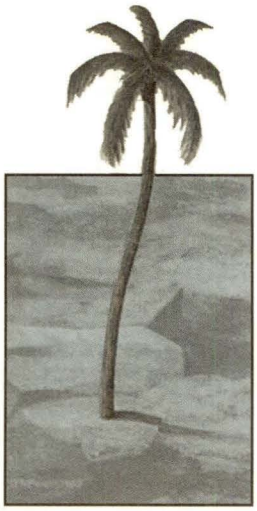
Winter 1992

ITEMS

UNIVERSITY OF MINNESOTA
INSTITUTE OF TECHNOLOGY

Global Change

University scientists delve into the past to fathom future climate changes under the greenhouse effect



Features

Departments

ITEMS

University of Minnesota
Institute of Technology

Winter 1992

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Russell K. Hobbie . . . . . Associate Dean
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ITEMS is published three times a year to inform Institute of Technology alumni and friends about news, interesting alumni and faculty, and relevant issues. Letters to the editor, requests to receive *ITEMS*, and notices of address changes should be sent to the Office of External Relations, Institute of Technology, 107 Walter Library, 117 Pleasant St. S.E., University of Minnesota, Minneapolis, MN 55455, or call Jon Meister, 612/626-1804. *ITEMS* welcomes letters and ideas from all readers.

The University of Minnesota is an equal opportunity educator and employer.

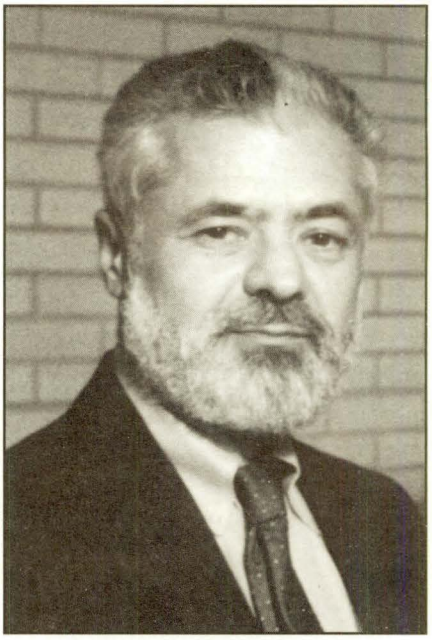
About the Cover: The greenhouse effect has scientists scrambling to understand global climate changes. Cover illustration from the book *Climate—our future?* written by Ulrich Schotterer, illustrated by Peter Andermatt, and translated by Kerry R. Kelts, IT geology professor and director of the Limnological Research Center.

NEWS

Infante Serving as Senior VP for Academic Affairs

Ettore Infante has taken a one-year leave of absence from his post as dean of IT, which he has held for seven years, to accept the position of acting senior vice president of Academic Affairs for the University of Minnesota and provost for the Twin Cities Campus, effective August 1. Stepping in for Infante as acting dean is Gordon Beavers, previously associate dean.

During Infante's one-year appointment at Morrill Hall, the University will conduct a search for a permanent senior vice president of Academic Affairs and provost—a position for which Infante intends to apply.



Ettore Infante

The decision to take the temporary appointment did not come easily or without mixed feelings for Infante. "I am extremely proud and deeply grateful to have been associated with the Institute for these seven years," he says. "One of the things that made me hesitate about moving to Morrill Hall was precisely the thought of leaving this excellent organization."

Infante felt, however, that the call to broaden his contributions and service to the University had to take precedence. "I chose to accept these new responsibilities because the president of the University, the Board of Regents, and the community in general said in effect they thought I could make a contribution to the University as a whole, rather than just IT. I felt I owed it to the University and the Institute to accept this opportunity."

Beavers (to whom the move came as something of a surprise) and the rest of IT's faculty and staff remain confident that this change won't be disruptive. "Infante and I worked very closely for these seven years and thought along the same lines," Beavers says. "Certainly we'll all miss him very much; his influence over the years has been enormous and very positive. Nevertheless, we intend to keep on in the positive directions we've been going. I think the fact that he and I worked toward, and so strongly believed in, the same goals really brings continuity to this change."

In what now seems to be a rather quick seven years, Infante speaks with satisfaction about several areas in which IT has grown during that time. "Looking back, we've seen steady, constant, and successful improvement by the Institute's faculty, staff, and students at the instructional and research levels, as well

as in interactions with the larger technological community. We significantly improved our instructional capabilities by bringing about a more appropriate relationship between faculty capabilities and capacities and student needs.

"The Departments of Electrical Engineering and Computer Science were living in rather threadbare conditions seven years ago. Over 50 percent of the faculty in those departments have been recruited in the past six years. We've twice had the Institute of Mathematics' major grants renewed, and we received the Army High Performance Computing grant, which was the largest grant ever awarded the University."

Infante also points out that IT students now receive the level of attention appropriate to fostering excellent education. This year, we addressed the curricular problems at the freshman and sophomore levels in ways we believe will have a significant impact on instruction," he says. "And at the graduate level, we feel we've really improved, too, judging by the fact that the level of external research funding has essentially doubled over the last seven years."

Infante was quick to point out, however, that IT's successes are not the result of one individual's work. "You have to have the right resources and support—and a lot of competent, hard-working people. That's what the Institute has, and that's why it's a good, solid organization that I admire deeply. The strength of the Institute resides in the entire organization."

Recent successes notwithstanding, both Beavers and Infante recognize the heavy challenges facing the Institute, the University, and higher education nationwide. The first challenge is twofold, says Beavers. "First, we constantly see increasing levels of expectations from society on what organizations like ours can do, yet we also see financial resources becoming ever more limited. With an ever-growing rate of technological change, the level of education will need to improve significantly if our young women and men are to make a positive contribution to the society in which they live. And, second, the Institute must continue moving forward in building an economically and culturally strong society as the U.S. faces challenges from our competitors on both sides of the ocean."

Infante believes IT has an obligation to prepare students in more than just technological excellence. "We must also prepare our students for the 'offices of life.' Many of them will have to be part of this country's leadership," he says. "More than ever before, this is a period of time for the U.S. and the world to work better and more intelligently, productively, and thoughtfully.

"An Edward Hume quote I'm very fond of says that when everything is said and done, two things really count in a society: civility and industriousness. The task at the Institute is to make significant contributions to both of those areas. Those are big challenges, but I am very confident that the Institute, because of the nature of the organization and the quality of its people, can meet them."

As Infante assumes his new responsibilities as acting senior vice president of Academic Affairs and provost, there is little doubt among the people with whom he has worked that, if he is as successful in this new role as he has been as dean of IT, the University—and IT as part of that institution—will significantly benefit from his contributions. ■

By Joseph Moriarity

IT Placement Office Needs You

Despite the recession, jobs are available and Herb Harmison, director of IT Placement Services, wants to help IT alumni find them.

"This is one area where we can continue to do something for Institute of Technology graduates after they complete their education," Harmison says. "We get inquiries from employers around the country who are looking for qualified applicants in all disciplines."

Harmison added that the service is also an excellent resource for companies looking to fill positions.

For more information, contact the IT Placement Office at 50 Lind Hall, 207 Church St. S.E., Minneapolis, MN 55455, 612/624-4090. ■

IT 400 in the News

More than 40 founders, alumni, members of the media, and University officials attended a press conference September 4 announcing the results of IT's study of its entrepreneurial alumni. Among the founders present was Thomas G. Kamp (1949/EE), former Control Data Corporation president of peripheral products and founder of four computer-related companies.

"Institute of Technology graduates are making Minnesota a very famous place," says Kamp. "The implication of revenue from just one start-up like Medtronic or Control Data Corporation is incredible."

Local newspapers and television and radio stations did several stories on the results of the study. Along with the publication of the special entrepreneurial issue of *ITEMS*, the publicity helped IT uncover an additional 63 firms founded by IT alumni, which are listed on p. 4.

The latest figures show a total of 470 companies founded by IT graduates, 304 of which are in Minnesota. Worldwide sales of these companies total $13 billion, and worldwide they employ 101,000 people.

U.S. Senator David Durenberger (R/Minn.) wrote to Acting IT Dean Gordon Beavers, "I was very impressed with the results of your founder's study. The positive impact of the Institute of Technology on Minnesota and the world is remarkable. I can only hope that the stunning success of the Institute continues, and that the study allows you to illustrate the achievements of the Institute of Technology to every possible supporter."

Alice Johnson, assistant majority leader of the Minnesota House of Representatives, wrote:

"Thank you for the information about companies founded by graduates of IT. It certainly demonstrates an impressive track record.

"My daughter is currently enrolled in IT, so maybe someday she'll be starting one of these companies."

"[The issue] was enlightening," wrote Susan Parsons (1978/AEM). "I enjoy reading about what's going on at IT."

"It's time to start advertising the facts about IT's progress, particularly in engineering since most, if not all, human progress has been in that area," wrote John Kerwin (1968/ME). "This could help lift the U of M out of mediocrity."

Finally, Steven Bauer (1978/AgE) described Earl Bakken's "Viewpoint" as "lucid, informative, and direct," and included a donation toward future publications. ■

Additional Companies Founded by IT Alumni
(Not Listed in the Special Issue)

Corporation	*Worldwide Employment*	*Sales in $1000s*	*City*	*State*	*IT Founders*
Abeln Associates, Inc.	4	400	St. Louis	MO	Raymond J. Abeln 48/ME
Advantage Enterprises	**7**	**150**	**Minneapolis**	**MN**	**Steve J. Stroncek 83/EE**
ALC®USA, Inc.	19	4,500	Marietta	GA	Jae Moon 71/ME
Alltech Engineering Corp.	**30**	**3,500**	**Bloomington**	**MN**	**Robert D. Lawrence 59/CE**
Angeion	124	5,091	Plymouth	MN	Wendell L. King 64/PH
Angelase	**5**		**Plymouth**	**MN**	**Wendell L. King 64/PH, Gregory G. Brucker 71/ME**
Applied Information Systems	2	10	Minneapolis	MN	Marius O. Poliac 89/Ctls/DynSys
AZX International Corp.	**5**	**300**	**Huntington Beach**	**CA**	**Phillip J. White 80/EE**
Carlson Brothers, Inc.			Springfield	MN	Elner W. Carlson 27/CE
Cilantro Computing Services	**4**		**St. Paul**	**MN**	**Kevin M. McMahon 74/PH**
Co-Z Development Corp.	2	60	Mesa	AZ	Nathan D. Puffer 50/ChemE
Corporate Technical Training	**2**	**20**	**Red Wing**	**MN**	**Glenn E. Bowie 60/AE**
Curtis, Inc.	6	1,000	Roseville	MN	Curtis Fritze 47/EE
Cypress MN	**350**	**60,000**	**Bloomington**	**MN**	**Thomas E. Hendrickson 77/EE**
Dahl-Tech	35		Stillwater	MN	Robert Dahlke 57/ME
Datamyte	**160**	**20,000**	**Minnetonka**	**MN**	**Glenn W. Shifflet, Jr. 60/EE**
Derald West - Architect	4	160	Lake Geneva	WI	Derald M. West 41/Arch
Derrick Construction Co., Inc.	**50**	**7,000**	**New Richmond**	**WI**	**William M. Derrick 77/CE**
DMR Electronics, Inc.	5	333	Hibbing	MN	Hugh Vidovic 73/EE
Douglas Corp.	**500**	**28,000**	**Minneapolis**	**MN**	**Carl T. Skanse 29/ME**
Dygert - Peck Co.			Cedar Rapids	IA	Edwin S. Dygert 43/ME
E. S. Dygert Co.			**Minneapolis**	**MN**	**Edwin S. Dygert 43/ME**
Entech Industries	3		Minneapolis	MN	Kenneth M. Merdan ME/90
Experimental Services, Inc.	**4**	**400**	**Akron**	**OH**	**Thomas F. Brovold 71/CE**
Financial Information Management	10	1,000	Eden Prairie	MN	John Nauman 78/CS
Gareri Consulting Assoc.	**1**	**80**	**Fairfax Station**	**VA**	**Dan J. Gereri 47/AE**
Geeco			Minneapolis	MN	Harold W. Gee 44/ME
Girard Electronics	**8**		**Hudson**	**WI**	**Michael G. Golden 68/EE**
High Technology Sales	7	20,000	Eden Prairie	MN	David J. Turnquist 69/ME
Industrial Solar Energy Corp.			**Denver**	**CO**	**Randall C. Gee 78/ME**
Intercomp Co.	30	3,000			Mark W. Kroll 75/Math
Jones and Brown Co., Inc.	**300**	**30,000**	**Addison**	**IL**	**Wilson C. Brown 39/CE**
Judd Supply Company	35	15,000	Coon Rapids	MN	Gary L. Nereson 31/EE
Juris Curiskis Architects, Inc.	**4**		**St. Louis Park**	**MN**	**Juris Curiskis 62/Arch**
Lowry Manufacturing	15		Lowry	MN	John Dahlseng 73/ME
Luger Industries, Inc.	**100**	**2,000**	**Port Charlotte**	**FL**	**Rennold J. Luger 49/ChemE**
MCON and Florida, Inc.	3	1,500			Jae Moon 71/ME
Microdynamics			**Eden Prairie**	**MN**	**Glenn W. Shifflet, Jr. 60/EE**
Molinaro and Associates, P.A.	1		Northfield	MN	Peter J. Molinaro 73/CE
Moll Associates, Inc.	**2**	**40**	**Roswell**	**GA**	**Donald R. Moll 48/EE**
Mores Cardiovascular Research			Minneapolis	MN	Marius O. Poliac 89/Ctls/DynSys
N. K. Biotechnical Engineering	**8**	**750**	**Minneapolis**	**MN**	**Nebojsa D. Kovacevic 60/AE**
Nicollet Restoration, Inc.	4	500	Minneapolis	MN	John J. Kerwin 68/ME
North Star Field Services	**16**	**2,500**	**Stillwater**	**MN**	**Michael J. Radford 74/ME**
Northern Systems Engineering	1		St. Paul	MN	John A. Kallevig 58/AE
Pierson Co.	**6**		**Denver**	**CO**	**Edward D. Pierson 39/ME**
Pine Instrument Co.	165	10,000	Grove City	PA	Theodore G. Hines 58/EE
Pioneer Engineering, P.A.	**30**		**Mendota Heights**	**MN**	**Peter Molinaro 73/CE**
Poliac Research Corp.	7	250	Minneapolis	MN	Marius O. Poliac 89/Ctls/DynSys
Productivity, Inc.	**70**		**Minneapolis**	**MN**	**Daniel M. Stenoien 57/ME**
Quadic Systems	18	4,000	Portland	ME	Thomas E. Hendrickson 77/EE
R. C. Lambert and Associates	**1**		**Roseville**	**MN**	**Richard C. Lambert 67/EE**
Short, Elliot, Hendrickson, Inc.	200		St. Paul	MN	Roger B. Short 42/CE
Silicon Concepts	**20**	**5,000**	**Burnsville**	**MN**	**Thomas E. Hendrickson 77/EE**
Specrotech	1		Minneapolis	MN	Jim R. Sutherland 61/AgE
Stat - Ease, Inc.	**9**	**800**	**Minneapolis**	**MN**	**Pat J. Whitcomb 73/ChemE**
Techpower, Inc.	150	5,000	Edina	MN	Neil Clark 48/ME
The Diagnostic Group, Inc.	**4**	**500**	**Neenah**	**WI**	**Rodger Whipple 72/AE**
Umpqua Research Company	38		Myrtle Creek	OR	Gerald V. Columbo 60/ChemE
Veritas	**1**		**Rosemount**	**MN**	**Steven Duggan 62/EE**
Videoccasions	2	3	Rochester	MN	Gerard N. Weisensel 85/ME
Wilstein Software	**2**		**Wilmette**	**IL**	**Scott A. Jenkins 89/Chem**

Please send additions or corrections to John W. Larson at 107 Walter Library, 117 Pleasant St. S.E., Minneapolis, MN 55455; telephone: 612/626-1807.

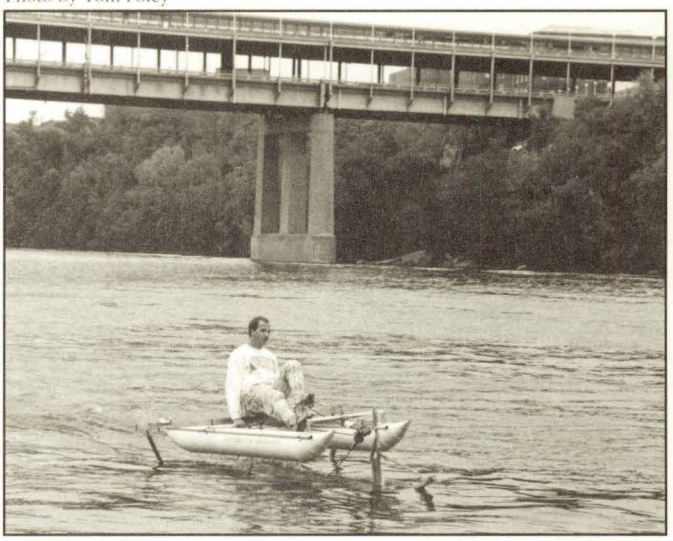
ME Students Set World Speed Record

In August, a team of IT mechanical engineering students set a new world's speed record for human-powered hydrofoils—13 miles per hour—during the 1991 International Human-Powered Speed Championships held in Milwaukee, Wis. The IT students competed against teams from around the world in 100- and 400-meter sprints, as well as slalom and other events.

The students designed and built their hydrofoil, dubbed the "Soggy Gopher," as part of a mechanical engineering class project. Weighing just 48 pounds, the Soggy Gopher is the final product of numerous prototypes, test-runs, and redesign efforts. Mechanical engineering senior Phil Tetzlaff and incoming freshman Eli Anthony provided the pedal-power during the competition.

Praising the role the project plays in their education, senior and project leader Ben Leonard says, "You finally get to see the relationship between what you do on paper and what happens in real life."

Photo by Tom Foley



Senior ME student Dan Meus pedaled the Soggy Gopher during a test run on the Mississippi River near the Washington Avenue Bridge.

IT Budget Slashed by Governor

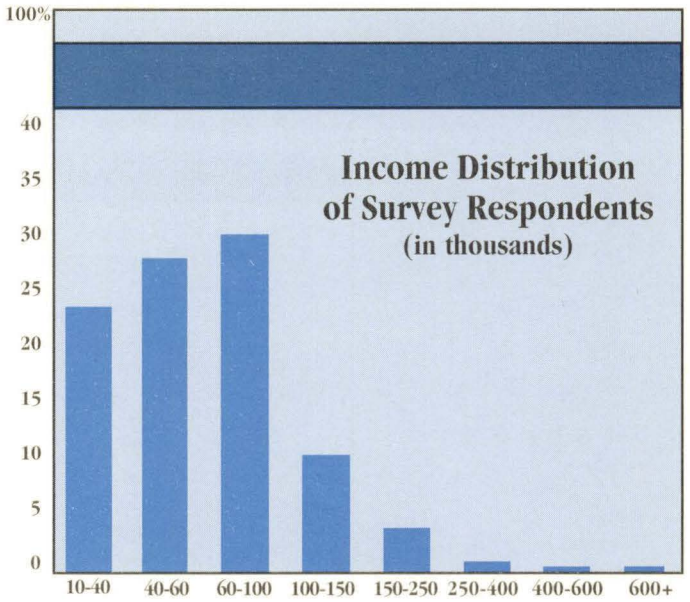
Governor Arne Carlson eliminated several IT programs through line-item vetoes before signing the Higher Education Funding Bill. The $3.6 million in cuts would take place during 1992-93, the second year of the current biennium.

IT programs to be cut are:

- University of Minnesota Talented Youth Mathematics Program
- Minnesota Geological Survey
- Microelectronics and Information Sciences Center
- Productivity Center
- Underground Space Center

Through additional vetoes, Governor Carlson cut $8 million from the Supercomputer Institute and $1 million from the Institute for Advanced Studies in Biological Process Technology. Although Governor Carlson says he will work to reinstate a portion of this funding, without further legislative action, the cuts will stand.

If you would like to work to reverse these cuts, contact Frank Medved, IT Alumni Society legislative liaison, at 612/636-4342.



IT Survey Provides Important Feedback

While IT alumni surveys (contained in the last issue of *ITEMS)* continue to pour into the Institute, initial results have provided IT with important information regarding both strengths and weaknesses of the Institute's programs.

The most frequently cited strengths and weaknesses are:

Strengths

- Quality of the faculty
- Rigorousness of the technical education
- Reputation of IT

Weaknesses

- Old facilities and equipment
- Large size of classes

Still, more than 89 percent of 927 people who responded by November 15, said they feel they have greatly benefitted from their educational experience at IT. Income distribution of survey respondents is represented in the above chart.

In Pursuit of "Lost" Alumni

IT has embarked on MADCAP—the acronym for Missing Alumni and Donor Correct Address Project—in search of its "missing" alumni. Of the 45,000 IT students who graduated from IT since 1920, only about half have their correct addresses listed in the University's database.

To set the record straight, IT needs your help as an IT class associate—a rewarding and fun position in which you locate former school chums and learn what they've been doing with their lives since you last saw them.

Bill Caddy (1940/ME) started doing just that one day when he began wondering what had happened to his former classmates. "As a retired mechanical engineer, I decided to find my classmates to see what kinds of careers they had," Caddy says. "I began with just two addresses, and within a couple of years, I contacted about 90 percent of my class—through personal letters, sheer persistence, and a little luck. My classmates' responses were overwhelming!

continued on page 37

REUNIONS

Class of 1942 Reunion to be Held May 6

Where were you in '42? If you were just finishing your last class at IT and anxiously preparing for graduation day, get ready to celebrate your 50-year class reunion. On May 6, 1992, the IT class of 1942 will hold a reunion that may include departmental receptions, tours, and activities prior to a dinner reception.

Glenn Bakken (1942/ME), chair of the 1942 Reunion Planning Committee, is putting together plans for the upcoming reunion. For more information, contact Bakken at 503/378-0503.

In the meantime, take a minute to help us find your "missing" classmates (as of November 19, 1991) from the list below. If you have any information about their whereabouts, contact MADCAP (Missing Alumni and Donor Correct Address Project) at 612/626-1800, or Janet Schwappach, director of special programs, at 612/624-9561. You may also write to: MADCAP, Institute of Technology, 107 Walter Library, Minneapolis, MN 55455.

Aeronautical Engineering

Wayne G. Andersen
Curtis B. Berg
Ralph B. Bergan
Charles R. Boller
George D. Brewer
Adelbert Carpenter
Ou-wen W. Chen
Roland E. Dufrene
George W. Engstrom
Donald P. Graham
Frank T. Gustafson
Elwood J. V. Hathaway
Louis Hoffman
Philip W. Houghton
Frank B. Ingham
Reuben G. Klammer
Robert E. Kvale
Curtis P. Liljengren
David Loevinger
Jay W. MacFarland
Bernard W. Marschner
Kenneth L. Melin
William A. Norlander
Alan E. Palmer
Lloyd E. Schumacher
John C. Solvason
Donald L. Stull
Wendell C. Wilkins
Richard K. Wilson
Harold W. Zimmerman

Agricultural Engineering

Virgil H. Johnson
William H. Johnson

Chemical Engineering

Thomas R. Braun
Robert M. Brice
Philip R. Cloutier
John J. Dorsey
Robert E. Drummond
Raymond R. Fitzgerald
Hayden C. Flor
Harlan G. Formo
Grant Gridley
Raymond G. Hegstad
John F. Johnson
Robert C. Jondal
Everett E. Klicker
Allen A. Levi
Gilbert L. Michel
Roy E. Nystrom
Allen E. Polson
Roger D. Samdahl
Richard H. Schliem
Donald L. Schott
Richard T. Solsten
Robert J. Stiefel
Gerald H. Thurston
Albert J. Turk
Kenneth A. Voge
Alfred W. Woker

Chemistry

Orville E. Bruss
Harry F. Herbrandson
Roy T. Holm
Sherman E. J. Johnsen
Merlin O. Juvrud
Richard A. Matthews
Richard M. Ovestrud
Ralph L. Rowland
David D. M. Streed

Among the attractions at the 1942 IT Engineers' Day was a "Kissometer" purported to measure sex appeal.

Civil Engineering

Kenneth A. Anderson
Danforth E. Apker
Lewis P. Carpenter
Clarence E. Dalstrom
Leo L. George
James A. Johnson
Edwin E. Kinney
Henry A. Knieff
Clarence R. Pearson
Guillermo A. Reina
Henry B. Schmidt
Emil J. F. Vodonick
Sylvester S. Yuzna

Electrical Engineering

Burton W. Bostad
Oliver F. Cheney
Chuan C. Chu
Ernest D. Davidson
John A. Engstrom
Charles F. Faltin
Lloyd M. Frederickson
Maurice F. Gay
James W. Gordon
Gerald J. Granros
George S. Hanson
Merlin G. Haugen
John A. Howard
George F. Jenkins
Arnleiv Jensen
Frank A. Lovshin
Kent M. Mack
Irwin L. Mattson
Lawrence E. Moline
Robert A. Poe
Victor O. Ray
Calvin I. Ricketts
Leif H. Rovick
Howard W. Sheldon
Richard M. Siefken
Henry J. Stinger
Torvall E. Sundvor
Victor W. Zeiher

Geological Engineering

Donald E. Hohenhaus
Mark A. Nothaft

Mechanical Engineering

John W. Bentley
Orlo J. Blomquist
Charles Boutin
Roger W. Clements
George C. Collins
Richard E. Dahlstrom
Robert D. Donaldson
John E. Douglas
Donald E. Drake
Orland R. Evans
Paul J. Fetzek
Russell O. Gunderson
Elmer J. Hill
Richard F. Huettl
Merlin R. Jensen
Henry Kartarik
James I. Kistle
Raymond S. Megarry
Robert S. Mills
Gerald H. Mullaney
Howard W. Nicol
Robert C. Olsen
Robert N. Peterson
Robert O. Ringoen
Richard Sass
Sidney S. Silberg
Donald K. Strohschein
Wellington J. Tong
Robert G. Winter

Metallurgical Engineering

Irving C. Mattson
Robert W. Rebholz
Gene D. Selmanoff
Merle D. Wiltrout

Mining Engineering

Curtis E. Stanius

Physics

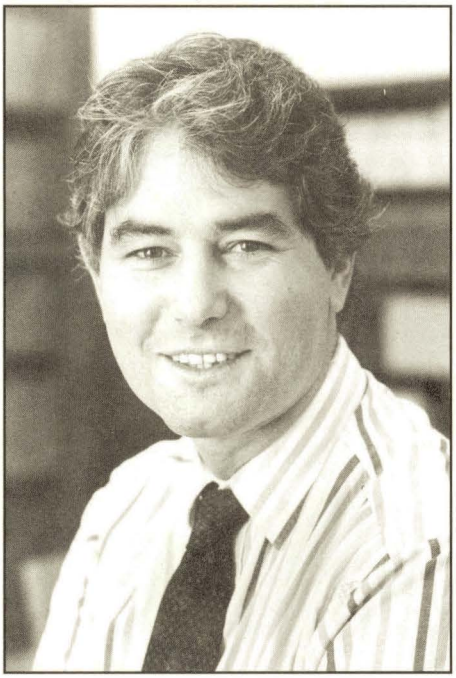
Elmer E. Green
Brice M. Rustad
David D. Webster

VIEWPOINT

Climate Change Strategy

By Kerry Kelts

Photo by Patrick O'Leary



Kerry Kelts, professor of geology and director of the Limnological Research Center

Global change is a buzz word of such scope that it seems to lose meaning. Even among scientists, we confuse science and issues. To some, it is an agenda for social reform; for others, it represents unproven hypotheses. The questions are perhaps less "who's right?" than "how much must we know for how much insurance?"

Global Change is perhaps best summarized as a combination of five problems that appear unstoppable within the next half century. These encompass deforestation, desertification, loss of planetary biological diversity, increase in dispersed pollutants (including greenhouse gases), and population growth and demand, which underlies the others. They appear unstoppable because they derive from innumerable small, seemingly harmless actions, and there is a significant time lag between cause and effect.

Changing climate—one aspect of global change—was once in the domain of fate. We have now learned that the burning of fossil fuels and other human activities that started in the early 19th century—only a minute ago from a geological perspective—may override natural climate trends. This is a global problem of mutual responsibility and a collective social threat.

In November 1990, the Intergovernmental Panel on Climate Change (IPCC) presented convincing evidence to the Second World Climate Conference that a continuation of greenhouse gas emissions at present levels (notably, carbon dioxide, methane, nitrous oxide, tropospheric ozone, and chlorofluorocarbons) can progressively increase global mean temperatures and likely affect global climates. Although severity, rate, and regional aspects of climate change cannot yet be predicted with confidence, its potential impact poses threats to both natural and socio-economic systems of this planet.

Social perception of this human-induced climate change can produce repercussions comparable to actual events, ranging from individual despair, to social group demands for action, to intergovernmental threats. The problem of global climate change, however, also presents numerous opportunities—opportunities to understand the Earth as a system, enhance international research collaboration with scientists in both developed and developing countries, and broaden the education of our students through the interdisciplinary approach this area demands.

Research Collaboration and Policy Making

Minnesotans may now have forgotten global warming thanks to the Halloween Megastorm of '91 and those following. Unfortunately, this represents a confusion

of local weather events with global trends; modelers still predict that 1991 will again set a record for increased annual temperature of the globe, following the rise through the 1980s.

Climate feedbacks are complex and trends cannot be read from events. Although there are clear trends in regional and global climate patterns over the last century, it may be 30 or more years before we can prove statistically whether they are solely due to enhanced greenhouse gases. This is disquieting for policymakers who wish to make risk-free decisions.

Education in research is not about training or mastering techniques, but rather about answering questions not yet asked.

Global change—a topic closely linked with the welfare and behavior of billions of humans and other living species—has been on the agenda of every world government and many presidents during the past eight years. Are we any closer to decisive policy action as a result? Not really.

Few deny that massive interdisciplinary research efforts at the international level are necessary to lay the groundwork for these decisions. Indeed, there have been many dramatic steps taken in that direction. On the national level, U.S. federal agencies recently banded together to support the U.S. Global Change Research Program—a step viewed as a breakthrough in science coordination. At the same time, Congress authorized an additional $1 billion for research in this area in spite of budgetary cuts in other domains.

Internationally, a broad effort called the International Geosphere Biosphere Program (IGBP) has been building steam with countless scientific workshops defining urgent interdisciplinary research agendas to confront the uncertainties of global change. Great progress has been made toward tracking the pulse of the planet and observing temperatures, gas concentrations, weather patterns, and ocean currents.

Because climate change is an issue that transcends borders, on the political front, it has been used as a tool of diplomacy among the European nations tending toward unity. Promotion of scientific cooperation programs on global change is viewed as a way to strengthen the European Community (EC).

Recent years have seen a sort of environmental one-upmanship as governments compete to look environmentally conscious. With low debt burdens, policy directions needed to curb greenhouse gas build-up are in concert with the goals of both left and right political groupings. New economic horizons are expected from the development of technologies for light, energy-efficient transportation, energy conservation, and microelectronics for monitoring and controlling the environment. Several countries, and the EC, have launched serious proposals for a carbon tax on fossil fuels, as well as superfunds aimed at support of lesser developed countries. In the meantime, the EC pursues efforts to convince the U.S. to join in a commitment to stabilize carbon dioxide emissions by 2000.

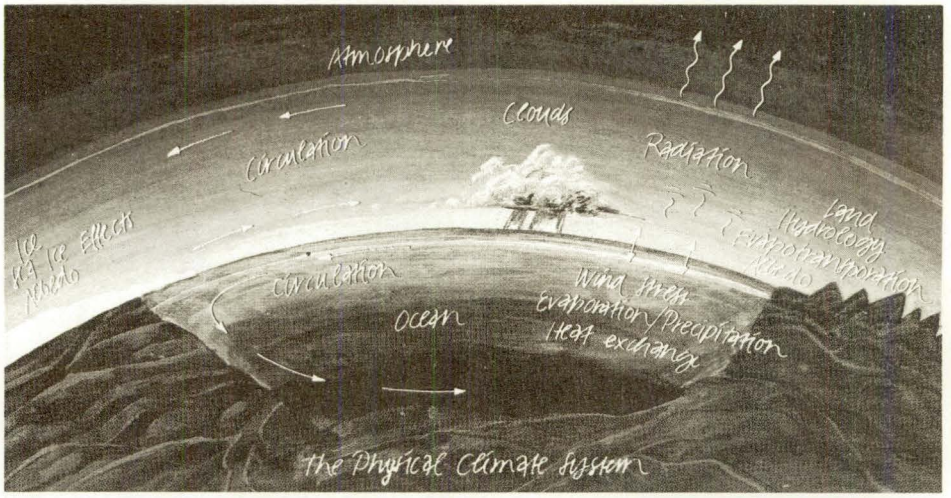
Next year will see the issues of climate and global change heating up as countries prepare their positions for the June 1992 United Nations Conference on Environment and Development. Treaties are expected on greenhouse emissions, and developing countries will have a strong voice. The U.S. will undoubtedly come under considerable pressure, as it currently rejects proposed targets based on the belief that scientific evidence for human-induced global warming is too tenuous to form a basis for policy toward reductions. The American government favors abundant new research and states that the U.S. has de facto currently stabilized greenhouse gas emissions at 1987 levels (taking into account restriction on chlorofluorocarbons). Climate adaptation is preferred to precipitous economic change.

With respect to adaptation, it is clear that lesser developed countries will have much more difficulty than developed countries adjusting to climate change caused by the latter's excesses. The IGBP plans a network of regional research centers in developing regions to promote exchanges with scientists in developing countries. One IGBP project called PAGES (Past Global Change Research) will attempt to reconstruct climate interactions at an annual scale over the entire globe for the last 2000 years. A second goal of the project targets the last two interglacial periods (beginning 150,000 years ago) in a study of all proxy records of change and response to warming, linking continents, oceans, atmosphere, and polar ice. Thousands of scientists will be involved.

It will be up to the scientists in developing countries to convince their leaders as to how to avoid our mistakes. For this reason and the fact we are badly in need of regional data from those areas of the world, it is in our interest to promote scientists in these countries to conduct global change research from their own perspectives.

This presents a positive challenge and new opportunities for so-called "barefoot" scientists to work on joint research projects. A key to success is that these projects be jointly planned and developed. Support should include direct grants to cooperating scientists at their universities, rather than paternally filtered through ministerial hierarchies.

Illustration by Peter Andermatt



Different parts of the Earth's climate system interact in a way that makes it difficult to predict what the final outcome will be. Cloud cover change could affect radiation balances, which in turn could affect the exchange of energy between the oceans and the atmosphere.

Opportunities in Education

Education in research is not about training or mastering techniques, but rather about answering questions not yet asked. A good researcher doubts rationally and comes up with testable hypotheses and solutions. Discovery, of course, includes a lot of hard work, time spent on the wrong track, and daily frustrations. The early entry of students into the realistic world of research removes illusions, but also opens their eyes to the pursuit of knowledge as a positive, collective experience, akin to work in industry or elsewhere.

Recent years have seen a sort of environmental one-upmanship as governments compete to look environmentally conscious.

With respect to global climate change, there are many unanswered questions. An engineering student, for example, might be inspired to discover how bacteria exert control on the atmosphere, or whether plankton in the ocean emit volatile sulfur compounds that affect the formation of cloud condensation nuclei. Everyone has now heard of the possible link between El Niño and weather events. But how does it work?

Answers to global climate change questions will come from linking highly focused basic research efforts to various disciplines. For this reason, global change questions have a unifying effect on science.

Do we need to create a global change discipline to address these needs? Strong foundations in math and scientific logic will be necessary for interdisciplinary communication as well as educating students to understand the big picture—how does the universe and Earth system work; what is life, and where is its origins; and what about geosphere/biosphere history and other criteria, such as dynamics, interaction, development, motion, and change? In a holistic approach, the drier parts of science and math are of immediate interest and relevance to career directions concerned with enhancement of human life and society.

Five Types of Global Warming Research

Climate system processes: This includes research on greenhouse gases, the atmosphere, ocean, and geosphere-biosphere interactions carried out by individuals or teams with models, observations, and theory. This arena, which relies heavily on global climate modeling and space-based data collection, is aimed at understanding the fundamental controls of climate and using basic principles to forecast future global climate conditions.

Much of the current public debate revolves around uncertainties in global climate models and current evidence of human-induced climate change. Climate models have also been particularly unsuccessful in determining regional aspects of climate.

Paleorecords: Interdisciplinary teams reconstruct past climate and environmental dynamics from archives of geosphere-biosphere interactions. By unravelling the lessons of the past, they gain insight for testing climate models and understanding complex feedbacks and thresholds that affect the magnitude and rate of regional response to global change. Records of past climate indicators unveil natural variations before human interference began. Past climate information is stored in a variety of natural and human archives (such as the annual layers of glaciers, polar ice, and lake deposits; ocean sediments; tree rings; coral growth bands; and historical chronicles and weather data) each holding information on different parameters of the climate system (e.g., dust, seasonality, storms, vegetation, temperature, and precipitation).

Impacts: Research on the impact of climate change attempts to assess the sensitivity of regional economies, water, crops, landscape, and social behavior to predicted regional scenarios of future equilibrium climates. Scientists in this area must choose an assumed regional climate, usually based on climate models, in order to compare results.

Prevention: Research on global climate change prevention is probably the most costly and has the greatest scope of all global climate change research, encompassing everything from energy and transportation to international law and policymaking. Technologies and methods to reduce greenhouse gas emissions are under study in almost every university department.

Adaptation: Adaptation research focuses on how to insulate societies and economies from the predicted impact of climate change. It is the area of research most likely to lead to international agreements. The necessity for this research is based on the belief that the magnitude of change can be managed better than the economic chaos that might result from mitigation. ■

Visionary leaders of IGBP and other programs seek to recruit and educate a new and larger generation of scientists worldwide to work in the environmental sciences and strengthen both interdisciplinary and disciplinary capabilities.

Efforts are also underway to rewrite educational materials at all school levels to incorporate the issues and science of global change. These efforts cannot fail to have a major impact on research and education at the University of Minnesota, as well as on the career prospects of the upcoming generation of young scientists and engineers.

Emerging Professional and Technological Needs

Satellite information is an example of an emerging interdisciplinary perspective. The lion's share of the new U.S. Global Change Program funding is going to develop NASA's "Mission to Earth," a new generation of earth-monitoring satellites, some known as the Earth Orbiting System (EOS). These will gather and beam unprecedented data on Earth conditions derived from recording a wide spectrum of energies related to the biosphere, hydrosphere, geosphere, and atmosphere. The amount of information to be compiled is mind boggling. Only about 1 percent of the data sent back to Earth from satellites so far has been analyzed. Yet, the EOS alone is expected to generate 10 trillion bytes of environmental data daily. This deluge will drive a demand for converting data into comprehensible images. In turn, this stimulates supercomputer development and applications. The result is billions of cheap FLOPS. Available computing power will lead to more sophisticated computer models better able to simulate the natural world.

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The Heat Is On!

Things are warming up at the University as IT and other faculty members collaborate on the puzzle of global climate change.

By Maggi Aitkens

Illustrations by Peter Andermatt from the book *Climate—our future?*

The steady onslaught of hyped-up stories about the greenhouse effect in the popular media during the past several years may have created more misunderstanding than understanding. Many of these stories have depicted future scenarios that are simple, precise, and yet, too often, sensational. Unfortunately, the science of global climate change is neither simple nor precise. The impact on life as we know it, however, may be sensational.

While current predictions for global climate change are fuzzy—ranging from a warming of 2° to 5° C over a period of anywhere from 20 to 100 years—experts agree that no society would be able to adjust to even a 2° C warming if it occurs during a short period of time. If, on the other hand, it occurs over a relatively long period—say 100 years or so—the only way society could absorb the shock is by preparing for it now.

Although inevitable global climate change is an urgent problem, what to do about it remains a nagging question for politicians, the public, and scientists alike. The reason: too many unknowns about the pending degree of change and its potential impact.

Piecing together the global climate change puzzle is like piecing together a zillion-piece jigsaw puzzle—without the picture on the box. What's more, many of the pieces are missing, such as important information about the Earth's systems (oceans, clouds, ice cover, land, soil moisture, etc.), the solar system, gases in the atmosphere, and more. All of these systems not only vary from one region to another, they also have their own self-regulating cycles that must be understood in any form of computer modeling or analytical study on predicting future climate change.

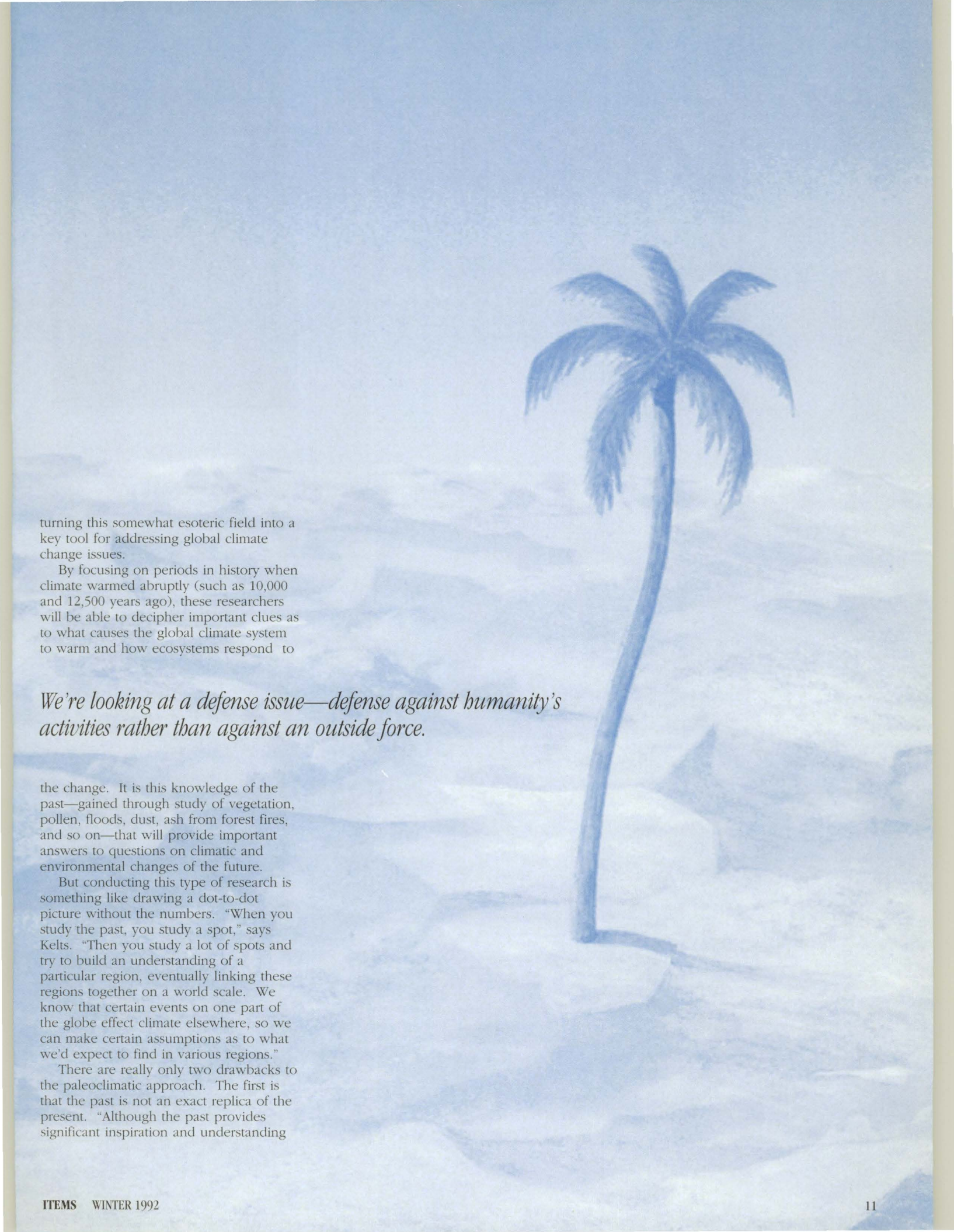
At the Institute of Technology, a clearer picture of global climate change is taking shape under the direction of Professor of Geology Kerry R. Kelts, newly recruited this past January to head the University's Limnological Research Center.

According to Kelts, who previously served as program director for the National Climate Program at the Swiss Academy of Sciences in Switzerland, "We're facing global changes that may change almost everything we do. The greatest critics agree that, on a regional scale, we probably face very important adjustments over a short period of time—say, 10 to 30 years down the line. The odds of this climate change becoming a world problem are far greater than the odds of having nuclear war. So, we're looking at a defense issue—defense against humanity's activities rather than against an outside force."

Kelts plans to strengthen a tradition commenced by his predecessor, Regents' Professor Herb Wright, by enhancing interdisciplinary research at the University, as well as at the national and international levels, with a focus on the past—namely, paleoclimatic research.

Tapping the Past

With the addition of Kelts to the list of renowned University faculty members in paleoclimatic research, IT is quickly



turning this somewhat esoteric field into a key tool for addressing global climate change issues.

By focusing on periods in history when climate warmed abruptly (such as 10,000 and 12,500 years ago), these researchers will be able to decipher important clues as to what causes the global climate system to warm and how ecosystems respond to the change. It is this knowledge of the past—gained through study of vegetation, pollen, floods, dust, ash from forest fires, and so on—that will provide important answers to questions on climatic and environmental changes of the future.

We're looking at a defense issue—defense against humanity's activities rather than against an outside force.

But conducting this type of research is something like drawing a dot-to-dot picture without the numbers. "When you study the past, you study a spot," says Kelts. "Then you study a lot of spots and try to build an understanding of a particular region, eventually linking these regions together on a world scale. We know that certain events on one part of the globe effect climate elsewhere, so we can make certain assumptions as to what we'd expect to find in various regions."

There are really only two drawbacks to the paleoclimatic approach. The first is that the past is not an exact replica of the present. "Although the past provides significant inspiration and understanding

about our climate system," says Kelts "we still can't predict the future very well because the temperature rise projected over the next 100 years goes beyond any oscillations we have had over the last several 100,000 to one million years. This projected change due to an unparalleled level of greenhouse gas emissions is very abrupt and brings us to a new regime."

The second drawback is inadequate techniques for accurately dating core samples. "We need better dating methods to link core samples taken worldwide," says Kelts. "We are in a situation now where we have the ideas, but we lack the hard facts. If I say, for example, that the Sahara dried up 4,000 years ago, that means about then. Obviously, this is a big problem because if we want to compare regions on a world scale, we need to know the *exact* time. Otherwise, it's comparing apples and pears."

Finding the Answers

In the past, geologists' methods for dating materials were good enough. If they said, "It's 100,000 years old—give or take 15,000 years," it was actually considered a close estimation. Those days are gone, however, regarding research for global climate change. Now, being off by a few hundred years is too much.

That's why when Assistant Professor of Geology Larry Edwards discovered a new method to date coral—give or take three years—people within IT and around the world got excited. The method has to do with the radioactive decay of uranium 238 to thorium 230, which takes place over time in coral—something that has been known since the mid-1950s. What wasn't known and that which Edwards developed was a method for precisely measuring the thorium/uranium ratio. The result: precision dating.

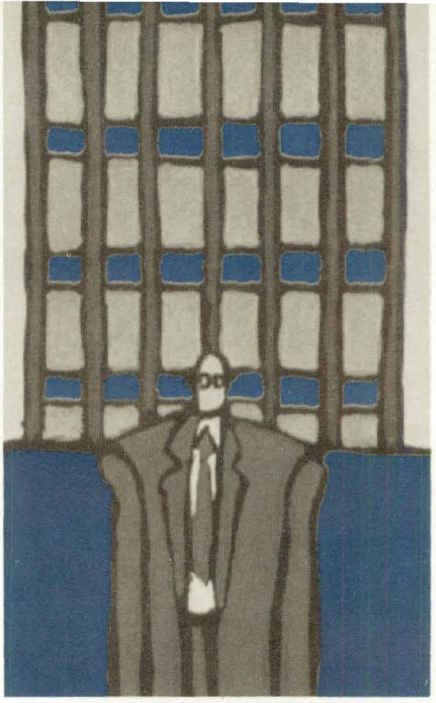
"The most important story told by coral is about the height of sea level," says Edwards. "Because certain species of coral grow very close to sea level, these fossil corals record the sea's height. Basically, there's no reason why sea level should have gone up and down over the last hundreds of thousand years other than as a result of glaciers. The water that made those glaciers ultimately came from the ocean. During glacial periods, sea level was about 130 meters lower than at present. When the glaciers melted, that water ultimately made its way back to the ocean and the ocean rose. Consequently, by being able to precisely date the coral, we can work out the precise timing of these climatic changes."

Graduate student Christina Gallup, Adjunct Professor of Geology Robert G. Johnson, and Edwards are collecting and dating fossil corals from Barbados and New Guinea in order to reconstruct sea-level history. In addition to sea levels, post-doctoral researcher Warren Beck, Associate Professor of Geology Emi Ito, and Edwards are working on a method to squeeze the history of ocean temperature out of coral.

"It appears that the strontium content of the coral skeleton is a function of temperature," Edwards says. "So by measuring the strontium content, we may have a chance to get temperatures of sea water back in time." This, coupled with precision dating should give global climate change scientists important pieces to the puzzle.

Using a set of corals obtained from a temperature recording station in Tahiti, Beck, Ito, and Edwards will analyze bits to see if the strontium content mimics the record of temperature changes recorded at the station. This has already been done at another site, and the results matched.

According to Edwards, these new measuring techniques have opened up numerous avenues to pursue in examining other materials that might contain climatic information. One such material is cave deposits, which only grow above water.



"If you started with one cave deposit and go back in time, there will be a gap—a jump in age," says Edwards. "Every jump in age is a time when sea level came up and submerged the cave, and when it went back down, the cave deposit started

What We Know—And Don't Know About Global Climate Change

The greenhouse effect is probably one of the best accepted theories in atmospheric science. Yet, very little is known about how this translates to climate. Scientists know with a reasonable amount of certitude, for example, that global temperature has risen approximately 0.5° C (1° F) during the past 100 years. Many disagree, however, about the rate at which this will continue and how other aspects of climate and ecosystems will be affected.

There is no doubt that CO_2 in the atmosphere is on the rise and that it's not the only greenhouse gas out there. Other gases include methane, nitrous oxide, freon, ozone, and water vapor, and all have risen at accelerated rates throughout this century. The current total increase of greenhouse gases is equivalent to an increase of carbon dioxide of about 50 percent in the atmosphere over the last 200 years.

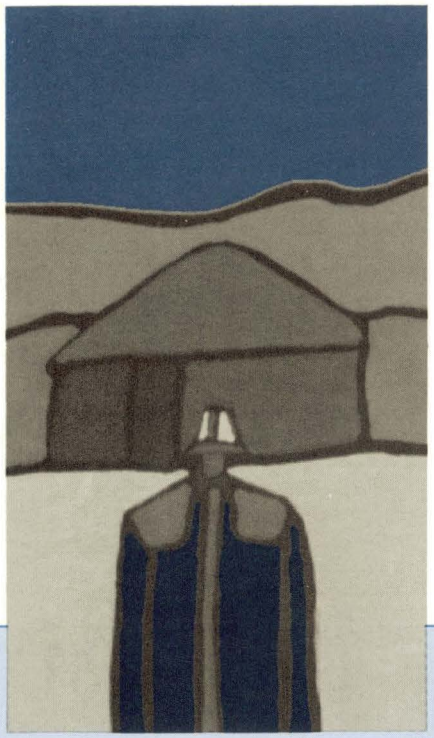
Scientists also know that over the last 100 years, sea level has risen approximately 10 centimeters, but whether this is due to human-induced climatic change is still unknown. Also unknown is how the world's oceans, which are "sinks" for CO_2,

growing again. So, it's another way in addition to the coral method to get information about past sea levels."

On another note and in another part of the world closer to home, Research Associate and Adjunct Professor of Geology and Geophysics Daniel R. Engstrom and his colleague Sherilyn Fritz, also a research associate in the department of Geology, are working on a high-resolution record of moisture conditions over the last 10,000 years in the Northern Great Plains.

This region is potentially sensitive to future climatic change for two reasons. First, computer global climate models predict that the effects of doubling of atmospheric CO_2 on the Earth's temperature will be felt most strongly in high-latitude regions and in the continental interior, so this region should feel the effects of climate change sooner and more strongly than elsewhere. Second, because it's an agricultural area that depends on marginal water supplies, a change in precipitation will have a major impact on crops and, consequently, the economy.

Engstrom and Fritz will focus on two periods of time for high-resolution work, one about 10,000 years ago when climates warmed dramatically and another starting about 500 years ago and running up to the present time when historic records indicate both cooler and warmer intervals. Their goal will be to understand how climate in this area has fluctuated in the past—particularly how moisture conditions have changed—to better predict what might happen in the future.



"It's not the temperature increase per se that is of greatest concern to policy makers, scientists, and the public at large," says Engstrom. "It's the changes in moisture and precipitation that will most strongly affect societies. The distribution of that moisture in the future is very hard to predict. Most general circulation models from which we have our sense of impending climate change do a fairly good job of tracking temperature but are very poor at predicting precipitation. The reason is that precipitation is controlled primarily by local factors rather than the broad variables that control temperature.

"Up until now," Engstrom continues, "we've really only been able to say that it was wetter in qualitative terms. If we can refine our scale, we'll be able to match the past to the kinds of questions being asked about the future. This is important because, although we can say what the past climate was on a 100-year basis, it's the annual basis that will drive farmers out of business and have the impact."

To get to the "numbers," Fritz and Engstrom work on the remains of different fossil groups in the sediments of closed-

absorb the gas and how the oceans' biosystem will react to climatic change. This is an important "unknown" because oceans control much of the world's climate.

According to Kerry R. Kelts, professor of geology and director of the Limnological Research Center at the University, we also know who's at fault. "We all are," he says. "We cut the forests in Europe and America some time ago, and now we're burning the forests in the tropical belt, all of which contribute to the rise of greenhouse gases. Per capita, the U.S. is one of the largest producers of CO_2 output and some Eastern European countries are worse."

If we're all at fault, the problem only stands to get worse because another known factor in the equation is that the population is growing—and population, not surprisingly, correlates positively to the increase in the level of methane and CO_2 in the atmosphere.

We all know that historically climate has been anything but a steady-state partner. Ice ages have come and gone, as have droughts and floods. So, isn't this projected climatic change just more of the same thing? A good question, and one to which there is not a definite answer.

"There's no way to know whether what we're experiencing right now is part of natural variation or not," says Kelts. "We don't understand the cause of decade-by-decade natural variation very clearly. Is it in fact caused by oscillations of the sun like some people believe, and, if so, why does it occur, what triggers the system, and what conditions make it stable? How will our own activities affect natural variation and what is its current trend? One theory suggests we're having trouble seeing the greenhouse effect right now because natural variation is actually moving in the direction of cooler temperatures."

Another nagging question to those trying to model future climatic change is whether or not the Earth contains self-regulating mechanisms that will naturally resolve or modify any future climatic change caused by greenhouse gases. If so, what are they, and how do they work?

"It's possible that the Earth has self-regulating mechanisms that could either eliminate warming altogether or cause a leveling out of temperatures globally," says Kelts. "On the one hand, warming may produce more clouds, and more clouds will shield the earth from radiation and produce cooler temperatures. Likewise, more CO_2 may cause more trees to grow faster, which could smooth out the effect.

"On the other hand, while the average *global* temperature change could almost be zero because of these many self-regulating mechanisms, these mechanisms may exact a very high price in terms of *regional* climate changes. What may happen eventually during this process is the gradient between the equator and the poles will be eliminated, making it as warm at the poles as it is at the equator. The Earth will be very happy, but you can imagine what this will do to society and some living things."

Herein lies another problem associated with modeling global climatic change—regionalization. Currently, climate models are so large that they reduce several hundred kilometers into a single data point. The Alps, for instance, become an invisible feature to the model, as do numerous other regions in the world that, because of their particular landscape and

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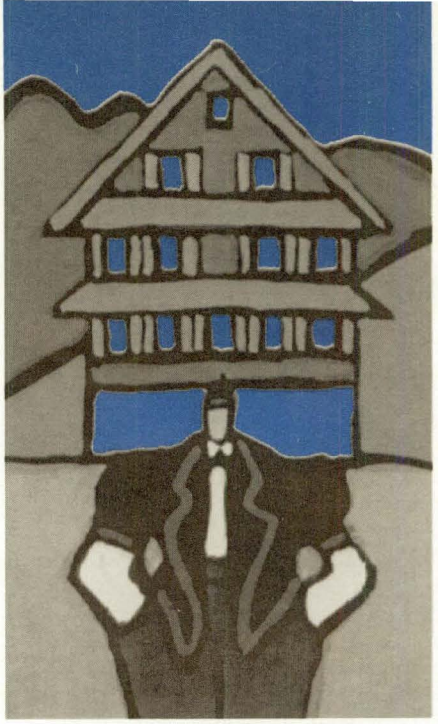
It's not the temperature increase per se that is of greatest concern . . . It's the changes in moisture and precipitation that will most strongly affect societies.

basin lakes that provide information about past fluctuations in salinity—namely, fossil diatoms (which are microscopic silica shell algae) and the carbonate shells of small crustaceans called ostra codes. Salinity is important because closed-basin lakes generally become more saline as climate becomes more arid and fresher as climate becomes wetter. Consequently, tracking the salinity of lakes over time tracks changes in climate.

"Each lake is different," says Engstrom. "You have to understand the mechanisms that connect the climate to the salinity. You can have two lakes sitting side by side, and one will be fresh and one will be highly saline. They really differ in how they're hydrologically connected to the climate system." That's the hard part. The beauty of lake sediments, however, is that they represent a time scale that can be resolved on the order of less than a decade. Then, by looking at other records, such as that from fossil pollen, it's possible to determine how vegetation responded to the change.

"This is critically important because what we might expect in the future is based largely on how we see the vegetational/climate relationship today," says Engstrom. "For instance, if we gradually warmed things up a bit, the boundaries where trees like spruce grow would shift. But what happens to forests if the change occurs very rapidly? We need independent climate proxies for past periods of rapid climate change to see how vegetation actually responded.

"This type of work is done well at an institution like Minnesota because we have expertise in a lot of different areas; we have concentrations of people working in global change, and we've had that for many years. It just so happens that it's now become a topical area of research."



What We Know

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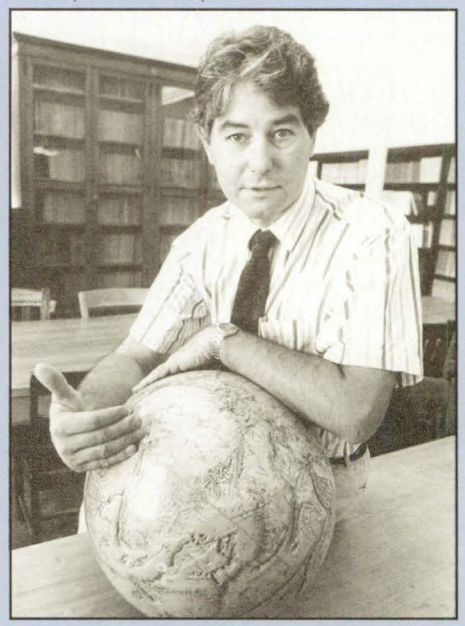
ecosystem, have a climate different from their neighbors. As a result, these regions will respond differently to future climatic changes as will their specific ecosystems.

"That's why, even though global temperatures have risen over the past 100 years, temperatures in the U.S. as a whole have actually gone down," says Kelts. "On the other hand, if you split the U.S. in half, temperatures in the Eastern portion have decreased while temperatures in the Western area have warmed at the same rate as the global system."

Right now, very little is known as to what to expect on a regional level—namely in our own back yards. In planning for the future, this information is imperative. Knowing that the globe or even a large area of the world is expected to warm 2° C by a given year won't be very helpful in terms of formulating agricultural policies, for example, if our primary agricultural areas, such as the Wheat Belt in the U.S., deviate from the global forecast because of their regional peculiarities. ■

Photo by Patrick O'Leary



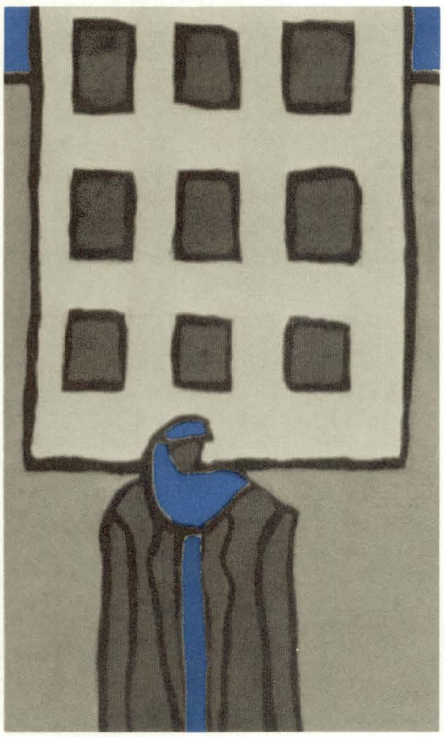
Kerry Kelts, professor of geology and director of the Limnological Research Center

Most people, when they feel pangs of guilt about the emission of greenhouse gases into the atmosphere, think about those coming directly from cars, industry, and our other human pursuits. But human emissions of greenhouse gases are small compared to the exchanges that take place in the Earth's natural carbon dioxide reservoirs.

Peatlands, for example (which are any waterlogged terrestrial ecosystem in which organic matter has accumulated to a depth of about one foot or more), are one of the largest terrestrial reservoirs for carbon. There's approximately three times the amount of carbon stored in the soil as opposed to living plants and animals, and this carbon reservoir is potentially unstable. It's maintained only because it's waterlogged or frozen. With global warming, however, the water table will fall or the frozen peatlands will melt, and carbon will be exposed to oxygen. The result is very rapid decomposition or fire that releases a catastrophic injection of CO_2 into the atmosphere, compounding an already intense problem.

Peatlands have also been identified as one of the most important sources for methane entering the atmosphere. Methane concentrations, which have been increasing at an alarming rate since measurements began 20 years ago, have about 100 times the efficiency of absorbing infrared radiation compared to CO_2—meaning, it's a much more potent greenhouse gas. In addition, certain peatlands are important emitters of dimethyl sulfide—another greenhouse gas.

Paul H. Glaser, research associate at the Limnological Research Center is trying to unearth some of the mysteries buried in the waterlogged peat that will have an impact on future climatic change. With a $1 million, three-year grant from the National Science Foundation and Department of Energy, Glaser and his colleagues are forging ahead into the mire of unanswered questions, looking specifically at two major peat basins and their status as carbon reservoirs, including the rates of accumulation of carbon and the rates of loss. The primary pathway of loss would be emissions of CO_2 and methane to the



atmosphere or into the groundwater with water flow.

At the same time, Glaser and his colleagues have linked this project with another (one that includes 24 co-principle investigators!) to look at both methane emission rates and those of other trace gases and hydrocarbons from the Red Lake peatland, while simultaneously studying the processes for methane production, oxidation, and the peat profile of transport into the surface or into the groundwater.

Glaser took advantage of the dry climate last summer to look at methane production and emissions. "The dry year last year gave us tremendous insight into how climate controls the groundwater flow system, which in turn controls peatland patterns. The interesting thing from the methane standpoint is that there was a draw-down of the water table from one to three meters at the crest of these raised bogs. The depth at which methane can be produced is restricted to the lower levels below the water table. And the methane that was being produced, if it was being emitted, could be oxidized in this very deep aerobic zone. This information is very important for predicting the effect of global warming on northern peatlands."

Like lakes, one of the beauties of peatlands is that they're an in-situ record of past vegetation. "Since the plants are so closely adjusted to water chemistry, we can interpret hydrologic changes—changes in groundwater flow systems from vegetation systems," says Glaser. "We have a hypothesis because of our work in the drought last year of how this is linked with climate. And the system may be much more sensitive to climatic change than the pollen record suggests."

Glaser's research on peatlands is not without criticism, however. In fact, he criticizes it himself. "Peatlands are inaccessible," he says. "You can't just drive in and sample them when you want. It requires a helicopter because often they're about 150 miles from the nearest road. As a result, you only go in one time of year to take your measurement, and there's no standard of comparison from year to year as to what the variability is. One of the problems with a lot of the measurements taken of methane or surface emissions is they're highly variable—seasonally and spatially—from place to place. Certain plants are very efficient pumps for pumping methane out of the peat, and other plants are less efficient."

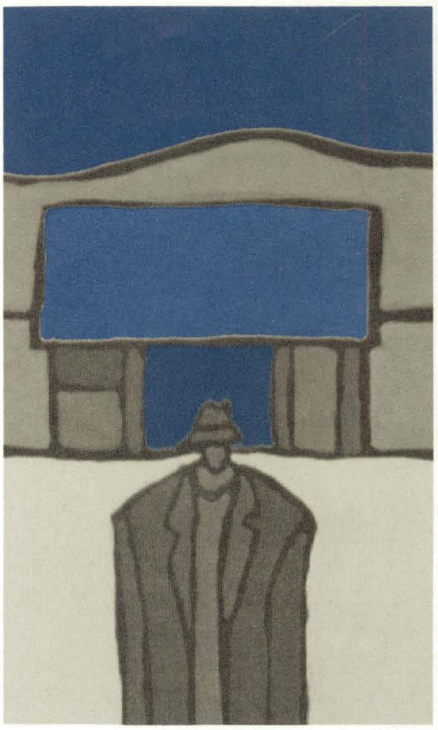
There's a reason why the media hasn't spread too much ink covering the topics of bogs and peat, coral and cave deposits, and murky sediments at the bottom of lakes in its reporting on global climate change. People are more interested in how it's going to directly affect their lives—not what's causing it.

Although there are very few physical theories as solid as the greenhouse effect, unfortunately, knowledge about how this will impact the world is uncertain because Earth system response rates are not clearly known. Will agricultural land become unsuitable for farming? Will there be more typhoons, fires, and hurricanes? What about the trees and the landscape as we know it? Speculations on these matters outnumber the questions at least five to one.

World renown ecologist and Regents' Professor Margaret B. Davis at the University is attempting to answer some of these questions—specifically, how forests and their vegetation will respond to climatic change and the relationship between climate and fires. A leader in paleoclimatic studies, her approach, like that of her colleagues, is to look to the past for the answers. She has a long career in examining vegetational response to climate, looking at changes that occurred since the end of the last glacial period—about 15,000 years ago.

Although many people predict that forest fires would become more frequent with global warming, no one really knows whether there's a connection or not. As Davis points out, it could be that the nature of the vegetation affects fire frequency as well as climate.

"Trees, for example, have various effects, she says. "The fossil records indicate that when eastern hemlock moved into certain areas, there was a sharp decrease in the frequency of fires, possibly because of changes in the local environment produced by that tree, such as lower temperatures and higher humidity in the shade of the trees. As the fire frequency went down, however, other species that were less fire-resistant became more abundant. The question is, if you removed hemlock, would fire frequency increase again? This is a very important question now—what the role is of each species and what would be the impact of their loss?



Although no one is predicting the total loss of trees, according to Davis, our landscape is likely to change with global warming. "In general, forest trees have shifted their ranges in response to changing climate," she says. "They haven't just stayed in one place and evolved new physiological characteristics so they could withstand the change. Instead, local populations go extinct, and plants move in from the south to replace them. And that's what we expect will happen in forests.

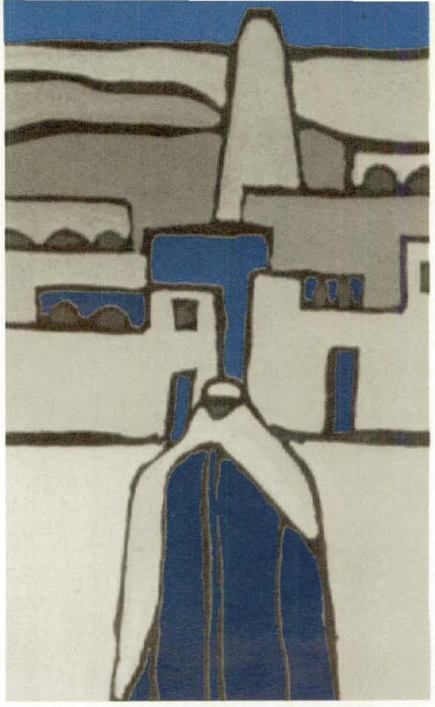
"We know from the past about how fast a forest has been able to respond to climate changes. Except for a few circumstances, however, climate changes in the past have been about one-tenth as fast as what we're predicting. What's going to happen in the next century is catastrophic in its speed, so the real problem is, can vegetation possibly move to new areas fast enough? If trees can't disperse rapidly enough to track the climate change, certain species may go extinct.

"Humans are very effective dispersal agents, however. We move a lot of weeds, trees, and plants—both on purpose and accidentally—and we're always introducing new agricultural varieties. I suspect that foresters would move trees to new localities. The question will become which variety should we plant."

The worst possible scenario according to Davis would be extreme, rapid change. "If that happens," she says, "long-lived trees that take 100 years to achieve full growth would never be able to live more than two or three decades. If a tree started its life in a spot to which it was suited, that spot would be too warm for it before it achieved the end of its life.

"We'd have to select for very short-lived, rapidly growing species that could grow under a variety of conditions. Trees like aspen and paper birch would be everywhere. They're useful species for certain things, but you'd lose the tall timber trees that have lived for centuries. It would be a pretty scrappy landscape."

Because some species of small plants that grow on the forest floor are strongly affected by the tree species in the forest canopy, Davis also projects a major change in other vegetation. "If you changed the forest canopy, you'd change the growth conditions underneath and, as



Multidisciplinary Scientists

Addressing the problem of global climate change requires a world of knowledge. "The physicists can't solve it. The agronomists can't solve it. The sociologists can't solve it," says Professor of Agriculture and Applied Economics Vernon W. Ruttan, who is currently working on the formulation of agricultural policies surrounding this issue. "Each discipline can provide knowledge, but there has to be an interdisciplinary approach—a coming together of all that knowledge—before decisions can be made about what needs to be done."

Such is the goal of two new programs at the University, one that came in the way of a $1.4 million, five-year National Science Foundation (NSF) research training grant last year for building on an already strong interdisciplinary graduate program in paleorecords of global change, and another that will take a multidisciplinary approach to teaching science to undergraduate students.

The NSF grant supports a long-standing tradition at the University for interdisciplinary training across biology, geology, and anthropology in the area of paleoenvironmental research—focusing on the paleoenvironment of the ice age. "Essentially, the grant will help us modernize our existing program on paleoenvironments and teach people new techniques—especially those being developed in the geology department—in the context of global change," says Regents' Professor of Ecology Margaret B. Davis.

The program has already accomplished numerous goals, a primary one being the exchange of ideas—not only among the students, but the faculty as well. For example, students from numerous areas meet weekly and attend seminars with faculty from a variety of disciplines.

"At some universities, it's hard to interact across departmental lines," says Davis. But, it's very much enhanced by a group like this that bridges IT, the College of Biology, and CLA. Although the faculty knew one another before, we meet now every month in a steering committee meeting to discuss the program and at weekly seminars. This increased interaction is resulting in many more collaborative projects."

The training grant also provides funds for students to attend other institutions throughout the nation to learn techniques that aren't taught at the University and vice versa. In addition, some of the funds are being used to upgrade existing research facilities and purchase equipment

a result, probably the whole forest flora," she says.

"There's a lot of concern among ecologists because many species are quite rare now, and the only place where they're growing is in reserves. It's hard to say what would happen to reserves if the climate changed rapidly because successful northward dispersal would be unlikely; generally there's another kind of habitat between the reserves, such as farm land. We would have to intervene for those species, much like we do for zoo animals, and move the whole 'garden.'"

Catastrophe or Lack of Imagination?

While newspapers continue to report sensational scenarios for our warmer future, few of the details have as yet been proven true. To date, however, one thing is perfectly clear: It will be warmer. While to many Minnesotans that may not seem too discouraging, a future of transplanting vegetation, animal life, and ourselves to survive in the changing world rings of catastrophe.

Rather than notions of doom and dispair, however, scientists at the University are approaching the problem with enthusiasm for finding answers to urgent questions that will desperately affect our future—everything from world politics and economics to our lifestyles and environment. In addition to enthusiasm, they share a more optimistic view than the media about what's to come.

"We've come an incredible distance in understanding the universe in the past 100 years," says Calvin E. Alexander, professor of geology and geophysics. "And, I see no reason to believe that we're anywhere near the end of surprises the universe holds for us.

"Half of the things in human commerce right now would have been sheer utter magic 50 years ago. If you walked up to Einstein when he was young and handed him a calculator, he wouldn't have been able to understand how it worked. I see no reason to disbelieve that 100 years from now, we'll feel the same magical surprise over the accomplishments of our third- and fourth-generation descendants—that is, if there are any." ■

Climate–Our Future?

The University of Minnesota Press will soon publish *Climate—our future?* a visually appealing book written by Ulrich Schotterer and translated by Professor of Geology Kerry Kelts, director of the University's Limnological Research Center.

This 175-page book combines substantial information about global climatic change—what it means and its potential impact—with more than 300 color illustrations by artist Peter Andermatt. The illustrations accompanying this article are from the book.

Climate—our future? which will be published in January 1992, presents scientific information in clear and easy-to-understand language, making it of interest to a wide variety of audiences. ■

for student research.

Along with funds provided by the University and NSF, for example, Assistant Professor of Geology Larry Edwards upgraded his mass spectrometer facilities to one of the best, state-of-the-art facilities in the country. Professor of Geology and Director of the Limnological Research Center Kerry R. Kelts, in turn, is in the process of building a facility for analyzing sediment cores from lakes—a type of archive if you will—where people worldwide can study the record, exchange ideas, and conduct research.

"These facilities are going to benefit everyone," says Edwards. "But the primary outcome of the program is that students are developing an interdisciplinary approach to their work and learning what other people are doing. These are connections that would never have been made—at least not until later in their careers—and it's these links that are going to make a difference in the field."

Remember when you were an undergraduate and you walked into your first introductory science course? A large lecture hall, no doubt, where you learned mathematical equations, how to name rocks, and the like. A push is on within the Institute of Technology to change all that by a team of seven faculty members that includes, in part, three Distinguished Teaching Award winners, one Regents' Professor, and one College of Education professor. Their role will be to teach four team-oriented, multidisciplinary undergraduate science courses starting fall 1992.

"The topic of global climate change is perfectly suited to these endeavors because it integrates aspects of biology, geology, astronomy, physics, and then of course, the interdisciplinary sciences like meteorology," says Rama V. Murthy, professor of geology. "In addition, people can see a connection to it in their personal lives."

The courses will introduce students to the Earth's systems—how they operate and how they're linked, how they change and what the responses are to that change, and, of course, how our own interactions impact the planet.

"Science courses are particularly frustrating for two reasons," says Murthy, First, we need to move away from the large-class, lecture approach in science and create more of a one-to-one relationship. Second, science courses are taught in a terribly discipline-bound fashion—as if the sciences were all disconnected. People don't have any extensive knowledge about how all this relates.

"Training students on the 'interconnectedness' of things, however, is a hard job because, first of all, there are no books," Murthy continues. "There are beginning geology books and beginning biology and astronomy books, but nothing that gives the perspective of how all these things interact."

Not only will Murthy and his multidisciplinary team members create those materials, they will also specially train and recruit the teaching assistants needed for their classes.

When it comes to global climate change, people agree that if tomorrow's scientists are to be properly trained to deal with the problems of the not-so-distant future, science needs to be taught as a whole rather than, as Murthy says, "lumps of information." ■

The Countdown to Zero Emission

Fueled by both economic and environmental concerns, IT professors continue breakthrough research in developing alternative energy resources.

By Maggi Aitkens

Americans understand economics. That's why, when the price of gasoline went up at their local filling stations in the late 1970s, it was relatively easy to change attitudes about the use of energy from the notion that it was "penny cheap" to one that necessitated strict conservation measures and more R&D on alternative sources. It's also why they were able to reverse that thinking once the Arab Cartel fell apart several years later and the price of gasoline went down.

The energy problem and the need to develop alternative energy sources, however, did not disappear. At the present rate of use, remaining North American reserves are about 10 years according to the British Statistical Review of World Energy. In the Middle East, 110 years remain, which translates into a dependency on Middle Eastern petroleum.

Economics aside, the energy problem has taken on new meaning because Americans have become quite good at understanding another matter that necessitates the development of alternative energy resources—that is, our environment.

Currently, 90 percent of the world's energy comes from the burning of fossil fuels—coal, oil, and natural gas—all of which emit greenhouse gases. And, the use of coal stands to increase.

"Right now, U.S. oil imports total something on the order of $100 billion a year," says Calvin E. Alexander, professor of geology and geophysics. "I don't think we can continue to do that economically. One of our obvious options is coal, given that this country has adequate supplies to last a couple of thousand years at current production levels and for several hundred years if production is increased to replace other conventional energy sources. The environmental consequences of that, however, would be disastrous in my opinion, given the carbon dioxide emissions. That means we have to look for alternatives."

During the past two decades, David B. Kittelson and Edward A. Fletcher, both professors of mechanical engineering at the University, have been doing just that through their work on improving engine performance and harvesting the sun's energy, respectively. Although both readily admit that applications of their research are not yet economically viable, neither is concerned. Whether fueled by inevitable future economics or an environmentally aware society, the end result is the same—their work will have significant bearing on our future.

Motor vehicle travel in the U.S. reached 1.9 trillion miles in 1987, an increase of 27 percent from 1977. At 20 miles per gallon, that equates to dispensing into the atmosphere the pollutants from 95 billion gallons of gasoline per year. Given this trend and the unlikelihood that the public will modify its driving habits any time soon, the race is on to find alternative, non-polluting energy to fuel motor vehicles. Thus far, albeit in small numbers, cars powered by everything from electricity to diesel and alcohol fuels have hit the streets.

According to Kittelson, who has focused his work on improving engine performance and reducing emissions primarily with respect to the use of diesel, alcohol, and natural gas fuels, we will have a mix of different types of engines and fuels in the future, with each occupying a certain niche: spark ignition and alcohol fuels for small, high-performance vehicles; natural gas (both compressed and liquified) for "short-trip" transportation industries, such as airport shuttle buses and local delivery fleets; and diesel for industries where fuel is a major operating expense.

Although diesel engines use about 30 percent less fossil fuel than spark-ignition engines—resulting in less carbon dioxide emissions—they have more than one drawback. "The down side is that they tend to be a little more expensive than a conventional spark-ignition engine," Kittelson says "and their power-to-weight ratio isn't quite as good as gasoline engines so performance suffers. Diesel engines also produce small amounts of oxide and nitrogen, which are greenhouse gases."

But that's not what has people fuming about a possible increase in the use of diesel engines as currently designed. It's the smoky, sooty "mess" they leave in their trail. Anyone who drives behind a bus for more than a block is probably all too familiar with the problem. The City of Los Angeles, for example, just spent a sizeable sum of money cleaning the blackened soot from its face caused in large part by diesel engines.

To resolve the problem, Kittelson is researching the question of how smoke is formed in diesel engines and how it can be eliminated or reduced. "We have a fair bit of evidence that suggests some of the soot coming from diesel engines is formed early in the process," says Kittelson. "It sticks on cylinder surfaces where it can't be oxidized and is later blown off and into the air. If we can support this hypothesis, combustion chambers could be redesigned

to keep primary combustion zones away from these surfaces, allowing the soot to be suspended and accessible for oxidation which would result in substantially less soot emission."

The type of combustion that takes place in a diesel engine is one in which fuel and air are mixing and burning at the same time—a process that produces smoke. "To reduce smoke formation, you need a very rapid, intimate mixing of the fuel and air," says Kittelson. "Unfortunately, increasing the speed of that mixing process also increases the formation of oxides and nitrogens. It's a balancing act. Somehow we need to find a path between the two—where you mix fast enough to reduce smoke, but not so fast that the production of oxides and nitrogens is substantially increased."

With new concerns about emission of soot, oxides, and nitrogen, there's pressure in some areas to actually outlaw diesel engines, according to Kittelson. "That could become counter productive," he says, "Although it would eliminate some local emissions, it will increase problems of global warming. In larger vehicles, I think diesel engines are going to have a place for a long time. We're just trying to ensure they maintain this niche in a way that's environmentally acceptable."

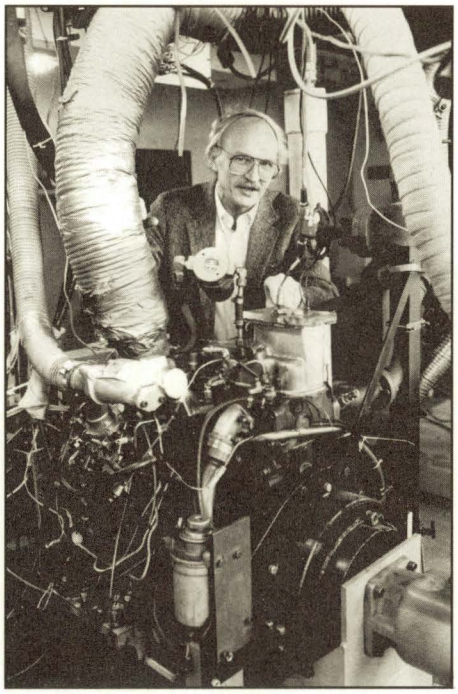
"Environmentally acceptable" means different things to different people. To many Minnesotans it simply means being able to start their cars in the winter—something they aren't able to do right now with alcohol fuels since these fuels have difficulty starting below 40° to 50° F.

Kittelson hopes to change that. Working with the Regional Transit Board, he is in the process of developing a fuel system for both ethanol- and methanol-based alcohol fuels that would start at -40° F without problems.

Minnesota farmers, in particular, are interested in his work on ethanol-based fuel since it can be made from biomass. "When you use fossil fuels, it takes more energy to make ethanol than you get out of the alcohol fuel because of various process inputs," says Kittelson. "As a result, making ethanol from biomass energy is very attractive because biomass is something you can sustain in a steady state and it doesn't contribute to the greenhouse effect."

Another alternative engine fuel Kittelson is researching for both vehicle and stationary engines is natural gas, which has a number of advantages over

Photo by Patrick O'Leary



David B. Kittleson, mechanical engineering professor, with one of the engines he uses in his research.

other conventional liquid fuels. First, natural-gas-fueled engines are easier to start in winter than liquid-fueled engines. Second, natural gas is cheaper than comparable gasoline or diesel fuel and has lower greenhouse potential than other fossil fuels because, unlike gasoline or diesel fuels, a significant quantity of energy in natural gas is associated with the hydrogen part of the molecule rather than the carbon. Third, it burns cleanly.

Kittelson's research, however, addresses one of the problems associated with natural gas—namely, that it's variable in its properties. "We're developing adaptive control systems that will control the introduction of fuel into the engine and the ignition fuel," he says. "The gas people use in their furnaces, for example, varies from day to day because it comes from different wells with different mixes. Because the properties of the gas change, you need a fairly intelligent engine controller to deal with these variations."

Natural gas also carries with it numerous other problems. Because it's a gas and can't just be poured into a gasoline tank, it has to be compressed. "If you have a natural-gas-fueled car, you have to have compressed gas cylinders instead of a normal liquid-fuel tank," says Kittelson. "The pressure in these tanks is way above atmospheric pressure, and that complicates fueling, which is not only slower, but requires expensive equipment and expensive compression stations."

Natural gas also emits methane. "Even though methane is a much worse greenhouse gas than carbon dioxide," says Kittelson, "methane emissions from natural gas don't enhance the greenhouse effect. When you analyze the entire cycle—from production to exhaust emissions—natural-gas-fueled vehicles have less greenhouse potential than gasoline-fueled vehicles by about 5 to 10 percent."

Vehicles fueled by compressed natural gas are not new. Currently, there are about 200 in the Twin Cities alone. Kittelson, however, hopes to optimize their performance. "These vehicles are relatively new, and even though they work well with a relatively simple retrofit, they could work better," he says. "We could make the engines cleaner, more powerful, more efficient, and, as a result, expand the market beyond their current niche, such as to local delivery fleets where vehicles travel short distances and return to central refueling stations."

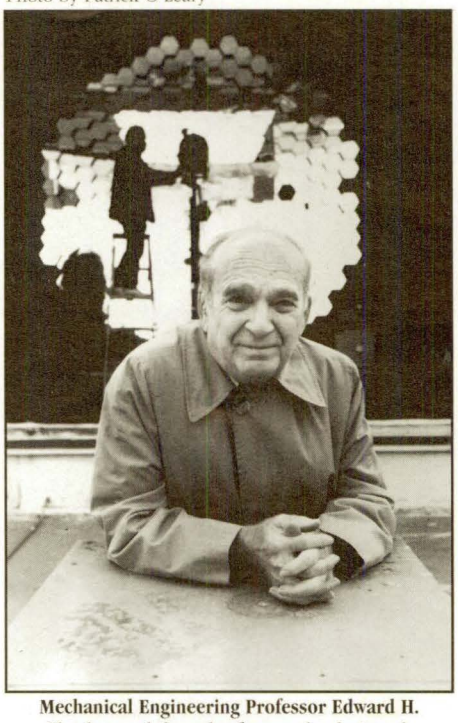
An alternative to compressed natural gas is liquid natural gas, which bypasses the above problems. Unfortunately, it has many of its own. First, to transform natural gas to liquid requires temperatures in the same range as those required for liquid nitrogen—on the order of -180° C, according to Kittelson. "This necessitates insulated fuel and storage tanks," he says. "And if you don't keep these well insulated, the liquid gradually heats up and evaporates into thin air."

Nonetheless, the use of liquid natural gas is growing quite rapidly in the U.S. and other parts of the world, particularly in industries where fuel is burned at high rates and, as a result, has little chance of warming and evaporating.

Although Kittelson clearly foresees a more environmentally conscious nation driving the country toward new and better uses of existing fuels, he offers a few words of warning to the newly initiated.

"There are a lot of traps you can get into," he says. "People call electric vehicles zero-emission vehicles, but they're not; they're displaced emission vehicles. If you have an electric vehicle, all you've done is transfer the pollution from the vehicle or a city to a power plant some place else. Likewise, some people believe that because hydrogen doesn't produce any methane or carbon dioxide, it doesn't contribute to the greenhouse effect. But you have to ask how the hydrogen is produced. If it's produce from coal, it obviously contributes to the problem. On the other hand, if it's produced from solar energy, then you know it's zero emission."

Photo by Patrick O'Leary



Mechanical Engineering Professor Edward H. Fletcher and the solar furnace he designed.

Solar energy. The idea is not new. In mythological times, the Greeks destroyed a roman fleet by issuing polished shields to their soldiers, who then superimposed the sun's reflection on the sails of their enemy's fleet, lighting them afire.

Unfortunately, when it comes to harnessing the sun's energy for modern application, solar power presents two problems: "It's a diffused and discontinuous resource," says Alexander, "which means it's spread out over the country and the sun doesn't shine all the time. If we're going to use it, we need an efficient way of gathering it and storing it because people want to be able to use energy any time of the day or season."

Toward that end, Fletcher and his colleagues designed and constructed one of the best solar furnaces at any university for the study of highly concentrated solar processes in the late 1970s on the roof of the Mechanical Engineering Building. Since that time, their work has focused on developing a non-polluting alternative energy source, decreasing carbon dioxide emissions associated with fossil fuels and biomass, and replacing energy that comes from those sources (such as in industrial processes) with solar.

"With respect to our first goal—producing non-polluting energy—in my opinion we only have two alternatives: nuclear and solar, neither of which produce carbon dioxide," says Fletcher. "Personally, I don't believe it should be nuclear, because accidents in nuclear plants are too unforgiving and are generally the result of poor human judgment rather than technological failures. Solar, on the other hand, is a thermonuclear process in which humans can't mess with the controls."

Even though the sun generates enormous amounts of natural, non-polluting energy (the amount of solar energy that reaches the surface of the U.S. is on the order of 400 times current U.S. energy consumption), current processes used to harness that energy, which use coal, result in carbon dioxide emissions.

Fletcher, on the other hand, has developed a technique for producing hydrogen and oxygen from water using solar instead of coal and is attempting to apply that technique to industrial processes that use large amounts of energy, such as in the manufacture of aluminum.

"It's a little easier to produce hydrogen and oxygen with coal and water than just straight water," says Darryl Thayer, one of Fletcher's graduate students who is conducting research on that process. "We produce about one-fourth the amount of carbon dioxide per unit of electrical energy generated compared to burning coal to generate electricity. It's not as clean as I'd like it to be, but it's better than using straight coal."

This process also lends itself to producing other potentially valuable resources. "If you react carbon—a principle component of coal—with water in a solar furnace, you produce a mixture of hydrogen and carbon monoxide gases called synthesis gas," Fletcher says. "From this, you can make methanol or any of a large number of products used in the chemical industry. In that process of making synthesis gas, you also make a product we used as much as 100 years ago to fuel gas stoves prior to natural gas becoming plentiful. Although that gas can contain carbon dioxide, you increase the energy content of the carbon by 40 percent when you change it into synthesis gas and increase the amount of electrical energy derived from that coal by 50 percent due to the storage of solar energy in the intermediate process."

Along the way, Fletcher and his colleagues have also unearthed techniques for making hydrogen and sulphur—two useful products from hydrogen sulfide using the solar furnace. "This has a promise of converting hydrogen sulfide into a very valuable resource," says Fletcher. "What's more, hydrogen sulfide is widely available and is a component of virtually all natural gas. Gas wells containing more than a few percent of hydrogen sulfide are never used—they're capped—and some of these wells contain more than 90 percent hydrogen sulfide.

"In addition, you could then use hydrogen sulfide to make ammonium sulfate fertilizer, which has the capacity to help render desert-like, alkaline soils in the world fertile."

Given his successes, Fletcher was approached some time ago by people at the Weizmann Institute in Israel who were interested in developing a laboratory to conduct similar studies. "Since then, the Israelis have built a fantastic research facility patterned very much after ours, although it's much larger and better equipped," says Fletcher, who also serves as a scientist professor at that institute.

"They developed a new process called a Heat Pipe through this facility that is intended to transport zero-emission energy from the desert regions in South Israel to the industrial areas in Galilee. It's a closed loop, and therefore doesn't emit any carbon dioxide into the atmosphere."

That process and Fletcher's work brings us several steps closer to making solar energy a viable non-polluting energy resource for the future. "I think solar has a definite future, which is attested to by the interest other countries in the world have shown in its development," says Fletcher. "Saudi Arabia, for example, which intends to maintain a substantial position in meeting the world's future energy demands (even when their oil resources have been depleted), is developing solar energy technology for that reason. European countries, many of which are not good places for solar establishments, are also developing solar because they know there will be a strong market for it in the future."

A large amount of Fletcher's energy, however, has gone into producing more energy in the form of students. "At this point, I think every major solar facility in the world has one of Dr. Fletcher's graduates working at it, including in Europe and Israel," says Thayer.

"I think that's a very important product we need to produce," says Fletcher. "Competent people. We're nowhere near producing an economically viable process, but we are producing people who will be able to carry on the work and, hopefully, become a nucleus for enhancing research, commercialization, and industrialization efforts." ■

NEW PRODUCTS

New products developed by IT alumni or companies they founded are displayed in ITEMS as space permits. To have your product considered, send a press release or product brochure along with camera-ready art work to Linda Goertzen, associate development officer, *ITEMS*, Institute of Technology, 117 Pleasant St. S.E., Minneapolis, MN 55455.

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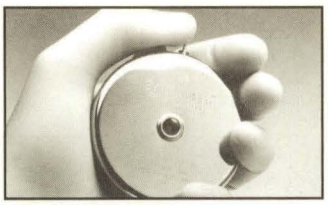

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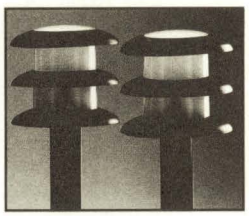

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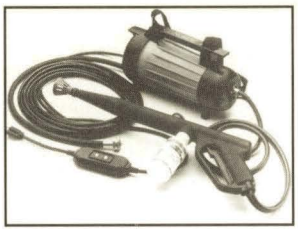

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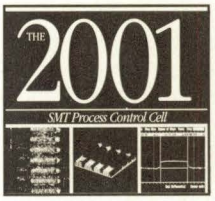

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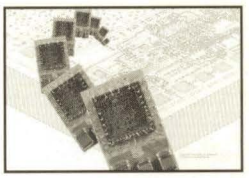

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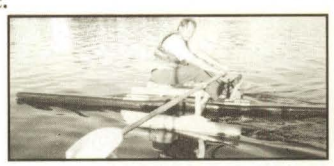

Catfish I™ Rowing Shell

The Catfish I™ rowing shell folds from a 15-foot length to 7 feet, 7 inches—small enough to store in an apartment closet—and can be reassembled in three minutes through one center-locking mechanism. The shell hull is constructed of roto-molded polyethylene while the outrigger-frame is welded aluminum tubing with precision machined parts for seat rollers and oarlocks. The Catfish I™ weighs 75 lbs. and has a carrying capacity of 280 lbs.

FACULTY

All in the (Academic) Family

Large book cases protrude into the room from almost every wall of retired Professor Edward P. Ney's (1942/Physics) office, making it feel more like a long hallway than a work area. Not unusual for a professor's office—particularly for a Regents' Professor of physics and astronomy who, through years of intensive work and resulting discovery, has amassed a long list of numerous distinctions and titles in his wake, including election to the prestigious National Academy of Science in 1971.

But, at a second glance, it's clear this man is no typical professor. Maybe it's the sporty 1965 Jaguar he drives to work during Minnesota's warmer months or, better yet, the red high-top sneakers you can't help but notice when he spins around in his chair to eagerly greet you with his warm, welcoming smile. Or, maybe it's the fact that, of all his titles, the one he treasures most is that bestowed upon him by several of his many doctoral students, who fondly refer to him as their "academic father."

"In addition to my blood family, I feel I have a second family of students throughout the world," says Ney, who believes the most important contribution one can make to the field of science is to produce outstanding Ph.D. students. "It was an honor for me to be elected to the National Academy," Ney says, "but it was even more exciting to me when Frank McDonald, one of my Ph.D. students who was then the chief scientist at NASA, was elected. He was one of only three people in the entire Space Agency ever elected to the academy." What's more, of the four people to hold the position of chief scientist thus far at NASA, two have been Ney's academic offspring.

No one can deny that Ney has done a fine job in raising his academic family. Since 1947, when he joined the University faculty, Ney has worked with 16 Ph.D. students, all of whom went on to pursue outstanding careers in their fields. One student, Bob Danielson, now deceased, was a faculty member at Princeton, and another, Phyllis Freier, set down roots at the University of Minnesota. While Robert Gehrz and John Hackwell went on to build the biggest computer-controlled infrared telescope in the world in the 1970s, another student, Leland Bohl, joined the ranks at General Electric Company to design nuclear submarines. And Nahmin Horowitz, another of Ney's students, Ney proudly says, *almost* won a Nobel prize for discovering the negative proton—if only Emilio Segre hadn't gotten into the act with a competing experiment at the time.

But if Ney's students have benefitted from his guidance, so has Ney from his students' influence. In fact, in a round-about way, his students are responsible for Ney's numerous discoveries in so many different fields—from cosmic rays to atmospheric physics to solar physics, and, finally, to infrared astronomy.

"I have certainly learned more from my students than I have taught them," says Ney. "And the reason I've changed fields so many times is because of them and the fact that science is such a competitive field." It all began when Ney was an undergraduate student. He and Al Nier spent all of one summer working 24 hours a day, working alternating 12-hour shifts, to separate the first five micrograms of uranium 235, which, according to Ney, is now the biggest threat to humanity given the American and Russian stockpiles that total 100 trillion times that much.

"I knew I couldn't compete with Al Nier," says Ney, "so after that I started working in the field of cosmic rays, where we discovered primary cosmic rays using balloons and showed that the universe is mostly hydrogen." Later on, Ney found that particles from outer space come from the universe's galactic cosmic rays as well as from solar flare events, which accelerate cosmic rays to high energies. These solar particles pose perhaps the biggest threat to human space travel because of the unpredictability of those events.

"After awhile, I realized my graduate students were getting better at this field than I was," says Ney, "so I decided I had better move on once again. That's when I went into atmospheric physics." But, alas, the same thing happened. "The four Ph.D. students I worked with at the time got better than I was," Ney says with a modest laugh, "so I went into solar physics and worked with the astronauts in Mercury and Gemini."

Photo by Patrick O'Leary

Ed Ney (1942/Physics), retired Regents' Professor of physics and astronomy

As one could guess, there, too, Ney felt his graduate students surpassing him in the field and, consequently, decided to move on to new horizons—this time, infrared astronomy. The question he tackled was, if hydrogen and helium are so prevalent in cosmos, then where did the Earth come from? Here, he and Nick Woolf discovered that large stars have earth-like silicate shells surrounding them, and that these stars blew off molecules containing the silicate materials. These materials gave birth to our planet.

Given his numerous discoveries, it's perhaps not surprising that, for Ney, the biggest thrill possible in science is when you make a discovery and feel quite certain that you're among the first people to see through the mystery. According to Ney, that generally demands a lot of brainstorming and constructive interaction with other people. "When you have several people who work together constructively with different backgrounds, you get more than the sum of the parts," he says. "And that's what I liked best about working with my students—because of that interaction, we were able to produce more than any of us would have done alone."

Ney admits he misses teaching since retiring last fall. Except for that, and the fact that "every day feels a little like Sunday," he says, little has changed in his life. He's still poring over research notes in his crowded office—this time on the natural radioactivity of the earth and data he has compiled on comets. And, he's still sporting clothing that appropriately reflects his colorful character and dynamic career—this time, a sweater of large bright yellow, green, and blue checks scattered randomly on a background of brilliant magenta. I

Aerospace
Professor ***Richard James*** was given the 1990-91 George Taylor/IT Alumni Society Research Award. ***Professor Daniel D. Joseph*** has been named to the Russell J. Penrose Professorship in Aerospace Engineering and Mechanics. Joseph, who was named to the National Academy of Sciences this year, also received the G.I. Taylor Medal from the Society of Engineering Science for his work in fluid mechanics.

Chemical
Regents' Professor ***Rutherford Aris*** received the Damköhler Medal from the Deutsche Vereinigung für Chemie und Verfahrenstechnik at the 4th World Congress of Chemical Engineers. ***C. Barry Carter*** joined the department as the 3M Heltzer Professor in August. Professor ***Jeffrey J. Derby*** received the McKnight-Land Grant Professorship in February 1991. Assistant Professor ***Alon V. McCormick*** received the Distinguished Teaching Award for spring 1991 from the IT Student Board. Professor ***L.E. (Skip) Scriven*** was the 1991 Eugenie Ulmer Lamothe Lecturer in the Department of Chemical Engineering at McGill University in Montreal, Quebec. Assistant Professor ***Robert T. Tranquillo*** received the National Institute of Health's FIRST Award—a five-year, $495,000 research grant.

Chemistry
Professor ***Wayne Gladfelter*** was named Best Chemistry Professor by the IT Student Board in June. Professor ***Wayland Noland*** received a three-year grant from the National Science Foundation to provide research opportunities for undergraduate chemistry students. Assistant Professor ***Scott Rychnovsky*** was named a 1991 Presidential Young Investigator. Rychnovsky also received an unrestricted research grant from Eli Lilly & Company of Indianapolis, Ind. Assistant Professor ***Jeffrey T. Roberts*** was awarded a McKnight-Land Grant Professorship in January.

Civil and Mineral Engineering
Assistant Professor ***Randal Barnes*** received the SME Robert Peele Memorial Award for his paper, "A Geostatistical Approach to Operational Sample Design for Ore/Waste Selection in Surface Gold Mining." Professor ***Patrick Brezonik*** has been appointed to a National Research Council committee to review the U.S. Environmental Protection Agency's (EPA) new initiative, the Environmental Monitoring and Assessment Program. His paper, "Climatically Induced Rapid Acidification of a Software Seepage Lake," accepted by the journal *Nature*, was selected by the EPA's Quarterly Incentive Awards as the Best Journal Article. Professor ***Steven Eisenreich*** and a group of researchers at Michigan State University received a $460,354 grant to develop a model for studying 14 critical air pollutants contaminating the Great Lakes. ***Charles Fairhurst***, Pfleider Professor of Mining Engineering and Rock Mechanics, has been elected to the National Academy of Engineering. Associate Professor ***Efi Foufoula-Georgiou*** received a faculty summer research fellowship for $4,500 and a $9,091 Graduate School grant-in-aid for research in modeling pollutant transport in groundwater. ***Theodore V. Galambos***, James L. Record Professor of Civil Engineering, has been named an honorary member of ASCE for his contributions to the field of structural engineering. Associate Professor ***John Gulliver*** received the 1990 Rickey Award from the Energy Division of the American Society of Civil Engineers. Gulliver is also co-editor of *Hydropower Engineering Handbook*, a new publication produced by McGraw-Hill. ***Kenneth J. Reid***, professor and director of the Mineral Resources Research Center (MRRC), received the Partnership Minnesota 1991 Cooperative Public Service Award from the board of directors of Partnership Minnesota. Reid also accepted a certificate of commendation from Minnesota Governor Arne Carlson honoring MRRC for cooperative research in critical and strategic minerals. Professor **Michael Semmens** has been granted a patent for a method of removing organic volatile and semi-volatile contaminants from an aqueous solution. Associate Professor ***Karl Smith*** received the ASCE Merl K. Miller Award for 1990 for his paper titled, "Personal Computers and Modeling in Engineering Education." Professor ***Charles C.S. Song*** of the St. Anthony Falls Hydraulic Laboratory served as a United Nation's consultant to the Central Water and Power Research Station of the Government of India from December 9, 1990 to January 6, 1991 to help establish the Mathematical Modeling Center in Pune, India. Associate Professor and Director of the Underground Space Center ***Raymond L. Sterling*** has been appointed to the National Research Council's Committee on Infrastructure for 1992.

Computer Science
Professor ***Linda Petzold*** received the Wilkinson Prize for Numerical Software from Argonne National Laboratory/National Physical Laboratory/Numerical Algorithms Group. ***Ahmed Sameh*** has been named professor and head of the computer science department as well as holder of the William Norris Chair in Computer Science. He had been a professor of computer science at the University of Illinois, as well as associate director of that university's Center for Supercomputing Research and Development. Professor ***James Slagle*** was named a fellow of the American Association for the Advancement of Science.

Earth Sciences
Professor ***E. Calvin Alexander, Jr.***, received the George Taylor Award for Teaching from the IT Alumni Society. Alexander was also selected as Best Professor in Geology and Geophysics by the IT Student Board. ***G. B. Morey***, professor of geology and geophysics and associate director of the Minnesota Geological Survey, was appointed by the Geological Society of America to a three-year term as one of three representatives to the North American Commission on Stratigraphic Nomenclature. Professor ***William E. Seyfried*** has received funding from the National Science Foundation to help the department acquire an inductively coupled plasma mass spectrometer. ***Joseph Shapiro***, professor of geology and geophysics and associate director of the Limnological Research Center, received an award for Technical Excellence in Research on Lake Restoration, Protection, and Management from the North American Lake Management Society. ***Christian Teyssier*** was promoted to associate professor with tenure and is spending the 1991-92 academic year at the Centre de Recherche Geologique et Geophysique at the Université de Montpellier, France, as part of his McKnight-Land Grant Professorship. Professor ***David A. Yuen*** received a Fullbright fellowship which he will use in Germany in 1992. Professor ***Tibor Zoltai*** is being honored by an article in the next issue of *Acta Crystallographica (B)* for the 30 years of existence of his "sharing coefficient" in crystal structures with tetrahedral coordination.

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ALUMNI

Patient Persistence

Photo by Patrick O'Leary

Richard G. Gray, 1940/Geology

It's almost impossible to look at the career of a man like Richard Gray without wondering, "How *does* he do it?" His accomplishments are such that one might think they were the work of a dozen men.

After graduating from IT in 1940 with his bachelor's degree in geology, Gray worked for his family's oil refinery business, then joined the service during World War II.

In 1948, Gray founded Zero-Max Industries, Inc.—a company that manufactures mechanical and electronic variable-speed drives, tachometers, and office furniture and systems—and served as chair of the board until the company was sold in 1979. In 1968, he became a board member of IDS Mutual Fund Group from which he retired in 1982 as CEO. He continues to serve as a director and member of several of the company's committees, however, and is a partner and/or shareholder in several other Minnesota companies.

Along with his work in the private sector, Gray has devoted much of his time to non-profit work. He founded the Freshwater Foundation in 1968, a non-profit organization that supports freshwater environmental research and, in 1976, donated the foundation's $5 million research facility—the Freshwater Biological Institute—to the University of Minnesota. He serves on the boards of numerous non-profit organizations, including the Freshwater Foundation, the Wolf Ridge Environmental Learning Center in Finland, Minn., the North Star Foundation, and the Ridgeview Foundation.

In his spare time, Gray has written numerous articles for magazines, and for 23 years wrote a weekly column published in various magazines and newspapers. Two anthologies of his columns were published: *Pass-Words for All Seasons* and *Open Season.* His many honors and awards include the Rotary Club of Minneapolis Service-Above-Self Award and the University of Minnesota Outstanding Achievement Award.

> *One of our greatest challenges today is toxic chemicals. We invented them, and we don't know where to put them.*

What's his secret? "I thrive under pressure," Gray says. "I just love it." But he's also quick to turn the spotlight away from himself.

"Everything in my business and professional career taught me that you're successful only because of the people around you and your society," he says. "That's why I try to pay society back for making it possible for me to have the kind of life I've had. And that's why I would never leave Minnesota. Minnesota made me."

The effort that went into getting Zero-Max started also sheds light on the secrets of Gray's success.

"Starting a business from scratch is a tough deal," he says. "For the first 20 years or so, I really kept my nose to the grindstone. The inventor of the device we manufactured was really unpredictable. Many a time I stopped at his house early, got his kids up, fed them breakfast, and got them off to school so that I could get him to the office to do some design work."

And yet Gray says people like the inventor and many other employees are those who made his success possible. Which is why, once the company was on solid footing in the late 1960s, he turned his energy to helping others. "It's my belief that a person can never do enough to pay back those who made his or her life possible."

In addition to fund raising and serving on the boards of non-profit corporations, Gray gives numerous speeches and presentations, sharing the abundance of knowledge he has accumulated thus far at age 73. "I know about a lot of things, but I don't know much about anything," he says modestly.

The popularity of his writing and speaking engagements suggests otherwise, however, and many of his insights into contemporary life are well worth sharing.

- On education: "I don't care if you want to be a lawyer, a doctor, or work for Greenpeace," he says. "The very first, fundamental goal of education is to broaden yourself. Get a good liberal base and go from there.

"Our greatest challenge is to educate our children. When you see this marvelous sponge that is a young kid's brain, it's just a crime we're not saturating that sponge at the right time. We don't challenge them enough."

- On the environment: "One of our greatest challenges today is toxic chemicals. We invented them, and we don't know where to put them. Even if we find a place, they don't degrade. We end up with contaminated groundwater, reservoirs, polluted air, acid rain, and global warming because of man's misuse of the environment. The main underlying cause is overpopulation."
- On technology: "The upside is, we have wonderful science today, wonderful equipment. The tools we have to work on our problems are much better. We must continue to provide very precise scientific education."
- On the future: "If I die tomorrow, I'll die with the realization that there is a generation of kids coming up that care. They realize we have to care for our environment, that we do need birth control. Today's graduates were in grade school when the environmental movement started. Their ingrained attitude is much different from that of my generation.

"There are two slogans by which I operate. One is, 'You can't take it with you, but if you could, it would only burn,'" he says jokingly. "And the other is, 'Never underestimate the power of patient persistence.' I tell people to imagine a sturdy steel girder—rigid and strong. Just put your finger on it. If you hold it there long enough, it's going to bend. You may not realize it, but it does.

"Don't get discouraged. Don't get excited. Just have patient persistence." I

1924

Harold W. Dahl *(Electrical)* retired in 1966 and is living in Minneapolis, Minn.

1925

August L. Untinen *(Electrical)* retired in 1968 from his position as a toll transmission engineer/ toll plant extension engineer for Northwestern Bell Telephone Co. and is living in Minneapolis, Minn.

1927

Elmer W. Carlson *(Civil)* retired in 1991 from Carlson Bros, Inc., a road surfacing company he founded in 1944 in Springfield, Minn., where Carlson currently resides.

1931

Ray E. Kullberg *(Mechanical)* retired in 1986 and is living in Edina, Minn. Kullberg had been president of Kullberg Manufacturing Company, a millwork firm founded by his grandfather in 1894. **Gary L. Nereson** *(Electrical)* is president and founder of Judd Supply Company, a wholesale/ distributor located in Coon Rapids, Minn. Nereson, who currently resides in Andover, Minn., is a member of the National Association of Electrical Distributors and has served for six years as area chair. **Robert E. Rice** *(Electrical)* is retired and living in Crystal, Minn.

1932

Lincoln R. Page *(Geology, M.A., 1937 Ph.D.)* retired in 1973 and is living in Melvin Village, N.H. Page received the U.S. Department of Interior Distinguished Service Award and the Geological Survey of Finland 100-Year Geological Survey Award. He wrote numerous *U.S. Geological Survey Bulletins* and professional papers on mineral resources.

1933

Kenneth B. Goldblum *(Chemical, 1935 M.S., 1939 Ph.D.)* retired in 1972 and is living in Pittsfield, Mass. He was an engineer in plastics research and development for General Electric Co. Goldblum holds 11 patents assigned to General Electric and was a member of the American Chemical Society, the American Association of Chemical Engineers, and Sigma Xi. **Albert E. Olson** *(Electrical)* retired in 1976 and is living in Carol Stream, Ill. **William T. Pettijohn** *(Geology)* retired in 1982 and lives in Tucson, Ariz. He was an exploration geologist for Rhodesian Selection Trust Ltd. in London, England, and is a retired director of Hecla Mining Co. He was a member of AIME and the Mining and Metallurgical Society of America. He also received the Gold Medal from the Institution of Mining and Metallurgy in London.

1934

Courtland W. Agre *(Chemical; 1937 Chemistry, Ph.D.)* retired from E.I. du Pont de Nemours and is living in Maplewood, Minn. Agre received the Minnesota Chemist Award in 1964. **John A. Anthes** *(Chemical, 1939 Ph.D.)* retired in 1978 and is living in Arapahoe, N.C. He holds several patents. **Maurice W. Stacey** *(Civil, 1947 M.S.)* retired in 1973 as a superintendent at Standard Oil Co. in Chicago, Ill. Stacey, who currently resides in Valparaiso, Ind., is a retired major (infantry) of the U.S. Army. He is the holder of five patents and was awarded a Silver Star and a Purple Heart during his military career.

1937

Richard M. Billings *(Chemistry)* retired in 1977 and is living in Neenah, Wis. He was the director of Environmental Control Corporate Enterprises in Neenah. He was also a member of the AIChE and served on the Wisconsin Advisory Council (Air Pollution), the Fox Valley Water Quality Commission, the Great Lakes Illinois River Basin Project, the National Council for Air and Stream Improvement, and the Wisconsin Committee on Air Pollution. He is the author of several professional papers and a chapter in a McGraw-Hill manual on industrial pollution. **Duncan McConnell** *(Minerals, Ph.D.)* retired in 1976. McConnell, who earned his bachelor's degree in chemistry from Washington and Lee University in 1931 and his master's degree in geology from Cornell University in 1932, was professor emeritus of geological science at Ohio State University. He is a life fellow of the Mineralogical Society of America and a senior fellow of the Society of Economic Geologists. He was a member of the Mineralogical Society (London), Sigma Xi, and the American Concrete Institute. He is also the author of approximately 150 professional publications, including a book and articles in the *Encyclopedia Britannica*.

1938

Carl Roger Freberg *(Mechanical, 1940 M.S.)* is professor emeritus of mechanical engineering at the University of Southern California in Los Angeles, Calif., where he currently resides. Freberg received a Ph.D. degree in mechanical engineering in 1943 from Purdue University. He is currently a life fellow of ASME and is listed in *Who's Who in America*. He is author of a book titled *Elements of Mechanical Vibration*. **Howard E. Turner** *(Chemical, 1940 M.S.)* retired in 1981 and is living in Wilmington, Del. He had been manager of chemical engineering for E. I. du Pont de Nemours & Co.

1939

Hugh J. Leach *(Mining)* retired in 1980 and is living in Chagrin Falls, Ohio. He had worked for U.S. Steel and Cleveland Cliffs Iron Co. where he was vice president of research and development.

1940

Vincent D. Gibney *(Mechanical)* retired in 1982 from Bendix Corp. He lives in South Bend, Inc. **Daniel J. Greenwalds** *(Mechanical)* works for Advantel Inc. in Eden Prairie, Minn. He is a member of the American Society of Mechanical Engineers. **Harold E. Hicks** *(Chemical)* retired in 1980 and is living in St. Simons Island, Ga. **John A. King** *(Chemistry, M.S., 1942 Ph.D.)* retired in 1986 and is living in Princeton, N.J. King published about 50 technical papers in refereed journals and holds about a dozen U.S. patents as well as several foreign patents. **Willard W. Parker** *(Aerospace)* retired in 1990 and is living in Laguna Niguel, Calif. For 27 years, Parker was manager of the Southern California office of Simpson Electric Co.--a manufacturer of electrical and electronic instrumentation.

1941

Allen R. Crawford *(Chemical)* retired in 1978 and is living in Loveland, Colo.

1942

Barton C. Brown *(Metals)* retired from the U.S. Air Force as a lieutenant colonel in 1969. He currently operates an income tax service in Albuquerque, N.M. Brown received the Army Air Corps medal for his service in World War II and the Minute Man Award from ROA. He flew 24 combat missions as a navigator. **Donald A. Dahlstrom** *(Chemical)* is a professor of chemical engineering and metallurgical engineering at the University of Utah. He earned his Ph.D. degree in chemical engineering from Northwestern University in 1949. He is a member of numerous professional societies, including the American Institute of Chemical Engineers, the American Institute of Mechanical Engineers, and the National Academy of Engineering. He is the author of more than 100 technical papers and editor of sections in five engineering handbooks. **Edward F. Levy** *(Chemistry)* retired in 1987 and is living in Somerset, N.J. Levy earned his Ph.D. degree in 1946 from the University of California, Los Angeles. **Peter R. McGowan** *(Aerospace)* retired in 1981 and is living in Long Beach, Calif. He was a senior staff engineer in contract research and development for Douglas Aircraft Co. He earned his master's degree in aeronautical and astronautical engineering from the University of Southern California in 1942. He is a member of the Institute of Aeronautical Sciences and has been an active supporter of the Long Beach Memorial Medical Center and the Lakewood Meals on Wheels Program. McGowan is the author of several technical papers.

1943

Robert F. Acker *(Chemical)* retired in 1987 and is living in Salem, S.C. He was a research associate for USG Corporation. **Edwin S. Dygert** *(Mechanical)* is the founder of E. S. Dygert Co., an industrial distributing company in Minneapolis, Minn., and Dygert-Peck Co. in Cedar Rapids, Iowa. Dygert, who lives in Madeira Beach, Fla., retired in 1987. He holds two patents. **Robert W. Haack** *(Chemical)* retired in 1982 and is living in Clinton, Iowa. Haack served as manager and technical coordinator of planning for Clinton Corn Processing Division of Nabisco Brands (now RJR Nabisco). **Harold L. Hildestad** *(Mechanical)* retired in 1983 and is living in Swarthmore, Pa. Hildestad, who worked for Westinghouse Electric Corp. for 40 years, holds four patents on jet engines. **Charles R. Molenaar** *(Electrical/Mechanical)* retired in 1982 as a product planner/sales engineer, manager of electronic design application engineer, for

The Curious CEO

John Kelberer
1950/EE

Editor's note: *John Kelberer died on June 26, 1991, several weeks after he was interviewed for this article.*

Curiosity serves a CEO well. At least it did for John Kelberer, former chair and CEO of Aramco, the world's largest producer of oil. His insatiable curiosity not only gained him the respect of his colleagues but also may have saved their lives.

"I was flying out to supervise the repair of a leaking section of pipeline," Kelberer says. "With my education as an electrical engineer, I was more or less considered a 'relay man,' but on the way out, I studied a schematic of the pipeline, including the hydraulics and jotted down some figures."

When Kelberer arrived at the site, the welders had already begun work on the pipe. With his figures in hand, Kelberer quickly checked the pressure in the pipeline and discovered that the oil flow had fallen to unsafe levels for welding—an incident that can cause explosion or fire. His curiosity paid off. Kelberer immediately ordered a halt to the welding.

"Ten minutes later, I received a desperate phone call from the superintendent at the pump station telling me to stop the welders," Kelberer says.

But curiosity alone didn't carry Kelberer to the top of his profession. The attributes that Kelberer believes served him best over the years are:

- concern for people;
- a solid, broadly based technical background;
- a sense of humor (which is essential when working for a company that employs more than 100 nationalities living in austere environments, Kelberer says); and
- a strong work ethic.

These attributes carried Kelberer a long way from his small town roots. Born in Rochester, Minn., he developed an early interest in radios. By the time he was a junior in high school, he had not only learned to repair radios and teletype machines, he had earned a first-class radio operator's license and served as chief engineer for a Winona radio station.

When World War II broke out, Kelberer attended radio school in Chicago and then enlisted in the service where he taught math, radio, and electronics courses to servicemen and repaired the electronic equipment on aircraft carriers.

Following the war, Kelberer enrolled at the University of Minnesota to study electrical engineering. The solid background and confidence Kelberer acquired at IT prepared him well enough that, in one of his first jobs out of school with Tapco in 1950, he redesigned the control system developed by RCA for the Trans Arabian Pipeline. (Kelberer heard about the job opening from Electrical Engineering Professor William G. Shepherd, 1933/EE.) The pipeline, which was to cross Saudi Arabia, Jordan, Syria, and Lebanon, was the largest pipeline ever built, and Kelberer's role was to supervise communications on the project.

> *U.S. energy policy should focus more on the development of alternative sources of energy, such as solar energy collected in space and beamed to earth through microwaves.*

While working on the project, Kelberer began hiring Bedouin nomads and helped set up schools to offer training and teach English, beginning what was to develop into a long tradition of Aramco's dedication to training and educating nationals and their families. The current president of Aramco, Ali Naimi, went through this training program as a child.

Kelberer climbed quickly through the ranks in the oil industry. In 1956, he became chief engineer of Tapco, and in 1959, was promoted to general manager. Then, in 1973, he became chief of the U.S. liaison for Aramco. He continued his

General Electric Industrial Products. He currently lives in Saginaw, Mich., and is chapter chair of the American Welding Society, IEEE. He is the holder of one patent. **Lester J. Rose** *(Aerospace)* retired in 1989 and is living in Newport News, Va. He worked for Glenn L. Martin Co. (now Martin-Marietta) and also as an aerospace consultant. He has a patent pending on a variable vision visor. **William M. Staudenmaier** *(Chemical)* retired in 1981 and is living in Henersonville, N.C. He was a senior engineer for E. I. du Pont in Brevard, N.C.

1944

Lee M. Berlin *(Chemical)* recently became chair of Lectec Corporation, a medical/mechanical products company in Minnetonka, Minn. In 1989, Berlin received the Medical Alley Award for International Service. He also received the 1990 World Trader of the Year Award. **Harry J. Foehringer** *(Mechanical, 1947 M.S.)* retired in 1987 as director of manufacturing for TRW, Inc. He is founder and president of Management Engineering Services, Inc., an industrial manufacturing engineering consulting firm. Foehringer, who lives in Solon, Ohio, entered semi-retirement in 1987. He is a member of the Society of Manufacturing Engineers and the Institute of Industrial Engineers. He is a registered professional engineer in Ohio, and a certified manufacturing engineer. **Jerome R. Giantvalley** *(Electrical)* retired in 1991 and is currently living in San Diego, Calif. In 1974, he founded Giantvalley Pro-Quip, a manufacturing company of playground equipment. He is the former chair and a current board member of the Peninsula Family YMCA and a senior member of IEEE, San Diego Section. He received the IEEE Region VI Community Service Award in 1974, the General Dynamics Convair-Division EXCEL Award in 1984 for his advance program design efforts, and the General Dynamics Convair-Division Community Service Award in 1989. He was also awarded the Military Order of World Wars Patrick Henry Award in 1990. **Raymond L. Grismer, Jr.** *(Mechanical)* retired in 1989 and is living in Cincinnati, Ohio. Grismer was a manager in airline sales for General Electric Aircraft Engines in Cincinnati. **William J. Kurzeka** *(Mechanical)* retired in 1986 and is living in Fallbrook, Calif. He worked as both a mechanical and nuclear engineer. Kurzeka was awarded the Certificate of Merit by the Nuclear Engineering Division of the American Society of Mechanical Engineers. **William W. McGuire** *(Electrical)* is retired and lives in Glenview, Ill. He was chief engineer for Sheaffer and Roland, Inc. in Wheaton, Ill., and currently serves as a director for that company. **Ray E. Monahan** *(Aerospace; 1948 Math, B.S.)* is founder of and a consultant with R. E. Monahan Associates, a consulting firm he founded in 1982 in Edina, Minn. Monahan, who retired from Control Data Corporation in 1985, is a member and previous president of the International Federation for Application of Standards (IFAS) and a member and past president of Standards Engineering Society (SES). He is the author of numerous technical papers and the recipient of the Leo B. Moore Award, the highest

climb, finally reaching the top in 1978 when he was named chair and CEO of Aramco, a position he held until 1988.

During his years in the Middle East, Kelberer saw Saudi Arabia change from an under-developed country to a developing and educated country. Kelberer's assistance in that change included managing the consolidation of all electrical utilities in Saudi Arabia, a monumental task that required close interaction with Crown Prince Fahd as well as negotiations with several small Saudi electrical utilities. Kelberer persuaded 28 cooperatives to switch their systems to 60 cycles and join the grid. The new system, which was efficient and economical, opened the door for thousands of Saudis who previously couldn't afford electricity.

Kelberer also had a hand in developing Aramco's Local Industrial Development Department, through which Saudi businesses sell products and services to Aramco. These businesses run the gamut from chicken and vegetable farms, to bakeries and glass factories.

During his long career in the energy industry, Kelberer developed a keen understanding of the problems confronting the U.S. today, both in terms of the environment and energy policy. To help resolve some of the environmental problems, Kelberer recommends a U.S. energy policy that includes:

- more emphasis on conservation, particularly with regard to automobiles, and a higher tax on gasoline to force that conservation;
- more focus on the development of alternative sources of energy, such as solar energy collected in space and beamed to earth through microwaves; and
- more atomic energy, using smaller, standardized, and safer nuclear plants modeled after those developed in France.

Nonetheless, the greatest problem facing America today is to remain competitive in the world market, according to Kelberer, who received the University of Minnesota Outstanding Achievement Award. A sinking work ethic is the problem behind the problem, he says, but if we can regain that ethic, the possibilities are unlimited.

"We are still the largest market in the world and the most technologically advanced nation," Kelberer says. "The opportunity for America is there." ■

honor awarded by SES. He was also awarded the Georges Garel Award, the highest award presented by IFAS.

1945

M. Edward Carlson *(Electrical; 1957 B.B.A)* is president of Carlson Associates International, Inc., a company he founded in 1987 that provides consulting on high-tech marketing. The company is located in Bethesda, Md., where Carlson resides. Carlson is president of Eta Kappa Nu Hkn at the University and has published a technical paper. **Richard C. Drayer** *(Electrical)* retired in 1986 and is living in Bloomington, Minn. He was an engineering manager for Control Data Corp. in Minneapolis, Minn.

1946

Charles A. Amann *(Aerospace/Mechanical; 1948 Mechanical, M.S.)* is a research fellow and director of the Engineering Research Council for General Motors Research Laboratories in Warren, Mich. Amann, who lives in Bloomfield Hills, Mich., has received numerous awards, including the Clayton Prize, Colwell Award and the Woodbury Award. He was elected to the National Academy of Engineering in 1989. Amann holds 18 patents and has written more than 50 technical papers. **Walter D. Beisner** *(Chemical)* retired in 1985 and is living in Baton Rouge, La. Beisner worked for Exxon Company, USA, and received a corporate award for his work in bacalli infestation of stretford solutions used in sulfur recovery, identification, and treatment. **John C. Heising** *(Electrical)* is a senior engineering specialist at General Dynamics in San Diego, Calif., where Heising currently resides. Heising received his bachelor's degree in 1947 from MIT.

1947

Curtis W. Fritze *(Electrical)* is president and founder of Curtis, Inc. in Roseville, Minn. Fritze, who lives in North Oaks, Minn., is on the board of directors of Presbyterian Homes of Minnesota and is an honorary member of the board of trustees of the Science Museum of Minnesota. He is the holder of six patents. **Albert C. Holler** *(Chemistry)* retired in 1985 and is living in Minneapolis, Minn.

1948

Frank Akutowicz *(Mechanical, M.S.)* retired in 1974 and is living in Wilmington, Del. **Rolland B. Arndt** *(Electrical)* retired in 1986 and is living in Lakeland, Minn. He was a manager and professional engineer for Unisys and a member of the Institute of Electrical and Electronics Engineers, serving as vice president of that organization's IEEE Computer Society. He also is the recipient of the IEEE Centennial Medal and IEEE Computer Society Special Award. Arndt holds one patent. **Douglas W. Barr** *(Civil, 1949 M.S.)* retired in 1990 and is living in Minneapolis, Minn. He was the founder of Barr Engineering Co., a Minneapolis firm that employs approximately 50 people, and worked as a consulting hydraulic engineer. He was named Engineer of the Year in 1989 by the Minneapolis Society of Professional Engineers. **Donald C. Burkness** *(Mechanical)* retired in 1988 from government where he worked as a mechanical engineer/electrical engineer/management. In 1969, Burkness founded Micro-Design, Inc., which performs CAB design of LSI systems. The company was purchased by American Micro-Systems in 1971. Burness, who resides in Edgewater, Md., holds four patents. **Warren P. Burrell** *(Electrical)* lives in Edina, Minn., and is a principal engineer in communications for the State of Minnesota. He is a member of the Institute of Electrical and Electronics Engineers and holds several patents. **Neil M. Clark** *(Mechanical)* is president and founder of Techpower, Inc., a technical services firm located in Edina, Minn. Clark, who resides in St. Louis Park, Minn., is president of the Minnesota Technical Services Association. He holds four patents with one pending. **Kenneth F. Dowell** *(Mechanical; 1965 M.B.A.)* is semi-retired and lives in Bloomington, Minn. He is the founder of Dowell Consultants, Inc., a Bloomington consulting engineering firm. **Wallace Hohman** *(Electrical)* is retired and living in Ft. Myers, Fla. **Clarence E. Josephs** *(Chemical)* retired in 1981 and is living in Seneca Falls, N.Y. He was a facilities engineer for Sylvania Electric Products, Inc., which was subsequently purchased by GTE and N. A. Philips. Josephs was a member of the American Chemical Society. **Fred T. Lanners** *(Chemical)* retired in 1983 and is living in St. Paul, Minn. Lanners is the founder and owner of several companies, including FTL Corporation, a retail beverage sales company, and CFR Corp., a manufacturing company. In 1943, Lanners received the Purple Heart and the Bronze Star. **Erwin L. Long** *(Aerospace)* is president and founder of Artic Foundations, Inc. in Anchorage, Ala. Long, who lives in Anchorage, Ala., is a member of ASTM. He holds four U.S. and six Canadian patents and has published 13 papers. In 1977, he was awarded the Engineer of the Year Award by ASCE/AK, and in 1991, the Hal R. Peyton Award for Artic Engineering. **Douglas A. McArdle** *(Chemical)* retired in 1962 and is living in Orlando, Fla. McArdle worked for Esso Standard Oil. He earned a bachelor's degree in chemistry and mathematics from Concordia College in 1944. **Donald R. Moll** *(Electrical)* retired in 1988 as a senior engineer with Kimberly Clark Corp. In 1990, Moll founded Moll Associates, Inc., a consulting firm in Roswell, Ga., where Moll currently resides. **Marilyn J. Reece** *(Civil and Mineral)* retired in 1983 and is living in Hacienda Heights, Calif. She worked as a civil engineer for the California State Division of Highways and was a member of the American Society of Civil Engineers and Professional Engineers in California Government. Reece received the Governor's Design Award and various Los Angeles City awards for her work, which included the Foothill Freeway Project, the largest project in California state highway contract history.

1949

Harry Bernat *(Electrical; 1949 B.B.A; 1951 Public Admin., M.A.)* is vice president of Manna Financial Planning Corp. in Fairfax, Va. He received the Distinguished Toastmaster Award

Mr. Hustle

Not one to waste time, Jack Braun went into business for himself as soon as he graduated from the Institute of Technology. The business he founded, Regional Engineering Services, was the forerunner of Braun Intertec, one of the largest engineering/testing firms in the Midwest.

"I couldn't find a job so I had to start a business," Braun says jokingly. Judging from the extraordinary success of his company, however, it's doubtful he ever would have had trouble finding a job.

With just $600 of start-up capital that came in the form of an advance from his first client—a highway contractor who needed test borings from the routes on which they were bidding—Braun was off and drilling.

Braun's company, which started exclusively in the soils business, did pre-bid testing for contractors as well as soundings and borings in the early days of the freeway program. The projects in which they were involved included Interstate 35W from 29th Street to the Crosstown Freeway, all of the bridges on Interstate 94 from the Capitol approach interchange to Prospect Park, and Highway 280 from University Avenue north through New Brighton.

Although the company expanded it's services to include concrete and asphalt building materials in the early 1960s, its name was nonetheless changed to Soil Engineering Services to reflect that it was still primarily a soil-testing company. At that time, the company employed about a dozen people.

As the company continued to grow, they expanded their testing services to just about every kind of building and construction material known (including windows, insulation, and metals), resulting in another name change—this time to Braun Engineering Testing.

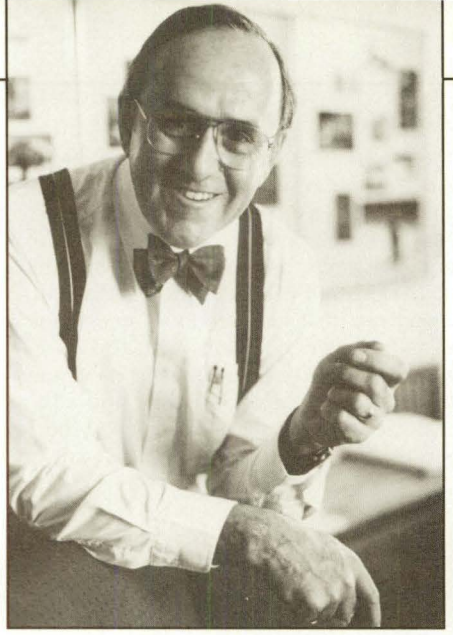
We should do what we can to reduce production of greenhouse gases without resorting to simply throwing money at the problem.

In 1974, Braun opened a branch office in Hibbing, Minn., to take on the taconite-related work in that area. It was the first of many offices to follow. In 1977, he opened an office in his hometown, St. Cloud; 1978, Duluth; 1979 Rochester; and two offices in North Dakota in 1980 when he expanded his company's testing activities into the environmental arena, doing test borings and installing groundwater monitoring wells. In the late 1980s, more offices were opened in Milwaukee, Chicago, and Billings, when he again expanded the company's services to include health evaluations of industrial environments. In 1991, Braun created a parent organization, (Braun Intertec Corporation) to handle corporate services and operating companies to handle each area of testing.

Today, Braun Intertec employs nearly 800 people in offices around the country. Although their work covers a wide spectrum of testing activities, environmental testing is perhaps what gives Braun the greatest pleasure.

"That's where the real growth has been," Braun says. "About 65 percent of our work this year will be in the environmental area."

Among the most exciting projects Braun and his colleagues are tackling is the environmental side of a pipeline project for the Great Lakes Gas Transmission Company. The $1.5 billion project involves constructing a 700-mile, 30-inch gas transmission line from Canada to the United States near the Minnesota-North Dakota-Canadian border. The pipeline passes through many sensitive environments where Braun Intertec's responsibility is to keep environmental impact to a minimum.



J. S. (Jack) Braun
1956/CME

"Our people negotiate the environmental permits with the various units of government," says Braun. "During construction, our environmental inspectors monitor the process to ensure permit conditions are met. We have about 75 people on this project who have unparalleled experience and qualifications for this kind of work. We're hoping there will be lots of additional natural gas pipeline construction because gas is such an environmentally sound fuel."

In addition to his professional concern for the environment, Braun is worried about other threats to the environment, especially air pollution because of the rapid and widespread dispersal of airborne pollutants. He is also concerned about the use of pesticides. As for the greenhouse effect, he feels we should do what we can to reduce production of greenhouse gases without resorting to simply throwing money at the problem before we have an adequate understanding of the issue. One problem he foresees is that newly independent nations in Europe may rush to expand their industrial sectors without taking proper precautions to prevent excess production of greenhouse gases.

Among the personal skills Braun credits for his success are:

- what he calls hustle—being intensely involved in things and having a high degree of energy;
- a combination of being solution- and task-oriented while still being able to look ahead; and
- respect for other people.

"It sounds corny, but my door's always open. I give a considerable amount of personal attention to employees, writing each a congratulatory note on the anniversary of their employment with us."

Braun chose IT because he believes you should attend a school in the area in which you intend to work; this allows you to build life-long friendships and contacts that will help in your career. To IT students, Braun recommends:

- Take some non-technical electives, especially communications and writing courses. Good writing skills are critical.
- Take some business classes, regardless of your career plans. It will give you a different perspective.
- Participate in student organizations. It will help develop leadership skills.
- When looking for a job, take a hard look at small to mid-size companies. It's the wave of the future.

And don't overlook the possibility of starting your own business. It worked for Braun.

from Toastmaster's International and the Totastmaster's International Meritorious Civilian Service Award. He was also named an honorary doctor of Humane Letters at Washington Saturday College in 1987. **James B. Delano** *(Mechanical)* retired in 1967 and is living in Minneapolis, Minn. He had been director of Metro Public Affairs for Northern States Power Co. in Minneapolis, Minn. **Daniel C. Harrington** *(Electrical)* retired in 1985 from Control Data Corporation where he worked as an engineer. Harrington, who lives in Fridley, Minn., earned his master's degree in electrical engineering from the University of New Mexico in 1958. **Rennold J. Luger** *(Chemical)* is founder of Luger Industries, Inc., a boat manufacturing company with annual sales of more than $2 million. Luger, who lives in Port Charlotte, Fla., retired in 1965 and is the holder of several patents. He is president of the Charlotte Symphony Society and has been certified by the Florida Supreme Court as a mediator. **Harold J. Olson** *(Electrical)* retired in 1986 and is living in Sun City, Ariz. He was a principal systems engineer for Honeywell, Inc. in Arlington Heights, Ill. He holds several U.S. patents. **Glen W. Schwartz** *(Electrical)* retired in 1989 as director of facilities management for Unisys Corp. in Roseville, Minn. Schwartz received the Paul Harris Fellow Award from Rotary International.

1950

James H. Anderson *(Electrical)* retired in 1985 and is living in Edina, Minn. He was chief electrical engineer for International Multifoods in Minneapolis, Minn. **George A. Backholm** *(Electrical)* retired in 1990 and is living in Lompoc, Calif. **Norman J. Foot** *(Electrical)* retired in 1980 and is living in Elmhurst, Ill. He is the founder and served as president of Footronics Engineering, a consulting firm in Elmhurst. **George J. Kilbame** *(Mechanical)* retired in 1987 as a principal engineer for 3M Co. Kilbame, who lives in White Bear Lake, holds four patents in the fields of electrostatics, unique adhesive applications, and electrical wiring systems for explosive environments. **Mark A. Mathews** *(Mechanical, 1960 M.S)* lives in Minnetonka, Minn. He retired in 1988. **Nathan D. Puffer** *(Chemical)* is president and founder of Co-Z Development Corp., an aircraft design firm located in Mesa, Ariz. Puffer, who retired from 3M Co. in 1985, is a technical counselor of the Experimental Aircraft Association. He holds two patents and copyrights for two aircraft designs.

1951

Keith J. Allard *(Electrical)* retired in 1978 and is living in St. Paul, Minn. He was a planning engineer for Northern States Power Co. **William R. Carr** *(Civil)* retired as a construction consultant from Carr Associates in 1991, a company he founded. He is a member of NSP and ESD. **Howard E. Holmquist** *(Chemistry, Ph.D.)* retired in 1989 as a research associate and chemist for E. I. du Pont de Nemours & Co. Holmquist, who earned his bachelor's degree in chemistry from Northwestern University, holds 21 patents as inventor or co-inventor and has authored or co-authored 14 technical papers. **Arnold Lindberg** *(Civil)* retired in 1989 and is living in St. Paul, Minn. **George W. Parshall** *(Chemistry)* is director of chemical science for E. I. du Pont de Nemours & Co. in Wilmington, Del. Parshall, who is a member of the National Academy of Science, received the 1992 Chemical Pioneer Award from the American Institute of Chemists. **Norman F. Schulz** *(Chemical, Ph.D.)* retired in 1985 and is living in Minneapolis, Minn.

1952

Thomas O. Moore *(Civil)* retired in 1987 and is living in Rochester, Minn. He was planning director for the Rochester-Olmsted Consolidated Planning Department. He received an award of excellence from the Minnesota Planning Association and a lifetime achievement award from the Rochester Committee on Urban Environment.

1953

Philip D. Freeman *(Mechanical)* lives in St. Paul, Minn., and is a sales engineer for The Trane Company in Minneapolis, Minn. **Terence T. Quirke, Jr.** *(Geology, M.S., 1958 Geology, Ph.D.)*, is retired and currently lives in Golden, Colo. Quirke received his bachelor's degree in geology in 1951 from the University of Illinois. He is a member of the Computer Interest Group of the Colorado Geneological Society and is chair of one of the society's steering committees. **John V. Vold** *(Electrical)* retired in 1983 and is living in Osceola, Wis. He was plant engineering manager for Uniroyal-Goodrich Tire Co. in Opelika, Ala. He holds one U.S. patent.

1954

Joseph E. Doescher is president and CEO of X-Cel Optical Co. in Sauk Rapids, Minn. Doescher lives in St. Cloud, Minn. **Vincent A. Doyle** *(Mechanical)* retired in 1984 and is living in San Diego, Calif.

1955

James R. Forest *(Electrical)* retired in 1988 and is living in Minneapolis, Minn. He worked for Northern States Power Co. **David O. Halvorson** *(Chemical)* is senior industrial hygienist at E. I. du Pont Co. in Wilmington, N.C. Halvorson, who resides in Wilmington, N.C., is the founder of David O. Halverson, CIH, an asbestos removal consulting firm he founded in 1988. Halvorson holds two patents and has published several technical papers. He is a member of the American Industrial Hygiene Association and the American Chemical Society. **Robert C. Robertson** *(Civil)* is chair and manager of municipal engineering for Rieke Carroll Muller Associates Inc. in Minnetonka, Minn. Robertson, who lives in Shakopee, Minn., received the CEC Grand Award from the Metropolitan Waste Control Commission in 1987. **John B. Smith** *(Mechanical)* is president and founder of Gopher Sign Company, a manufacturing company with sales of more than $2 million located in St. Paul, Minn.

1956

Richard J. Petschauer *(Electrical; Business Administration)* works for Unisys in Roseville, Minn., and lives in Edina, Minn. He was named a fellow by Unisys in 1987 and holds 10 patents in computer memory and computer circuits. He has published some 20 papers on computer technology. **Harvey A. Ramlow** *(Civil)* is a principal engineer for the University of Minnesota and lives in St. Paul, Minn. **Paul A. Seaburg** *(Civil, 1957 M.S.)* is head of the Department of Architectural Engineering at Penn State University. Seaburg earned his Ph.D. degree in civil engineering from the University of Wisconsin in 1969. He lives in State College, Pa., and holds five U.S. patents.

1957

Richard G. Brasket *(Aerospace)* is vice president of FluiDyne Engineering Corp. in Minneapolis and lives in Minnetonka, Minn. **Jerry A. Ferm** *(Mechanical)* is supervisor of the fluid/controls laboratory for Martin-Marietta Aerospace in Orlando, Fla. **Greg V. Parker** *(Mining)* is a construction supervisor for ARCO in Anaconda, Mont.

1958

David Alt *(Geology, M.S.)* is a professor of geology at the University of Montana in Missoula. Alt earned his Ph.D. degree in geology from the University of Texas in 1961. **Gerald E. Bergum** *(Mathematics)* is a professor and head of the Computer Science Department at South Dakota State University in Brookings. Bergum earned his master's degree from Notre Dame University in 1962 and his Ph.D. degree from Washington State University in 1969. He received a Regent's Award for Excellence in Education in 1985 and the Burlington Northern Faculty Achievement Award for Significant Scholarship in 1990. He is active in several professional organizations in mathematics and computer science and has served as editor of *The Fibouacci Quarterly* for 10 years. Bergum reports, "I'm 59 years old, my ten children are grown (I hope), and I'll retire in six more years (maybe!). **Richard J. Harju** *(Mechanical)* is a utilities manager for 3M Co. in St. Paul, Minn. Harju lives in Shoreview, Minn. **Bradford A. Lemberg** *(Civil)* is founder, president, and CEO of Independent Consulting Engineers, Inc., a St. Paul firm that specializes in ice arena design. Lemberg, who lives in Arden Hills, Minn., served as president of the Consulting Engineers Council of Minnesota during 1986-87.

1959

Kenneth Kustin *(Chemistry, Ph.D.)* is a professor of chemistry in the Department of Chemistry at Brandeis University in Waltham, Mass. Kustin, who currently resides in Cambridge, Mass., received his bachelor's degree in chemistry in 1955 from Queens University. **Paul B. Martinsen** *(Mechanical)* is manager of the Mechanical/Electrical Department for R.C.M. in Minnetonka, Minn. Martinsen lives in Brooklyn Center, Minn. **Bernard N. Svendsen** *(Electrical)* is a sales person for

Motorola, Inc. in Eden Prairie, Minn. Svendsen lives in Bloomington, Minn. **Wayne H. Traffas** *(Mechanical)* is vice president of the Wagner Group for Day & Zimmerman in Reading, Pa. Traffas lives in Wyomissing, Pa.

1960

Craig Andersson *(Chemical)* is president of Aristech Chemical Corp. of Pittsburgh, Pa. The company, which was formed to purchase USX's chemical operations, has annual sales of $1 billion. **Lawrence D. Bonicatto** *(Civil and Mineral)* is senior vice president for Champion, Inc. in Iron Mountain, Mich. He is a member of the American Institute of Mining and Metallurgical Engineers. **Glenn E. Bowie** *(Mechanical, M.S., 1962 Ph.D.)* is founder of Corporate Technical Training, a company he founded in 1989. Bowie, who lives in Red Wing, Minn., retired in 1987. He received his bachelor's degree in mines at Columbia University in 1954. He is a member of AIAA, ASA, and the International Association for Identification. **James W. Christopherson** *(Mechanical)* is principal engineer of software development for Hamilton Standard Division UTC in Windsor Locks, Conn. He is a member of the Institute of Electrical and Electronics Engineers Computer Society. **Gerald Colombo** *(Chemical, 1962 M.S.)* is vice president and founder of Umpqua Research Company, an aerospace/environmental firm located in Myrtle Creek, Ore., where Colombo currently resides. Colombo founded the company in 1972. In 1968, he received his M.B.A. degree from the University of California--Los Angeles. He is a member of AICE, ACS, and ASTM. He is the holder of one patent and author of more than 25 publications. **James M. Eakman** *(Chemical, 1966 Ph.D.)* is a senior research associate for Exxon Production Research in Houston, Texas. Eakman, who lives in Friendswood, Texas, holds 11 U.S. patents, several foreign patents, and has published more than 12 technical papers. **Donald C. Getschel** *(Civil)* is president of Pioneer Power, Inc. in St. Paul, Minn. Getschel, who lives in Osceola, Wis., is secretary of a local Lion's Club and a member of ASME. **Andrew Perlbachs** *(Aerospace, 1963 M.S.)* is an engineering manager for The Boeing Co. in Seattle, Wash. **Thomas K. Rose** *(Mechanical)* is manager of new business development for Onan in Minneapolis, Minn. He is a member of the Society of American Engineers and the National Society of Professional Engineers. **Paul J. Stary** *(Electrical)* is an engineering consultant living in Audubon, Minn. Stary earned his M.B.A. from the University of Arizona in 1967 and a bachelor's degree in civil engineering from North Dakota State University in 1972. **Derek J. Sturges** *(Physics, M.S.; 1965 Electrical, Ph.D.)* is a principal consultant, Technology Applications, for General Electric Aircraft Engines in Cincinnati, Ohio. **Robert E. Sundell** *(Mechanical, 1962 M.S.)* is a mechanical engineer in corporate research and development for General Electric Co. in Schenectady, N.Y. Sundell, who earned his Ph.D. degree in fluid mechanics from Yale University in 1971, is a member of the American Society of Mechanical Engineers. He holds two patents and is the author of several scientific papers.

1961

Harold M. Ableiter *(Chemical)* is a principal systems analyst for Unisys in Roseville, Minn. Ableiter lives in St. Paul, Minn. **Peter R. Bjornberg** *(Civil, 1963 M.S.)* is a construction manager for Sverdrup Corp. in New York, N.Y. **Stanley J. Brodsky** *(Physics, 1964 Ph.D.)* is a professor at Stanford University in Stanford, Calif. Brodsky received the U.S. Distinguished Scientist Award from the Von Kunboldt Foundation. **Richard L. Hoppenrath** *(Civil)* is a principal engineer for the Minnesota Department of Transportation in Eden Prairie, Minn. He lives in Bloomington, Minn. **Earl O. Knutson** *(Physics, M.S.; 1972 Mechanical, Ph.D.)* is a physical scientist for the United States Department of Energy in New York City. Knutson, who earned his bachelor's degree in physics from Concordia College in 1958, is a member of the American Association for Aerosol Research and Gesellschaft für Aerosol Forschung. **Dennis G. Kohanek** *(Aerospace)* is a marketing manager for Microdot Industries in South Pasadena, Calif. He holds four patents. **John W. Lester** *(Mechanical, M.S.)*, who lives in Tempe, Ariz., recently retired from Allied-Signal Aerospace Company. He is listed in *Who's Who in Engineering, 1980*, and was director of the Society of Automotive Engineers from 1977-1980. Lester received his bachelor's degree in mechanical engineering from Clarkson University in 1952. **James B. Mehl** *(Physics, 1964 M.S., 1966 Ph.D.)* is a professor and chair of the Physics Department at the University of Delaware in Newark, Del. **James Ofelt** *(Chemical)* is employed at Bechtel, Inc. in Houston, Texas. **Jerry A. Schreiber** *(Geology)* is area manager of operations for Amoco Pipeline Co. in League City, Texas. **Rodney J. Soukup** *(Electrical, 1964 M.S., 1969 Ph.D.)* is a professor and chair of the Department of Electrical Engineering at the University of Nebraska in Lincoln, Neb. Soukup is chair of the National Electrical Engineering Department Heads Association and has published 22 technical papers in refereed journals.

1962

Ray R. Kaste *(Electrical, 1971 M.S.)* is a senior development engineer for Honeywell, Inc. in St. Louis Park, Minn. Kaste lives in Golden Valley, Minn. **Gordon L. Kelling** *(Mechanical)* is an engineering manager for Phillips-Temro Inc. in Eden Prairie, Minn. Kelling, who lives in Minnetonka, Minn., holds nine patents and has written several technical publications. **James A. Kyikstad** *(Chemical)* works in Technical Service at 3M Co. in St. Paul, Minn. Kyikstad, who lives in Shoreview, Minn., received his master's degree in chemical engineering in 1969 from Suny-Buffalo.

1963

Conrad F. Fingerson *(Mechanical)* is CEO and founder of Geotek, Inc., a manufacturing firm with annual sales of more than $2 million located in Rushford, Minn. Fingerson, who resides in Chatfield, Minn., also founded AFC, Inc. He is on the advisory boards of Rochester Community College, the Winona Technical College--Composites Program, and the Agricultural Utilization Research Institute. He holds six patents, with two pending. **Norm L. Ledeboer** *(Mechanical)* works in research for Northern States Power Co. in Minneapolis, Minn. Ledeboer, who lives in St. Louis Park, Minn., received a professional development citation from the University of Minnesota in 1976.

1964

Kenneth G. Bach *(Electrical; 1991 Computer Science)* is an engineer manager for Aero Systems Engineering, Inc. in St. Paul, Minn. **Robert A. Bell** *(Aerospace)* is founder and owner of SlideGRAFIX, a Colorado Springs, Colo., computer graphics firm. **Stanley N. Bormann** *(Mechanical)* is president of Zetaco Inc. in Eden Prairie, Minn. Bormann lives in Apple Valley, Minn. **Ron A. Butterworth** *(Geology)* works in offshore explorations for Pennzoil in Houston, Texas. Butterworth, who earned his master's degree in geology from the University of Texas in 1970, lives in Woodlands, Texas. **George Chesley** *(Mechanical)* is with his family firm in Mankato, Minn. The company is a distributor of freight liner truck parts. **Gerald J. Dittberner** *(Electrical)* is a senior scientist for Kamm Sciences Corporation in Alexandria, Va. Dittberner earned his master's degree in meteorology and space science engineering and his Ph.D. degree in meteorology from the University of Wisconsin in 1969 and 1977, respectively. **Norman A. Foss** *(Electrical, 1966 M.S.)* is a department manager for Honeywell, Inc., in Minneapolis, Minn. Foss, who lives in North Oaks, Minn., holds three patents and has published 25 technical papers. **Kenneth D. Larson** *(Mathematics)* is president and chief operating officer of Polaris Industries LP in Minneapolis, Minn. Larson, who lives in Bloomington, Minn., is also director of Executive Futures, Inc. **William J. Mayer** *(Electrical, 1967 M.S.)* is a distinguished member of the technical staff for AT&T Bell Laboratories in Holmdel, N.J. He is a member of the Institute of Electrical and Electronics Engineers and ACM. **Bruce R. Meyer** *(Mechanical)* is president of Daytons Bluff Sheet Metal, Inc. in St. Paul, Minn. He lives in White Bear Lake, Minn.

1965

Louis B. Bushard *(Mathematics, 1967 M.S., 1970 Ph.D.)* is an engineering consultant for Unisys. Bushard lives in Andover, Minn. **Patrick D. Holiday** *(Electrical)* is a founder of Product Development & Marketing, a consulting firm located in Waco, Texas. Holiday, who resides in Waco, Texas, also founded Holiday-Hammond Corp, a manufacturer of commercial dryers. **Jacqueline E. Jeffrey** *(Mathematics)* is director of marketing, consulting services, for Coopers and Lybrand in New York City. Jeffrey earned her master's degree in communications from

Start Early and Stay Late

Lee Raymond found himself in a rather pleasant predicament after earning his doctorate in chemical engineering from IT in 1963. He received numerous job offers, including several from different divisions of Exxon Corp.

"I'll be honest," Raymond says. "I didn't know what I wanted to do. I didn't know if I wanted to stay in research or get into the operating side of business."

Exxon provided the solution. Since it had offered him some jobs in research and some in operations, Raymond decided to go with that company because it would give him the opportunity to find out what he wanted to do without having to jump from one organization to another every few years, trying out different positions.

"In hindsight, it was a good decision," he says.

Given Raymond's successful career, calling the decision 'good' is a bit of an understatement. Joining Exxon became the first step in a long and adventure-filled journey upward through the ranks of Exxon and around the Western Hemisphere. Starting out as a production engineer, Raymond moved on through managerial positions in planning and analysis and cargo trading, to executive positions in various divisions of the company, to president and director of the parent corporation—a position he has held since 1987. Along the way, he has lived and worked in Houston, Texas; Caracas, Venezuela; the island of Aruba in the Caribbean; Seattle, Wash.; New York, N.Y.; Coral Gables, Fla.; and, finally, Dallas, Texas.

In describing his typical work day Raymond simply says, "It starts early, ends late." He spends most of his time on the phone or meeting with people in groups of two and three. A heavy load of reading keeps him abreast of developments.

We have to make energy too expensive to waste.

Although he says he sometimes doesn't think of himself as being particularly successful, Raymond has a very good idea of what it takes to succeed.

"In our business and in our company, a strong technical background is very important," he says. "The training I received in undergraduate and graduate school was as good as anybody in the world could have in chemical engineering."

After completing his undergraduate education at the University of Wisconsin, Raymond chose IT for his graduate studies because he was interested in a mathematical orientation to chemical engineering.

"I was advised that the leading department in that area was at the University of Minnesota," Raymond says. "And that they had the leading person in that field—Professor Neil Amundson. I decided it would be a good place to go."

According to Raymond, training alone isn't enough, however. He couldn't have succeeded, or even stayed with Exxon, if he had not been in agreement with the fundamental values of the company.

"A core set of values is important in terms of how you get things done and decide what's important and what isn't—values like integrity, ethics, technology, and a strong work ethic," he says. "If a company's values aren't sound or don't support your personal values, there's no point in beating your head against the wall; you have to find a more compatible company."

Like many others in his industry, Raymond pays close attention to U.S. energy policy. He disagrees with those who say the U.S. doesn't have an energy policy. "What they mean is that we don't have a coherent policy or that they don't like the current policy," he says. "Although I see a need for change, through the actions of the various administrations and Congress, we *do* have an energy policy."

Lee Raymond
1963/ChemE

One of the things Raymond would like to see changed in the existing policy is the creation of a better climate for domestic energy production. "Whether that's drilling for oil or putting in proper controls for nuclear energy development, it doesn't matter," he says. "We cannot afford the view that we should pass up economical production of domestic energy.

"Secondly, we need to focus on conservation. Because conservation gets structured through the market place, we have to make energy too expensive to waste. Otherwise, you have to ration it, and I don't think that's a very good way to conduct business in this country."

Although one way to encourage conservation would be through various taxes on energy use, Raymond doesn't see that as being acceptable to the public.

"We want security in terms of our energy supply, but the only way we're really ever going to have that is by paying the price," he says. "Unfortunately, people aren't willing to pay that price. Americans want to consume cheap energy but aren't necessarily willing to produce it.

"People need to realize that it's only in a country as wealthy as our's that you can afford these types of discussions. People in Brazil and other developing countries don't worry too much about these kinds of things. The concept of *not* trying to explore for oil is totally foreign to people in developing countries of the world. I believe the only reason the environmental movement can exist, for example, is because of our country's economic strength."

Beyond energy issues, Raymond perceives our slipping edge in an increasingly competitive world market as one of the most significant problems facing our country. "Ultimately, it comes back to the skills of our people," he says. "It's in our own interest to make sure that everyone participates in the process—that everyone has the opportunity and encouragement to develop those skills—beginning with our educational system."

With those opportunities, people may find themselves in positions like that of Raymond, who, after his educational training, had options, chose to get involved, worked hard, and is making a difference. I

Rensselaer in 1967 and her M.B.A. from Harvard. **Kenneth A. Kline** *(Aerospace, Ph.D.)* is professor and chair of the Mechanical Engineering Department at Wayne State University in Detroit, Mich. He was recently named a fellow of the American Society of Mechanical Engineers. **Robert L. Kuhn** *(Mechanical)* is a research associate for Dupont in Neward, Del. Kuhn lives in Exton, Pa. **David L. Quam** *(Aerospace)* is a project consultant for QuesTech Inc. in Dayton, Ohio. **Harold Wellnitz** *(Electrical)* is a senior electrical engineering service engineer for Westinghouse Electric Corp. in Duluth, Minn.

1966

Robert J. Ahlstrom *(Mathematics)* is senior vice president for First National Supermarkets in Windsor Locks, Conn. Ahlstrom earned his master's degree in mathematics from the Stevens Institute of Technology in 1968 and his M.B.A. degree from Wharton School at the University of Pennsylvania in 1990. He is past president of the Association for Computing Machinery, Twin City Chapter, and past chair of the Food Marketing Institute, Advanced MIS Committee. **David C. Defferding** *(Aerospace)* is an associate civil engineer for the Seattle Water Department. Defferding worked for The Boeing Co. for a few years before earning his bachelor's degree in civil engineering from the University of Washington in 1972. He is a member of the American Water Works Association. **Norman A. Foss** *(Electrical)* is a department manager for Honeywell, Inc. in Minneapolis, Minn. Foss, who lives in North Oaks, Minn., holds four patents and has published 26 technical papers. He received the Technology Advancement Award from Honeywell. **Gary L. Hayden** *(Civil and Mineral)* is division chair/facilities engineering for the Mayo Foundation in Rochester, Minn. Hayden earned his M.B.A. degree from Loyola University. He is a member of the National Society of Professional Engineers, the Minnesota Society of Professional Engineers, and PEC. **John M. Kannas** *(Civil and Mineral)* is superintendent of mine operations for the Hibbing Taconite Co. in Hibbing, Minn.

1967

LeRoy E. Gerlach *(Mechanical, M.S.)* is vice president of operations for Laserdyne in Eden Prairie, Minn. Gerlach, who lives in Bloomington, Minn., holds nine U.S. patents. **Duane T. Hove** *(Aerospace)* is a division manager for Sparta, Inc. in Torrance, Calif. Hove, who earned his master's degree in aeronautical engineering from CalTech in 1968, has published more than 12 technical papers. **Gary W. Y. Kwong** *(Chemistry, 1975 Ph.D.)* is a senior research chemist for 3M Co. in St. Paul, Minn. Kwong holds six U.S. patents. **In 1978, Richard C. Lambert** *(Electrical)* is president and founder of R. C. Lambert and Associates, Inc., a consulting firm located in Roseville, Minn., where Lambert resides. Lambert is a member of the Consulting Engineers Counsel of Minnesota and was previously a board member of that organization. **Jack F. Tocko** *(Mechanical)* is manager of manufacturing engineering for Lucht Engineering in Bloomington, Minn. Tocko lives in Woodbury, Minn.

1968

George (Ross) Alexander *(Physics)* works for Rockwell International, Graphic Systems Division, in Westmont, Ill. He received an M.B.A. degree from the University of Massachusetts in 1974 and a master's degree in accounting and international business in 1983 from De Paul University. **Richard G. Ballintine** *(Physics; 1970 M.B.A.)* is vice president of administration for Rosemount Inc. in Burnsville, Minn. **James L. Claypool** *(Chemical, M.S.)* is a division manager for Raychem Corp. in Menlo Park, Calif. Claypool, who earned his bachelor's degree in chemical engineering from the University of Washington in 1967, lives in Los Altos Hills, Calif., and holds six patents. **John P. Cooke** *(Electrical)* is a consulting engineer living in Bloomington, Minn. **William J. Croke** *(Civil)* is an assistant district engineer for the Minnesota Department of Transportation in Duluth, Minn. **Richard Giersten** *(Mechanical)* reports that his son is the fourth generation to work in the family construction company. **Bernard E. Horwath** *(Mechanical)* is vice president for Endotronics in Coon Rapids, Minn. He lives in Vadnais Heights, Minn. **Lowell A. Johnson** *(Electrical)* is a senior engineer for the Minnesota Department of Transportation in St. Paul, Minn. Johnson lives in New Brighton, Minn. **John J. Kerwin** *(Mechanical)* is a real estate developer and founder with Nicollet Restoration, Inc., a building restoration firm in Minneapolis, Minn. Kerwin, who received an M.B.A. degree in 1970 from Stanford University, is a board member of Projects for Pride in Living and was a Fulbright lecturer in 1985 and a Latin American Teaching Fellow in 1975. **Donald H. Lucast** *(Chemistry, 1976 Ph.D.)* is a research specialist at 3M Co. in St. Paul, Minn. He is the holder of five patents. **Ralph J. Preston** *(Geology)* is a division geophysicist for Amerada Hess Corp. in Houston, Texas. Preston earned his master's degree in geophysics from Texas A&M University in 1970. He is a member of the Society of Exploration Geophysicists. **Thomas W. Rusch** *(Electrical, 1970 M.S., 1973 Ph.D.)* is a senior product manager for Perkin-Elmer Corporation in Eden Prairie, Minn. He is listed in *Who's Who in the Midwest* and *Who's Who in America*. He is a member of the American Vacuum Society, holds four patents, and has edited two books and written 15 journal articles. **Kenneth R. Saffert** *(Civil and Mineral)* is a city engineer for the City of Mankato in Mankato, Minn. He received the 1990 City Engineer of the Year Award. **Roger D. Ten Napel** *(Chemical)* is vice president of refining for Koch Refining Co. in Wichita, Kan. He is a member of the American Institute of Chemical Engineers and AXE.

1969

Robert A. Bieckinger *(Mechanical)* is a senior specialist for 3M Co. in St. Paul, Minn. Bieckinger lives in Circle Pines, Minn. **John T. Hudachek** *(Mathematics)* is a senior simulator analyst and software engineer for Vermont Yankee Nuclear Power Corp. in Brattleboro, Vt. Hudachek lives in Chesterfield, N.H. **Duane L. Jensen** *(Aerospace)* is a design specialist at Lockheed Missiles and Space in Calif. He was the recipient of the Lockheed Disclosure of Invention Award in 1977 and four-time recipient of the Lockheed Technical Publication Award. **David G. Madland** *(Physics, M.S., 1970 Ph.D.)* is a staff physicist for Los Alamos National Laboratory in Los Alamos, N.M. Madland has published more than 100 technical papers on nuclear physics. **David L. Runkle** *(Electrical)* is a district sales manager for Advanced Micro Devices in Minneapolis, Minn. Runkle lives in Wayzata, Minn. **John A. Uttermark** *(Electrical)* is a senior principal engineer and engineering director for ADC Telecommunications in Minneapolis, Minn. Uttermark, who lives in Eden Prairie, Minn., holds U.S. patents for an electronic labeler and a fiber optic multiplexer.

1970

William A. Bergman *(Civil)* is a principal civil engineer at Metro Water Reclamation District of Greater Chicago in Chicago, Ill., where Bergman currently resides. He received his master's degree in environmental engineering in 1981 from IIT. He is a member of ASCE and ISPE. In 1985, he became the Winston Churchill Traveling Fellow of the English Speaking Union of the U.S. He is the author of many technical papers. **Douglas A. Edmonson** *(Chemical)* is a research manager, Food Process Technology, at Anheuser-Busch in St. Louis, Mo. He was project director for the installation of the world's largest twin screw food extruder last winter and has received his fourth U.S. patent in refrigerated food processing. **L.D. Erchull** *(Chemistry)* is a senior environmental specialist for UNO-VEN Company in Lemont, Ill. He lives in Naverville, Ill. **Alan T. Forsberg** *(Civil, 1985 M.S.)* is a county engineer for Blue Earth County in Mankato, Minn. **Steve W. Johnson** *(Mechanical)* is director of technical operations for Tekna Seal in Fridley, Minn. **Vernon G. Menk** *(Electrical)* is director of engineering/ops. at EdenTec in Eden Prairie, Minn. Menk lives in Champlin, Minn. **Jeffrey D. Parker** *(Electrical)* is a program manager for Unisys in St. Paul, Minn. Parker lives in Bloomington, Minn. **Gary W. Sjolander** *(Physics, 1975 Ph.D.)* is a senior staff engineer at Martin Marietta Astronautics in Denver, Colo. He was the recipient of the NRL Publication Award in 1979 and the Westinghouse Engineering Award in 1983.

1971

Thomas E. Brovold *(Civil; 1973 B.S.E.; 1979 Mechanial, M.S.)* is a sales engineer at Interlaken Technology Corporation in Eden Prairie, Minn. He is the founder of Experimental Services, Inc., a testing services company in Akron, Ohio. He is a member of SAE and a holder of three patents. He has published several technical papers.

Lawrence W. Craighead *(Chemical)* is a principal engineering specialist for 3M Co. in St. Paul, Minn. Craighead lives in Mendota Heights, Minn. **Richard L. Jambor** *(Chemical)* is a research engineer at Factory Mutual Research Corp. in Norwood, Mass. **Terence A. Keefe** *(Electrical/Economics)* is a senior engineer for Chevron Corporation in San Raman, Calif. Keefe, who lives in Pleasant Hill, Calif., earned his M.B.A. degree from the University of California-Berkeley in 1977. **Lyle G. Keller** *(Civil)* is an estimator/project manager for Dave Schmitt Construction Co. in Cedar Rapids, Iowa, where he resides. He is chair of both the Labor Policy Committee and Collective Bargaining Committee of AGC of Iowa. **William R. Kramlinger** *(Aerospace)* is a senior research design engineer for St. Jude Medical in St. Paul. Kramlinger, who lives in Shoreview, Minn., holds one U.S. patent. **John B. Lenertz** *(Agriculture)* is a product manager for Farmhand Inc. in Excelsior, Minn. Lenertz holds several U.S. and foreign patents. **Richard P. Rozek** *(Mathematics)* is vice president of National Economic Research Associates, Inc. in Washington D.C. Rozek received his master's and Ph.D. degrees in economics from the University of Iowa in 1974 and 1976, respectively. **William J. Sonsin** *(Mathematics, M.S.)* is a certified financial planner for IDS Financial Services in Plymouth, Minn. Sonsin lives in New Hope, Minn.

1972

James R. Bakken *(Civil and Mineral)* is manager of Water Resource Services for Ayres Associates in Eau Claire, Wis., and is a member of the American Society of Civil Engineers. He received an honor award from the American Consulting Engineers Council. **Ray Getsug** *(Mechanical)* is a senior project engineer at Planmark Architecture Engineering, a division of Super Valu Stores, Inc. in Eden Prairie, Minn. **Robert A. Grandt** *(Chemistry)* is a project leader for Betz Laboratories in The Woodlands, Texas. He is a member of the Society of Applied Spectroscopy and the Water and Wastewater Association. **Vincent J. Graziano** is a senior programmer for Cray Research in Egan, Minn. He resides in St. Paul, Minn. **David A. Hill** *(Electrical)* is a senior electrical engineer for the Raytheon Company in Galeta, Calif. **Andrew J. Holewa** *(Electrical; 1973 Computer Science; 1974 Math)* is president of Holewa Management Consulting Group, a consulting company he founded in 1991. Holewa lives in Arden Hills, Minn. **Robert A. Johnson** *(Civil and Mineral)* is president of Lovering-Johnson, a general contracting firm founded in 1920 in Wayzata, Minn. The firm is currently replacing the paving at the Hennepin Plaza Government Center in Minneapolis, Minn. **Daniel P. Korolchuk** *(Physics)* is director of operations for Perkin Elmer's Physical Electronics Division in Eden Prairie, Minn. Korolchuk, who earned an M.B.A. degree from Boston University in 1977, lives in Minnetonka, Minn. **Barton B. Murphy** *(Civil and Mineral)* is superintendent of water supply and district heating for Willmar Municipal Utilities in Willmar, Minn. Willmar's hot water district heating system is the first of its kind to operate in the United States. **Peter R. Pujado** *(Chemical, Ph.D.)* is manager of research and development associates for Allied-Signal and Union Carbide in Des Plaines, Ill. Pujado, who lives in Palatine, Ill., holds 15 U.S. patents and has written some 50 technical papers and publications. **Brian C. Torgerson** *(Metallurgy, 1973 M.S.; 1978 M.D.)* is a physician at the American Medical International Central Carolina Hospital in Sanford, N.C., where Torgerson currently resides. **Fred L. Vandergraft** *(Electrical)* is supervisor of manufacturing engineering for Rosemount, Inc. in Burnsville, Minn.

1973

Robert C. Anderson *(Chemical)* is Northern Division president for GenEx in Roseville, Minn. Anderson lives in Mahtomedi, Minn. **Richard Dorshow** *(Physics)* is a physicist with BP Research and is the author of 20 publications. **Donald W. Hillger** *(Physics)* is a meteorologist at NOAA/NESDIS/RAMM Branch, Colorado State University in Fort Collins, Colo. Hillger received his master's and Ph.D. degrees in atmospheric science from Colorado State University in 1976 and 1983, respectively. He has published many papers on satellite meteorology and articles on topical stamp collecting. He is a member of the American Meteorological Society, a volunteer officer of the U.S. Metric Association, and committee member of the American Society for Testing and Materials. **Patrick C. Hyde** *(Mechanical)* founded Hyde Engineering, a consulting firm located in Fort Worth, Texas. Hyde, who resides in Fort Worth, Texas, is the holder of one patent. **WuShyong Li** *(Chemistry, Ph.D.)* is a senior research specialist for 3M Co. in Maplewood, Minn. Li, who lives in Woodbury, Minn., holds two U.S. patents. **Kenneth M. Manke** *(Electrical)* is general manager at MTS Sistemas do Brasil Ltda. of MTS Systems Corporation. Manke lives in Sao Paulo, Brazil. **Jeremy S. Nichols** *(Electrical)* is a principal electrical engineer at Unisys Corp. in St. Paul, Minn. **James A. Vashro** *(Electrical)* is an engineering manager at Hewlett Packard in Boise, Idaho. **Thomas A. Vashro** *(Aerospace)* is manager of network services for Rosemount Inc. in Eden Prairie, Minn. Vashro received his M.B.A. degree from the University of California-Los Angeles in 1979.

1974

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1975

Paul H. Boening *(Civil)* is vice president of Andrews Knitting Mills Inc. in St. Paul, Minn. He earned his master's degree in 1976 and his Ph.D. degree in 1980, both from the University of Illinois. **David C. Naatz** *(Electrical)* is a program manager of engineering at IBM in Somers, N.Y. **Jeffrey A. Paasch** *(Electrical; 1979 D.V.M.)* is a veterinarian and partner in Nicollet Veterinary Clinic in Nicollet, Minn. **Daniel J. Tich** *(Electrical)* is a marketing manager at Cardiac Pacemakers, Inc. in St. Paul, Minn. **Joan M. Verba** *(Physics)* is a word processor for Lerner Publications, Inc. in Minneapolis, Minn. She has written a book about the Voyager space probes that is scheduled for publication this year. **Thomas H. West** *(Math)* is a training coordinator for Westinghouse Electric Corp. in Lake Bluff, Ill. West, who lives in Chicago, Ill., received his master's of education degree in 1985 from the University of Illinois. **Gary E. Zimmerman** *(Computer Science)* is a senior computer applications engineer for Alliant Techsystems in Edina, Minn.

1976

Jon K. Ahlness *(Geology)* is a supervisory physical scientist for the United States Bureau of Mines in Minneapolis, Minn. Ahlness is a member of the Society of Mining Engineers (SME). He received the 1988 Robert Peale Memorial Award from SME and is a co-holder of a U.S. patent and author of several technical papers. **Roger A. Anderson** *(Civil, M.S.; 1974 Math, B.S.)* is a district engineer for the Indian Health Service in Shiprock, N.M. Anderson, who currently resides in Farmington, N.M., received a master's degree in 1989 from the University of Alaska. **Hadley M. Bedbury** *(Chemistry)* is a project manager at Maxus Energy in Dallas, Texas. **Richard G. (Rick) Dargatz** *(Chemical, M.S.)* recently left E. I. du Pont after 14 years to join Eli Lilly and Co. in Indianapolis, Ind. Dargatz is working on expansion projects in the pharmaceutical industry. Dargatz's wife, Gail Whitechurch (B.A 1974, M.A. 1981), worked in the chemical engineering department at IT from 1971 to 1974 and was recently appointed as an assistant professor in the Department of Communications at Indiana University. **Richard B. Dorshow** *(Physics)* is a physicist for B.P. Research

in Cleveland, Ohio. Dorshow earned his master's (1978) and Ph.D. (1983) degrees in physics from the University of California. He is a member of the American Physical Society, the Society of Petroleum Engineers, and the American Chemical Society. He is the author of some 20 technical papers. **Paul F. Emerson** *(Mechanical, 1980 M.S., 1988 Ph.D.)* is a senior principal engineer for Baxter Healthcare, Inc. in Minneapolis, Minn. Emerson was previously a research associate for PDRI, Inc. **Gregory I. Farmer** *(Electrical)* is a senior logician for Unisys Corp. in Roseville, Minn. **Carla P. Haugen** *(Math; 1976 Economics; 1976 Statistics)* is a managing director at Rogers, Casey & Associates in Darien, Conn. Haugen, who resides in Rowayton, Conn., received her M.B.A. degree from Harvard University in 1980. **Jeffrey D. Ingram** *(Electrical)* is a regional sales manager at Gould/AMI in Edina, Minn. Ingram resides in St. Louis Park, Minn. **Thomas A. Kerestes** *(Electrical)* is manager of information services for Northern States Power Co. in Eau Claire, Wis. Kerestes lives in Elk Mound, Wis. **Vernon E. Lippert** *(Electrical)* is a maintenance engineer for Geo. A. Hormel & Co. in Austin, Minn. He is listed in the 1992 edition of *Who's Who in the Midwest.* **Jane E. Rothman** *(Mechanical)* is a senior quality assurance engineer for Union Carbide Coatings Service in Indianapolis, Ind. She is a member of the Society of Women Engineers.

1977

Rodney M. Anderson *(Electrical)* is an attorney for Vinson & Elkins in Dallas, Texas. Anderson, who earned his J.D. degree from the University of Houston in 1984, lives in Richardson, Texas. **Douglas M. Brikholz** *(Electrical)* is a senior engineer at Cardiac Pacemakers, Inc. in St. Paul, Minn. **Michael J. Carroll** *(Mechanical; 1986 M.B.A.)* is a senior manufacturing engineer at Management Graphics, Inc. in Minneapolis, Minn. Carroll resides in Columbia Heights, Minn. **William M. Derrick** *(Civil; 1985 M.B.A.)* is president and founder of Derrick Construction Co., Inc., a general contracting firm with annual sales of $7 million located in New Richmond, Wis. Derrick resides in Woodbury, Minn. **Ross T. Hammond** *(Electrical)* is director of environmental affairs for Northern States Power Co. in Minneapolis, Minn. **Ray A. Huber** *(Civil)* is an office manager at Braun Intertec in Apple Valley, Minn. **Bruce R. McClintick** *(Chemical)* is science and technology director for Dow Corning Corp. in Midland, Mich. McClintick earned his M.B.A. degree from Central Michigan University in 1977. **Tho Vu** *(Electrical, 1980 M.S., 1982 Ph.D.)* is founder and president of Top-Vu Technology, Inc., a semiconductor-microsystems firm in New Brighton, Minn. Vu, who resides in New Brighton, Minn., is an associate editor and senior manager of IEEE. He is the author of numerous technical papers and the holder of 11 patents. **Paul L. Weber** *(Chemistry, Ph.D.)* is a professor of chemistry at Briar Cliff College in Sioux City, Iowa. **David A. Zumbrunnen** *(Mechanical)* is a professor at Clemson University in Clemson, S.C. Zumbrunnen received his master's and doctorate degrees from Purdue University in 1984 and 1988, respectively.

1978

Nathan R. Brunner *(Mechanical)* is a senior engineer for 3M Co. in St. Paul, Minn. Brunner, who lives in Maple Grove, Minn., earned his master's degree in mechanical engineering from the University of Michigan-Dearborn in 1980. **Mark C. Dicke** *(Physics)* is a programmer/analyst for the Federal Reserve Bank of Minneapolis. **Dale J. Forsberg** *(Civil)* is a project manager for Watson-Forsberg Co. in Minneapolis, Minn. **Jerome P. Janzen** *(Electrical; 1982 M.B.A.)* is chief engineer for Dynamic Systems Inc. in Minneapolis, Minn. Janzen lives in Eden Prairie, Minn. **Janie H. Miernik** *(Chemistry; 1984 Chemical)* is a senior design engineer for Boeing Aerospace and Electric Company in Huntsville, Ala. Miernik, who earned her master's degree in chemistry from the University of Alabama--Huntsville in 1991, has published five technical papers and received an academic award from the University of Alabama--Huntsville in 1991. **John A. Nauman** *(Computer Science; 1978 Math, B.S.)* is president and founder of Financial Information Management, Inc. in Eden Prairie, Minn. **Susan V. Parsons** *(Aerospace)* works in New Business Development at Northrop B-2 Division in Pico Rivera, Calif. Parsons received an M.B.A. degree in 1984 at California State University. **Thomas M. Stankey** *(Electrical, M.S.)* is an engineer with Gilson Medical Electronics in Middleton, Wis.

1979

Thomas M. Christensen *(Physics and Astrophysics)* is an assistant professor at the University of Colorado in Colorado Springs, Colo. Christensen received his master's and doctorate degrees in applied physics at the University of Cornell in 1981 and 1985, respectively. **Mark D. Glewwe** *(Computer Science)* is self-employed as a software engineer and lives in Prior Lake, Minn. He is a member of the Institute of Electrical and Electronics Engineers Computer Society and the National ACM. **David M. Griep** *(Astrophysics; 1981 Astronomy, M.S.)* is a research associate V for NASA's Infrared Telescope Facility in Hilo, Hawaii. **Scott R. Knapp** *(Mechanical)* is a senior mechanical project engineer for Kohler Company in Kohler, Wis. Knapp, who lives in Sheboygan, Wis., holds a patent for a water distribution system. **Jay B. Krafthefer** *(Civil and Mineral)* is a G.I.S. manager for Washington County in Stillwater, Minn. He is a member of the Minnesota Society of Professional Engineers and the Urban and Regional Information Systems Association. **Anthony P. Matczak** *(Mechanical)* is vice president of engineering for State Refrigeration and Air Conditioning, Inc. in Philadelphia, Pa. **David H. Owens** *(Chemical; 1986 M.B.A.)* is a section manager in process development for Kraft General Foods in Glenview, Ill. Owens lives in Vernon Hills, Ill. **David L. Simmons** *(Chemical)* is a plant engineering manager for Gould Inc., Foil Division, in Chandler, Ariz. Simmons is a registered professional engineer in Arizona and a member of the Instrument Society of America. **Michael F. Skinner** *(Mechanical)* is a senior mechanical engineer for Northern States Power Co. in Minneapolis, Minn. He is a member of the Association of Energy Engineers.

1980

Michael T. Frankenberg *(Electrical)* is vice president, product assurance and regulatory affairs for SCIMED Life Systems, Inc. in Maple Grove, Minn. **Jeffrey B. Galush** *(Civil)* is a sales engineer for Ingersoll-Rand in St. Louis, Mo. Galush lives in Ballwin, Mo. **Ronald A. Hagen** *(Electrical, 1989 M.S.)* is a senior electrical design engineer at 3M Co. in St. Paul, Minn. Hagen resides in Stillwater, Minn. **Timothy J. Hoffmann** *(Computer Science)* is a data analyst at Power Computing Co. in Dallas, Texas. **Stephen W. Jones** *(Civil)* is an associate with Zimmerman Consulting Engineers in West Covina, Calif. He earned his master's degree in management technology from Northrop University. **Larry J. Mestad** *(Mechanical)* is chief engineer at General Dynamics in Forth Worth, Texas. **Michael L. Rancour** *(Mechanical)* is a manufacturing engineering manager for Seagate Technology in Minneapolis, Minn. **Dan E. Rathke** *(Geology, M.S.)* is vice president of sales and marketing at Kebco, Inc. in Eden Prairie, Minn. **Paul A. Rodrian** *(Aerospace)* is a manager at Martin-Marietta in Denver, Colo. He received the Martin-Marietta Technical Achievement Award in 1990. **Michael P. Ryan** *(Mechanical)* is manager of business analysis for Donaldson Company in Bloomington, Minn. Ryan lives in Eagan, Minn. **Stephen C. Sanders** *(Chemical)* is manager of economics and planning for Koch Refining Co. He lives in Woodbury, Minn. **Rick L. Thienes** *(Mechanical)* is founder and president of Eclipse Industries, Inc. in St. Cloud, Minn. Thienes earned his M.B.A. degree in finance in 1981. **Wayne R. Vohnoutke** *(Mechanical; 1988 M.B.A.)* is a project engineer, electro-mechanical design, at General Electric Medical Systems in Milwaukee, Wis.

1981

Scott W. Bjorlin *(Chemical)* is a manager of process engineering for PepsiCo in Valhalla, N.Y. He is a member of the American Institute of Chemical Engineers, the Institute of Food Technologists, and the Society of Soft Drink Technologists. **Richard R. Ferguson** *(Geology, M.S.)* is a hydrogeologist at Cham Hill in Portland, Ore. Ferguson, who lives in Dr. Beaverton, Ore., received his bachelor's degree in geology from Oregon State University. **Gene A. Kelly** *(Electrical)* is a senior electrical engineer and field service representative for FMC Corp., Naval Systems Division, in Minneapolis, Minn. He earned his master's degree in electrical engineering from the University of Maine in 1990 and is a member of the Institute of Electrical and Electronics Engineers. **Fereidoon**

Khosravi *(Physics)* is manager of knowledge-based systems for Southern California Edison in Rosemead, Calif. Khosravi earned his master's degree in industrial engineering with honors from the University of Michigan. He is a member of the American Association of Artificial Intelligence and president of the Artificial Intelligence Corporation Western Region Users Group. **Kathryn J. Kleiter** *(Geology; 1982 Geophysics)* is an environmental project manager and geologist for Twin City Testing. Kleiter, who lives in Waite Park, Minn., earned her master's degree in geology from the South Dakota School of Mines and Technology in 1988. **Thomas E. Nelson** *(Chemical; 1986 M.D.)* is an orthopedic surgery resident at the University of Minnesota Hospitals Clinic. He is a member of the Alpha Omega Alpha Medical Honor Society. **G. Peter Nichols** *(Chemical)* is an attorney for Willian, Brinks, Olds, Hofer, Gilson, and Lione in Chicago, Ill. He is a member of the American Bar Association, the Chicago Bar Association, and the Federal Circuit Bar Association.

1982

Martha (Marty) Anker *(Chemical, 1988 M.S.)* is a project leader in research and development for Beatreme Foods Inc. in Beloit, Wis. **Raymond J. Bloom** *(Mechanical)* is a manufacturing engineer for Advantek, Inc. in Eden Prairie, Minn. Bloom lives in Eagan, Minn. **Karen L. Chandler** *(Civil, 1987 M.S.)* is a professional engineer for Barr Engineering Co. in Minneapolis, Minn. Chandler lives in St. Louis Park, Minn. **Paul F. Dye** *(Aerospace)* is a senior flight engineer and head of the Mechanical Systems Section at NASA-Johnson Space Center in Houston, Texas. **Coleen A. Frink** *(Mathematics)* is a programmer analyst for Northern Telecom in Minnetonka, Minn. Frink lives in St. Louis Park, Minn. **Mark A. Hoffbauer** *(Chemical Physics, Ph.D.)* is a technical staff member at Los Alamos National Laboratory in Los Alamos, N.M. **Joseph P. Holewa** *(Electrical)* is a program marketing manager for Control Data Corp. in Calif. **David R. Janecky** *(Geochemistry, Ph.D.)* is a geochemist and technical staff member of the University of California Los Alamos National Laboratory in Los Alamos, N.M. Janecky, who earned his bachelor's degree in geology from the University of California in 1975, has published several technical papers. **Mark C. Joyce** *(Mechanical)* is a senior project engineer for TRW-VSSI in Washington. He is a member of SAE and the Oakland University Alumni Association. Joyce received an M.B.A. degree in 1990 from Oakland University.

1983

Ellen G. Anderson *(Civil and Mineral)* is a development engineer for the Minnesota Department of Transportation in Golden Valley, Minn. **Colleen B. Athans** *(Mechanical)* is manager of quality and technical planning for GE Aircraft Engines in Lynn, Mass. Athans, who earned her master's degree in manufacturing engineering from Boston University in 1989, received the Managerial Award, the Quality and Cost Reduction Award, and the Fred O. MacFee Award for Academic and Work Place Excellence from GE. **Michael T. Beaupre** *(Civil; 1986 Computer Science)* is a geotechnical engineer for the St. Paul District Corps of Engineers. Beaupre, who lives in Minneapolis, Minn., received a letter of commendation and cash award for his work on dewatering Lock & Dam No. 10. **Minh D. Bui** *(Chemical)* is a principal engineer for Unisys Corp. in San Diego, Calif. **Rebecca Ellis** *(Mechanical)* is vice president of J. M. Silverston and Associates, Inc. in Waltham, Mass. Ellis lives in Haverhill, Mass. **C. Gustavo Farell** *(Mechanical; 1987 M.B.A.)* is president and owner of Cesar-Scott, Inc. in El Paso, Texas. Farell founded a 20-employee manufacturing operation in Juarez, Mexico. The firm manufactures electronic and electromechanical products. **Robert J. Giorgi** *(Electrical)* is a senior software engineer and LAN system administrator for Martin Marietta Corporation in Orlando, Fla. He is a member of the Institute of Electrical and Electronics Engineers and is listed in *Who's Who in the South and Southwest* and *Who's Who in Emerging Leaders in America.* **Jeffrey A. Gorski** *(Geology)* is a senior sales engineer for Schlumberger Limited in Houston, Texas. He is a member of the Society of Petroleum Engineers and the Society of Petroleum Wireline Log Analysts. He received the Schlumberger Wildcatter Award. **Steven N. Hidy** *(Computer Science)* is a systems analyst for National Computer Systems in Eagan, Minn. He is a member of the Prime Users Group. **Vincent M. Hietala** *(Electrical, 1987 M.S., 1988 Ph.D.)* is a senior member of the technical staff at Sandia National Laboratories in Albuquerque, N.M. Hietala lives in Pacitus, N.M. **David L. Holmstrom** *(Computer Science)* is a principal software engineer at Medtronic Inc. in Fridley, Minn., where he. **Diane M. Kuberski** *(Civil and Mineral)* is a development assistant for Pro-life Action ministries in St. Paul, Minn. **Scott R. Messer** *(Mechanical)* is vice president and sales manager for General Sprinkler Corp. in St. Paul, Minn. Messer lives in Vadnais Heights, Minn. **Michael M. Moen** *(Mechanical)* is a mechanical design engineer for MTS Systems Corp. in Minneapolis, Minn. Moen lives in Brooklyn Park, Minn. **Eric H. Mohring** *(Geology, M.S.)* is a hydrogeologist for the State Board of Water and Soil in St. Paul, Minn. Mohring, who earned his bachelor's degree from Princeton University in 1979, is a member of the American Geological Union. **Jeff J. Murray** *(Chemical)* is an engineer for Intel Corporation in Santa Clara, Calif. Murray earned his master's degree from Stanford University in 1989 and expects to receive his Ph.D. from Stanford in 1991. He is a member of the Northern California Chapter of the American Vacuum Society and the Materials Research Society. He is the author of several research papers and received the Best Poster Award at the Intel Process Technology Conference in 1988 and the Best Student Paper Award at the 11th Crystal Growth Conference in 1989. **Jim M. Nehl** *(Mechanical)* is a manager of process engineering at Rosemount, Inc. in Burnsville, Minn. He completed an M.B.A. degree in 1988 at the College of St. Thomas.

1984

Bradley C. Boyle *(Civil)* is a project manager, facilities, for Northwest Airlines, Inc. in St. Paul, Minn. Boyle holds a U.S. patent for load cell technology. **Elizabeth A. Floyd** *(Mechanical)* worked as a project engineer for 3M Co. She is currently a full-time biomedical graduate student and lives in St. Paul, Minn. **Thomas S. Freeman** *(Electrical)* is a senior associate engineer for IBM in Rochester, Minn. Freeman received an IBM cash award for extra effort on the job. **Jeffrey G. Koenigsmark** *(Electrical)* is a senior design electrical engineer for Despatch Ind. in Minneapolis, Minn. Koenigsmark lives in Oakdale, Minn. **Keith A. Larson** *(Electrical)* is a lieutenant/submarines for the United States Navy in Orlando, Fla. Larson is currently pursuing an M.B.A. degree at Rollins College. **J. P. Little** *(Computer Science)* is a manager of knowledge engineering at United Health Corp. in Minneapolis, Minn. Little received a master's degree in computer science in 1989 from the College of St. Thomas. **Christopher D. McElligott** *(Geology, M.S.)* is an engineer for Malcolm Pirnie, Inc. in Minneapolis, Minn. **Doug J. Petesch** *(Aerospace)* is an applications analyst at Cray Research, Inc. in Egan, Minn., where he currently resides. He received a master's degree in aerospace engineering in 1985 at Stanford University. He is a member of AIAA and was awarded the Lockheed Leadership Fellowship for study at Stanford and the Cray Research Leadership and Innovation Award. **John F. Reed** *(Materials, M.S.)* is an R&D supervisor at 3M Co. in St. Paul, Minn. He currently resides in Arden Hills, Minn., and is the holder of two patents. He received his bachelor's degree in materials science and engineering in 1982 from Cornell University.

1985

Steven M. Baier *(Electrical, M.S.)* is a principal research scientist for Honeywell Systems and Research Center in Bloomington, Minn. Baier lives in Richfield, Minn. **Jeanne M. Blaskowski** *(Computer Science)* is a senior software engineer for Unisys Defense Systems, Inc. in Camarillo, Calif. Blaskowski, who lives in Port Hueneme, Calif., is a member of the National Association of Female Executives and the Twin Cities Sig. ADA. **Robert G. Booker** *(Aerospace)* is a mechanical engineer at Hughes Aircraft Co. in Conoga Park, Calif. He is a recipient of the Hughes Aircraft Co. graduate study fellowship. Booker received a master's degree in mechanical engineering in 1990 from the University of California--Berkeley. **Jayaram Bhasker** (Computer Science) is an MTS for AT&T Bell Laboratories in Allentown, Pa. **Alan L. Carlson** *(Mechanical, 1987 M.S.)* is a senior mechanical design engineer at Honeywell Residential/Building Controls in Golden Valley, Minn. He received the Honeywell

MOTEC award in 1988. **Nguyen T. Dang** *(Mechanical)* is a product development engineer for Semco/Courtaulds in Glendale, Calif. Dang, who lives in Gardena, Calif., holds several U.S. patents. **Timothy J. Haney** *(Aerospace)* is founder and president/chief engineer of Flight Engineering, Inc. in South San Francisco, Calif., where he resides. Flight Engineering, Inc. is an aeronautical engineering consulting firm that supplies data on air-craft performance to airlines. **Kevin J. Hyde** *(Mechanical)* is a system engineer at PRC, Inc. in Reston, Va. He received an M.B.A. degree in 1987 from George Washington University and is currently pursuing a Ph.D. degree in information technology at George Mason University. **George F. Klemmick, III** *(Geology)* is a project geologist at Addwest Minerals, Inc. in Arvada, Colo. **Lisa M. Lee** *(Geology)* is a professional engineer at Bar Engineering in Bloomington, Minn., where she currently resides. She is chair of the Private Practice Division Employee Advancement Committee and president of the Professional Engineers in Private Practice Committee of the Minnesota Society of Professional Engineers. **Thomas J. Lincoln** *(Civil)* is a project engineer for BRW, Inc., in Minneapolis, Minn. **Mark A. Loosbrock** *(Chemical)* is an engineer/instructor at Northern States Power, Prairie Island Nuclear Generating Plant, Training Center, in Welch, Minn. **Douglas G. Ohs** *(Mechanical)* is a production engineering manager for Heatex, Inc. in St. Paul, Minn. **Constantine S. Papageorgiou** *(Chemistry)* is a doctoral candidate in chemistry at San Diego State University in San Diego, Calif. He earned his master's degree in chemistry from the University of California--Santa Barbara in 1987 and received a San Diego State University Foundation Doctoral Scholarship. **Bruce R. Petersen** *(Computer Science)* is a software engineer for Empros International in Plymouth, Minn. **Steven P. Plager** *(Mechanical)* is a design engineer for Graco Inc. in Minneapolis, Minn.

1986

Rankin C. Ahlm *(Mechanical)* is a plant manager at Perrier Group of America in Calistoga, Calif. **Judson K. Champlin** *(Electrical)* is an attorney for Kinney & Lange in Minneapolis, Minn. Champlin earned his J.D. degree from William Mitchell College of Law in 1989. **Jim Chiodi** *(Mechanical)* is a project engineer for Gilbert Paper Co., Division of Mead, in Menasha, Wis. **Kenneth J. Dens** *(Mechanical)* is an engineer at Eastman Kodak in Rochester, N.Y. **David D. Koester** *(Mechanical)* is a mechanical engineer at Seagate Technology in Bloomington, Minn. **Steven E. Poss** *(Chemical)* is a senior development engineer for 3M Co. in St. Paul, Minn. **Brett R. Swanson** *(Chemical)* is a chemical engineer for Deluxe Corp. in Shoreview, Minn. Swanson lives in New Brighton, Minn. **Jon L. Wanzek** *(Civil)* is a project manager for Wanzek Construction in Fargo, N.D.

1987

Gregory D. Alm *(Computer Science)* is a computer programmer for Miles Homes, Inc. in Minnetonka, Minn. **Arthur E. Borland** *(Mechanical)* is a development engineer for Mammoth, a Nortek Company, in Plymouth, Minn. **Mark D. Conner** *(Mechanical)* is manager of product engineering for Dynamic Air Inc. in St. Paul, Minn. Conner lives in Plymouth, Minn. **B. Kevin Edgar** *(Astrophysics, Ph.D.)* is living in Minneapolis, Minn. **David B. Ellingson** *(Electrical, M.S.)* is a research engineer for Motorolo, Inc. in Fort Worth, Texas. **David B. Engmark** *(Mechanical)* is a mechanical design engineer for Supercomputer Systems Inc. in Eau Claire, Wis. **Eric J. Hansen** *(Geology)* is a hydrogeologist and geological engineer for L. Lehman & Associates in Burnsville, Minn. **Thomas J. Howard** *(Electrical/Mechanical)* is a logistics engineer in the United States Air Force in Ohio. Howard received a master's degree in management science in 1991 from the University of Dayton. He is living in Kettering, Ohio. **John E. Knudson** *(Metallurgy)* is a process engineer for Micron Technology, Inc. in Boise, Idaho. **Paul A. Kotz** *(Chemical)* works in Technical Services for BGF Industries in Greensboro, N.C. **Richard S. Nelson** *(Civil)* is an officer-in-charge of the 90th Aircraft Maintenance Unit of the United States Air Force at Elmendorf Air Force Base in Ark. **Bao Nsuyen** *(Electrical)* is a senior design engineer at Honeywell, Inc. in St. Louis Park, Minn. He received an M.B.A. degree in 1990 from the College of St. Thomas. **Erik J. Rasmussen** *(Mathematics)* is an assistant actuary for North American Life and Casualty Co. in Minneapolis, Minn. **Gary L. Ries** *(Civil)* is a research engineer for the Minnesota Department of Transportation Traffic Management Center in Minneapolis, Minn.

1988

Greg M. Carson *(Electrical)* is an electrical engineer for Control Data Corporation in Bloomington, Minn. He lives in Minneapolis, Minn. **Gbolahan I. Gbadamosi** *(Civil)* is a staff engineer for the State of Minnesota, Minnesota Pollution Control Agency, in St. Paul, Minn. **Pamela J. Gotz** *(Chemical)* is a project engineer for 3M Co. in St. Paul, Minn. Gotz won a Pollution Prevention Award for her work at 3M. **Peter W. Lee** *(Chemical, Ph.D.)* is a senior process engineer at Applied Materials, Inc. in Santa Clara, Calif. He currently holds two patents. **Gregory R. Ley** *(Mechanical)* is a mechanical engineer at Cardiac Pacemakers, Inc. in Arden Hills, Minn. He is living in River Falls, Wis. **Mark S. Nicpon** *(Chemical)* is a technical manager, tape products, for Lectel Corporation in Minnetonka, Minn. **Gregory J. Novak** *(Mechanical)* is a project engineer for Mereen-Johnson Machine Co. in Minneapolis, Minn. Novak is active in Toastmasters and several professional engineering societies. **Galen A. Peterson** *(Civil)* is an engineer with Bruce A. Liesch & Associates, Inc. in Plymouth, Minn., where he currently resides. **Rick A. Pierce** *(Mechanical)* is a quality engineer at Rosemount, Inc. in Burnsville, Minn. **Michael G. Richardson** *(Civil)* is a graduate student and undergraduate advisor at Ohio State University in Columbus, Ohio. **David A. Tettey** *(Geology)* is an environmental geologist for Braun Environmental Laboratories in Minneapolis, Minn. **Mark V. Weckwerth** *(Electrical)* is a doctorate student at Stanford University in Sanford, Calif., Weckwerth, who resides in Palo Alto, Calif. received his master's degree in electrical engineering in 1990 from Stanford University. **Ellen K. Weed** *(Electrical)* is currently an "at-home mother" in Maple Grove, Minn. She had been working as a regional sales manager for Honeywell Micro Switch in Edina, Minn.

1989

Steven J. Anderson *(Civil)* is a civil engineer with Bolton & Menk, Inc. in Mankato, Minn. **Richard A. Arett** *(Aerospace)* is a project engineer for Mico Inc. in Mankato, Minn. **Daniel J. Cokley** *(Civil)* is a civil engineer at Schmueser Gordon Meyer, Inc. in Glenwood Springs, Colo., where he resides. He received his bachelor's degree in 1987 from St. Scholastica. **Heidi E. Cramdall** *(Mechanical)* is a heat transfer engineer for General Electric Aircraft Engines in Cincinnati, Ohio. She lives in Westchester, Ohio. **Paul A. Elletson** *(Computer Science)* is a computer scientist for G. E. Corporate Research and Development in Schenectady, N.Y. **Kevin L. Erickson** *(Electrical)* is a design engineer for Zytec Corp. in Eden Prairie, Minn. **Peter K. Jongewaard** *(Geology, M.S.)* is a project geologist for Noranda Exploration Inc. in Hibbing, Minn. Jongewaard, who earned his bachelor's degree in geology from the University of Minnesota, Duluth, lives in Canyon, Minn. **Brad A. Kramer** *(Chemical)* is a process engineer for American National Can Co. in Minneapolis, Minn. **Daniel R. Morehead** *(Electrical)* is a sales engineer for Dexter Corporation in Chanhassen, Minn. He lives in Minneapolis, Minn. **Joseph C. Nelson** *(Computer Science)* is a programmer at Dynamix in Eugene, Ore., where he is just completing the development of his second independent software product to be marketed since graduating.

1990

William J. Baeten *(Electrical)* is a design analysis engineer at Honeywell, Inc. in Golden Valley, Minn. **Jeffrey A. Boettcher** *(Electrical)* is a research engineer at 3M Co., ES&T Division, in St. Paul, Minn. **Tracy L. Cowan** *(Electrical)* is a communication-computer systems engineer with the U.S. Air Force at the Hanscon Air Force Base in Mass. **Timothy L. Eiler** *(Mechanical)* is an astronaut training engineer at Rockwell Space Ops Co/NASA, Johnson Space Center, in Houston, Texas. Eiler, who was recently married, has been appointed Western Region field director for Triangle Fraternity. He has been accepted to the M.B.A. program at the University of Houston. **David Jensen** *(Electrical)* is a second lieutenant in the United States Air Force and is stationed at Holloman Air Force Base in N.M., where he works as an electrical design engineer, civil engineering. He was systems engineer for Honeywell's

integration of Global Positioning System and Inertial Reference System for use on the McDonald-Douglas MD-11 before being called to active duty. **Theresa L. Johnson** *(Mathematics)* is an actuarial assistant for Lutheran Brotherhood in Minneapolis, Minn. **Daniel J. Kloek** *(Electrical)* is an electrical engineer for Unisys in Roseville, Minn. **Sherman H. Kwan** *(Aerospace)* is an associate service engineer at Snyder General Corp. in Plymouth, Minn. **Kenneth M. Merdan** *(Mechanical)* is a senior designer for Advance Technical Services/Sci-Med Life Systems in Minneapolis, Minn., where he resides. Merdan recently founded EnTech Industries, a firm that specializes in mobile equipment design-environmental. **James Murray** *(Mechanical)* is now living in Rochester, Minn., working for IBM Co. He recently received an Area Achievement Award for his work on the new version of the AS-400 released in May 1991. **Thu H. Pham** *(Electrical)* is a research assistant for Hughes Training in Minneapolis, Minn., where he currently resides. **Ronald L. Siefert** *(Chemical)* is a graduate student at CalTech in Pasadena, Calif.

1991

Michael R. Dietrich *(Mechanical)* is a mechanical engineer at AFG Industries in Springhill, Kan. **John P. Hamre** *(Mathematics)* is a graduate assistant coach for the University of Minnesota hockey team. He is currently pursuing an M.B.A. degree at the University and is living in Roseville, Minn. **Cheng-Chen Hsueh** *(Materials Science, Ph.D.)* is a senior process engineer with National Semiconductor Corp. in Santa Clara, Calif. He is living in Mountain View, Calif. **Thomas J. Knutson** *(Civil)* is a pilot with Great Lakes Airlines in Spencer, Iowa. He is living in Chetek, Wis. **Julie M. Lind** *(Chemical)* is a research chemical engineer at General Mills, Inc. and is living in New Hope, Minn. **Dan M. Rieken** *(Aerospace)* is an ensign in the Navy and is living in Fridley, Minn. **Scott H.Weislow** *(Geology)* is an environmental consultant with Eneco Tech Midwest, Inc. in Bloomington, Minn. **David D. Winslow** *(Computer Science)* is living in Duluth, Minn., where he is pursuing a master's degree in computer science at the University of Minnesota. ■

"I found the experience very rewarding," Caddy continues. "When I received my first letter from an old friend, I couldn't wait for the mail to come. But, it didn't happen overnight. I wrote many letters and tracked down many clues before I completed my search."

If you're interested in a similar experience as a class associate, call Janet Schwappach, director of special programs, at 612/624-9561, or write Bill Caddy, chair, MADCAP Executive Commission, Institute of Technology, 107 Walter Library, Minneapolis, MN 55455. ■

Errata

Curtis Green (1946/Arch), founder of Hammel, Green, Abrahamson, Inc., was erroneously listed as deceased in the last issue of *ITEMS*. Several days after publication, IT experienced its first case of a founder rising from the Great Beyond when it received a letter from Green saying, "I am very much alive and well, putting in full energies to our architectural and engineering firm."

Also, our "IT 400" Special Issue listed incorrect information (corrected here) for the following three firms:

Nelson-Rudie and Associates
Minneapolis, MN
Founders: Dennis A. Nelson 65/CE, Scott F. Rudie 69/ME
Employees: 43 Sales (in $1000s): $2,400

Samsung Semiconductor
San Jose, CA
Founder: Sang Joon Lee 72/EE
Employees: 350 Sales (in 1000s): $500,000

Strgar-Roscoe-Fausch, Inc.
Minneapolis, MN
Founders: Robert Roscoe 67/CE, Peter Fausch 64/CE. ■

Viewpoint
continued from page 9

In turn, more natural scientists will be needed who can work closely with engineers on implications and data analysis.

In addition to taking a highly interdisciplinary approach, we need efficient mechanisms for the exchange of relevant results among these highly disparate disciplines, without overloading the demands on the scientists. This may require a cadre of scientists who are able to translate this multidisciplinary, complex information for use in the public realm.

Man is now a geological force on a par with nature.

As a result of perceived climate threat, shifts toward public demands for environmental quality also enhance the development of new products from engineers with global change perspectives. For example, in the area of paleoclimate research, there is a need for improved age data, and miniaturization of technologies also used in ocean sciences in order to obtain and better analyze core samples from a worldwide network of key lake sites. Marine science developed on the heels of technological breakthroughs that allowed scientists to probe the depths of the oceans. Many of these derived from defense efforts against enemy aggressors. Data collected to monitor nuclear explosions led to a revolution in earth sciences that we call Plate Tectonics. We can expect a similar symbiosis from current efforts in the collection of global environmental data as part of a defense against a collective threat.

The scope of global change has made scientists and engineers aware of our limited knowledge of global processes. Natural conditions are rarely in equilibrium, but reflect dynamic balances and continuous variability. Clearly, man is now a geological force on a par with nature. As with any defense effort, we should not confuse the timing to act with a desire to know everything. The role of science is not to produce unanimous democratic agreement, but to seek understanding by the doubting and testing of hypotheses. The challenge of climate change does not call for doomsday resignation, but is rather an opportunity to discover the Earth as a system, to intensify international solidarity, and seek new levels of technical quality that match the fundamental equilibria of our planet.

There is plenty to occupy generations of IT students, staff, and alumni. ■

Faculty

continued from page 23

Electrical Engineering

Professor ***Fred Bailey*** was a visiting professor at the Department of Computer Science of the Technical University of Madrid and the Institute for Industrial Automation in Madrid, Spain. Assistant Professor ***Stephen Chou*** was named a McKnight-Land Grant Professor. Chou also received a research equipment grant from Hewlett Packard Corporation. Associate Professor ***Douglas Ernie*** recently returned from a two-week visit to Japan where he gave invited talks at the International Seminar on Reactive Plasmas and the Fourth Japanese Symposium on Plasma Chemistry. Professor ***K. S. P. Kumar*** received the George Taylor Distinguished Service Award from IT. Associate Professor ***Ned Mohan*** completed a Visiting Erskine Fellowship at the University of Canterbury, Christchurch, New Zealand in January. Assistant Professor ***Ahmed Tewfik*** received a grant from Texas Instruments to support his research in speech processing. ***R. M. Warner, Jr.***, professor emeritus, is co-author of a new textbook, *Semiconductor-Device Electronics,* recently published by HRW-Saunders of Philadelphia, Pa. Warner's co-author, B. L. Grung, received his Ph.D. in electrical engineering from IT in 1977 and is currently employed by Honeywell, Inc. Assistant Professors ***R. Harjani, M. O'Keefe, J. Moon, and J. Zhu*** received National Science Foundation Research Initiation Awards. Moon also received an Engineering Foundation Research Initiation Award and an IBM Faculty Development Award.

Mechanical Engineering

Associate Professor ***Thomas R. Chase*** received the Outstanding Instructor Award from the IT Student Board. Assistant Professor ***Kevin J. Dooley*** was chosen as an examiner for the 1991 Minnesota Quality Award. Dooley and co-investigator John Anderson, associate professor of operations and management, also received a $60,000 grant from 3M Company for research on "Knowledge Bases for Continual Process Improvement." Professor ***Arthur G. Erdman*** received the American Society of Mechanical Engineers Dedicated Service Award. ***Richard J. Goldstein***, Regents' Professor, James J. Ryan professor, and department head, received the Max Jakob Memorial Award for 1990. Professor ***Warren E. Ibele*** received the Horace T. Morse-Minnesota Alumni Association Award. Professor ***Thomas H. Kuehn*** recently presented an invited paper titled "Heat and Mass Transfer in Occupied Buildings" at the Ninth International Heat Transfer Conference in Jerusalem, Israel. He also helped teach a short course on "Computer Assisted Modeling of Air Pollution," September 24-28, 1990, in Copenhagen, Denmark. Alumni Distinguished Professor ***Benjamin Y. H. Liu*** was awarded an honorary doctorate by the University of Kupio, Finland.

Physics

Professor ***John H. Broadhurst*** visited the Nihon University in Tokyo, Japan, as part of an exchange agreement between the two universities to focus on the development of undergraduate physics laboratories. Professor ***Charles E. Campbell*** was co-organizer of the Seventh International Conference on Recent Progress in Many-Body Theories held at the University in August. Assistant Professor ***James Kakalios*** was nominated for the David and Lucille Packard Fellowship in Science and Engineering. In honor of Regents' Professor Emeritus ***Alfred O. C. Nier's*** 80th birthday, the Isotope Geochemistry Group of Los Alamos National Laboratory held the Alfred O. C. Nier Symposium on Inorganic Mass Spectrometry in Durango, Colo. ■

DEATHS

Lt. Colonel Roger E. Bracken *(Mechanical 1950)*, 73, on October 6, 1991 at his home in Falls Church, Va. Bracken, who attended North High School in Minneapolis, Minn., was retired from the United States Air Force.

John Kelberer *(Electrical 1950)* on June 26, 1991. (See profile on p. 26.)

Milton Olson *(Electrical 1932; 1934 M.S.)* on September 3, 1991, in Syosset, N.Y. Olson was retired from Ebasco.

Leonard C. Odell *(Chemistry)*, 83, on October 4, 1991 at his home in Edina, Minn. Odell, who left IT before receiving his degree to begin working for his father, created the early Burma Shave jingles along with his brother, Allan. Odell's father, Clinton, hired a chemist to develop a brushless shaving cream, which he called Burma Shave. Sales of the new product were slow until Leonard and his brother began writing the popular jingles on a series of road signs. ("In this world, through thick and thin, man grows bald, but not his chin. Burma Shave.) At the peak of their popularity, there were some 7,000 signs posted along U.S. highways. The jingles helped his father's Burma-Vita Co. generate annual sales of $1 million. Odell served as vice president and secretary of the company and later as its president. In addition to his skills as a roadside poet, Odell was an accomplished jazz clarinet player.

Heinrich Wilhelm Rathmann *(Mines and Metallurgy 1931)*, 83, of West Chester, Pa., on August 28, 1991. Rathmann was a manager with the Metallurgical Process Development Division of Foote Mineral before he retired following 35 years of service. Prior to that time, he worked four years for Russian companies in Sverdlovsk, U.S.S.R. Rathmann, who was born in St. Paul, Minn., was a member of AIME and ASM.

Robert H. Teuber *(Mechanical 1950)* on June 2, 1991, in Lakeland, Fla. ■

IT DONOR PROFILE

Sophia and Jan Laskowski

Home:
Mountain View, California

Career:
Jan and Sophia graduated from IT's Department of Chemical Engineering and Materials Science exactly one year apart—Jan in 1968 and Sophia in 1969—each with a doctorate degree.

Following graduation, Sophia joined American Electric Power and Jan went to work for IBM in Poughkeepsie, N.Y. In 1970, the Laskowskis moved to San Jose, Calif., where Jan continued his work with IBM on system technology and Sophia worked in research for Electric Power Research Institute. In 1980, Sophia joined the ranks of IBM as well, where she currently serves on the technical staff to the site general manager.

Recent Gift:
Each year the Laskowskis generously contribute to the Department of Chemical Engineering and Materials Science through donations to scholarship programs, drawing on their employer's (IBM) matching gift program. "We wanted to pay back a little bit of what was given to us," say the Laskowskis, who are both members of the U of M President's Club. "IBM provides its employees with a very lucrative matching opportunity, currently providing a 5-to-1 match for IBM equipment purchases."

Quote:
"Minnesota was a great experience," Jan says. "One of the best decisions I made in my life. My education from IT rounded me out and built my self confidence on the theoretical end of the business."

Photo by Tom Van Dyke

IT WEEK 1992

Entrepreneurs to Share Expertise

If our Special Issue on entrepreneurship kindled a few ideas for starting a new business, the time to polish those ideas is during IT Week 1992. Among the highlights of IT Week—to be held May 4-8—will be a series of workshops on financing a start-up, marketing, communications, management, and other pertinent topics conducted by some of IT's most successful entrepreneurs and a conference on quality.

Although the complete itinerary for IT week is not yet set, the workshops (tentatively scheduled for May 7-8) and conference will allow IT alumni the opportunity to have their questions answered by other IT grads who have turned their entrepreneurial dreams into reality.

Joseph Juran (1924/EE), profiled in the last issue of *ITEMS*, and other nationally renown experts on quality, management, and productivity will address conference participants. A reception and banquet will be held after each day's workshops.

Science and Technology Day 1992 will also be held during IT Week, along with the class of 1942's 50th reunion and a Gold Plus reunion for IT alumni from all classes prior to and including the class of 1941.

For more information, contact Marilyn Scapanski at 612/626-9385. The next issue of *ITEMS* will contain the complete itinerary of workshop leaders and speakers, as well as events. The tentative schedule is listed below.

May 4-8

Monday, May 4

Opening Ceremonies

Tuesday, May 5

Sand Volleyball Tournaments

Wednesday, May 6

TECH FAIR: A two-day career fair for students featuring IT-founded companies.

Awards and Recognition Banquet: A banquet honoring IT student leaders.

OAA Luncheon: A gathering of all of IT's Outstanding Achievement Award winners.

IT Class of 1942 Reunion: A reunion featuring departmental receptions, tours, and activities prior to a dinner, and, possibly, an informal "engineers" gathering.

Gold Plus Reunion: A reunion dinner for IT alumni from the class of 1941 and all previous classes.

Thursday, May 7

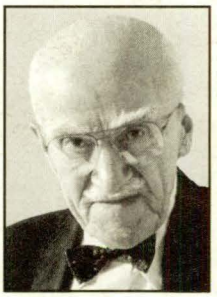
TECH FAIR

IT Press Conference: Announcing the second edition of the IT Founders' study.

S&T Day: Sponsored by the IT Alumni Society, a day-long event focusing on the "entrepreneurship" theme. Keynote speakers, a luncheon, and five tracks of workshops on everything pertaining to starting, growing, and managing a business are planned. All IT founders, IT alumni, IT class of 1942 attendees, Gold Plus reunion participants, OAA winners, and IT students are invited. Seating will be by class year and reunion participants will be recognized. Outstanding Achievement Awards will also be presented.

Friday, May 8

Quality Conference: A day-long quality conference and workshops featuring well known quality experts. The conference, which may be open to the public, includes IT founders, IT alumni, IT class of 1942 attendees, Gold Plus reunion participants, OAA winners, and IT students.



Joseph Juran 1924/EE

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