Class members include Harley Weatherley, baccalaureate student in environmental management (*l.*) and William Engelhaupt, baccalaureate in environmental management and government (*r.*).

Sustainable Environmental Planning Process for the Port of Houston



THE PORT OF HOUSTON IS A MULTI-billion dollar asset to the City of Houston and the region. Since 1914, when human ingenuity combined with nature to open Houston's port to oceanic ships, a partnership was formed that has grown and continues to flourish, blending economic gain and environmental enhancement.

While the Port of Houston Authority strives to keep the port competitive and working for the Houston area, a delicate balance is achieved by combining growth with responsible environmental planning.

However, much more can be done and the Port of Houston Authority is eager to support the grant and community and environmental initiatives, throughout its impact area.

The proposal to the Environmental Institute of Houston was to assist the University of Houston's Gerald D. Hines College of Architecture's Center for Urban Ecology in the procurement of grants, funds and/or contracts from the Port of Houston Authority, the United States Army Corps of Engineers, Texas Parks and Wildlife Department, TNRCC, United States Department of Interior Bureau of Reclamation, Department of Housing and Urban Development, and others to establish a regional vision for the Port of Houston and begin the environmental planning process for the area.

The six-month effort was to create a plan of action for submission to the Port Authority of Houston for the purposes of a specific grant to initiate a regional plan. The University of Houston's Center for Urban Ecology, in early 1997, initiated a "probe" into how Houston's greatest business and commerce asset can more significantly impact the communities along its banks. A partnership was formed of the university, the Environmental Institute of Houston, the Center for Urban Ecology, the Port Authority, and the east side communities of Harrisburg, Magnolia, Manchester, and Pasadena to become the mechanism to effect an economic, environmental, and educational impact within the region.

Researchers investigated a variety of initiatives including proposals for urban environmental interpretive centers, providing educational and stewardship training to inner urban minority students, to community service and health programs administered by the University of Texas Health Science Center School of Public Health. The east end of Houston, our oldest community, will prosper with the infusion of social, environmental, and economic services resultant from the port's landside investment.

Funding from the Environmental Institute of Houston allowed the partnership to initiate a variety of studies.

For each consideration—such as trafficways, neighborhoods, parks, schools, etc.—the Center for Urban Ecology first converted the program into detailed standards and criteria and then into study solutions. To be meaningful, each study proposal included notes on costs and a brief environmental impact assessment. All the studies evolved through the process of comparative analysis, moving always toward improved performance within the limits of feasibility.

As the study progresses, investigators will record conclusions or directions on a set of long-range development plans for the port area. These will be published periodically and "approved in principle" by the Houston Port Authority.

The study was a six-month-long event to investigate, analyze, focus, and initiate a regional environmental planning effort to create a sustainable development planning process for the Port of Houston Authority. With the funds and support provided by the Environmental Institute of Houston and others, the Center for Urban Ecology is attempting to secure further grants and contracts from the Port of Houston Authority or other sources to initiate a yearlong sustainable development plan.

Principal Investigator: Lewis Mayo Adjunct Associate Professor of Architecture; Ralph Bradley, co-principal investigator; and Juanita Salinas, research assistant at the University of Houston

The Environmental Community in Houston: Origins, Programs, and Contributions

THIS EFFORT AT UNDERSTANDING THE environmental community in Houston was divided into two parts: (a) the completion of an MA thesis on the environmental community in Houston; and (b) organization of privately held collections dealing with key members of that environmental community. Public history student David Radcliff wrote and successfully defended his thesis, "The Evolution of Houston's Environmental Organizations," which is the first study of its kind and treats several locally spawned environmental groups. Radcliff also organized archival materials in the possession of Mr. Army Emmott, which included materials on several key local environmentalists and local environmental groups. The grant proposal also had called for the organization of archival materials held by Mrs. Terry Hershey. However, Mrs. Hershey decided to retain these materials. Based on Radcliff's work on the Emmott Collection, the decision of Mrs. Hershey to retain her materials, and the discovery of local environmental materials at the Houston Public Library, the University of Houston library staff decided not to pursue the acquisition of the Emmott and Hershey collections. The recommendation was that the Houston Public Library should enhance its collection with these materials if they become available. Nevertheless, Radcliff's work has been pathbreaking in beginning a history of several locally significant environmental groups.

Radcliff worked extensively with the Army Emmott collection—boxing, inventorying, and processing. Copies of the lists have been delivered to Mr. Emmott and to the curator of the Mehra Collection, University of Houston Archives.

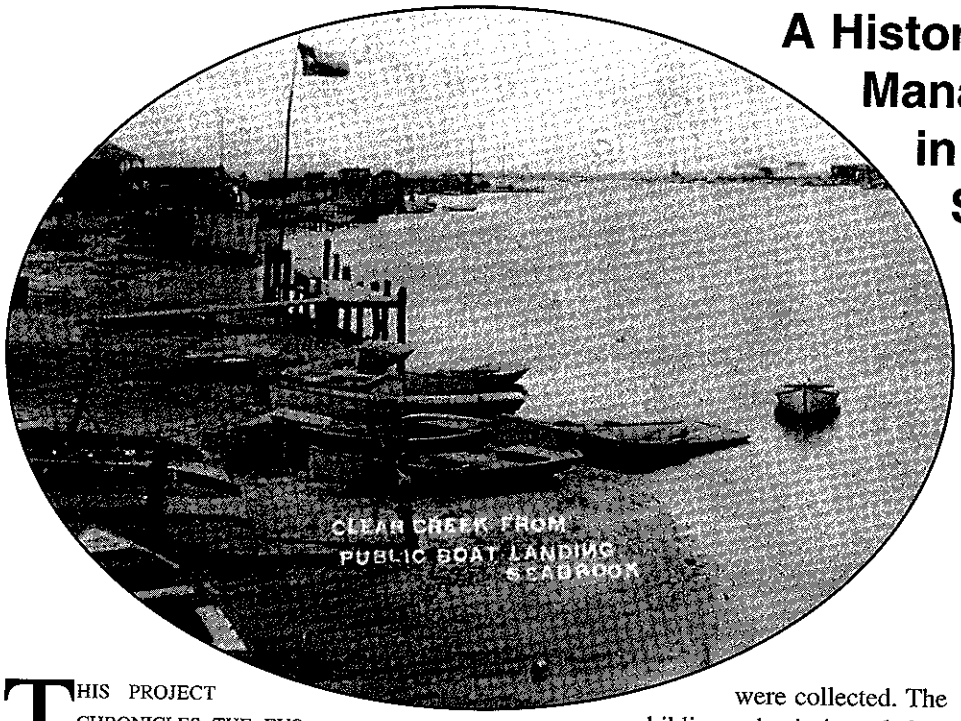
An integral part of the research for Radcliff's master's thesis was a set of oral histories. Seven interviews were recorded and three transcribed. The interviews covered 57 hours. All tapes, transcripts, indices, and permission forms have been deposited with the Mehra collection. Another UH student, Charles Closmann, provided his 1993 interview with Terry Hershey. For three of the interviews (Ginzberg, Zimmelman, and Emanuel), Radcliff worked with David Todd, who is conducting oral history interviews of Texas environmentalists in conjunction with the Texas Historical Commission and the University of Texas, Austin.

Radcliff has provided the Mehra collection with a list of possible sources to increase the university's holdings of environmental materials. The vast majority of his information came from Houston sources, except for the Anella Dexter Collection at the University of Texas, Austin, which remains unprocessed.

Site-specific longitudinal studies, like the history project described in this study, are beginning to receive attention. Research into Houston's environmental history has just begun under the direction of Dr. Martin Melosi, shown on the balcony of Agnes Arnold Hall at the University of Houston. In the background, the lights of Robertson Stadium, within view of metropolitan Houston.

Principal Investigator—
Martin V. Melosi, Professor
of History and Earth Program
Research Associate at the
University of Houston

A History of the Scientific Management of Shrimp in the Galveston Bay System



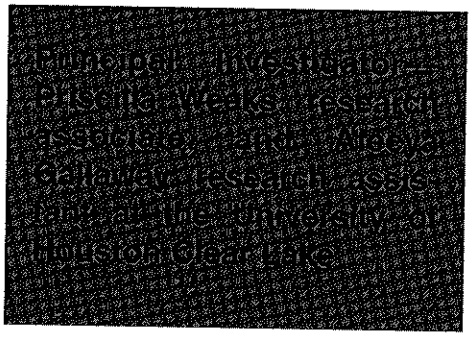
THIS PROJECT CHRONICLES THE EVOlution of scientifically based management of the shrimp fisheries around Galveston Bay. Specific objectives included: (a) chronicling changes in scientific models on which shrimp management decisions were made and (b) analysis of the role of scientific, social, institutional, political and economic factors in the evolution of shrimp management.

To meet these objectives, the following materials have been assembled and were available to the public as of September 1997:

- TPWD management plans, technical reports and regulations pertaining to shrimp.
- Early research on the nursery grounds (including Clear Lake which was once considered to be an important nursery for shrimp).
- Archival information from three newspapers: *The Galveston Daily News*, *The Houston Post*, and *the Houston Chronicle*.
- Journal articles on the social and biological aspects of shrimp management.
- Original circulars on the earliest research conducted by NMFS on Galveston Bay, the history of NMFS, and its role in shrimping.
- A chronologically-organized bibliography of all extant information related to the social and biological aspects of shrimp fishing in the Galveston area. Not all materials in the bibliography were collected. The bibliography is intended to serve as a guide for further research.

Materials have been collected and collated but not yet analyzed. However, it is clear that the two agencies historically associated with the shrimp fishery in Texas, TPWD and NMFS, did not devote attention to the shrimp industry until after the turn of the century. Shrimp was being exported to Japan from the Galveston area as early as the late 1800s but was not important to the local food market until after World War II. The subject was not intensively researched or managed until the mid-1900s. Early research conducted by the agencies was largely directed toward answering basic questions, such as where shrimp went when they left the bays, rather than questions specific to management. Knowledge of changes in management policy will help us resolve future challenges to sustainable natural resources.

Photo courtesy of the Chapman/Christy Family.



Environment in Education

Teaching Urban Students To Be Eco-Writers

James Langston III, doctoral student in English and writing coordinator

Claire Lawrence, doctoral student in English and writing coordinator

During the hot, muggy summers of 1996 and 1997, students from six inner-city grade schools gathered in Houston's Hermann Park to attend the "Writers in the Park" summer camp. These "kids" wanted to have water sprayed on them. They wanted to play kick-ball. They wanted to have a break from the grind of being subjected to educators. Two out of three isn't bad. Group leaders—seven graduate student English teachers selected by Dr. Terrell Dixon—soaked them and kept track of outs, but they also performed ecologically-oriented science projects, ventured on nature-trail walks, and joined field trips, all the time having the students write about their experiences in their journals.

Leaders accomplished two primary goals. The first one satisfied the sponsors, the Friends of Hermann Park, who wanted to demonstrate to the community that the park is an educational resource. FOHP is a non-profit citizens' organization dedicated to the protection and enhancement of one of Houston's oldest and most historically significant green spaces. Its goal is to preserve the integrity of the park, to enrich its heritage as a unique landmark, and to transform it into one of the nation's premier urban parks. The second goal was more specific. Group leaders wanted to teach the students to enjoy writing, and then to teach them through their writing that even though they are city kids, they are still part of a unique ecosystem.

The first goal was relatively easy to achieve. Parents were happy to have an inexpensive and safe place for their children to spend the summer days. They were also thrilled by the notion that their youngsters' standardized test scores might improve because of the UH emphasis on writing. Further, both parents and children became acquainted with the parks other educational resources, such as the nature trails, the Children's Museum, the Museum of Natural Science, the Japanese Gardens, the Medical Center Museum, and the Houston Zoo.

The second goal was a bit more challenging, but also more rewarding. Group leaders had to overcome the firm belief which the children had somehow acquired that writing could not possibly be fun. They got over this hurdle in a variety of ways. First of all, leaders took advantage of the fact that no one was trapped in a room. Writing became an activity they could engage in almost anywhere. Everyone carried journals (group leaders, too). Leaders and students were free to stop and record their thoughts whenever they felt like it. This kind of careful observation leads to writing that shows an incredible awareness of the world, as is evidenced by this Haiku by Alicia Brown:

Butcher bird fly high
A snake hanging like a string
From its scissor beak.

Next, leaders and students shared their writing with each other by reading it out loud. The children loved to be the center of attention, and the performing of the text became the incentive for the writing of it. Finally, the group leaders took the journals home each night and responded to what the students had written by putting messages on post-it notes. Students always read a positive message because leaders did not want to run the risk of discouraging them. But offering positive support was not difficult—their writing was philosophical, imaginative, and surprisingly perceptive:

Two Haiku
by David Cuthbert, age 8

It is so peaceful
I wish it would stay like this
The cars roar by.

It is so hot here
The river seems not to like us
The shade feels so good.

James Langston III is a doctoral student in English and writing coordinator at the University of Houston.
Claire Lawrence is a doctoral student in English and writing coordinator at the University of Houston.

Along with the goals of increasing awareness of the park and decreasing resistance to writing, the intention of the program was to focus the youngsters on the idea that ecological degradation is occurring on a worldwide scale. Thus, these students studied environmental problems of different countries (Africa, Japan, and India) and compared them to related problems in Houston: air pollution, clean water, and wetlands preservation. They also were exposed to the literature and poetic forms of these countries and began to feel not only part of an ecosystem but also part of the world. Their poetry reflects this awareness, as shown in the movement from small observation to larger ideas in the poem by 10-year-old Cheland Smith.

Text by Jimmy Langston III and Claire Lawrence

Nature Walk
Cheland Smith, age 10

We saw a ladybug but it
ran away from everybody.

Then we sat down and talked about
Haiku. Then we talked about how we need
solutions.

Then I looked around, saw flowers
and bugs. Then I saw a big bunch
of weeds.

Then a big pile of dirt caught
my eyes. Then I saw pieces of glass
on the ground.

Then we walked to the sidewalk and sat
and talked about a rock garden that
she had for a surprise.

Then we just played with the
flowers.

Then I looked up at the sky.

Then I looked at the bridge.
It looked small from far away.

Then I looked at the bayou. It
looked relaxing. But if I fall in
it wouldn't be so nice.

Every time we speak,
pollution is being made.

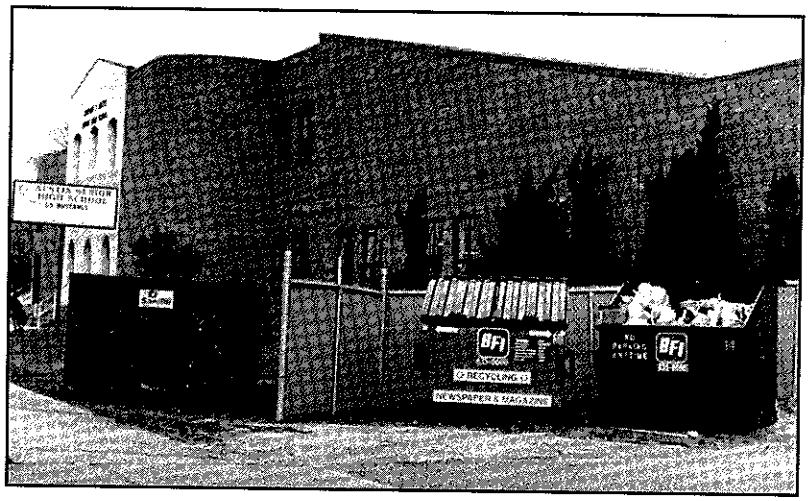
• Reduce • Reuse • Recycle

• Reduce • Reuse • Recycle

During July and August of 1997, 18 teachers attended a three-day orientation for the R3 project and then developed or refined an activity for the project. All of these teachers had attended the Teaching Environmental Sciences (TES) course held at the University of Houston Clear Lake during June 1997.

Each teacher received a $200 stipend. In most cases, these stipends were applied toward tuition costs for the graduate course, Seminar in Environmental Education. In two cases, the stipends were paid directly to the participants.

The due date for the participant projects was September 1, 1997. As of September 10, 15 project reports had been received.



Recycle bins at the Stephen F. Austin High School, east of the University of Houston across the Gulf Freeway.

An initial review of these projects showed a wide variety in content, materials and grade level. Seven participants prepared drafts for new project activities while eight participants rewrote or revised activities presented in the three-day orientation. Activities ranged from art, making flowers from aluminum cans, to environmental science, using children's old wading in the construction of wetland models.

Currently, the activities previously developed and the new activities are being analyzed and classified in categories of recycled material, content area, and usability. At the same time, the process information developed for the orientation is being rewritten. These materials include the rationale for designing, building and using recyclable materials in student learning activities and instructions for developing classroom projects with paper, cardboard, plastic, aluminum, and steel.

A presentation on the history of the project with sample activities was presented on September 22 to the Houston Corporate Recycling Council. This presentation will be adapted as a workshop in science and environmental education beginning in spring 1998.

Principal Investigator: Robert M. Jones, professor of education at the University of Houston Clear Lake

Geographic Environmental Opportunity for Students (GEOS): An Interdisciplinary Curricula Project Using Space Age Technology

IN 1995, A TEACHER-TRAINING INSTITUTE was launched through a community-wide collaborative effort that included local social studies teachers, the University of Houston Clear Lake, NASA, and the Texas Alliance for Geographic Education/National Geographic Society. The Geography Institute for Teachers: Global and Environmental Geography with Space-Age Technology, conducted at UHCL, was designed to train teachers in the interpretation and instructional use of space shuttle photography along with curriculum development and teaching strategies pertaining to study skills and critical thinking in order to improve geographic/environmental literacy.

Numerous educators who have attended the institute's presentations at international, national, state, local and district professional meetings, have inquired how to purchase curricula materials developed at the institute. These educators have expressed strong positive reactions to our curricula materials because these materials utilize space shuttle photography, are problem-solving based, and many are interdisciplinary with multimedia presentations. Educators indicated that our curricula could help improve students' knowledge, attitudes, and decision-making about environmental problems. Because the institute can reach only a limited number of teachers, which, in turn, means a limited number of students, there is a need to utilize the Institute's curricula and the latest in computer technology as a prototype to develop K-12 curricula that could impact a larger K-12 market. The Geographic Environmental Opportunity for Students (GEOS) is designed to begin meeting this need. The purpose of the GEOS grant was the development of a pilot interdisciplinary curricula aimed at the seventh-grade level, using space acquired photography.

Project Progress

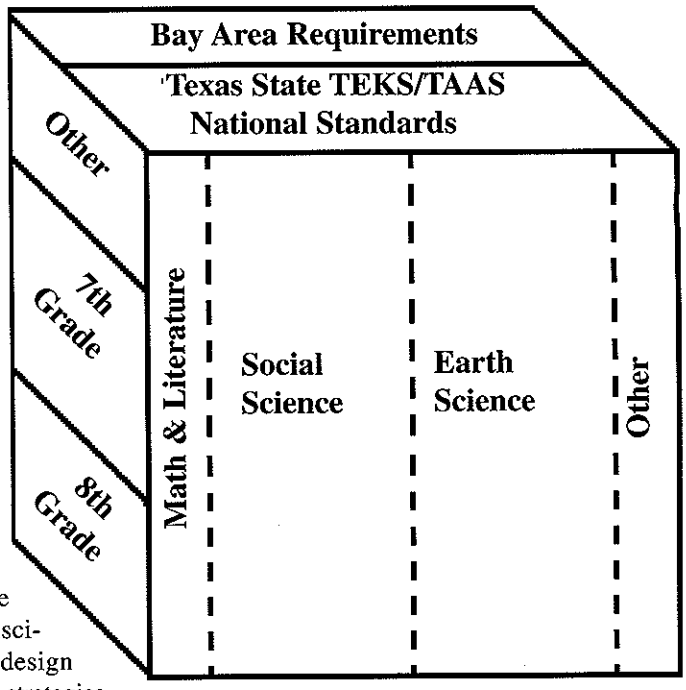
Funds provided by the Environmental Institute of Houston were utilized during summer 1997 to support Dr. Maier and Raymond Sanders in addressing the project objectives. These objectives, along with their current status are as follows:

"Geographic Environmental Opportunity for Students (GEOS) will:

1. Develop a prototype representative of a more extensive curricula plan (accomplished).
2. Develop a prototype that enhances traditional curricula materials and instructional practices (accomplished).
3. Develop a prototype based on an interdisciplinary curriculum design and problem-solving strategies (accomplished).
4. Utilize National Standards in Geographic Education and Environmental Education and Texas Essential Knowledge and Skills Statements (accomplished).
5. Integrate text, multimedia, space shuttle photography, and GIS data on a CD-ROM (in progress).
6. Utilize a multidisciplinary team of experts (in progress).
7. Assess effectiveness through student and expert feedback and evaluations (to be accomplished).
8. Investigate future technological applications (*i.e.*, touch screen, Internet) (in progress)."

Proposed Future Plans

Preliminary curricula design and instructional strategies based on project goals were selected but will continue to be evaluated. CD-ROM development and formative evaluation are in progress. Formative testing by end users of the CD-ROM will be conducted in late spring 1998.



Geographic Environmental Opportunity for Students (GEOS) Model

Principal Investigator: Joan Maier, assistant professor of education, and Raymond L. Sanders, Jr., lecturer at the University of Houston-Clear Lake

Developing a Texas-Based Environmental Education Telecommunications Alliance

EDUCATORS DEVELOPED AND CONDUCTED a collaborative K-12 environmental education telecommunications project in the College of Education (COE) at the University of Houston-Central during the 1996-1997 academic year. This joint project included Texas Parks and Wildlife (TPWD), UH-COE, and several participating Houston-area public and private K-12 schools. The focus of the project was the students' electronic characterization of selected East Texas ecoregions and resources for placement on the TPWD Website, (http://www.tpwd.state.tx.us) *Exploring Texas*.

The environment continues to be a central concern for the American public.[1] The intensity of interest and activity in the environment is evident at all levels of our society except one, public education from K-12. Five states mandate K-12 environmental education (EE); only four states mandate preservice EE training. Although K-12 education has been slow to embrace environmental education, an array of EE curricula is available from both government and private entities. Much of this effort is redundant, much of it is incomplete or narrowly conceived, some of it is invalid, and some of it is biased. Thus, the national scene in EE, best characterized as divergent, unfocused activity, does not, in general, reflect sound philosophical or pedagogical framework.

On the K-12 scene, one finds only limited, episodic activity in schools.[2,3] This activity is typically a function of individual teachers (as opposed to school-based programs) episodically attempting an EE lesson or unit within their classrooms. EE is typically not part of the formal curriculum. Teachers have not had EE inservice or preservice training, they are not aware of available resources, and neither teachers nor administrators have the expertise and experience to effectively plan, implement, and evaluate EE curricula and programs. Further, given the rigidity in K-12 programs, it is very difficult to undertake systemic or even "grass-roots" initiatives.

The Texas Scene

Texas recently recognized EE as an "educational priority," but it failed to specifically mandate its implementation at any grade level. Further, the state established an EE endorsement program to certify K-12 teachers in EE provided they complete certain prescribed training. Many K-12 teachers, both nationally and in the Houston area (an estimated 330), have indicated the need for EE in the K-12 settings and a willingness to implement EE programs. Unfortunately, most have also indicated that they don't know what to do or how to do it.[4,5]

In 1996, the Texas Parks and Wildlife Agency initiated a pilot outreach EE program, *Exploring Texas*. The goal of the program is to combine selected Texas K-12 students and their schools with Texas ecoregions and resources utilizing computer technology in a project that meets the needs of both EE and the agency mission. The project entails volunteer schools, working under the leadership of university science educators. This partnership would identify local ecoregions and resources, conduct research on their ecological basis, and develop electronic characterizations that would include text, images, sound, and scientific data in graphs, charts, and tables. These digital files would then be included in the *Explore Texas* Website and transmitted throughout Texas and the world. Approximately 25 schools from throughout Texas will be recruited for this pilot, "let's-see-how-this-works," year.

The role of university-based science educators was be to identify local schools, to facilitate the conceptualization of each Web topic, and to oversee the development of the electronic characterization. The university also provided human and technical support; *e.g.*, a digital camera, scanner, *etc.*, to the local educational units.

At one level, the combination of EE and computer technology is an excellent context for student-centered, constructive instruction utilizing the greatest technological resource of this era. At another level, it is a powerful alliance of state agency, university, and local schools in the important educational context of environmental education.

Prof. John Ramsey

TPWD conducted a preliminary meeting in early August to initiate the program. The agency has committed its Website, its database of print resources, research, and images, as well as the services of a number of its scientific experts. However, no additional TPWD funding is available to facilitate local-level project development. School-based technology, field trips, and materials are the responsibility of the individual participants.

Texas Initiatives

The UH project activity will be a part of a larger, Texas-wide initiative focusing upon regional ecoregions and resources. East Texas sites might conceivably include the Gulf Coast prairie, region rivers and bayous, Galveston Bay, state parks, national forests, wetlands, arboretums, *etc.* Several schools might choose to collaborate in a team approach for the study of a larger ecosystem such as Galveston Bay. Students in elementary, middle, and/or secondary schools may also become involved.

Principal Investigator: John Ramsey, associate professor of curriculum and instruction and Kristie Brandenberg, research assistant at the University of Houston

The electronic characterization of selected ecoregions will be based on 10 ecological principles cited in an *Exploring Texas* project manual. However, the format of the product has not been determined. TPWD is assuming that students will explore a number of options and that an evaluation of the products will determine the focus of future collaborative products and activities. TPWD will evaluate the validity of each project before its assignment to the website. At this point creativity is more valuable than control.

Objectives

- The identification of local K-12 public and private schools. This activity is already under way. Each school would provide a minimum of one class of students, approximately 25.
- The hiring of a 25 percent teaching assistant with computer technology expertise and with responsibilities for technical aspects of the product. Such an individual has been identified, a graduate physics student with World Wide Web development experience. The PI does not have the expertise or experience with this production aspect of the telecommunication technology.
- The staging of seven monthly meetings throughout the school year, beginning in October, for teachers in the project schools. The agendas for these meetings would include the conceptualization of project topics, instruction in computer technology associated with the use of the Internet Web site development, and the development of the electronic characterizations.
- The development of 12 electronic characterizations of regional ecoregions and resources for inclusion in the TPWD Website, *Exploring Texas*.
- Evaluation of both the project process, the electronic products, and the educational outcomes. TPWD is in the process of preparing an assessment, although it is not completed at this time. The educational outcomes are to include students' ecological and telecommunication knowledge, skills, and attitudes.

Fall 1996: Kristie Brandenberg, an instructional technology doctoral student at Cambridge, UK, was hired as the project research assistant. Ms. Brandenberg's expertise is in telecommunications. Twelve classroom teachers from the Houston metroplex were recruited to participate in the project. A series of meetings and workshops were conducted for the participants, with Ms. Brandenberg presenting telecommunications issues, Dr. Ramsey presenting details on community investigation, and Nancy Herron of Texas Parks and Wildlife presenting aspects of the Exploring Texas project.

Spring 1997: Participating teachers initiated projects with their students in at least one class. Ms. Brandenberg supported the project through site visits, interacting with both the teacher and the projects' students. By April 1, five projects were completed and sent to TPWD. The projects were edited and included on the TPWD Website in the *Exploring Texas* section.

The projects included the following topics:

1. Water Quality in West Harris County
2. Texas Endangered Species (several of these)
3. Historic Home Sites in Brazos County

Summer/Fall 1997: Project evaluation indicated high levels of interest in the project. Participating teachers indicated support of the project concept and were motivated to continue. The *Exploring Texas* project was then published in an article by Nancy Herron for *Texas Parks and Wildlife* in October 1997. Efforts are under way with TPWD to seek an enlarged funding base.

References

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[3]Hart, E. P. "Identification of Key Characteristics of Environmental Education," *J. of Environmental Education* 1.1 (1981): 12-16.

[4]Peyton, R. and B. Miller. "Developing an Internal Locus of Control as a Prerequisite to Environmental Action Taking." In *Current Issues in Environmental Education and Environmental Studies*. Eds. A. Sacks, *et al.* Columbus, OH: ERIC Clearinghouse for Science, Mathematics and Environmental Education, vol. 7, 1980. 261-275.

[5]Ramsey, J. and H. Hungerford. "Effects of Issue Investigation and Action Training on Characteristics Associated with Environmental Behavior in Seventh Grade Students," *J. of Environmental Education* 21.1 (1989): 26-30.

Effect of Environmental pH on Ionic Signals Mediating Early Neural Development

(Continued from page 13.)

ed with bFGF in the presence or absence of PD98059 and then assayed for MAP kinase activity and neural-specific gene expression. In the presence of the inhibitor, MAP kinase activity is nearly abolished and expression of several neural-specific genes greatly reduced or virtually absent.

Second, embryos were microinjected with *m*RNA encoding MAP Kinase Phosphatase (MKP), the major negative regulator of MAP kinase activity *in vivo*. Ectoderm was isolated from embryos overexpressing MKP and recombined with dorsal mesoderm from uninjected embryos.

As a negative control, similar experiments were performed with embryos overexpressing an inactive form of MKP. In recombinates using ectoderm expressing the inactive MKP, the dorsal mesoderm induces neural-specific gene expression in the ectoderm. Neural-specific gene expression is not detected in recombinates containing ectoderm that overexpresses MKP. Together, these results indicate that MAP kinase activity plays a critical role in the establishment of neural fate. The pH-dependent activation of this key signalling pathway may be especially vulnerable to conditions affecting environmental pH.

Fluorine-Doped Tin Oxide Films for Solar Cell and Heat Reflective Applications

FLUORINE-DOPED TIN oxide films are both highly conductive and transparent to visible light. Because of this unique combination of properties, the films can be used in thin film solar cells as transparent surface electrodes. They also reflect infrared radiation and can be used as energy conserving heat reflective coatings on windows. Chemical vapor deposition is the best technique for preparing fluorine-doped tin oxide films but problems are associated with the current processes. The goal of our research was to find new economical and safe methods to prepare high quality fluorine-doped tin oxide films by chemical vapor deposition so that their full potential in environmental applications can be realized.

New tin(IV) and tin(II) hexafluoroisopropoxide complexes were synthesized and used as precursors to tin oxide thin films in a low-pressure chemical vapor deposition process. The films were characterized by backscattering and elastic recoil spectrometries, Auger and UV-VIS spectroscopies, and nuclear reaction analysis. $Sn(OCH(CF_3)_2)_4(HNMe_2)_2$, a volatile solid, was synthesized in high yield by reacting $Sn(NMe_2)_4$ with $(CF_3)_2CHOH$. A crystal structure determination shows that it has an octahedral structure with trans-amine ligands. Low pressure chemical vapor deposition using $Sn(OCH(CF_3)_2)_4(HNMe_2)_2$ and air as precursors gave fluorine-doped tin oxide films (O/Sn = 1.8-2.4; F/Sn = 0.005-0.026) at substrate temperatures of 200-450°C. The films are highly transparent in the visible region (>85%) and have resistivities as low as 2.1 x 10^{-3} Ω cm. In contrast to the results obtained for the tin(IV) precursor, the tin(II) compound $Sn(OCH(CF_3)_2)_2(HNMe_2)$ in combination with air or water vapor gave nonconductive transparent films at substrate temperatures of 180-250°C having composition $SnO_{0.9\text{-}1.3}F_{0.1\text{-}0.4}$. These film stoichiometries suggest that hydrolysis was the primary film forming reaction and that tin(II) was not oxidized in the deposition process. Further chemical vapor deposition studies are in progress involving these and other tin oxide precursors.

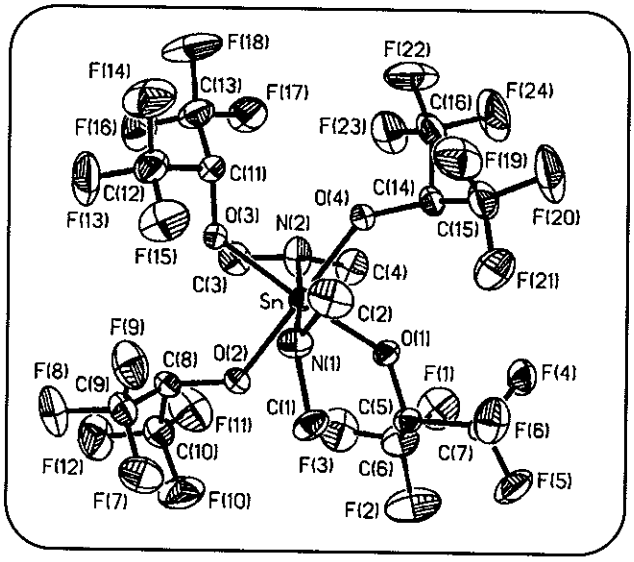


Figure 1. Thermal ellipsoid plot of $Sn(OCH(CF_3)_2)_4(HNMe_2)_2$, a new precursor to SnO_2:F films, taken from a single-crystal X-ray diffraction study.

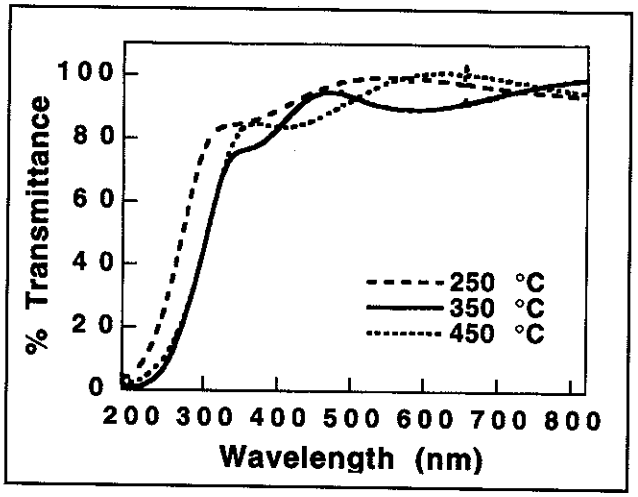
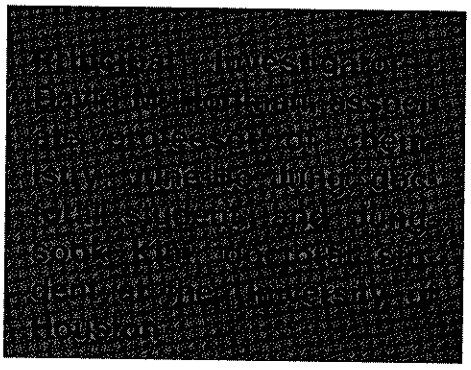


Figure 2. Transmittance spectra for tin oxide films deposited on quartz from $Sn(OCH(CF_3)_2)_4(HNMe_2)_2$ and air at 250°C, 350°C and 450°C.



Catalyst Deactivation During the Destruction of Chlorinated Hydrocarbons with Catalytic Steam Reforming

A SUPERIOR METHOD FOR DESTROYING chlorinated hydrocarbons in waste streams is catalytic reaction with steam *via* the following reactions (*e.g.* for 1,1,1-trichloroethane):

$$CCl_3CH_3 + 2H_2O \rightarrow 2CO + 2H_2 + 3HCl \quad (1)$$

$$CO + H_2O \leftrightarrow CO_2 + H_2 \quad (2)$$

$$CCl_3CH_3 \rightarrow CH_x, C, HCl \quad (3)$$

The product contains useful compounds, and estimates indicate lower costs than existing technology. However, noncatalytic pyrolysis reactions, such as Reaction (3), deposit carbonaceous surface species that lead to catalyst deactivation. Since Reaction (1) is at least 50 times faster than Reaction (3), the catalyst can be maintained carbon-free by operating at extremely high conversion. Typical results are shown in Fig. 1 from a test on trichloroethylene (TCE) with a radial-flow reactor containing a catalyst comprising 0.5 wt% *Pt* dispersed on an α-Al_2O_3 ceramic foam. Conversion was constant at better than 99.9999+% for over 400 hours, at which time the activity became insufficient, and unconverted TCE appeared. This led to carbon formation *via* Reaction (3) and to further deactivation. Although the carbon was removed by combustion with oxygen and the original activity returned, the conversion declined at an accelerated rate. This decline showed that the original deactivation was irreversible and did not result from carbon deposition. The purpose of this project was to initiate an investigation into the causes of this effect, so that appropriate steps could be taken to prevent or alleviate long-term deactivation.

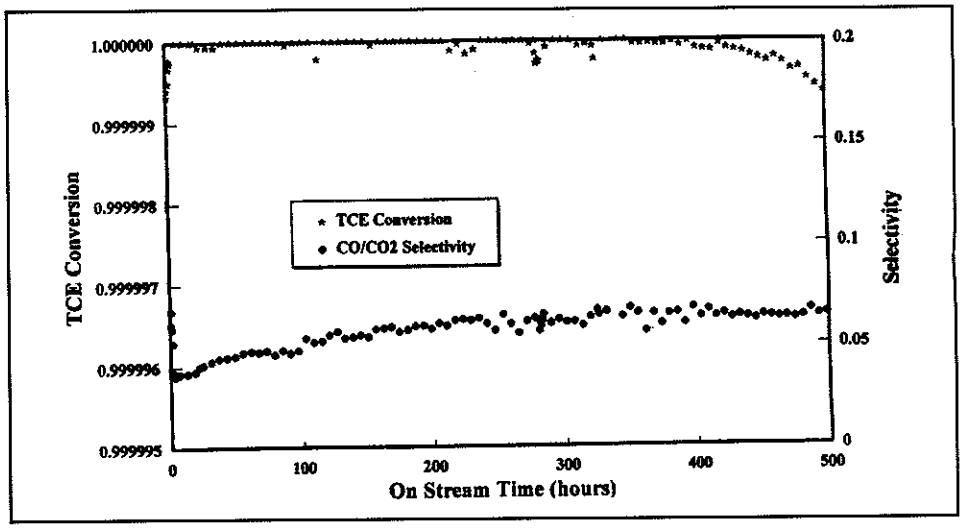


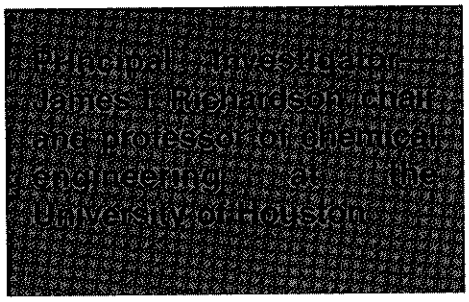
Figure 1. Typical results with the radial reactor feed = 2 vol% TCE in steam, inlet temp = 150°C, steam flow rate = 5 liters min^{-1}.

We investigated sintering of both *Pt* crystallites and the support substrate. Total surface area measurements before and after use showed only a moderate (<10%) loss. The ceramic foam included a high area γ-Al_2O_3 washcoat containing *Pt* crystallites, and its surface area was fairly constant (90 m^{2}g^{-1}) at up to 800°C. Above 800°C, a rapid decrease in surface area occurred as γ-Al_2O_3 transformed to α-Al_2O_3, and this was confirmed by x-ray diffraction analysis. We concluded that washcoat sintering was not significant.

We injected pulses of H_2 into the catalyst bed during the reaction sequences to measure *Pt* surface area by hydrogen chemisorption. Dispersion (*H/Pt*) ratios for the catalyst in Fig. 1 dropped from 0.32 to 0.065 after about 400 hours, indicating that only 20 percent of the original *Pt* area remained active. Carbon removal increased the dispersion ratio to 0.15, and subsequent combustion cycles reduced this to 0.04. Thus there was significant loss of *Pt* surface during reaction. Additional studies revealed this result was not uniform throughout the bed, since pronounced temperature profiles also existed.

We also explored chlorine poisoning of *Pt*. We knew from previous research with nickel catalysts that *HCl* in the product reacts with the catalyst to inhibit Reaction (2), thereby increasing the CO/CO_2 ratio. Although a slight increase in this ratio was perceptible (Fig. 1), pronounced changes were not evident with *Pt*. X-ray Photoelectron spectroscopy measurements also failed to detect *Pt-Cl* interactions, and Energy Dispersive Spectroscopy (EDS) revealed no increase in the *Cl* levels on the support. We conclude from these studies that chlorine poisoning is not a significant cause of deactivation.

These mechanisms and their sensitivity to *Cl* will be investigated in future research.



Prof. James T. Richardson

Using Remote Sensing to Determine Quantity, Source and Transport of Total Suspended Solid Loads within the Galveston Bay Complex

Kenneth McVay inputting data.

UNDERSTANDING THE SOURCE AND transport of sediment within the Galveston Bay Complex is important because of the effects high suspended loads can have in this environmentally sensitive area. Many pollutants, including metals, pesticides and pathogens, have a high affinity for particulate matter. Thus, suspended sediments serve as the main mode of pollutant distribution. Furthermore, the decline of filter feeding organisms and sea grass has been traced to high levels of suspended solids which tend to overwhelm these sessile organisms.

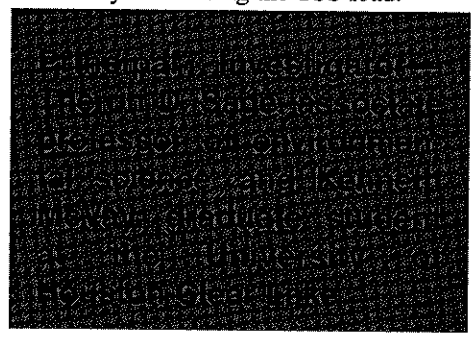
Researchers sought to determine whether remotely sensed data could be used to estimate the quantity of total suspended solids (TSS) and to determine the source and transport of these sediments. The Advanced Very High Resolution Radiometer (AVHRR) platform and space shuttle images provided the remote sensing data. By selecting appropriate reflectance bands of the AVHRR, investigators obtained adequate spectral resolution for sensing the TSS. However, the 1.1 kilometer ground resolution of the AVHRR made it necessary to tie the AVHRR data to the high resolution images taken from the Shuttle. The quantity of TSS represented by the images was determined by taking water samples on the same day as the images were taken. The coordinates of each sample were determined by using the Global Positioning System (GPS).

In the laboratory, the quantity of sediment in each sample was determined with a turbidity meter which had been calibrated to the weight of sediment represented at each GPS reading. The three data sets were then integrated by geo-referencing each set into a Geographical Information System (GIS). This procedure allowed each GPS point to be viewed in the context of AVHRR, Shuttle and ground truth data.

This procedure for estimating sediment source and transport offers significant improvements over the traditional methods of studying the TSS load. This study indicated that sediment source and transport are primarily influenced by wind energy. Thus, the synoptic "sampling" made possible with remotely sensed data overcomes the problem of sampling a large area under changing conditions. Furthermore, since AVHRR data are collected twice daily, "sampling" of the bay can be accomplished on a daily basis. This attribute is fundamental in determining trends in TSS load over time.

Since AVHRR data have been archived for many years, historical studies of TSS load in Galveston Bay can be conducted. This procedure makes it possible to "sample" the TSS load without physically taking samples, a great savings in manpower. Finally, by extrapolating between data points, researchers estimate the sediment load at a given time.

Early in 1998, this study will begin integrating the data from the recently launched SeaWifS satellite. This platform has a much higher spectral resolution than AVHRR and, thus, should provide better sensitivity for sensing the TSS load.



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Guy N. Cameron

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Regina M. Capuano

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Lisa B. Gossett

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James R. Lawrence

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Lewis T. May

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James T. Richardson

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Julie A. Robinson

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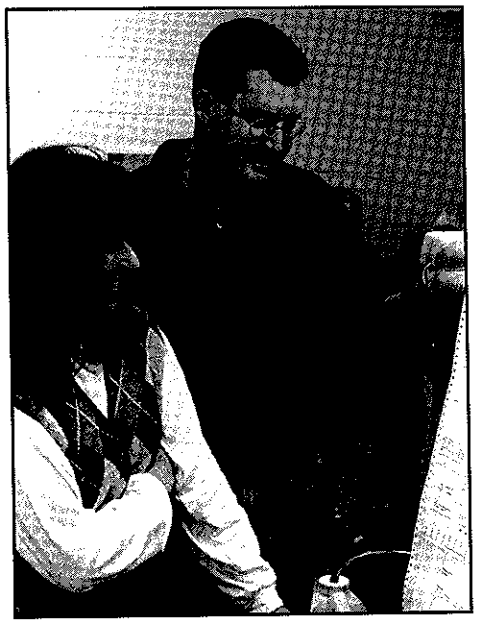

Scott Krauszer, pursuing a master's in geosciences/geology, conducts studies in hydrogeology, the study of water-porosity permeability, under the direction of Prof. Regina Capuano.

Amy K. Sater

Uzgare, A. R., J. A. Uzman, H. M. El-Hodiri, and A. K. Sater. "MAP Kinase and Neural Specification in *Xenopus*." (In preparation.)

Priscilla Weeks

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Richard C. Allison

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Edwin H. Bryant

Backus, V. L. and E. H. Bryant. "Long-Term Management of Captive Populations with Low Founder Number: Experiments with *Musca domestica*," Soc. for Conservation Biology, Providence, RI, June 1996.

Clark, M. E. and E. H. Bryant. "Sex Ratio Bias and Recombination in a Neo-Y Chromosome in the Housefly," Soc. for the Study of Evolution, Boulder, CO June 1997.

Reed, D. and E. H. Bryant. "Contribution of Mutation Load to the Evolution of Senescence in Laboratory Populations of the Housefly," Dept. of Biochemistry and Biology Poster Competition, Fall 1996.

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Guy N. Cameron

Cameron, G. N. "Climate Change and Biodiversity," Univ. de Guadalajara, Mexico, 1996.

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Cameron, G. N. and D. Inouye. "Community Ecology of Subterranean Rodents," Biology of Subterranean Rodents: Evolutionary Challenges and Opportunities Symp., Int'l Theriological Congress, Acapulco, Mexico, 1997.

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Kruchek, B. and G. N. Cameron. "Effect of Prescribed Burning on Quality of Cordgrass Vegetation," Am. Soc. of Mammalogists, Stillwater, 1997.

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Schwartz, S. S. and G. N. Cameron. "*Daphnia obtusa* Population Initiation and Termination in Winter Ponds in Southeast Texas," Soc. of Limnology and Oceanography, Gainesville, 1996.

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Seamon, J. O. and G. N. Cameron. "Rodent Communities and Changing Environments," Am. Soc. of Mammalogists, Univ. of North Dakota, 1996.

Regina M. Capuano

Bourgeois, F. M. and R. M. Capuano. "Elemental and Stable Isotope Study to Determine the Source(s) of Salt Contamination in the Chicot Aquifer," Geological Soc. of Am., South Central Mtg., Austin, TX, 1996.

Capuano, R. M. "Permeameter Tests of the Silty Clay from the Fluvial-Deltaic Beaumont Formation Can Underestimate Hydraulic Conductivity," invited, Houston Geological Soc., Houston, TX, June 11, 1997.

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Sam Chen

Chen, S. "Photo-Decomposition of Atrazine and Cyanazine in Water with Light-Activated Semiconductors," *Abstracts*, 17th Ann. Mtg. of the Soc. of Environmental Toxicology and Chemistry, Washington, DC.

Lisa B. Gossett

Allison, R. C., P. Bowman, and L. B. Gossett. "Techniques for Public Participation in Industrial Self-regulation," *Proc.*, Air & Waste Management Assoc., 90th Ann. Mtg. and Exhibition, June 1997.

Allison, R. C., R. Durand, L. B. Gossett, and S. Wilder. "Permit Non-Compliance in Wastewater Facilities: The Effects of Management Variables," Water Environment Assoc. of Texas, April 1997.

Gossett, L. B. "Property Rights Issues Raised by Recreational and Residential Uses Near Water Resource Projects," *Proc.*, 24th Ann. Water Resources Planning and Management Conf., Amer. Soc. of Civil Engineers, April 1997.

Gossett, L. B. "The Impact of Differing State and Federal Audit Policies," *Proc.*, 22nd Ann. Conf. of the Nat'l Assoc. of Environmental Professionals, May 1997.

Gossett, L. B. and M. Lillibridge. "Takings and Property Rights Concerns and Lake Management Practices," 17th Int'l Symp. of the North Am. Lake Management Soc., Dec. 3-6, 1997. (Accepted for presentation.)

James R. Lawrence

Lawrence, J. R., G. D. Gedzelman, X. Zhang, and R. Arnold. "Stable Isotope Ratios of Rain in Hurricanes," *Proc.*, 22nd Conf. on Hurricanes, Am. Meteorology Soc., May 19-23, 1997.

Jim Lester

Murray, C., J. Lester, and S. Easo. "Taura Syndrome in *Penaeus vannamei*," Centennial Mtg. of the Texas Academy of Science, Huntsville, TX, March 1997.

Teague, H., J. Lester, S. Lixey, and C. Howard. "Toxic Effects of a Fungicide in Penaeus vannamei," Centennial Mtg. of the Texas Academy of Science, Huntsville, TX, March 1997.

Lester, L. J. "Environmental Science Careers," SETAC Mtg. at the Nassau Bay Hilton, Houston, Texas, May 1997.

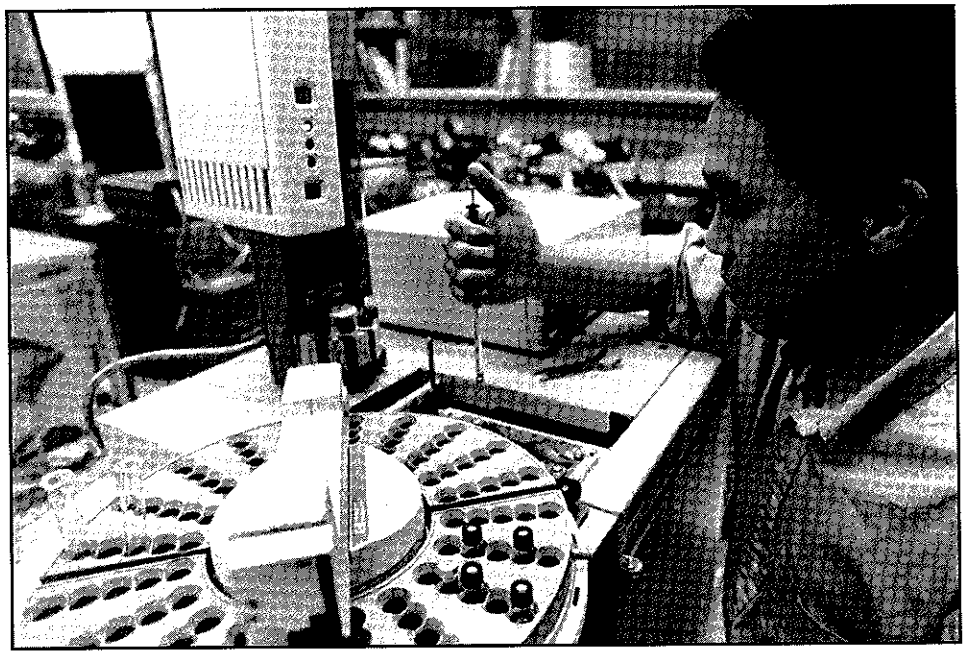
Martin V. Melosi

"Cities and Environment: Past Perspectives," commentator, Assoc. of Am. Geographers Ann. Mtg., Fort Worth, TX, 1997.

"Environmental Pollution in Cities: The Science, Regulation, and Neighborhood Impacts of Smokes and Stenches, 1840-1920," chair, Am. Soc. for Environmental History Biennial Conf., Baltimore, MD, 1997.

"Exposition and Edifice: Nature and the Built Environment in Seattle and New York," chair, Am. Soc. for Environmental History Biennial Conf., Baltimore, MD, 1997.

"The Urban Environment," keynote speaker, Workshop on the Baltic Countries and the Sea, Univ. of Helsinki, Helsinki, Finland, 1997.



The Environmental Institute of Houston investigating the effect of pesticides in vegetables, with Dat Tran, chemistry major, *(above)* assisting Dr. Sam Chen, in agricultural studies of spinach.

James T. Richardson

Moates, F. C. and J. T. Richardson. "Destruction of Chlorinated Hydrocarbons by Catalytic Steam Reforming," AIChE Nat'l Mtg., Houston, TX, April 1997.

Julie A. Robinson

Robinson, J. A. "Dynamics of a Shorebird Population in a Fragmented Landscape: Modeling Scales of Movement and Population Regulation Using STELLA II," Ecological Soc. of Am., Combined Mtg., Providence, RI, Aug. 1996.

Robinson, J. A. and G. N. Cameron. "Demographic Effects of Habitat Fragmentation on Small Mammals in a Coastal Salt Marsh," Int'l Theriological Congress, Acapulco, Mexico, 1997.

Robinson, J. A., J. Wu, and L. W. Oring. "Population Regulation, Semicolonial Nesting and Shorebird Conservation: What Can We Learn from American Avocets?" Am. Ornithologists' Union, Minneapolis, MN, Aug. 1997.

Amy K. Sater

Sater, A. K. "MAP Kinase Activity During Neural Specification in *Xenopus*," poster presentation, 13th Int'l Congress of Developmental Biology, Snowbird, UT, July 5-10, 1997.

Grants and Proposals

Edwin H. Bryant

"Conservation and Restoration Biology: Habitat fragmentation and Population Decline." Co-Investigators: J. A. Robinson and D. Zeh, NSF, $365,196; pending.

"Experimental Tests of Inbreeding Depressing." NSF, 1998-2001; pending.

"Population Size, Selection, and the Accumulation of Deleterious Mutations." 1997-2000, $323,000; not funded.

"The Relationship Among Domestication, Levels of Genetic Variation and Population Size: Implications for Managing Endangered Species." Co-Investigator: D. Reed, NSF Dissertation Improvement Award, 1995-1997, $7500.

"The Translocated Male Determining Factor in *Musca domestica*: A Model System for the Study of Sex Chromosome Evolution." Co-Investigator: M. Clark, NSF Dissertation Improvement Award, 1995-1997, $10,000.

Guy N. Cameron

American Assoc. of Univ. Women, American Fellowship, Post-doctoral, J. A. Robinson, $25,000, not funded.

"Analysis of Rare Resources in Texas." Texas Natural Heritage Program, Texas Parks and Wildlife Dept., 1995-1996, $25,000.

"Effect of Climate Change on Distribution, Diversity, and Productivity in Grassland, Forest Habitats: A Regional Perspective." Nat'l Institute for Global Environmental Change, Dept. of Energy, 1994-1996, $162,894.

"Effect of Prescribed Burning on Productivity, Structure, and Nutrient Content in a Gulf Cordgrass Habitat." Nature Conservancy of Texas, 1997-1998, $4,900.

"Effects of Habitat Fragmentation on Biodiversity: Implications for Management of Wetlands." U. S. Fish and Wildlife Service, 1995-1996, $12,164.

"Herbivory and Granivory by Rodents at *La Reserva de la Biosfera Sierra de Manantlan*." NSF, 1995-1997, $14,711.

"Mammal Survey of the Galveston Bay Prairie Preserve." Nature Conservancy of Texas, 1997-1998, $3000.

NASA Summer Faculty Fellowship, Johnson Space Center, 1997-1998, $10,000.

"Using Remotely-Sensed Data To Measure Primary Production." Research Fellows Program, Midwestern Regional Center, Nat'l Institute for Global Climate Change, 1995-1997, $3,500.

Regina M. Capuano

"Composition of Fluid Phase Responsible for the Precipitation of Carbonates in ALH84001." Co-Investigator: A. M. Reid, NSF, 1997, $54,698; not funded.

"Identification of Migration Pathways in Geopressured Sediments Using Hydrogen Isotopes of Clays." Texas Higher Education Board Advanced Research Program, 1996-1998, $100,798.

"Kazakhstan, A Case Study of Environmental, Geotechnical, Business, Regulatory, and Legal Issues in the Development of Oil and Gas in a Former Soviet Union Republic." Co-Investigators: J. F. Casey, G. Cameron, M. M. Foss, and J. Weaver, Shell Interdisciplinary Scholars Program, 1996, $115,550; not funded.

"Tracing Fluid Flow in the Vicinity of Salt Domes in Geopressured Sedimentary Basins." Texas Higher Education Coordinating Board, Advanced Research Program, 1997, $94,000.

Sam Chen

"Chemical Process Model for Oxidative Destruction of Toxic Organic Materials." Co-Investigator: E. Chen, Dept. of Defense Small Business Program, $26,700; pending.

"Photo-Decomposition of Triazine Herbicides in Water with Catalysts." Environmental Protection Agency, $347,732; pending.

Lisa B. Gossett

Faculty Research Support Fund (FRSF), April 1997, $369 (FRSF) and $125 (SBPA).

Faculty Research Support Fund (FRSF), May 1997, $953 (FRSF) and $315 (SBPA).

David M. Hoffman

"Chemical Synthesis of Oxide Films." Texas Center for Superconductivity, Sept. 1, 1996–Aug. 31, 1997, $40,000.

"New Reactivity and Structures for Rhenium Alkoxide Clusters." Robert A. Welch Foundation, June 1, 1997–May 31, 2000, $111,000.

"Synthetic and Reactivity Studies of Rhenium Alkoxides." Robert A. Welch Foundation, June 1, 1994–May 31, 1997, $95,000.

James R. Lawrence

"Hurricanes of the Past Along the Gulf Coast from Isotopic Analysis of Clam Shells." Texas Higher Education Coordinating Board, Jan. 1, 1998-Dec. 31, 1999, $49,876.

"Stable Isotope Studies of Present and Past Tropical Cyclone Activity." Univ. of Houston Coastal Center, Oct. 1996-Aug. 1997, $3000.

Jim Lester

"Exploring Texas: An Environmental Education Telecommunications Network." EPA, Feb. 1997, $19,953; not funded.

"Habitat Competition Among Native and Exotic Shrimp Species." Texas Sea Grant College Program, May 1997, $44,500; not funded.

"IT'S FRESH Workshops." TPWD, May 1997, $10,000.

"EE2000." NEEAP, June 1997, $7,700.

"Environmental Kiosk Project: A Public Environmental Education Project Using

Space photography—a modern technique for teaching geography in grades K-12, with Prof. Joan Maier, assistant professor of education, training school teachers to interpret NASA photos.

Interactive Computer Technology." NOAA, June 1997, $7,500.

"Comparative Risk Analysis of Coastal Aquacultural, Agricultural or Residential Development." ATP, June 1997, $90,000; not funded.

"Conservation Education in a City Center." Challenge Grant, National Fish and Wildlife Foundation, Aug. 1997, $17,000; Enron, Aug. 1997, $35,000.

Lewis T. May

In kind contributions. PageSoutherland-Page, $40,000.

Martin V. Melosi

"Federal Dam Development in the United States." National Parks Service, Corps of Engineers, and Bureau of Reclamation, $221,000; Energy Lab, $4,939.

"Nationally Significant Developments in the History of Sanitation in America." National Parks Service $6,000.

James T. Richardson

"Catalyst Lifetime Studies for Chlorinated Steam Reforming." Gulf Coast Hazardous Substance Research Center, 1997-1998, $134,272.

Deborah J. Roberts

"Biological Control Agents to Prevent Microbially Induced Concrete Corrosion." Texas Higher Education Coordinating Board, Advanced Research Program, $123,364; pending.

Julie A. Robinson

"Estuary Fragmentation and Population Decline." Co-Investigator: D. Zeh, Advanced Research Program, Texas Higher Education Coordinating Board, $166,640; not funded.

"Habitat Fragmentation and Population Decline." NSF Post-doctoral Fellowship, $80,000; not funded.

Amy K. Sater

"The Role of MAP Kinase in Neural Specification in *Xenopus*." NSF, $90,000/yr, Aug. 1, 1997-July 31, 2000; Nat'l Institute of Health; not funded.

Priscilla Weeks

"Cultural Models of Scientific Fisheries Management," Wenner Gren Foundation, $11,000; not funded.

"Feasibility of Using Cooperative Decision Making in the Regulation of Texas Shrimp Fisheries." Sea Grant, $75,000; not funded.

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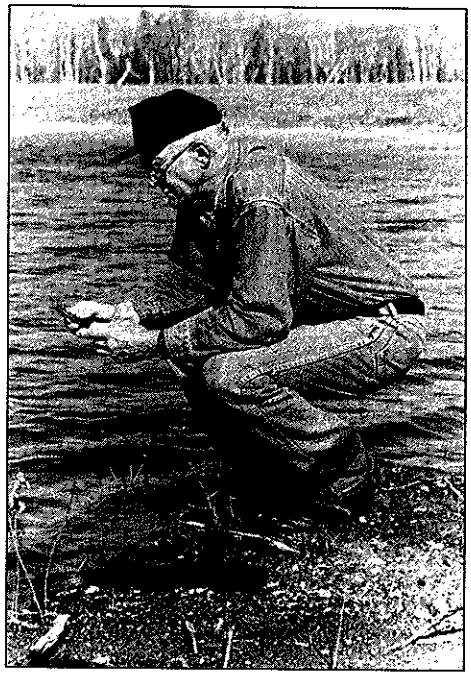

Dr. Glenn D. Aumann, co-director of the Environmental Institute of Houston, is shown at one of two newly-created lakes at the UH Coastal Center where UH researchers carry out biological and aquatic experiments. The Coastal Center is located on the north side of State Highway 7 and the west side of FM 2004, immediately west of Hitchcock, Texas. The Coastal Center covers 925.5 acres of prairie land, formerly the site of Camp Wallace.

Contributors

ARCO Chemical
Browning-Ferris Industries
Compaq
FMC Corporation
Fran Coppinger
Council for Environmental Education
East Harris County Manufacturers' Association
Enron
E. I. duPont de Nemours and Company
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