"CORRESPONDENCE TRACKING"

TYPE: INFORMATION DOCUMENT NUMBER: 9122382
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS

****

FROM: O'NEAL, Russell: ERIM

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 07/12/91

SUBJECT: RE: DR. BROMLEY'S ACCEPTANCE TO PRESENT THE KEYNOTE SPEECH AT THE THIRD ANNUAL CONFERENCE ON "EARTH OBSERVATIONS AND GLOBAL CHANGE DECISION MAKING: A NATIONAL PARTNERSHIP".

****

DIRECTORATE ASSIGNED: STAFF ASSIGNED:

ACTION REQUIRED: STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE: STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

****

COPIES TO: D. Allan Bromley
ENVIRONMENT

****

WHITE HOUSE TRACKING #: CONTACT PERSON:
PHONE: EXT:

REMARKS:

CLOSED

OSTP RECEIVED: 07/18/91 FILE: P-INVITATION-SPEECH
DEPT RECEIVED:

2382

NASA NOAA ERIM

Earth Observations & Global Change
Decision Making: A National Partnership

Fall Conference

RECEIVED
91 JUL 18 P6:09
OFFICE OF THE
DIRECTOR

12 July 1991

Dr. D. Allan Bromley
Assistant to the President for
Science & Technology
Room 358
17th & Pennsylvania Ave.
Washington, DC 20506

Dear Dr. Bromley:

On behalf of NOAA, NASA, and ERIM, sponsors of the Third Annual Conference on "Earth Observations and Global Change Decision Making: A National Partnership", I am again delighted that you, as Chief Scientist of the United States, will be able to join us on October 22, 1991 at the National Press Club as the conference's keynote speaker.

It has been very meaningful for you to articulate your vision of the United States' efforts in Global Change Research. Judging from participant and audience response following the first two national conferences, the meeting has proven to be a key forum for stimulating dialogue among U.S. partners and clarifying current thinking on global change science and policy issues. The conference proceedings, an important and widely distributed reference publication, provide an important record of our nation's science and policy efforts to respond to the needs of global environmental change. We are particularly grateful for your contribution to these meetings.

A program and list of participants will be sent to you under separate cover. Also, a member of the program committee will contact your staff to work out the details. The meetings will be held at the National Press Club and the keynote address is scheduled for 0915 on October 22.

Again, our thanks and I look forward to seeing you.

Sincerely,

Russ O'Neal ns

Russell D. O'Neal

P.O. Box 8618, Ann Arbor, MI 48107 313-994-1200, Ext. 3234 Fax: 313-994-0944 Telex: 4940991 ERIMARB

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION DOCUMENT NUMBER: 9121911
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS

****

FROM: WEERTMAN, Julia: NORTHWESTERN UNIVERSITY

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 06/27/91

SUBJECT: A THANK YOU FOR VISITING THE FACULTY AND STUDENTS OF THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT OF NORTHWESTERN.

****

DIRECTORATE ASSIGNED: STAFF ASSIGNED:

ACTION REQUIRED: STAFF ACTION:

****

SENDER'S DUE DATE:

OSTP DUE DATE: STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

****

COPIES TO: Steve Olson

****

WHITE HOUSE TRACKING #: CONTACT PERSON:
PHONE: EXT:

REMARKS:

OSTP RECEIVED: 06/27/91 FILE: P INVITATION-SPEECH ~~FOLLOW-UP~~
DEPT RECEIVED:

9/21/91

NORTHWESTERN

UNIVERSITY

RECEIVED

91 JUN 27 P 4:55

OFFICE OF THE DIRECTOR

ROBERT R. McCORMICK SCHOOL OF
ENGINEERING AND APPLIED SCIENCE

Department of Materials Science and Engineering

24 June 1991

Dr. D. Allan Bromley
Science Advisor to the President
Old Executive Building, Room 360
17th Street and Pennsylvania Avenue, NW
Washington, DC 20506

Dear Allan:

On behalf of all of us at Northwestern, and especially for the faculty and students of the Materials Science and Engineering Department, I wish to thank you for visiting us this past weekend. I have received many highly positive comments from my colleagues concerning your lecture. I think your lessons on the realities of the politics of science funding will be very beneficial for us all.

Quite apart from the Hilliard lecture, it was a great pleasure for Hans and me to meet you. I hope you made it back to NIH in time. I forgot to ask you about your air fare and cab fare when the limo broke down. We will be happy to reimburse you for these and any other expenses for the trip, but we do need the air ticket receipt.

Again, thank you for delivering our Hilliard Memorial lecture. It was a high point of our academic year.

With best regards,

Julia

Julia Weertman

TECHNOLOGICAL INSTITUTE 2145 SHERIDAN ROAD EVANSTON, ILLINOIS 60208-3108 708-491-3537 708-491-3587 FAX 708-491-7820

"INVITATION FOR DR. BROMLEY"

TYPE: INVITATION DOCUMENT NUMBER: 9123028

****

SPEECH: YES NO

FROM: HARRIS, Jack H.

DATE OF EVENT: 06/27/91

LOCATION OF EVENT:

TIME OF EVENT: 00 A.M.

SUBJECT: A BREAKFAST FEATURING A SPEECH ON THE SCIENCE ASPECTS OF SPACE STATION FREEDOM

****

RSVP:

CONTACT PERSON: MARGARET ROBERTS

CONTACT NUMBER: (703)391-6414

****

INVITATION ACCEPTED? YES NO

****

COPIES TO:

REMARKS:

CLOSED

DATE OF LETTER: 06/19/91 DATE RECEIVED: 06/19/91

FILE: P-INVITATION-SPEECH

CENTER for NATIONAL PROGRAM EVALUATION

June 19, 1991

Dr. D. Allen Bromley
President's Science Advisor
Old Executive Office Building
Washington, DC 20500

Dear Dr. Bromley:

Senator Garn, Senator Mikulksi, Senator Gore and the Center for National Program Evaluation, would like to invite you to speak on the science aspects of Space Station Freedom, at a breakfast to be given on June 27, 1991 from 8:30 to 10:00 in Dirksen 116 Senate Office Building.

The Center for National Program Evaluation is a nonprofit 501 (c)(3) organization set up in 1988 to study, review, and analyze significant information and events relating to U.S. national security and space policy.

The breakfasts are open to Congressional Members and staff only. This provides a good opportunity for candid discussion following your remarks.

Other planned breakfasts include the Astronaut crew from STS-40 on July 11, 1991 and one on the international aspects of the Space Station, speaker and date to be determined.

If you have any questions, please do not hesitate to call Margaret Roberts at 703-391-6414.

Sincerely,

Jack H. Harris
President

cc: Steve Olson

P.O. Box 3571, Reston, VA 22090 (703) 860-5150

THE CENTER FOR NATIONAL PROGRAM EVALUATION

1801 ROBERT FULTON DRIVE
RESTON, VIRGINIA 22091

TELECOPY TRANSMISSION SHEET

DATE: June 20 TIME: 1:30 PAGE 1 OF 2 PAGES

TO: Marian Nida

TO TELECOPIER NO:

CNPE CONFIRMATION NO: 703-391-6414

FROM: Margaret Roberts

TELECOPIER (703) 391-6495 ALTERNATE (703) 391-6496

MESSAGE:

Breakfast cosponsors include
Senators: Cranston
Dodd
Garn
Gore
Heflin
Mikulski
Robb
Warner

SENATOR CRANSTON *SENATOR DODD*
SENATOR GARN *SENATOR GORE*
SENATOR HEFLIN *SENATOR MIKULSKI*
SENATOR ROBB *SENATOR WARNER*
AND THE CENTER FOR NATIONAL PROGRAM EVALUATION

INVITE YOU TO ATTEND A BREAKFAST ON
THE SCIENCE ASPECTS OF
SPACE STATION FREEDOM

SPEAKER
DR. D. ALLAN BROMLEY
SCIENCE ADVISOR TO THE PRESIDENT

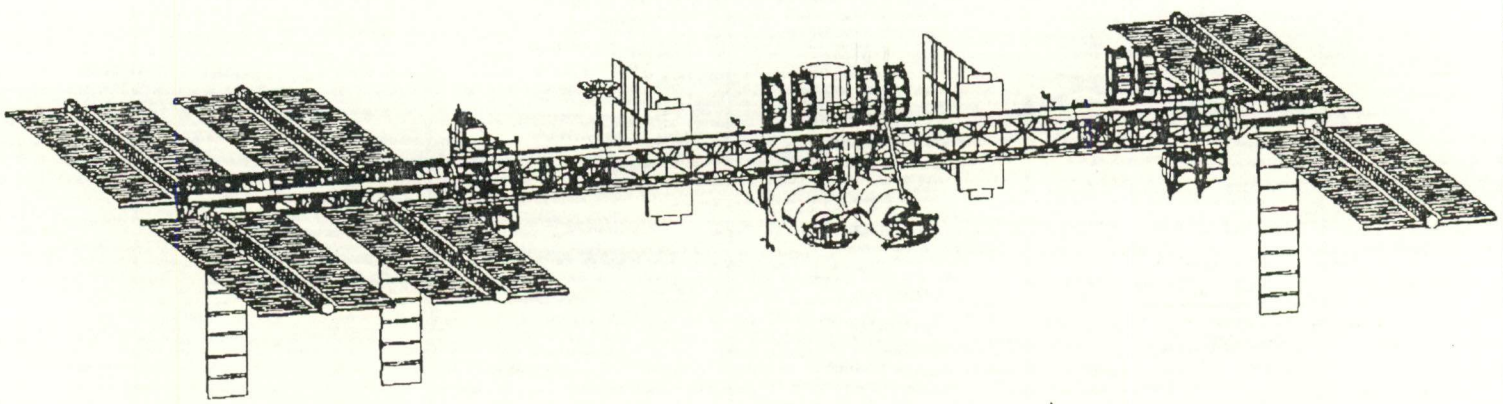
THURSDAY JUNE 27, 1991
8:30 AM TO 10:00 AM
116 DIRKSEN SENATE OFFICE BUILDING

SENATORS, CONGRESSMEN AND KEY STAFF ARE WELCOME
QUESTION AND ANSWER PERIOD TO FOLLOW

PLEASE RSVP TO MARGARET ROBERTS AT (703) 860-5150

CENTER FOR NATIONAL PROGRAM EVALUATION

Space Station



Breakfast

"INVITATION FOR DR. BROMLEY"

TYPE: INVITATION-SPEECH DOCUMENT NUMBER: 9121725

****

SPEECH: YES NO

FROM: ARCHES, William T.: U.S. CHAMBER OF COMMERCE

DATE OF EVENT: 07/16/91

LOCATION OF EVENT:

TIME OF EVENT: -9:15AM

SUBJECT: INVITATION TO ADDRESS THE U.S. CHAMBER'S INTERNATIONAL FORUM ON THE TOPIC "RESEARCH & DEVELOPMENT: THE ROLE OF GOVERNMENT & PRIVITE ENTERPRISE".

****

RSVP: 06/26/91

CONTACT PERSON:

CONTACT NUMBER:

****

INVITATION ACCEPTED? YES NO

****

COPIES TO:

REMARKS: 6/18/91 - Regretted to Gail!
MR

DATE OF LETTER: 06/10/91 DATE RECEIVED: 06/12/91

FILE: INVITATION-SPEECH

9121725

U.S. Chamber of Commerce

1615 H Street, N.W.
Washington, D.C. 20062
202/463-5455

RECEIVED

91 JUN 12 P4:53

OFFICE OF THE DIRECTOR

William T. Archey
Vice President
International

June 10, 1991

The Honorable D. Allan Bromley
Assistant to the President for Science
and Technology
Office of Science and Technology Policy
Old Executive Office Building, Room 358
17th Street and Pennsylvania Avenue, N.W.
Washington, D.C. 20506

Dear Dr. Bromley:

In February 1991, I wrote you inviting you to address the U.S. Chamber's International Forum on March 12 on the topic "Research and Development: The Role of Government and Private Enterprise." You did indeed show up on March 12 to speak at our Forum, but because your office had not notified us of your acceptance of our invitation, we reluctantly cancelled the meeting.

I hope you will once again consider an invitation to address our International Forum on the above-mentioned subject. Our members would be delighted if you could join us on Tuesday, July 16, and share your views of the current trends in U.S. competitiveness in the "cutting edge" technologies and the way you believe business and government need to interact in order to improve our future performance. An analysis of the recent report on the 22 critical technologies of the present and future would be of considerable interest to our audience.

The International Forum has become one of Washington's most prestigious platforms for the discussion of trade, foreign affairs and international economic policy. The Forum membership consists of over 200 senior executives of U.S. and foreign multinationals, corporate representatives, trade experts, and members of the diplomatic community. Members of the press also regularly attend our meetings, as they are on the record. Distinguished Forum speakers have included President Ronald Reagan, U.S. Trade Representative Carla Hills, House Majority Leader Richard Gephardt, and Senator Lloyd Bentsen.

The Forum meets from 8:00 to 9:15 a.m. in the Anheuser-Busch Briefing Center, located in the U.S. Chamber building at 1615 H Street, N.W., Washington, D.C. Upon completion of breakfast at approximately 8:20, we would like you to make brief formal remarks (about 15-20 minutes), followed by questions from the audience.

I hope you will be able to join us on July 16 and look forward to hearing from you soon as to whether or not you will be able to accept this invitation. If you have any questions about this event, please don't hesitate to call me.

Sincerely,

Bill Archey

William T. Archey

"INVITATION FOR DR. BROMLEY"

TYPE: CONGRESSIONAL INVITATION DOCUMENT NUMBER: 9121772

****

SPEECH: YES NO

FROM: McCAIN, John: U.S. SENATE

DATE OF EVENT: 01/17/92

LOCATION OF EVENT:

TIME OF EVENT:

SUBJECT: INVITATION TO PARTICIPATE IN A CONFERENCE ENTITLED, "ENERGY AND THE ENVIRONMENT: INTERSECTING GLOBAL ISSUES", AND A REQUEST TO PRESENT A KEYNOTE PAPER AT THE CONFERENCE.

****

RSVP: 06/21/91

CONTACT PERSON:

CONTACT NUMBER:

****

INVITATION ACCEPTED? YES NO

****

COPIES TO: Carl Bretscher
Ken Yale
Damar Hawkins
ENVIRONMENT

REMARKS:

DATE OF LETTER: 06/10/91 DATE RECEIVED: 06/17/91

FILE: P CONGRESSIONAL*INVITATION -SPEECH

1772

JOHN McCAIN
ARIZONA

COMMITTEE ON ARMED SERVICES
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
SELECT COMMITTEE ON INDIAN AFFAIRS
SPECIAL COMMITTEE ON AGING

RECEIVED

United States Senate

91 JUN 17 P2:53

OFFICE OF THE DIRECTOR

111 RUSSELL SENATE OFFICE BUILDING
WASHINGTON, DC 20510-0303
(202) 224-2235

TELEPHONE FOR HEARING IMPAIRED
(202) 224-7132

151 NORTH CENTENNIAL WAY
SUITE 1000
MESA, AZ 85201
(602) 835-8994

5353 NORTH 16TH STREET
SUITE 190
PHOENIX, AZ 85016
(602) 640-2567

5151 EAST BROADWAY
SUITE 170
TUCSON, AZ 85711
(602) 670-6334

June 10, 1991

The Honorable D. Allan Bromley
Assistant to the President for
Science and Technology
Office of Science and Technology Policy
Old Executive Office Building, Room 360
17th Street and Pennsylvania Avenue, N.W.
Washington, D.C. 20506

Dear Dr. Bromley:

On behalf of the University of Arizona, I would like to invite you to participate in a conference entitled Energy and the Environment: Intersecting Global Issues, to be held January 17 and 18, 1992, in Tucson, Arizona.

I understand that you have been contacted by Professor Guruswamy from the University, and that you have received preliminary information concerning this conference. It is hoped that you will be able to present a keynote paper at the conference, and participate in a national television seminar. The University has invited some of the most eminent scholars to participate in this event, and has already received many positive responses.

Your attendance at the conference would add to its success, and would highlight the importance of issues concerning energy and the environment.

I hope that you will be able to fit this most worthwhile event into your busy schedule. Thank you for your attention to this matter.

Sincerely,

John

John McCain
United States Senator

JM/vp

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

June 25, 1991

Dear Senator McCain:

Thank you for your invitation of June 10 for me to participate in the conference "Energy and the Environment: Intersecting Global Issues" on January 17 and 18, 1992, in Tucson, Arizona. Unfortunately, prior commitments make it impossible for me to accept the invitation, as much as I would have liked to visit Arizona in the middle of winter. I have contacted Professor Guruswamy from the University of Arizona to convey my regrets.

Thank you for thinking of me.

Sincerely,

D. Allan Bromley
Director

The Honorable John McCain
United States Senate
Washington, D.C. 20510-0303

"CORRESPONDENCE TRACKING"

TYPE: INVITATION-SPEECH DOCUMENT NUMBER: 9121680
ORIGINATOR: 02 STATUS I DIRECTORATE STATUS

****

FROM: SPAETH, Merrie: ARTHUR ANDERSEN & CO.

TO: DR. D.A. BROMLEY

DATE OF
CORRESPONDENCE: 06/04/91

SUBJECT: INVITATION TO SPEAK TO A GROUP OF NORTH TEXAS BUSINESS LEADERS. (THEY WILL CALL NEXT WEEK TO CHECK ON DR. BROMLEY'S AVAILABILITY)

****

DIRECTORATE ASSIGNED: DIRECTOR'S OFFICE

STAFF ASSIGNED:

ACTION REQUIRED: AS NECESSARY

STAFF ACTION:

****

SENDER'S DUE DATE:
OSTP DUE DATE: 06/24/91 STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:

****

COPIES TO: INDUSTRIAL
D. Allan Bromley

****

WHITE HOUSE TRACKING #: CONTACT PERSON:
PHONE: EXT:

REMARKS:

CLOSED

OSTP RECEIVED: 06/10/91 FILE: P-INVITATION-SPEECH
DEPT RECEIVED:

THE WHITE HOUSE

WASHINGTON

August 2, 1991

Dear Ms. Spaeth:

Some time ago you wrote me to ask if I could come to Texas to speak to a group of North Texas business leaders. As may have been conveyed to you by telephone, I would very much be interested in giving such a talk, but I cannot make a separate trip to Texas to do so.

What I would propose is that I keep your invitation available and if another event brings me south I will contact you.

Thank you for thinking of me.

Sincerely,

D. Allan Bromley
The Assistant to the President
for
Science and Technology

Ms. Merrie Spaeth
Arthur Andersen & Co.
901 Main Street
Suite 5600
Dallas, Texas 75202

9121680

ARTHUR ANDERSEN

ARTHUR ANDERSEN & CO., S.C.

Policy Briefings

RECEIVED

91 JUN 10 A10:58

OFFICE OF THE DIRECTOR

Recent Briefings

Gerald Ford
Former President of the United States

Edward Heath
Former Prime Minister, Great Britain

Carla Hills
United States Trade Representative

Casper Weinberger
Former Secretary, Department of Defense

Jeane Kirkpatrick
Former U.S. Ambassador, United Nations

Wendy Gramm
Chairman, Commodities Futures Trading Commission

Michael Shepherd
Deputy Comptroller of the Currency

Carol Hallett
Commissioner, U. S. Customs Service

Michael Darby
Under Secretary—Economic Affairs, U. S. Department of Commerce

Hideo Kagami
Ambassador, Japanese delegation, United Nations

Fred Zeder
CEO, Overseas Private Investment Corp.

Gen. Thomas Draude
Director, Defense Mgt. Review, Department of Defense

Dr. Richard Cyert
President, Carnegie Mellon University

Roger Wallace
Deputy Under Secretary, International Trade Administration, United States Department of Commerce

Dr. Sidney Jones
Assistant Secretary for Economic Policy, Department of Treasury

Philip Lochner
Commissioner, Securities & Exchange Commission

June 4, 1991

Dr. D. Allan Bromley
Executive Office of the President
Office of Science and Technology Policy
17th and Pennsylvania Ave.
OEOB - Room 360
Washington, DC 20503

Dear Dr. Bromley:

We wish to invite you to speak to a group of North Texas business leaders. We established a CEO Policy Briefing series more than four years ago, and we have accumulated quite a distinguished list of guest speakers during that time. The attendees are primarily corporate CEOs, presidents and other high level business executives representing a wide range of industries -- from Fortune 500 to emerging growth companies. The group numbers about 500, and attendance is usually between 25 and 80 or more.

The purpose of the Policy Briefing is to expose leaders in the business community to the trends and policies of the current administration and to allow the exchange of ideas between government and the private sector.

These breakfasts are sponsored as a public service by Arthur Andersen & Co., one of the largest accounting and consulting firms in the country. Since Arthur Andersen has offices across the nation, we could easily arrange events in other cities in addition to your stop in Dallas/Fort Worth. Most recently we scheduled events and press interviews for U.S. Trade Representative Carla Hills in both Dallas and Atlanta, SEC Chairman Richard Breeden in San Francisco, Treasury Deputy Secretary John Robson in Memphis, and others. You can see from the partial listing of past speakers at left that we have both prestige and diversity.

901 Main Street, Suite 5600
Dallas, Texas 75202
(214) 741-8300

801 Cherry Street, Suite 1200
Fort Worth, Texas 76102
(817) 335-7352

777 East Campbell Road, Suite 600
Richardson, Texas 75081
(214) 952-8500

These events are an excellent way to present your views to a key constituency and enlist them as your ambassadors. I learned the importance of these forums as a tool to reach key leaders and decision-makers in local business communities when I worked at the FBI, the FTC and in the Office of Media Relations at the White House under Reagan. We can maximize your exposure in a given area by arranging press interviews or selected company visits. For example, we would be able to coordinate newspaper editorial board meetings in both Dallas and Fort Worth, and/or interviews with local television and radio stations, including KRLD, the second largest all-news radio station in the country. KRLD feeds into the Texas State Network for statewide coverage.

Please let us know if you are planning a trip to the Southwest. We are also able to coordinate joint events with large non-profit organizations such as SMU, the Chamber of Commerce or the North Texas Commission, a group devoted to the economic advancement of North Texas. We will be in touch next week to check on your availability. We look forward to the opportunity to work with you and your staff in the future.

Sincerely,

Merrie Spaeth

Merrie Spaeth

"INVITATION FOR DR. BROMLEY"

TYPE: INVITATION-SPEECH DOCUMENT NUMBER: 9121625

****

SPEECH: YES NO

FROM: HOLME, Thomas A.: UNIVERSITY OF SOUTH DAKOTA

DATE OF EVENT: 10/06/92

LOCATION OF EVENT:

TIME OF EVENT:

SUBJECT: INVITATION TO PRESENT THE ESTEE LECTURE WHICH IS PART OF A FALL SEMESTER SERIES THAT EMPHASIZES THE IMPORTANCE OF SCIENCE EDUCATION, TO BE PRESENTED 10/92 IN SOUTH DAKOTA.

****

RSVP: 06/18/91

CONTACT PERSON:

CONTACT NUMBER:

****

INVITATION ACCEPTED? ~~YES~~ NO

****

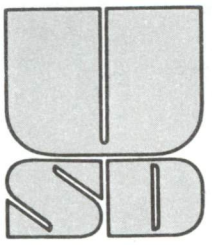
COPIES TO: INTERNATIONAL/POL

REMARKS:

DATE OF LETTER: 05/30/91 DATE RECEIVED: 06/04/91

FILE: P INVITATION-SPEECH

9121625



May 30, 1991

Dr. D. Allan Bromley
Office of Science and Technology Policy
Old Executive Office Building
17th St. and Pennsylvania Avenue NW
Washington, DC 20506

Dear Dr. Bromley;

The chemistry department of the University of South Dakota has recently instituted a fall seminar series that emphasizes the importance of science education. This series is named for Professor Charles Estee who was a dedicated chemical educator at the university for 44 years until his retirement this past spring. The department views the Estee Lecture as the premiere lecture event during the fall semester, serving as a counterpoise to our spring, research oriented keynote lecture, the Haines Lecture.

We have already scheduled the speaker for the lecture to be given in the fall of 1991. At this time, we would like to extend to you an invitation to present the Estee Lecture in October 1992. This far in advance, we have not set a specific date, but generally speaking Tuesdays are most convenient. If possible, October 6, 1992 would be ideal. This lecture includes a modest honorarium of $500, in addition to travel expenses for the speaker.

Our department has built a solid reputation for excellence in both education and research. We view the Estee Lecture as a cornerstone in our efforts to emphasize the role of universities in science education. Accordingly, we arrange our lecture series to separately highlight the role of higher education in research and education. We believe that such an environment is appropriate in the face of growing challenges to the scientific prowess of the country. Our hope is that by inviting you to address our campus, we will accentuate the expanded need for science education as a critical component of national science policy.

We recognize fully that your schedule may forbid you from accepting our invitation. We hope that by providing you with early notification we will be able to make arrangements for you to travel to South Dakota. Thank you for your consideration of this invitation. We look forward to hearing from you.

Sincerely;

Thomas A. Holme
Assistant Professor of Chemsitry
(605) 677-6189

THE WHITE HOUSE

WASHINGTON

June 10, 1991

Dear Professor Holme:

Thank you for your letter of May 30, 1991, inviting me to present the Estee Lecture in October 1992.

Since the date is so far in advance, would you please contact me again around the middle of 1992? As I am sure you are aware, Presidential requests require that I have a great deal of flexibility in my scheduling, particularly so close to an election, but I will be happy to try to accommodate your request.

I appreciate your thinking of me and look forward to hearing from you later next year.

Sincerely yours,

D. Allan Bromley
The Assistant to the President
for
Science and Technology

Professor Thomas A. Holme
Chemistry Department
The University of South Dakota
414 East Clark Street
Vermillion, South Dakota 57069

"INVITATION FOR DR. BROMLEY"

TYPE: INVITATION-SPEECH DOCUMENT NUMBER: 9121604

****

SPEECH: YES NO

FROM: REISENFELD, Herb: NATIONAL ALLIANCE FOR THE MENTALLY ILL.

DATE OF EVENT: 07/06/91

LOCATION OF EVENT:

TIME OF EVENT: 3:00PM

SUBJECT: INVITATION TO PRESENT THE KEYNOTE ADDRESS AT NAMI'S ANNUAL CONVENTION IN SAN FRANCISCO.

****

RSVP: 06/18/91

CONTACT PERSON: HERB REISENFELD

CONTACT NUMBER: 513/321-6228

****

INVITATION ACCEPTED? ~~YES~~ (NO)

****

COPIES TO: LIFE SCIENCES

REMARKS: 6/26/91 - Regretted to Mr. Reisenfeld. MR

(DAH is not available either!)

CLOSED

DATE OF LETTER: 05/30/91 DATE RECEIVED: 06/04/91

FILE: P INVITATION-SPEECH

9121604

NAMI

May 30, 1991

RECEIVED
91 JUN 4 A10:44
OFFICE OF THE DIRECTOR

D. Allan Bromley, MD
Assistant to the President
for Science and Technology
Old Executive Office Building, Room 360
17th St. & Pennsylvania Ave., NW
Washington, DC 20506

Dear Dr. Bromley:

I have read with great interest and admiration your comments in the recent edition of NAMI's research quarterly, The Decade of the Brain and that your office has been in close communication with NAMI's Office of Government Relations. Quite coincidentally, I am the father of Dan Reisenfeld, one of your former physics students at Yale. You may remember helping Dan gain admission to graduate work at Harvard's astrophysics program. For personal and professional reasons, I am therefore very grateful to you and wish to thank you.

I have also been heavily involved in NAMI's family movement, for the reason that Dan has an older brother who has been suffering from schizophrenia for twenty years. As a long-standing member of the NAMI Board of Directors, and its Treasurer, I would be thrilled if you could present the Keynote Address at our annual convention in San Francisco. I would be honored if you could find the time to attend the entire 3-day convention, which is scheduled for July 6th through 9th, but I would understand if your schedule permitted attendance on the date of the Keynote itself, currently scheduled for 3PM on Saturday, the 6th.

As I am sure you know, NAMI's 130,000 members have been the leading advocacy voice in the nation for implementation of the landmark national research plan in the neurosciences. Through research funding and support, family members of persons with serious mental illnesses, as well as those persons themselves, can envision a day when improved treatments, and ultimately cures, become available through scientific inquiry--and then life will once again become bearable for all of these people.

Please feel free to contact me at the address or telephone number shown on the letterhead, or by calling my office in Cincinnati at 513/321-6228. I look forward to hearing from you at your earliest convenience.

Sincerely yours,

Herb Reisenfeld

Herb Reisenfeld
Treasurer

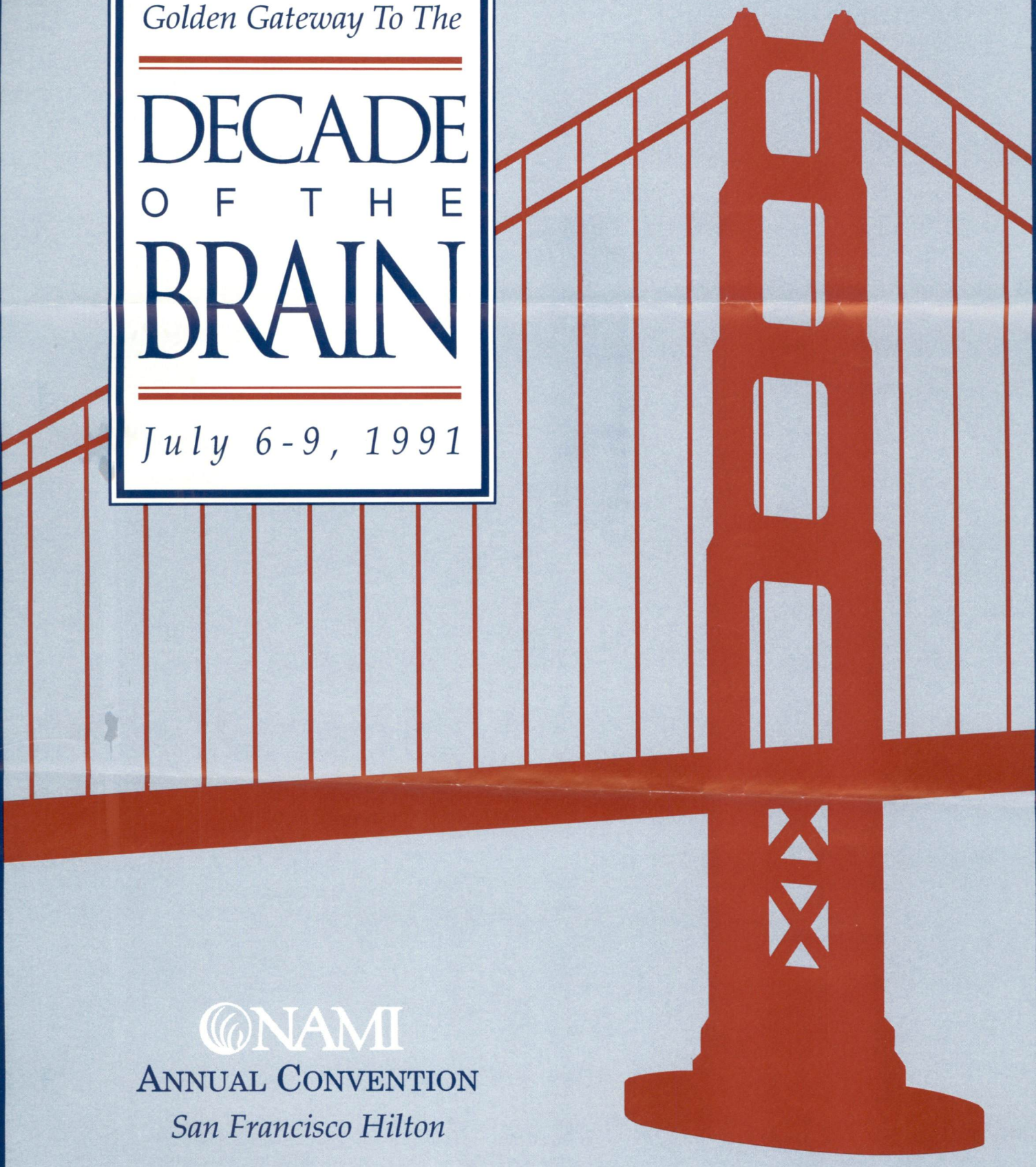
HR/bt

NATIONAL ALLIANCE FOR THE MENTALLY ILL
2101 WILSON BOULEVARD, SUITE 302 • ARLINGTON, VA 22201
703-524-7600 • FAX 703-524-9094

Golden Gateway To The

DECADE OF THE BRAIN

July 6-9, 1991



NAMI

ANNUAL CONVENTION

San Francisco Hilton

AT LAST...

The National Alliance for the Mentally Ill '91 Convention will be in everybody's favorite city—SAN FRANCISCO

The City

San Francisco! Beautiful, famous, controversial, exciting, and . . . the ideal convention site. It's a city where you can scale home-grown alps in antique cable cars, walk across the Pacific (on the Golden Gate Bridge), and island-hop by ferry. Keep reading for information on all of the exciting events we've planned for the 1991 Convention!

Program Highlights

OPENING SESSION *(July 6)*
Looking Ahead to the Decade of the Brain We've invited a very special keynote speaker to this year's opening session, Dr. Oliver Sacks, author of *Awakenings*. Don't miss this exciting presentation!

SERVICES DAY *(July 7)*
Services Plenary We've invited some of our top congressional supporters from California to address issues of vital importance to NAMI members—the national service system and the current state of services for those who depend on government-supported programs.

Special Topic Symposia and Workshops—*Planned sessions include:*

- *Public and Private Partnership in New Drug Development*
- *New Directions in Family Support and Education Programs*
- *Employment and Rehabilitation Programs That Work!*
- *Forensic Problems of the Mentally Ill*
- *Research on MH Services: Results of the MacArthur Project*
- *Advocating for Access to Medications*
- *Housing and the Homeless: How to Create One and Help the Other*
- *What Every NAMI Member Needs to Know About the New P&A Law*
- *Siblings and Adult Children's Network: Where Do We Go From Here?*
- *Compassionate Intervention—Not Police Action*

RESEARCH DAY *(July 8)*
Research Plenary We will highlight the work of three of NAMI's favorite researchers:
Floyd Bloom, M.D.; Director, Division of Preclinical Neuroscience, Scripps Clinic and Research Foundation
Jack Barchas, M.D.; Associate Dean of Neuroscience, UCLA School of Medicine
William Bunney, M.D.; Department of Psychiatry, University of California at Irvine

Ask the Doctors Sessions and Research Workshops will give you the opportunity to ask leading experts about mental illness and discover "the state of the art" in treatment. Sessions include:

- *The Genetics of Mental Illness*
- *How Body Chemistry Affects the Mind*
- *New Research in Affective Disorders*
- *Sexuality and Mental Illness*
- *Understanding Psychiatric Disorders in Children*
- *Update on Medication and Side Effects*
- *Overview of New Research in Schizophrenia*
- *New Research in Obsessive Compulsive Disorders*
- *The Assessment and Management of Violent Behavior*
- *AIDS Related Problems and Mental Illness*

Awards Dinner *(July 8)* Keynote Speaker: The Honorable Pete Wilson, Governor of California (invited)

SPECIAL TOURS There will be many interesting activities to partake in including a wonderful introductory tour of the city, a tour of the wine country, and a visit to Napa State Hospital. Register early and we'll send you details on each of these tours in your confirmation packet.

PRE-CONFERENCE SESSIONS: *(To attend these sessions you must pre-register for them.)*

- *Affiliate and Network Fundraising Day*—(July 5, 9:00 a.m.–5:00 p.m.) The $10 registration fee includes morning coffee and meeting materials. This conference will teach you valuable fundraising skills to share with your affiliate and network. For more information contact Lynne Saunders in Member Services at (703) 524-7600.
- *Curriculum & Training Forum*—(July 5, 9:00 a.m.–5:00 p.m.) The $10 registration fee includes morning coffee and meeting materials. For more information call Vicky Conn, C & T Chair, at (215) 356-1541.
- *Children and Adolescents' (NAMI-CAN) Network Meeting*—(July 5, 9:00 a.m.–5:00 p.m.) The $10 fee includes meeting materials and morning coffee. This full day conference will cover the following topics: Effectively Treating Children with Attention Deficit Hyperactivity Disorder; Creating Respite Services: Developing Comprehensive Community Services for Children; Planning Appropriate Education Programs; and Strengthening the Resiliency of Families. For more information call Rebecca Viers, NAMI-CAN Chair, at (505) 766-3034.

Golden Gateway To The

DECADE OF THE BRAIN

July 6-9, 1991

Convention Fees

- Early Bird Rates—NAMI members registering *before* May 31, 1991, will pay $160 per person.
  Nonmembers registering *before* May 31, 1991, will pay $200 per person.
- Last Minute Rates—NAMI members registering *after* May 31, 1991, will pay $175 per person.
  Nonmembers registering *after* May 31, 1991, will pay $220 per person.
- Consumer Rate—Consumers registering *before* May 31, 1991, will pay $100.
- Your registration fee covers the convention fee, the opening reception, the awards dinner on July 8, registration materials, and attendance at all sessions. It does not include your lodging or transportation costs. You must make these arrangements yourself.
- Day Rates—NAMI members registering for only one or two days will pay a registration fee of $60 per day.
  Nonmembers registering for only one or two days will pay a registration fee of $80 per day.

Reduced fees for early registration will not be available for day rate attendees. Day registrants will receive meal tickets for all meal functions which are scheduled on that day.

The deadline for all registrations is June 10, 1991!

Lodging Choices

San Francisco Hilton on Hilton Square
The Hilton is the site of all the convention activities and the most convenient lodging choice. NAMI recommends that attendees make their reservations at the Hilton. It is a beautiful hotel with sleeping rooms that are large and comfortable.
Single/Double—$90.00 per night Triple—$110.00 per night
To make reservations at the Hilton complete the hotel reservation form in this flyer or call Hilton Reservations (415) 771-1400. Be certain to tell them you are with the NAMI Convention.

Holiday Inn Union Square
The Holiday Inn, located at 480 Sutter Street, is a ten minute walk from the Hilton and has good-sized rooms. To make a reservation call (415) 398-8900. Be certain to tell them that you are with NAMI.
Single/Double—$70.00 per night Triple—$90.00 per night

King George Hotel
The King George, located at 334 Mason Street, is one block from the Hilton. Keep in mind that although it is a pleasant little hotel, the sleeping rooms are small. To make a reservation call (415) 781-5050. Be certain to tell them that you are with NAMI.
Single/Double Occupancy—$70.00 per night

ALL HOTEL RESERVATIONS MUST BE MADE BY JUNE 4, 1991!

Transportation

The Convention is scheduled to begin at 3:00 p.m. on Saturday, July 6 and conclude at 12:00 noon on Tuesday, July 9, so make your travel arrangements accordingly. (If you plan to attend a pre-conference session on July 5th be certain your travel plans reflect this.)

For your convenience we have designated three airlines as the official air carriers for the 1991 convention. Each of these airlines is offering a convention discount to NAMI members. You may choose to fly on whichever of the three airlines best meets your travel needs and still be guaranteed the convention discount. This discount can range from 40%–45% off normal coach fares!

- *To make reservations on United Airlines:* Call United toll-free at 1-800-521-4041. Be certain to give them the NAMI account number: 432RK.
- *To make reservations on American Airlines:* Call American toll-free at 1-800-433-1790. Be certain to give them the NAMI Star account: #SO271VR.
- *To make reservations on Northwest Airlines:* Call Northwest toll-free at 1-800-328-1111. Be certain to give them the NAMI Profile #08143.

All three of the official airlines fly into *San Francisco International Airport*, the most convenient airport to the convention site. Either you or your travel agent can make reservations by calling the appropriate numbers listed above. If you need assistance with your travel, call Karen Otter at *Global Travel*, the official travel agency of the NAMI convention, at 1-800-447-2455.

Registration Form

NAMI 1991 Annual Convention

NAME(s) _____

_____

(Print/type as you wish name(s) to appear on badge.)

FULL ADDRESS _____

CITY _____ STATE _____ ZIP _____

DAYTIME TELEPHONE Area Code: (___) _____

NAMI ID# _____ (# off NAMI Newsletter label)

PAYMENT INFORMATION (Check appropriate category of payment)

_____ $160 Early Bird member paid *before* May 31, 1991
_____ $200 Early Bird nonmember paid *before* May 31, 1991
_____ $175 Last Minute member paid *after* May 31, 1991
_____ $220 Last Minute nonmember paid *after* May 31, 1991
_____ $100 Consumer Rate paid *before* May 31, 1991
_____ $ 60 Day Rate (member) _____ $80 Day Rate (nonmember)
For day rates check day(s) you plan to attend:
_____ July 6, _____ July 7, _____ July 8, _____July 9

Pre-conference Sessions:

_____ $10 Fundraising Day (July 5)
_____ $10 Curriculum & Training Forum (July 5)
_____ $10 NAMI-CAN Network Meeting (July 5)

AMOUNT OF CHECK ENCLOSED $_____

AMOUNT OF CHARGE $_____ to: (check one.)
_____ VISA _____MASTERCARD

CHARGE ACCOUNT NUMBER _____

EXPIRATION DATE _____

SIGNATURE _____

Make check payable to and return to: **NAMI '91 Convention**
2101 Wilson Blvd., Suite 302, Arlington, VA 22201.

Cancellation Policy: It will be necessary to charge a $25 cancellation fee to cover operating costs if you cannot attend after registering. To cancel you must notify the NAMI Registrar in writing prior to June 20. No refunds can be made after this date!

SCHOLARSHIP FUND

Your donation will help us to sponsor client scholarships for the convention. You can contribute to the scholarship fund by adding a donation to your registration check or charge amount.

$_____ Amount of Donation

FOR OFFICE USE ONLY:

REG.# _____	**AMOUNT** _____
DATE RECEIVED _____	**DATE ENTERED** _____
CHECK# _____	**INITIALS** _____

Hotel Reservation Form

San Francisco Hilton on Hilton Square

_____	Single (1 person)	$90
_____	Double (2 persons, 1 bed)	$90
_____	Twin (2 persons, 2 beds)	$90

Check-in time is 3:00 p.m. Check-out time is 12:00 noon.

Each additional person in room (non-family member) is $20 per night. Maximum number in guest room is four.

Suites available starting at $195 & up. For suite information contact the Hilton at (415) 771-1400.

(Please type or print)

NAME _____

SHARING WITH _____

CONFIRM TO (Address) _____

CITY _____ STATE _____ ZIP _____

DAYTIME PHONE Area Code: (___) _____

ARR. DATE _____ HOUR _____ _ a.m. _ p.m.

DEPARTURE DATE _____

Rooms will be held until 6:00 p.m. To guarantee a late arrival, please provide a major credit card number:

CARD NAME _____

CARD NUMBER _____

EXPIRATION DATE _____

All room rates are subject to the prevailing California and San Francisco Accommodations Taxes which currently are 11%.

ROOM RESERVATIONS MUST BE MADE BY JUNE 4, 1991!

NATIONAL ALLIANCE FOR THE MENTALLY ILL
JULY 5–9, 1991

Return this form to: Reservations Manager
San Francisco Hilton on Hilton Square
One Hilton Square
San Francisco, CA 94102-9751

"INVITATION FOR DR. BROMLEY"

TYPE: INVITATION-SPEECH DOCUMENT NUMBER: 9121589

****

SPEECH: YES NO

FROM: TREAT, John E.: FORUM ON BUSINESS & TECHNOLOGY

DATE OF EVENT: 09/25/91

LOCATION OF EVENT:

TIME OF EVENT:

SUBJECT: INVITATION TO ADDRESS THE CONFERENCE, "THE FUTURE OF ACADEMIC RESEARCH AND SCIENCE FACILITIES" IN PHILADELPHIA.

****

RSVP: 06/17/91

CONTACT PERSON:

CONTACT NUMBER:

****

INVITATION ACCEPTED? ~~YES~~ NO

****

COPIES TO: INTERNATIONAL/POL

REMARKS: 6/26/91 - Regretted to John Treat!
MR

CLOSED

DATE OF LETTER: 05/27/91 DATE RECEIVED: 06/03/91

FILE: P-INVITATION-SPEECH

9121589

FORUM ON BUSINESS & TECHNOLOGY

RECEIVED

91 MAY 3 P12:35

OFFICE OF THE DIRECTOR

May 27, 1991

The Hon. D. Allan Bromley, Ph.D.
Assistant to the President for Science and Technology
Old Executive Office Building
17th Street and Pennsylvania Ave., NW -- Suite 358
Washington, DC 20506

Re: The Future of Academic Research and Science Facilities
-- conference in Philadelphia, September 25-27, 1991

Dear Dr. Bromley:

I'm writing to request your active support for this important meeting, at which a group of senior administrators and planners from U.S. universities will discuss plans and strategies for rejuvenating and maintaining our national academic research infrastructure. Enclosed is a full conference prospectus, for your reference.

We at Tradeline have been actively involved in coordinating opportunities for these people to exchange successful planning concepts, innovative financing approaches, and cost-effective design ideas. Inside the conference prospectus, you'll find a sample invitation from our last such event.

We have also been working recently with the "Higher Education Colloquium on Science Facilities," chaired by Senator Terry Sanford, in support of their efforts to establish guidelines for "efficient building methods," and to gather data on actual construction costs for university and industry labs.

I would like to invite you to address the audience at our next conference, sharing your insights into the changing environment for academic research, and offering your encouragement to those who are "in the trenches," working to create and re-create the infrastructure that will support U.S. science and science teaching. This would be a 30-minute presentation, preferably during the morning of September 25, though another day or time might also work.

I urge you to accept this invitation, and eagerly await your reply.

Very truly yours,

John E. Treat
Director of Program Planning

Enclosures: as described

TRADELINE, INC. • P.O. BOX 1568 • 115 ORINDA WAY • ORINDA, CALIFORNIA 94563
TELEPHONE (415) 254-1744 FAX (415) 254-2744

FORUM ON BUSINESS & TECHNOLOGY

University Science Facilities: Cost-Effective Plans and Management

Wednesday, Thursday and Friday
September 25-27, 1991

Sheraton Society Hill
Philadelphia

FORUM ON BUSINESS & TECHNOLOGY

TRADELINE, INC. P.O. BOX 1568 115 ORINDA WAY ORINDA, CA 94563 TELEPHONE: (415)254-1744

Contents

Event Profile

University Science Facilities: Cost-Effective Plans and Management

Wednesday, Thursday and Friday
September 25-27, 1991

Sheraton Society Hill, Philadelphia

- ➤ The New Environment for University Science
- ➤ Key Design Features for Successful Labs
- ➤ New Plans and Designs for Flexibility
- ➤ Decision-Making on Lab Interiors and Support Space
- ➤ Key Planning Issues for Lab Renovations
- ➤ Criteria for Selecting M/E Designs
- ➤ Latest Findings on Lab Standards
- ➤ Design Concepts for Research Productivity
- ➤ Project Delivery Strategies
- ➤ User Reports on Notable Recent Projects
- ➤ Strategies for Selecting A/Es and Contractors
- ➤ Costs, budgets and financial planning

A three-day planning conference on the latest concepts and strategies for creating successful, cost-effective research and science facilities. The program will be attended by research administrators, facilities planners and project managers from a variety of public and private institutions with major research programs and plans for upcoming facilities projects.

• Management & Planning Presentations • Technical Workshops •
• Case Reports • Open Forum Discussion Sessions •
• Luncheons • Hosted Breakfast • Wine Tasting Reception •
• Pre-Conference Reception •

Audience

Universities, colleges and medical schools that have been represented at recent Tradeline facilities planning conferences:

Albert Einstein College of Medicine
Baylor College of Medicine
Boston University Medical Campus
Brandeis University
Brigham Young University
Brown University
Carnegie Mellon University
Clemson University
Cornell University
Cornell University Medical College
Dartmouth College
Duke University
E Carolina University
Eastern Virginia Medical School
Frank J Seiler Research Lab USAFA
Fred Hutchinson Cancer Research
George Washington University
Georgetown University
Grand Valley State University
Harvard Medical School
Harvard University
Howard University
Indiana University Medical School
James Madison University
Johns Hopkins University
Kansas State University
LSU Medical Center
LSU School of Medicine
Massachusetts Institute of Technology
Medical College of Ohio
Medical University of South Carolina
Michigan State University
MIT Sloan School of Management
Moffitt Cancer Center
National Science Foundation
North Carolina State University
Northeastern University
NYU Medical Center
Oak Ridge Assoc. Universities
Ohio State University
Oklahoma University
Penn State University
Presbyterian Hospital
Princeton University
Purdue University
Rensselaer Polytechnic Institute
Stanford University
Stanford University Medical School
State University Construction Fund
State University of New York at Buffalo
Thomas Jefferson University
UBC-Campus Planning & Development
UC/Davis
UC/Irvine
UC/Irvine-College of Medicine
UCLA
UC/Riverside
UC/San Diego
UC/San Francisco
UC/Santa Cruz
University of Alabama at Birmingham
University of Alberta
University of Arizona
University of Chicago/Bioscience Div.
University of Cincinnati
University of Colorado Medical School
University of Connecticut Health Center
University of Idaho
University of Illinois College of Medicine
University of Illinois/Chicago
University of Illinois/Urbana-Champaign
University of Iowa
University of Kentucky
University of Kentucky Medical Center
University of Maryland
University of Maryland School of Medicine
University of Maryland Foundation
University of Massachusetts Medical Center
University of Michigan
University of Michigan-Cancer Center
University of Michigan Medical School
University of Missouri at Columbia
University of Nebraska-College of Medicine
University of North Carolina
University of North Dakota
University of Oklahoma-Health Sciences Center
University of Pennsylvania
University of South Carolina
University of South Florida
University of Tennessee

(continued)

Audience

University of Texas
University of Texas Health Science Center
University of Texas MD Anderson Cancer Center
University of Texas Medical Branch
University of Toronto-Facility of Medicine
University of Virginia
University of Washington
University System of New Hampshire
Virginia Commonwealth University
Virginia Tech University
Washington University
Wichita State University
Yale Medical School

Program

University Science Facilities: Cost-Effective Plans and Management

Day 1: Wednesday, September 25, 1991

CONFERENCE OVERVIEW (8:30-8:55 a.m.)

GUEST SPEAKER PRESENTATIONS (8:55-9:55 a.m.)

New National Priorities for Science and Research
Emerging and fast-growing fields to watch. Scientists and funds: where they will come from and where they will go. The effects of merging disciplines and interdisciplinary research. Specialty areas vs. broad programs. Implications for new university science programs, facilities and research environments.

The Latest Success Features for Functional, Cost-Effective Labs
Winning ideas to know about: corridor shcemes, "shell" lab space, lab mock-ups, cable tray systems. Mistakes to avoid: video-teleconferencing rooms, exposed roof-top HVAC, bench-top exhaust. Ideas still out for review: interstitial floors, programmatic buildings.

BREAK (9:55-10:20 a.m.)

PREVIEW OF CONCURRENT FORUMS (10:20-10:50 a.m.)
Brief introduction to each of the first day presentations.

CONCURRENT FORUM PRESENTATIONS (Session 1: 11:00 a.m.-12:15 p.m.)
Presentations on five of the following topics. Sponsors may submit alternate topics for consideration.

(1) New Directions and Key Planning Issues for Labs
Survey and analysis of recent successful lab projects. Evolving trends. Advanced concepts for laboratory support zones and work environments. Flexible approaches for lab layouts and usages. Strategies for interactive/intelligent building control systems. Designing for air quality.

(2) Decision-Making on Overall Building Concepts
Building shapes and number of floors. Options for image. Programming for modules and interiors. Open vs. closed labs. Windows for labs and offices. Utility distribution. Circulation, public spaces and service access. Flexibility, space efficiency and costs.

(3) Renovation Strategies for Research Buildings
New design criteria for exising labs. Evaluation of existing structures and utilities. Budgets and project feasibility. Strategies for continued occupancy. Wet vs. dry lab renovations. Pitfalls to avoid. Scheduling, staging and construction methodologies.

(4) Cost and Budget Implications of Key Project Elements
Results from an in-depth survey of university spending. Who's spending how much on what and why. Major decisions that impact costs. Trends and priorities. Justification of selected premiums. Recommendations.

(5) Decision-Making on Overall Mechanical System Approach
Survey and evaluation of alternative approaches to secondary air-handling systems for labs: VAV vs. constant-volume. Advantages and disadvantages of each. Cost comparisons. Criteria for decision-making. Examples from recent projects. Lessons and recommendations.

(continued)

Program

Day 1: Wednesday, September 25, 1991 (continued)

(6) Flexible M/E Design for Multi-Function Buildings
Design parameters that facilitate future modifications and adaptations. Criteria for evaluating alternative designs. Integration with architecture and structures. Special considerations for lab areas, classrooms and offices. Examples. Costs.

(7) Construction Lessons for Cost-Efficiency
Cost implications of flexibility and building systems issues: lab modules, hood/bench design standards, systems distribution. Survey of current costs of key lab components. Successful value-engineering target items. Design-phase management ideas.

HOSTED LUNCHEON (12:15-1:30 p.m.)

CONCURRENT FORUM PRESENTATIONS (Session 2: 1:30-2:45 p.m.)

BREAK (2:45-3:00 p.m.)

ROUNDTABLE DISCUSSIONS (3:00-3:45 p.m.)
Open discussions on topics of current interest: Siting decisions. Programming data. HVAC. Lab modules. Renovation projects. Project management. Costs, budgets and financial planning.

CASE STUDIES (3:45-4:35 p.m.)
Two reports on notable recent projects. Example follows:

Baylor College of Medicine's Taub and Smith Buildings
Two new institutional spec buildings for research, part of the east campus development project. Space palnning and development. Building systems. Cost-saving decisions and trade-offs. Forward planning for "Research 2000." Recommendations.

WINE TASTING RECEPTION (4:35-6:00 p.m.)

* * *

Day 2: Thursday, September 26, 1991

HOSTED BREAKFAST MEETING (7:00-8:00 a.m.)

ROUNDTABLE DISCUSSIONS (8:10-8:55 a.m.)
Open discussions on topics of current interest: Siting decisions. Programming data. HVAC. Lab modules. Renovation projects. Project management. Costs, budgets and financial planning.

CASE REPORTS (9:00-9:50 a.m.)
Two reports on notable recent projects. Example follows:

UC San Diego's Engineering Building Unit I
Post-occupancy evaluation of this 215,000 sf, $46 million project, completed in March 1989. Program requirements and design solutions. Concepts for research and teaching labs. Building systems and utilities. User reactions. Best ideas for other projects. Lessons learned

(continued)

Program

Day 2: Thursday, September 26, 1991 (continued)

PREVIEW OF "ARMCHAIR TOURS" (9:50-10:20 a.m.)
Brief introduction to each of the second day presentations.

BREAK (10:20-10:40 a.m.)

CONCURRENT "ARMCHAIR TOURS" (10:40-11:30 a.m.; 11:40 a.m.-12:30 p.m.; 1:40-2:30 p.m.)
Six presentations on recent projects of national significance. Example follows:

U. Penn's Institute of Advanced Science and Technology
A new 260,000 sf complex which will incorporate facilities for bioengineering, chemical engineering, chemistry, computer sciences, and cognitive sciences research. Integration of architectural and engineering systems. Daylighting concepts. Project costs. Recommendations.

HOSTED LUNCHEON (12:35-1:35 p.m.)

BREAK (2:30-2:45 p.m.)

SPECIAL REPORT (2:45-3:15 p.m.)
Report on recent technological developments and facilities planning implications. Example follows:

Strategies for Low-Level Radioactive Wastes
Coming changes in legislation and disposal methods. Management and technical issues. Survey of technologies for handling and disposal. Options and decision-making. Costs. Implications for facilities plans and operations.

HOSTED DINNER/ENTERTAINMENT EXTRAVAGANZA: TO BE ANNOUNCED (4:00-7:00 p.m.)

* * *

Day 3: Friday, September 27, 1991

HOSTED BREAKFAST MEETING (8:00-9:00 a.m.)

SURVEY RESULTS FOR KEY LAB DESIGN ISSUES (9:00-11:15)
Three reports on the pros and cons of specific solutions to pressing design challenges, based on actual field data from a selection of recent projects. Example follows:

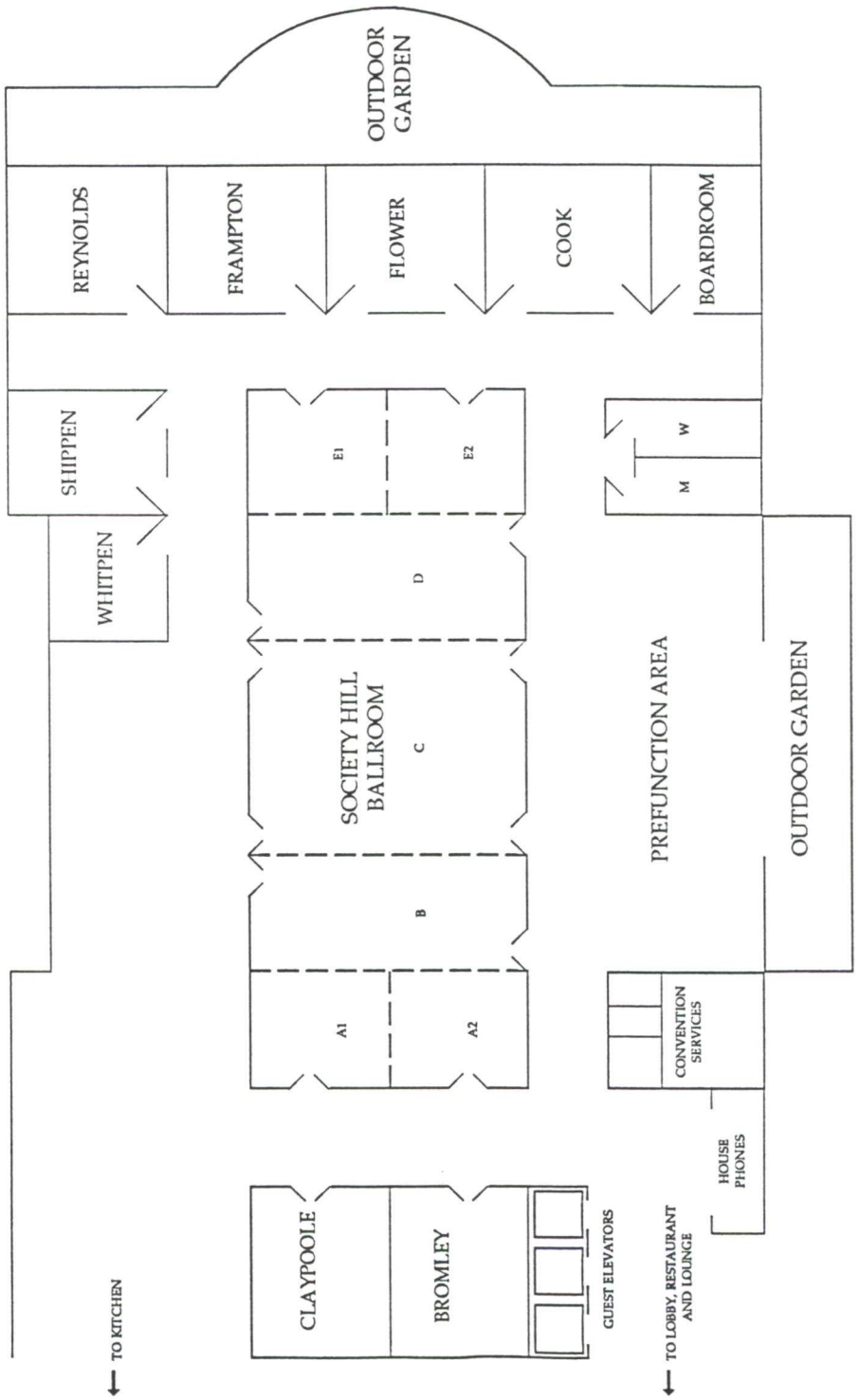
Lab-Office Relationships
Results from a survey of six university science buildings. What was built and why. Programmatic requirements. Trade-offs. Costs. User reactions and feedback. Analysis of successful and unsuccessful approaches. Lessons and recommendations. Planning lessons.

FOCUSING ON FACILITY INVESTMENTS THAT WORK (11:15 a.m.-12:00 noon)
Nine key features for university science building plans. Overall facility concepts. Work environments. Utility systems. Project organization and management. Managing user groups. What others are doing. Questions and answers.

ADJOURN (12:00 noon)

Conference Facilities

Sheraton Society Hill Philadelphia



Promotion & Endorsements

Advance publicity and direct mail invitations handled by Tradeline. Tradeline's prime list consists of approximately 3,000 names. Sponsors may furnish their own lists of firms to be invited.

Formal invitations to be mailed July 19, 1991.

Advertising and stories in **Facilities Planning News**, July 1991 issue.

Background

PROGRAM EVALUATIONS

Tradeline conferences consistently receive high audience ratings for providing substantive, leading-edge content and for being exceptionally well-organized. On average, more than 90% of attendees rate the conference as good or excellent. The average rating for the nine most recent conferences is as follows:

Excellent	Good	Satisfactory	Poor
55%	40%	4%	1%

The highest-rated program in the past year earned this audience rating:

Excellent	Good	Satisfactory	Poor
70%	30%	0%	0%

Here are some of the things attendees say about the conference:

*"Very nice; well organized; **good** speakers."*

"I came back with helpful suggestions from all sessions."

"Please notify me of future conferences!"

"The conference was professionally organized, well thought out & planned, highly informative and educational. Thanks!"

"My compliments for a well-organized, well-planned and well- presented conference."

"I must list this conference among the best that I have attended, start to finish."

"Fantastic format - especially beneficial since it permitted ample opportunity to interact."

"Easily the best conference I have attended for some time."

"The conference was intense, informative, helpful and enjoyable."

"The format was excellent, interesting and quick!"

"The first conference I've been to where everything started on time. Good job!"

Background

Representative sponsors of past Tradeline conferences include:

Service Organizations

3D International
A.M. Kinney Associates
Affiliated Engineers, Inc.
Anderson DeBartolo Pan
Anshen - Allen
Arthur D. Little, Inc
BBN Laboratories
Ballinger
Barton Malow
Bobrow/Thomas and Associates
Brown & Caldwell
Buss, Silvers and Hughes
Cabot Cabot & Forbes
CH2M-Hill
CRSS
CUH2A
Curtis Cox Kennerly
Daverman Associates
Davis Brody & Associates
Davy McKee
deTienne Associates
DMJM
Earl Walls Associates
Ellerbe Beckett
Engineering Science, Inc. (Parsons)
Fitness Systems, Inc.
Flack + Kurtz
Flad & Associates
Gilbane Building Company
Greiner Engineering
H2L2
Haines Lundberg Waehler
Hansen Lind Meyer
Harley Ellington Pierce Yee
The H.K. Ferguson Company
HMBH Architects
HOK Architects
Holabird & Root
Jacobs Engineering Group
Kaplan/McLaughlin/Diaz
KZF Incorporated
Leo A. Daly Company
Lester B. Knight & Associates
Lockwood, Andrews and Newnam
Lockwood Greene
Lohan Associates
McCarthy
McLellan & Copenhagen
Marenzana Group
MBT Associates
NBBJ Group
O'Brein/Atkins Associates
Odell Associates
Payette Associates
Perkins & Will
Peter A. Lendrum Associates
PBS Building Systems
Research Facilities Design
R.G. Vanderweil Engineers
Robert Morris Associates
Robinson, Mills and Williams
Russell Gibson von Dohlen
RTKL Associates
Smith Hincvhman & Grylls
Stone, Marraccini & Patterson
Symmes, Maini & McKee Associates
TAC, The Architects Collaborative
The Austin Group
The Carlson Group
The Hillier Group
The Kling-Lindquist Partnership
The PHH Design Group
The Sigel Group
The Stubbins Associates
Triad Technologies
Whisler-Patri
Woodward-Clyde

Furniture & Equipment Suppliers

Auto-Trol Technology
Fisher Scientific - Comtempra
Hamilton
Haworth
HEMCO
ISEC
JG Furniture Systems
Labmarc Corporation
Permalab Equipment Company
Phoenix Controls Corporation
SunarHauserman
Tate Access Floors
Thomas & Betts

(continued)

Background

Development Agencies

Anne Arundel County Office of Economic Development
Arkansas Industrial Development Commission
Baltimore Gas & Electric
Blount County/Tenn.
Cache County Economic Development/Utah
California Dept. of Commerce
Charlotte Chamber of Commerce
Colorado Office of Business Development
Dayton Development Council
Denver Chamber of Commerce
Florida Industrial Development Department
Illinois Department of Commerce
Ireland Industrial Development Authority
Massachusetts Dept. of Commerce & Development
METRO-UTAH
Nebraska Department of Economic Development
Oklahoma Department of Economic Development
Pacific Gas & Electric
San Antonio Economic Development Foundation
San Diego Economic Development Corp.
Solano County Development Corp./CA
State of Arizona
State of Colorado
State of Iowa High-Tech Council
State of Maryland
Texas Economic Development Commission
Utah Economic Development Office

Other Organizations

Corporate Design & Realty
Facilities Planning News
Hospital Council of Southern California
Semiconductor Industry Association

Background

Other recent Tradeline conferences on national management and technical issues include:

R&D Facilities: New Concepts for Flexible, Cost-Effective Buildings
San Diego, 1990

Corporate Training, Education and Conference Facilities
San Francisco, 1990

Cost-Effective Corporate Facilities: The Next Generation
Boston, 1990

Animal Research Facilities: Advanced Planning Concepts
Philadelphia, 1990

University Science & Research Facilities
San Francisco, 1990

Healthcare Facilities: The Next Generation
Boston, 1990

R&D Facilities: New Concepts for Flexible, Cost-Effective Buildings
Philadelphia, 1990

Cost-Effective Corporate Facilities of the Future
Newport Beach, 1990

Research Animal Facilities: New Plans & Designs
Austin, 1990

R&D Facilities: The Next Generation
San Francisco, 1989

Planning & Constructing Special-Purpose Facilities
San Francisco, 1989

University Research Facilities: New Plans & Systems
Boston, 1989

Process & Production Facilities for the 1990's
Philadelphia, 1989

Corporate Training Facilities: New Plans & Designs
Boston, 1989

R&D Facilities: The Next Generation
Philadelphia, 1989

Cost-Effective Corporate Facilities of the Future
Phoenix, 1989

(continued)

Background

R&D Facilities: Changing Concepts & Standards
San Francisco, 1988

New Biotechnology Facilities for the 1990's
San Francisco, 1988

Flexible Open/Closed Offices of the Future
Philadelphia, 1988

User/Developer Joint Venture Projects
Boston, 1988

Flexible High-Tech Facilities
San Francisco, 1988

New Biotechnology Facilities for the 1990's
Boston, 1988

R&D Facilities: Changing Concepts & Standards
Philadelphia, 1988

New Corporate Facilities for the 1990's
San Diego, 1988

The R&D Facility of the Future
San Francisco, 1987

Planning New Biotechnology Facilities for the 1990's
San Francisco, 1987

Knowledge Workers: High-Tech Facilities for the 1990's
Boston, 1987

The 1987 High-Tech Facilities Conference
San Francisco, 1987

Flexible Corporate Facilities for the 1990's
Boston, 1987

R&D Facilities: Changing Concepts & Standards
Boston, 1987

Elderly Care Programs for the 1990's
Tampa, 1987

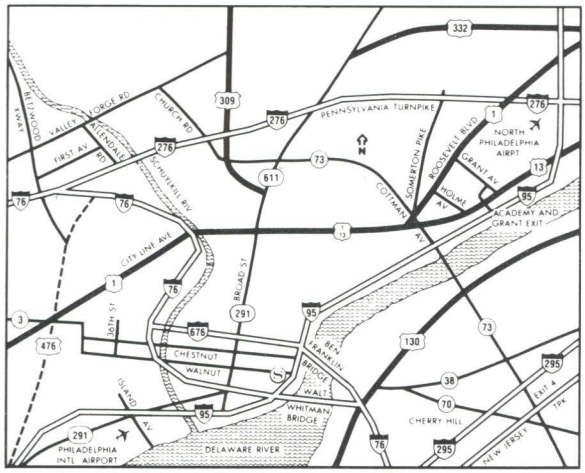
The R&D Facility of the Future
San Francisco, 1986

PHILADELPHIA, PENNSYLVANIA

Sheraton Society Hill Philadelphia

The hospitality people of ITT

One Dock Street
Philadelphia, PA 19106
215-238-6000



For reservations at one of over 500 Sheratons worldwide call toll-free 800-325-3535 in the U.S. and Canada. Or call your travel agent.

For free Sheraton Hotels & Inns Directory write Sheraton Directory, Sixty State Street, Boston, MA 02109

(150,000)

PHILADELPHIA PENNSYLVANIA

Sheraton Society Hill

Red carpet on t

Surround yourself in the comfort of The Courtyard. Our four-story atrium, with it's splendid skylight ceiling, captures all the charm of a lush Society Hill garden.

Settle down to coffee and the morning paper in an overstuffed chair. Or gather for cocktails and conversation under the trees. It's the perfect prelude to a night on the town. Or the perfect place to just relax and enjoy the sounds of Chopin on the grand piano.

The Sheraton Society Hill is the only fine hotel designed and built with the success of your meeting in mind. Our Society Hill Ballroom is an impressive setting for meetings, receptions and grand banquets. We feature a plush executive boardroom and nine private meeting rooms, most of which open out onto a formal garden. There's even an in-house audio visual company and a staff of Conference Coordinators to assist in keeping plans and proceedings running smoothly.

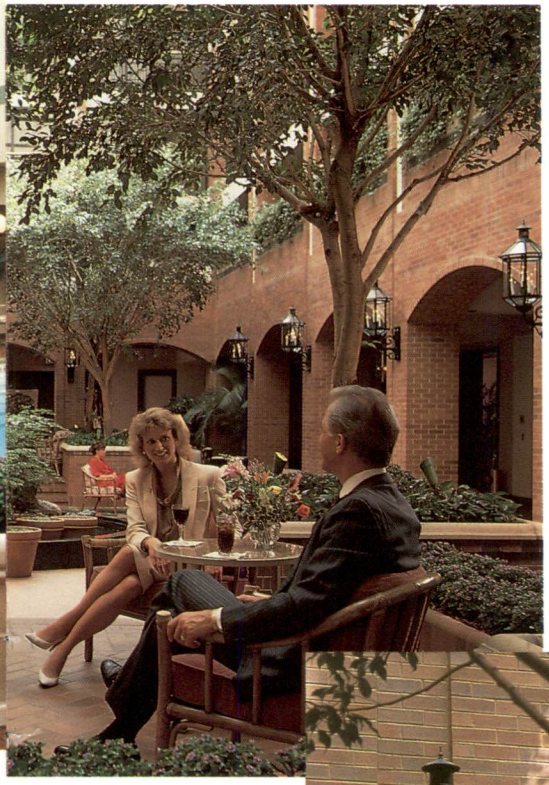
Take a moment and escape to our tropical indoor pool, sparkling beneath a glass sunroof. Or, for a fresh change of pace, make arrangements to enjoy a poolside breakfast or afternoon salad. Our room service staff is attentively at your call 24 hours a day.

Float tension away in our heated whirlpool or gear up for a work-out and sauna in our fitness center.

he cobblestones

Welcome to the only fine hotel in the heart of Philadelphia's most historic and exciting neighborhood. The only fine hotel to anticipate your every need. With an attentive and professional staff devoted to the belief that little things mean a lot.

Welcome to the Sheraton Society Hill.



Discover Americus, our premier restaurant, and enjoy sumptuous fare, delicately prepared with imagination and flair.

Built on the site of the colonial Dock Street Market, Americus blends the traditions of freshness and quality of that bygone era with contemporary culinary know-how. The result is innovative cuisine served morning, noon and night, in the most elegant surroundings.

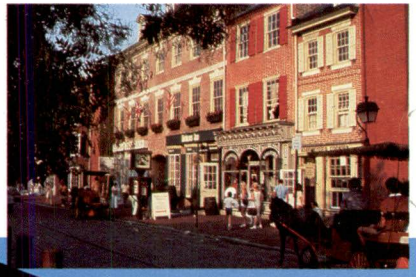
For centuries, attention to personal service has been the hallmark of the Concierge. In keeping with this tradition, we've assembled a full Concierge staff who go beyond the expected to perform last minute miracles.

Accommodations number 365 guest rooms, including 17 suites. Each is thoughtfully appointed in traditional style. Yet all feature up-to-the-minute amenities as a private bar and first-run movies on your remote control television.

Step out on the town without ever leaving the hotel. Our own video dance club, Spectacles, is one of Philadelphia's sizzling hot spots. Enjoy complimentary hors d'oeuvres, great dancing and the most sophisticated music video entertainment around. Everybody looks better in Spectacles!

We're the only fine hotel surrounded by a 300-year old Colonial neighborhood. And a shopping, restaurant and nightlife renaissance that's making new history in Philadelphia.

Ride a horse-drawn carriage and tour the most historic square mile in America. Independence National Historic Park, with Independence Hall and the Liberty Bell, is right next door. And the vibrant Penn's Landing riverfront, site of city celebrations, fairs and festivals, is right in our own backyard.



Stroll down cobblestone streets where quaint shops and trendsetting boutiques wait to be explored. Then sample a famous Philly cheese-steak or soft pretzel on the same corner where you'll find Cajun gumbo and country paté. It's all just steps away from your room.

Photographs of historic sites courtesy of
the Philadelphia Convention and Visitors Bureau

FACILITIES

THE NEXT GENERATION

1991 CONFERENCES:

New Building Concepts, Systems, & Work Environments

FORUM ON BUSINESS & TECHNOLOGY

TRADELINE, INC. P.O. BOX 1568 ORINDA, CA 94563 (415) 254-1744

Tear here.

FORUM ON BUSINESS & TECHNOLOGY
A TRADELINE PROGRAM

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 226 ORINDA, CA

POSTAGE WILL BE PAID BY ADDRESSEE

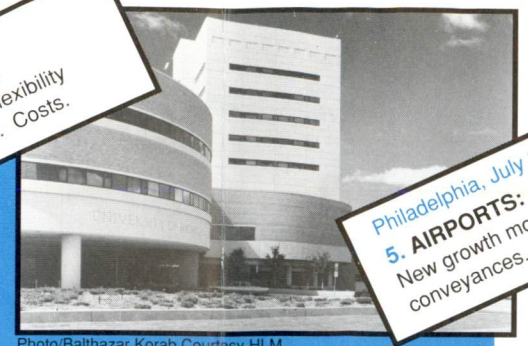
TRADELINE, INC.
P.O. Box 1568
Orinda, CA 94563-9949

NEW DATA, STANDARDS & RECENT FINDINGS YOU CAN BUILD ON

FORUM ON BUSINESS and TECHNOLOGY

TRADELINE, INC.
P.O. BOX 1568
ORINDA, CA 94563
415-254-1744

Houston, April 4-5
1. BIOMEDICAL RESEARCH FACILITIES
New concepts for multi-function buildings. Flexibility plans. Space standards. Building systems. Costs.

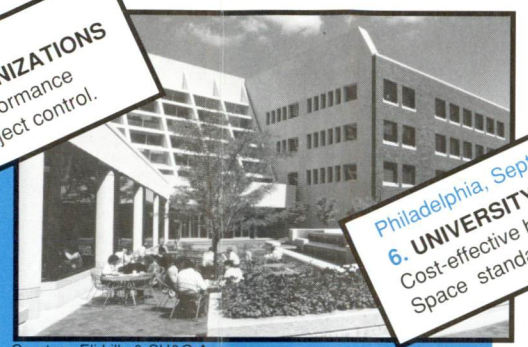


Photo/Balthazar Korab Courtesy HLM

Philadelphia, July 31 - August 1
5. AIRPORTS: NEW EXPANSION STRATEGIES
New growth models & designs. Terminals. Traffic & conveyances. Handling. Amenities. Environmental plans.

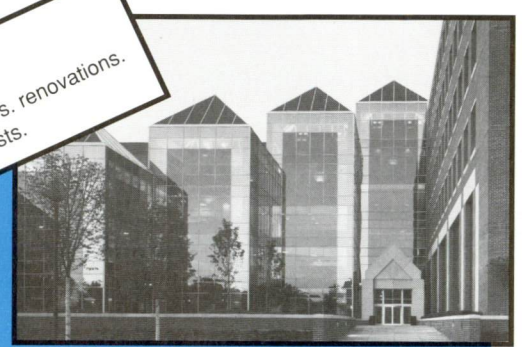
Courtesy Warren Aerial Photography, Inc.

San Diego, April 18-19
2. MANAGEMENT OF FACILITIES ORGANIZATIONS
Forecasting. Staffing and organization. Performance measures. Budgets and charge-backs. Project control.



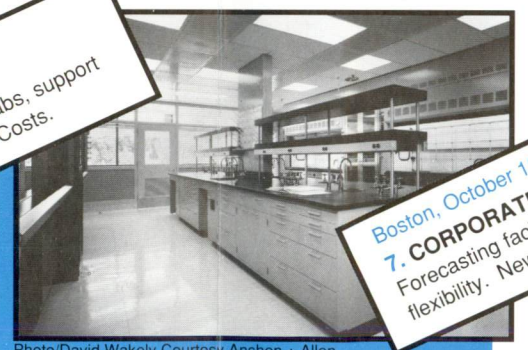
Courtesy Eli Lilly & SH&G Assoc.

Philadelphia, September 25-26
6. UNIVERSITY RESEARCH BUILDINGS
Cost-effective buildings. New construction vs. renovations. Space standards. Flexibility. Utilities. Costs.



Photo/Hedrich-Blessing Courtesy Ellerbe Beckett

Philadelphia, May 8-9
3. R&D FACILITIES AND LABS
Advanced planning concepts for buildings, labs, support space and building systems. Renovations. Costs.



Photo/David Wakely Courtesy Anshen + Allen

Boston, October 10-11
7. CORPORATE TRAINING FACILITIES
Forecasting facilities requirements. Plans for long-range flexibility. New concepts. Space standards. Costs.

Photo/Ron Jordan Courtesy HLW

Boston, May 16-17
4. HEALTHCARE FACILITIES
Flexible, cost-effective buildings. Space standards. Facility features. Ambulatory care. Renovations. Costs.

Photo/Steve Rosenthal Courtesy Payette Assoc.

San Diego, December 4-5
8. R&D FACILITIES AND LABS
Advanced planning concepts for buildings, labs, support space and building systems. Renovations. Costs.

Courtesy SH&G Assoc.

Cover Photo: Hedrich Blessing/Courtesy Burt Hill Kosar Rittelmann

Please send me an Invitation and Program to the 1991 Conferences:

Houston April 4-5	1 ❑	BIOMEDICAL RESEARCH FACILITIES
San Diego April 18-19	2. ❑	MANAGEMENT OF FACILITIES ORGANIZATIONS
Philadelphia May 8-9	3. ❑	R&D FACILITIES AND LABS
Boston May 16-17	4. ❑	HEALTHCARE FACILITIES
Philadelphia July 31 - Aug 1	5. ❑	AIRPORTS: NEW EXPANSION STRATEGIES
Philadelphia September 25-26	6. ❑	UNIVERSITY RESEARCH BUILDINGS
Boston October 10-11	7. ❑	CORPORATE TRAINING FACILITIES
San Diego December 4-5	8. ❑	R&D FACILITIES AND LABS

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____ M/S# _____

CITY/STATE/ZIP _____

PHONE ( ) _____

OUR COMPANY IS A:

- ❑ *High-tech Firm*
- ❑ *R & D Organzation*
- ❑ *Financial Firm*
- ❑ *Healthcare Firm*
- ❑ *Developer*
- ❑ *A/E Firm*
- ❑ *Supplier*
- ❑ *University*
- ❑ *Other* _____

Complete and return this section

SAMPLE INVITATION

UNIVERSITY SCIENCE & RESEARCH FACILITIES

June 13–14, 1990 — San Francisco

Photo by Craig Baird

Courtesy Haines Lundberg Waehler

UNIVERSITY SCIENCE

WEDNESDAY, JUNE 13, 1990 (8:00 a.m.–4:30 p.m.)

Registration and Conference Materials (8:00 a.m.)

Conference Overview *Westfall*

New National Priorities for Science and Research (8:55 a.m.)—Emerging and fast-growing fields to watch. Scientists and funds: where will they come from and where will they go? The effects of merging disciplines and interdisciplinary research. Specialty areas vs. broad programs. Implications for new university science programs, facilities and research environments. *Hagstrom*

Survey of Recent U.S. University and Industry Laboratory Projects (9:25 a.m.)—New programming, design and project delivery methods. Unique lab buildings. Lessons to be learned from industry. Successful ideas for flexibility, renovation, building systems, teaching environments, interaction and amenities. *Rietz*

Preview of Concurrent Forums (10:15 a.m.)

Concurrent Forums A, B, C, D and E (10:50 a.m.–12:05 p.m., repeated 1:20–2:35 p.m.)

Forum A: Decision-Making on Overall Building Concepts—Building shapes and number of floors. Options for image. Programming for modules and interiors. Open vs. closed labs. Windows for labs and offices. Utility distribution. Circulation, public spaces and service access. Flexibility, space efficiency and costs. *Garretson/Nunemaker*

Forum B: Special Problems & Solutions for Grant-Funded Projects—Effects of partial and full grant funding on programming, planning and design. Architectural and engineering considerations. Project management issues. Scheduling and decision-making. Proven solutions. Examples from recent projects. *Muskat/Kaplan*

Forum C: Latest Findings on University Lab Standards—Survey and analysis of critical numbers for labs. Modules. Hood provisions. CFM capacities. Floor-to-floor heights. Floor loading. Facility population. Building efficiencies. Costs. Developing a pro forma lab for the future. *Henry*

Forum D: Flexible M/E Design for Multi-Function Buildings—Presentation of design parameters that facilitate future modifications and adaptations. Criteria for evaluating alternative designs. Integration with architecture and structures. Special considerations for lab areas, classrooms and offices. Examples. Costs. *Rehak/Clark*

Forum E: Strategies for Saving Construction Dollars—Proprietary systems buying strategies. Negotiating strategies, purchase orders, contract language. Competitive bidding. Alternates for equipment and equipment features under bidding and negotiated strategies. *Bishop/Chappell/Carroll*

Hosted Luncheon (12:05–1:20 p.m.)

Concurrent Forums A, B, C, D and E (1:20–2:35 p.m.)

Roundtable Discussions (2:55 p.m.)—Open discussions on topics of current interest. Siting decisions. Programming data. HVAC. Lab modules. Renovation projects. Project management. Costs, budgets and financial planning.

Taub Research Center & Smith Research Building, Baylor College of Medicine (3:40 p.m.)—Two new institutional spec buildings for research, part of the east campus development project. Space planning and development. Building systems. Cost-saving decisions and trade-offs. Forward planning for "Research 2000." Recommendations. *Scoular*

UC San Diego's Engineering Building Unit I (4:05 p.m.)—A 215,000 sf, $46 million project, completed in March 1989. Program requirements and design solutions. Research and teaching labs. Building systems and utilities. Best ideas for others. Lessons learned. *Hellmann*

Hosted Wine Tasting Reception (4:30–6:00 p.m.)

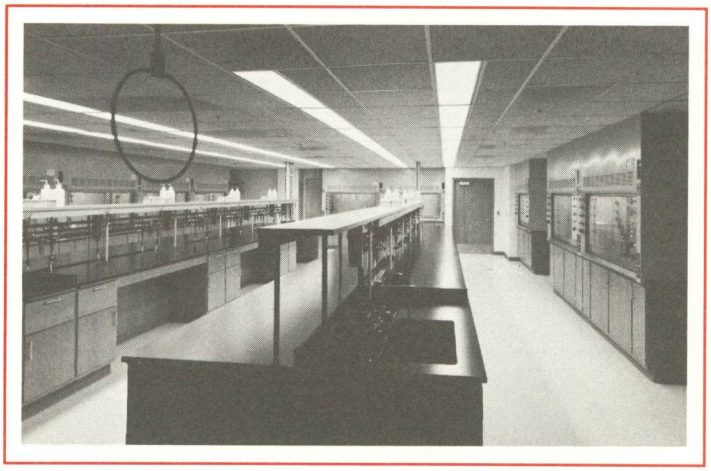


Photo by Timothy Hursley Courtesy Harley Ellington Pierce Yee Associates, Inc.

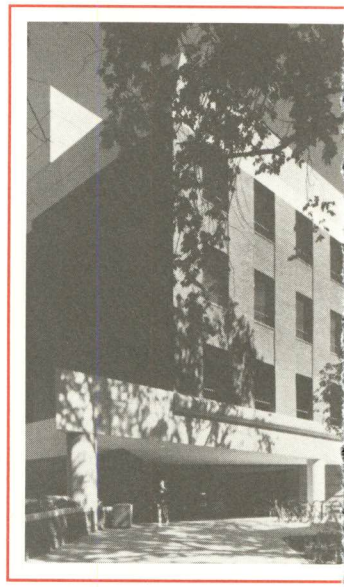
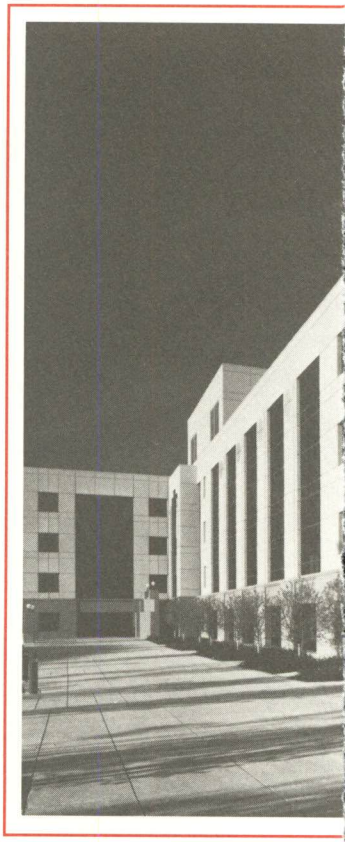


Photo by Balthazar Korab C



Preprogram Recept

There will be a hosted dessert and
Hyatt on Union Square on Tuesda
Attendees may pre-register and pi
this time.

& RESEARCH FACILITIES

- ► The Future of University Research
- ► Survey of Recent Science Building Projects
- ► Overall Building Concepts
- ► Latest Findings on Lab Standards
- ► Flexible Systems & Utilities
- ► Special Planning for Grant-Funded Projects
- ► Latest Project Design Solutions
- ► Strategies for Saving Construction Dollars
- ► Reports on Nationally Significant Projects
- ► Capital Project Management Approaches
- ► Costs and Budgets

with special reports from:

Baylor, University of California, Cornell, University of Iowa, Stanford, Rutgers, Princeton, University of Michigan, Indiana University, Colorado State and Rensselaer Polytechnic

Wednesday and Thursday, June 13–14, 1990

at the Grand Hyatt, San Francisco

— A Tradeline Program —

415/254-1744 (San Francisco)

Session Leaders

Henry Abernathy, AIA, Managing Principal, THE HILLIER GROUP

Victor A. Amoroso, P.E., Project Engineer, HANSEN LIND MEYER, INC.

Richard L. Anderson, FAIA, Principal, ANDERSON DeBARTOLO PAN, INC.

Malcolm Barksdale, AIA, Principal, RESEARCH FACILITIES DESIGN

Del Bishop, Senior Vice President, McCARTHY

John J. Carroll, Vice President, Construction, UNIVERSITY HOSPITALS OF CLEVELAND

Carter Chappell, Vice President Operations, Pacific Division, McCARTHY

Alan Chimacoff, AIA, Principal and Director of Design, THE HILLIER GROUP

Kenneth M. Clark, P.E., Project Manager, BURNS & McDONNELL

Jim Garretson, Vice President, PERKINS & WILL

Paul Griffen, Vice President, Facilities Planning & Construction, CORNELL UNIFERSITY

Dr. Stig Hagstrom, Department Chairman, Materials Science and Engineering, and Director, Center for Materials Research, STANFORD UNIVERSITY

M. Boone Hellmann, AIA, Assistant Vice Chancellor, Office of Facilities Design & Construction, UNIVERSITY OF CALIFORNIA, SAN DIEGO

Richard Henry, AIA, Partner, CUH2A

Alan Kaplan, Partner, HAINES LUNDBERG WAEHLER

Jan Keene, AIA, Partner-in-Charge, MITCHELL/GIURGOLA ARCHITECTS

Dennis M. King, AIA, Senior Vice President, Principal, HARLEY ELLINGTON PIERCE YEE ASSOCIATES, INC.

Jerry Kinkade, AIA, Project Architect, HANSEN LIND MEYER, INC.

Martin J. Meisel, AIA, Principal-in-Charge, HANSEN LIND MEYER, INC.

Carl Muskat, Partner, HAINES LUNDBERG WAEHLER

John Nunemaker, AIA, Executive Vice President, PERKINS & WILL

John J. Rehak, AIA, Project Architect, BURNS & McDONNELL

Richard R. Rietz, Ph.D., R&D facilities consultant and advisor

David N. Scoular, AIA, Director of Planning, BAYLOR COLLEGE OF MEDICINE

Gary L. Skog, AIA, Vice President, Principal, Director of Design, HARLEY ELLINGTON PIERCE YEE ASSOCIATES, INC.

Steve Westfall, President, TRADELINE, INC., and Publisher, *Facilities Planning News*

William F. Wilson, AIA, Principal, PAYETTE ASSOCIATES

Firms practicing in the design and planning of university facilities that have assisted in the organization and production of this program:

Anderson DeBartolo Pan, Inc.
Phoenix

Burns & McDonnell
Kansas City, Mo.

CUH2A
Princeton

Haines Lundberg Waehler
New York

Hansen Lind Meyer
Iowa City, Iowa

Harley Ellington Pierce Yee
Southfield, Mich.

The Hiller Group
Princeton

McCarthy
St. Louis

Mitchell/Giurgola Architects
New York

Payette Associates
Boston

Perkins & Will
Chicago

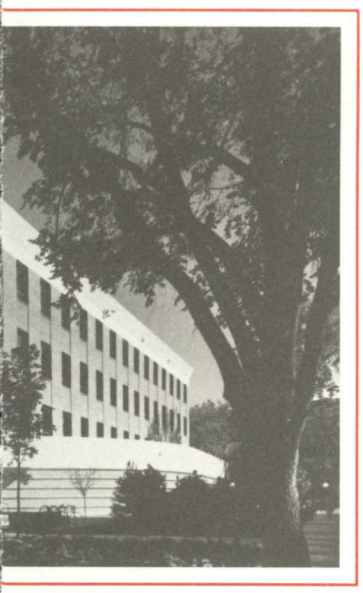
Research Facilities Design
San Diego

In cooperation with:

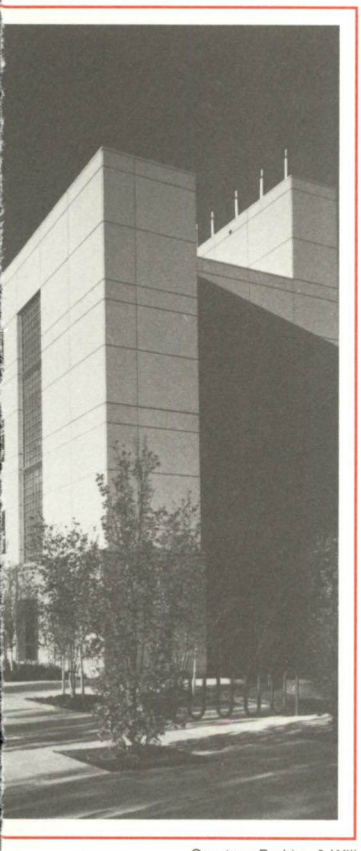
Hamilton Industries
Facilities Planning News

The conference fee is $740/attendee. Make checks payable to TRADELINE, INC.
TO REGISTER BY PHONE: Call Tradeline at 415/254-1744 (San Francisco) FAX: 415/254-2744

& RESEARCH FACILITIES



ourtesy Harley Ellington Pierce Yee Associates, Inc.



Courtesy Perkins & Will

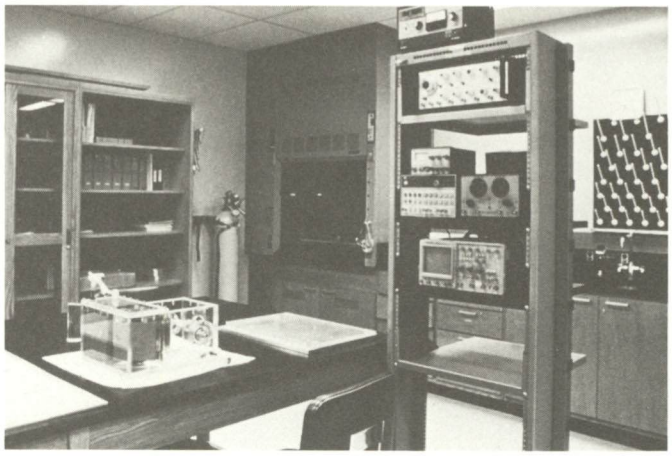


Photo by Craig Baird

Courtesy Haines Lundberg Waehler

THURSDAY, JUNE 14, 1990 (7:30 a.m.–3:30 p.m.)

Hosted Breakfast Meeting (7:30–8:30 a.m.)

Roundtable Discussions (8:45 a.m.)—Open discussions on topics of current interest. Siting decisions. Programming data. HVAC. Lab modules. Renovation projects. Project management. Costs, budgets and financial planning.

Capital Project Lessons from Cornell University (9:40 a.m.)—Major planning determinants for research programs and facilities. Research labs. Teaching spaces. Specialized facilities. Capital project management. Funding. Lessons from joint ventures with industry. Best ideas for others. *Griffen*

Six Project Case Reports of Notable University Facility Projects—Six concurrent case reports on projects of national significance. What was built and why. The key programming issues and facility standards that dictated building design. Special and unusual features. Amenities. Building systems and utility schemes. Architectural systems. Where the money was spent. Budgets. What worked and why. Ideas for the future.

(Reports #1 through #6 repeated concurrently at 10:30 a.m., 11:35 a.m. and 1:35 p.m.)

#1 University of Iowa's Medical Research Building—A 132,000 sf facility housing a variety of specialized medical research disciplines. Survey of program requirements. Lab module flexibility. Daylighting for offices and labs. Provisions for reconfiguration of services. Common and dining areas. Amenities. *Meisel/Kinkade/Amoroso*

#2 The Center for Advanced Biotechnology and Medicine—A joint-venture between Rutgers and UMDNJ, founded to provide a focal point for industrial and academic biotechnology. Special requirements for technical equipment. Interaction concepts. Provisions for natural light and views. Amenities. Costs. Lessons. *Wilson*

#3 The Chemistry Labs at University of Michigan and Indiana University—A comparison of flexibility, image, security, work environments and building systems for the 280,000 sf addition/240,000 sf renovation program at University of Michigan, and the 85,000 sf addition/176,000 sf renovation program at Indiana University. *King/Skog*

#4 Research Facilities at Rutgers University and Princeton University—Comparative programming, design, budget and mechanical/electrical issues at Rutgers' Environmental & Occupational Health Safety Institute and Princeton's Photonics and Opto-Electronics Materials Center. *Abernathy/Chimacoff*

#5 The Center for Industrial Innovation at Rensselaer Polytechnic—This 200,000 sf facility houses a high-bay laboratory for manufacturing technology experiments, an integrated circuit process facility, CAD space, and seminar and conference facilities. Lab modules. Service core concept. Comparisons to other projects. *Keene*

#6 Lab Buildings for Colorado State University and UCSD—Two new buildings reflecting different research programs: single-purpose and multi-disciplinary. Research and teaching labs. Open vs. dedicated labs. Flexibility. VAV and constant-volume HVAC systems. Costs and critical ratios. *Barksdale*

Hosted Luncheon (12:30–1:30 p.m.)

Where Did All the Money Go? (2:45 p.m.)—Survey of costs for university research buildings. Costing models for new buildings, additions and renovations. Standards and trends. Examples of successful cost-controlling decisions, and some that did the opposite. Where the money *should* have gone. *Anderson*

Adjourn 3:30 p.m.

ion: Tuesday Evening

Irish Coffee reception at the Grand
y, June 12, from 8:30 to 9:30 p.m.
ck up their conference materials at

Tradeline, Inc. • *P.O. Box 1568* • *115 Orinda Way* • *Orinda, CA 94563* • *(415) 254-1744*

"INVITATION FOR DR. BROMLEY"

TYPE: INVITATION-SPEECH DOCUMENT NUMBER: 9121584

****

SPEECH: YES NO

FROM: MACKE, R.C.: THE JOINT STAFF

DATE OF EVENT: 08/06/91

LOCATION OF EVENT:

TIME OF EVENT:

SUBJECT: REQUEST TO ADDRESS THE ELEVENTH ANNUAL COMMAND, CONTROL, COMMUNICATIONS AND COMPUTER CONFERENCE ATTENDEES AT THEIR LUNCHEON AT THE FORT McNAIR OFFICER'S CLUB.

****

RSVP: 06/17/91

CONTACT PERSON:

CONTACT NUMBER:

****

INVITATION ACCEPTED? ~~YES~~ NO

****

COPIES TO: NATIONAL SECURITY

REMARKS:

CLOSED

DATE OF LETTER: 05/24/91 DATE RECEIVED: 06/03/91

FILE: P- INVITATION-SPEECH

9121584

THE JOINT STAFF
WASHINGTON, D.C.

RECEIVED
91 MAY 3 A9:24
OFFICE OF THE DIRECTOR

24 May 1991

Reply ZIP Code:
20318-6000

Honorable D. Allan Bromley
Assistant to the President for
Science and Technology
Old Executive Office Building
Washington, D.C. 20506

Dear Dr. Bromley:

The Eleventh Annual Command, Control, Communications and Computer (C4) Conference will be held 5 and 6 August, at Baruch Auditorium, Industrial College of the Armed Forces, Fort McNair, Washington, D.C. The theme for this year's conference will be "Changing World/Changing Requirements."

The conference brings together the C4 leadership from the Services and unified and specified commands to discuss a wide range of topics and issues pertaining to the entire spectrum of C4. Given the extensive communications employed during operations DESERT SHIELD/STORM, this year's conference promises to be exciting.

It would be our great honor and pleasure if you could address the conference attendees at our luncheon on 6 August at the Fort McNair Officers' Club from 11:30 AM to 1:30 PM. Your insight into the future of information management technology would be extremely important as we prepare for the next century.

I look forward to hearing from you soon.

Sincerely,

R. C. MACKE
Vice Admiral, USN
Director for Command, Control,
Communications and Computer
Systems

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION DOCUMENT NUMBER: 9121502

****

FROM: NELSON, Frederick C.: TUFTS UNIVERSITY

TO: DR. BROMLEY

DATE OF CORRESPONDENCE: 05/20/91

SUBJECT: REGRET FOR ANY INCONVENIENCE THE CANCELLATION OF THE SCIENCE & TECHNOLOGY DINNER PLANNED FOR MAY 4 MAY HAVE CAUSED.

****

ASSIGNED TO:

ACTION REQUIRED:

****

SENDER'S DUE DATE: OSTP DUE DATE:

DATE COMPLETED:

****

COPIES TO: D. Allan Bromley

****

WHITE HOUSE TRACKING #: CONTACT PERSON:

REMARKS:

DATE RECEIVED: 05/23/91 FILE: P INVITATION-SPEECH [redacted]

9121502

RECEIVED
91 MAY 23 AM : 1
OFFICE OF THE DIRECTOR

TUFTS UNIVERSITY

College of Engineering
Office of the Dean

May 20, 1991

Dr. D. Allan Bromley
Assistant to the President
for Science & Technology
Old Executive Office Building
Washington, DC 20500

Dear Dr. Bromley:

Thank you for your willingness to address the Science & Technology Dinner which Tufts University had planned for May 4 at the Plaza in New York. We considered your presence and remarks to be the centerpieces of the entire event.

Thus, we were thoroughly disappointed when a number of events conspired which forced Tufts to postpone the occasion. Mr. and Mrs. Richardson, President Mayer, and I anticipate the dinner to be rescheduled to a date six to eight months hence.

They join me in expressing regret for any inconvenience which our cancellation might have caused. In addition, we all ask your indulgence in hopes that once our plans for the rescheduled event are firm, we can review them with you and again invite your participation.

I extend best wishes to you and continued success in your contributions to the country.

Sincerely yours,

FC Nelson

Frederick C. Nelson
Dean of Engineering

/mp

cc: Mr. & Mrs. D. Kenneth Richardson

Medford, Massachusetts 02155
617 381-3237

Sent to you with the compliments of

Frederick C. Nelson
Dean of Engineering
Tufts University

Document Originally
Attached to
Following Page

TUFTS WINTER 1991
ENGINEERING NEWS

Tufts welcomes high-tech at Sci-Tech

A sustained commitment to research and development is needed to restore the nation's economic strength, U.S. Energy Secretary Adm. James D. Watkins told 400 invitees at the dedication of Tufts' Science and Technology Center Nov. 3.

"Unless we better link basic research activities to national goals, we assuredly will not achieve one of the most important of these—namely economic competitiveness.

"The center you are dedicating today at Tufts demonstrates your commitment to these principles," Watkins said.

The $13.3 million, 89,000 square-foot center on Tufts' Medford/Somerville campus houses the College of Engineering's Laboratory for Materials and Interfaces and Electro-Optics Technology Center, which have both framed research to meet the current and future needs of American business and industry.

The new Science and Technology Center, founded in part by a $10 million grant from the Department of Energy under the sponsorship of U.S. Rep. Edward J. Markey (D-Mass.), is also a national model for retrofitting commercial buildings to make them energy conserving.

J. D. Sloan

Above: At the dedication, Dean Frederick C. Nelson greeted honored guests (from left) Constance Rogers Richardson, D. Kenneth Richardson, Secretary James D. Watkins and Sheila Watkins. In back is Anthony Cortese, Dean of Environmental Programs. Right: Main entrance to the Science and Technology Center.

The center contains more than $500,000 worth of energy-saving features from a heat recovery system to a variable air volume handling

continued on p. 4

Astill retires

Farewell to a man of many talents

People in Winchester, Mass., still remember Kenneth N. Astill as Paul Revere.

Actually, they remember him as a statue of Revere. Astill once gamely covered himself in bronze makeup to play the statue, complete with pigeons on his head. Leaving the pedestal and the pigeons, he continued as master of ceremonies in a show sponsored by a volunteer organization.

An ability to make people laugh is one of the traits that has made Astill, professor of mechanical engineering at Tufts, one of the most endearing figures around the College of Engineering for the past 44 years.

"He has a terrific sense of humor," said Allan M. Cormack, University Professor of Physics, who often shares a morning cup of coffee with Astill in Anderson Hall. "He's also very

continued on p. 14

WHAT'S INSIDE

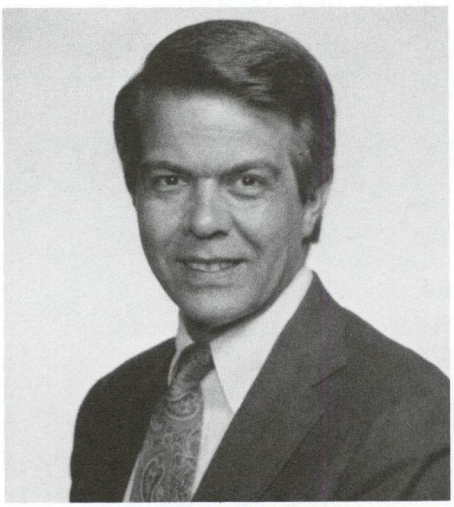
Raytheon backs LMI with $250,000 equipment grant

Last fall, engineering managers from Raytheon Co. toured Tufts' new Science and Technology Center. They liked what they saw. So much so that Raytheon recently awarded a $250,000 equipment grant to support the Laboratory for Materials and Interfaces, housed in the new center.

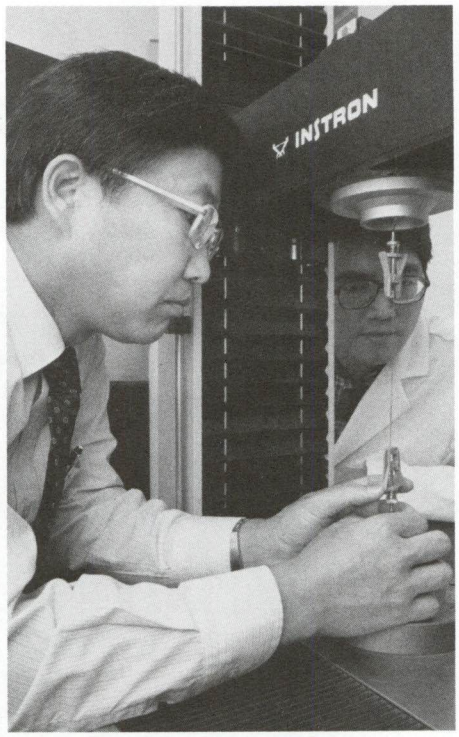
"The aspect that very much impressed me was Tufts' commitment to developing interdisciplinary engineering study. We were very pleased to see that Tufts had made a tangible academic and facility commitment to that area," said Carl H. Guild Jr., E65, program manager of the Hawk missile system in Raytheon's Missile Systems Division.

To insiders, it's no surprise that Tufts University actively promotes interdisciplinary approaches to engineering teaching and research. But to the engineering community at large, the opening of the Sci-Tech Center gives eloquent proof of that fact. The new facility's design is expressly geared to prompt collaborative projects—particularly in materials—between the electrical and chemical engineers and high-energy and condensed-matter physicists who occupy it.

"We extend our best wishes as you dedicate this new facility with its interdisciplinary approach, a hallmark of Tufts University's educational philosophy," wrote Thomas L. Phillips, retiring chairman and CEO of Raytheon, in a letter announcing the grant.



Carl H. Guild Jr., E65



J. D. Sloan

Nakho Sung

The five-year Raytheon grant will pay for new equipment for the LMI—the College of Engineering's newest center for technology—which focuses on materials science research. For his first purchase, Nakho Sung, director of the LMI and professor of chemical engineering, has his eye on an X-ray photospectrometer (XPS) or Auger/SIMMS/UHV system—both pieces of equipment that let engineers analyze and monitor the chemical composition of surfaces.

"These instruments are basic materials research tools, so I anticipate many people would use them—both faculty and graduate students," Sung said.

Currently, LMI researchers who need surface analysis capabilities must rely on equipment at other institutions in the region for this part of their work.

Raytheon has a long-standing relationship with Tufts' engineering departments through the company's active liaison group—chaired by Elizabeth Benedict, J59, manager of the automated test department in Raytheon's Missile Systems Division. The liaison group meets regularly with faculty and students to transfer information about industry's needs and open channels for recruitment. But this gift to the LMI represents Raytheon's commitment to building stronger ties with Tufts researchers, according to Guild.

"In 1990, we decided to take a look at our efforts with Tufts and see if there is a broader-based program we could put into place. The LMI was seen as a particularly interesting area," Guild said.

The work being done at the LMI relates to component-level work in semiconductors, of interest to Raytheon's Research Division, as well as to research that concerns several of the firm's operating divisions.

As more funds become available, the LMI will develop an undergraduate internship program to engage students in materials sciences research and a seed fund to spur more interdisciplinary faculty research.

Currently, materials science and engineering courses and research are scattered throughout the university, unconnected with a department or core center. "We are planning to have the LMI fill this role," Sung said.

Diane R. Krieger ■

ENGINEERING NEWS

Engineering News is a periodical report of the Tufts University College of Engineering, distributed to alumni, faculty and students of the school.

Editor – Diane R. Krieger
Editorial Advisers – Rosemarie Van Camp, Dean Frederick C. Nelson, Laurence Herron
Contributing Writers – Pamela Benson, Deborah Halber, Gail Bambrick, Jay Chrepta
Art Director – Suzanne Perry
Design – Julie Steinhilber

Comments and suggestions are welcome and should be directed to **Engineering News**, Editor, Tufts University, 550 Boston Ave., Medford, Mass. 02155.

Training an environmental work force

Every day, the city of Shanghai, China, discharges 95 percent of its untreated sewage directly into the Hangpu River—the main source of drinking water for the city's 12 million inhabitants. In Mexico City, 20 million people breathe air that contains ozone levels exceeding World Health Organization guidelines by more than 50 percent. Lettuce and apples grown in Poland contain 10 times as much lead as WHO guidelines allow for human ingestion.

These are examples of how environmental conditions around the world are threatening human health, if not human survival. Tufts University devotes a good deal of attention to environmental issues through its environmental programs in the College of Engineering and the Center for Environmental Management.

An anonymous $150,000 pledge from two Tufts engineering alumni recently strengthened the university's efforts in this area. Their support focuses on the most obvious need—the need for trained environmental professionals. The funds will build an endowment that will provide two yearly $3,500 undergraduate scholarships in environmental engineering.

"This nation has never made a commitment to develop an effective environmental work force. As we look back over the past two decades, we note many achievements in the war on pollution; however, we also note mistakes, failures and wasted resources," said N. Bruce Hanes, professor of civil engineering at Tufts.

"The lack of environmentally knowledgeable individuals in political, regulatory, educational and technical roles has resulted in implementation of the expedient rather than the most environmentally sound solutions to many of our problems. Precious resources will be squandered over the next two decades unless a concerted effort is made to develop an environmentally sound work force," Hanes said.

Tufts has been in the business of training such an environmental work force for nearly 30 years. Undergraduate courses in environmental engineering were first offered in 1961, and an undergraduate major and graduate program were formalized in 1963. According to Hanes, Tufts-educated environmental engineers can be found today in important policy-making roles: a few examples are two high-level U.S. Environmental Protection Agency officials in charge of drinking water, several senior assistants to the Massachusetts Secretary of Environment, the CEO of a major hazardous materials management consulting firm, a trustee of Tufts University and the dean of Tufts' environmental programs.

Today, of the approximately 100 undergraduate and 90 graduate students in civil engineering at Tufts, half specialize in environmental engineering. Many other students choose double majors combining environmental engineering with another discipline or enter the environmental health program within the civil engineering major.

Students in environmental programs can also pursue their interests through CEM, an independent center that conducts multidisciplinary research, organizes seminars and analyzes policy relating to environmental problems linked to toxic substances and solid wastes.

"We are heartened by the donors' decision to endow a scholarship for students preparing for a career in the environment," said Frederick C. Nelson, dean of the engineering college. "The fund will strengthen the college's ability both to attract the best students and support their environmental study."

In addition to undergraduate environmental programs, Tufts sponsors numerous graduate programs stressing environmental issues, including one of only three master's degree programs in the nation focused on hazardous materials management. Last year, Tufts created the first ecodeanship in America when it named Anthony Cortese, E68, G72, former director of CEM, dean of Tufts' environmental programs.

Another distinguishing characteristic of environmental programs at Tufts is their global emphasis. Last fall, the university hosted an international conference on environmental education at its European Center in Talloires, France. The conference, which was endorsed by the EPA and the United Nations Environment Programme, was attended by 40 university presidents from around the world.

Diane R. Krieger ■

Tufts welcomes new engineering overseer

President Jean Mayer and Stig Host, G86P, at the recent Alexander Host Foundation dinner in New York. Host, president of the foundation and a strong supporter of Tufts' environmental programs, has joined the College of Engineering's Board of Overseers.

High-tech at Sci-Tech

continued from p. 1

system controlled by electronic sensors throughout the building.

"Lab buildings are energy hogs, and we wanted to test energy conservation measures that would save energy in the long run," said Robert P. Guertin, dean of Tufts' Graduate School of Arts and Sciences and chief planner for the project.

Both the research and teaching at Tufts' Science and Technology Center will be critical for the nation's economic recovery and global competitiveness, Markey said at the dedication.

Markey focused on Tufts' Electro-Optics Technology Center, winner of the U.S. Department of Energy Innovation Award in 1987 for its development of electrochromic windows.

"Tufts is in the international forefront in developing smart windows, which know when to be clear and when to be shaded. Smart windows will be able to reduce heating, cooling and lighting requirements by one-fourth or more," Markey said. "This work, which has already moved into Sci-Tech, holds tremendous promise to improve our nation's energy, economy, environment and trade balance."

Markey said that because energy losses and gains through windows account for 5 percent of the total U.S. energy consumption, and electric lighting for an additional 5 percent, the savings and impact from this technology could be tremendous.

"Energy Secretary Watkins has promised the nation a reinvigoration of energy efficiency R&D, and let me say to Secretary Watkins right here and now that high quality research into electrochromic windows merits a prominent place within your efforts," Markey said.

Other dedication speakers were D. Kenneth Richardson, E52, president and chief operating officer of Hughes Aircraft Co., and his wife Constance Rogers Richardson, J52, who established the Richardson Conference Center in the facility.

An EOTC graduate student demonstrates the floating bench for laser experiments to children from neighboring Lincoln Junior High/Kennedy Elementary School during a walk-through of the center.

Guests watched the dedication ceremony from the walkway that bisects the center's dramatic entrance atrium.

President Mayer shows Terry Haas, professor of chemistry, his newly repaired glasses. The branches broke during the dedication and were fixed on the spot courtesy of the Sci-Tech Center's new machine shop.

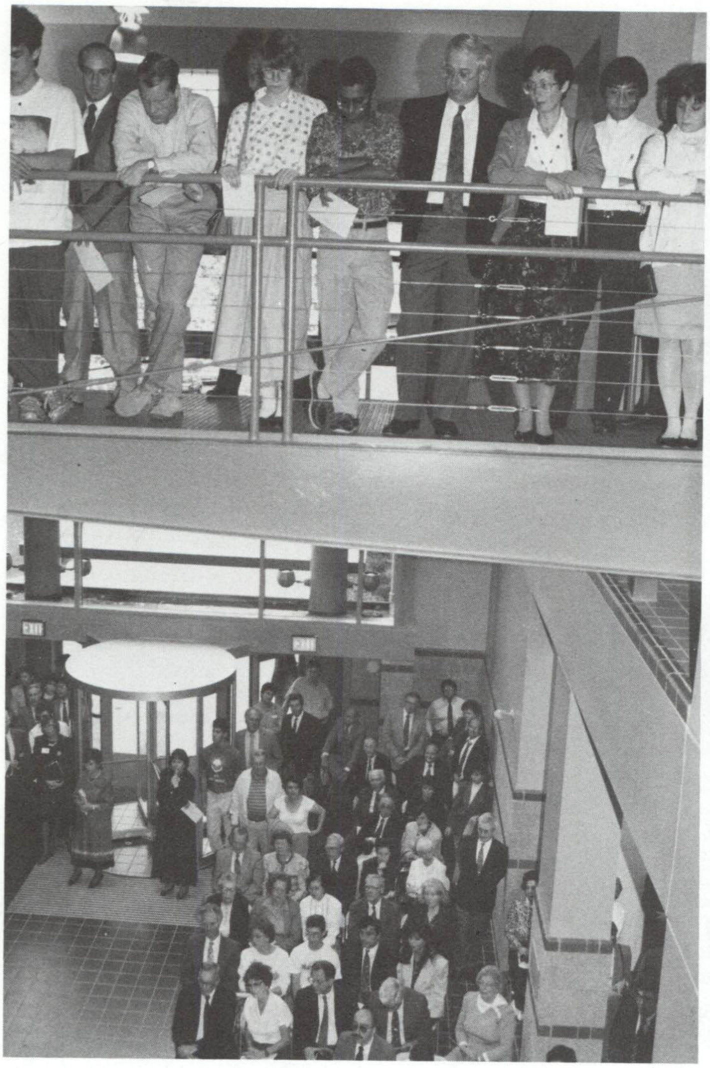
School children from the Lincoln/Kennedy School sit behind the wheel of Tufts' solar car during an open house held the day before the dedication, while Tufts engineering overseer Jordan Birger, E43, looks on.

According to Tufts President Jean Mayer, the center is the fulfillment of his vision of ongoing interdisciplinary research in the sciences.

"We believe the work that will happen at this center will have profound implications for the country as it educates its next generation of scientists and pursues those research avenues that will keep it a competitive force in the global marketplace," Mayer said.

Gail Bambrick ■

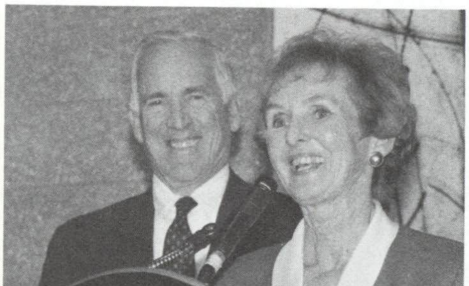
Photography by J. D. Sloan



U.S. Rep. Edward J. Markey

▲ Secretary James D. Watkins and Sheila Watkins with Robert Guertin, dean of the Graduate School of Arts and Sciences, and engineering dean Frederick C. Nelson.

Constance Rogers Richardson addresses the assembled guests at the dedication, while her husband, D. Kenneth Richardson, stands by. ▼



EOTC corporate affiliates program thrives

Looking toward the future, this year 14 major high-tech companies are supporting cutting-edge research and educational programs at Tufts' Electro-Optics Technology Center.

"Electro-optics is the future of information transfer and will have a major impact on the high-tech industry by the year 2000," said Robert Gonsalves, professor of electrical engineering and director of the EOTC. "It's important for companies to think about what will be happening 10 to 15 years down the road."

Corporate affiliates provide funds and equipment to help the center maintain its unique laboratory curriculum. In return, members receive benefits such as regular consultations with EOTC faculty and staff, copies of research reports, access to students for possible employment and the opportunity to nominate a professional for a visiting industry professorship. Many of the EOTC's students are also employees of corporate affiliates.

Raytheon Co. of Lexington, Mass., has 12 employees enrolled in courses at the EOTC. This is the third year that Raytheon has been a corporate affiliate.

Pilkington of Lancashire, England, has renewed its corporate affiliate membership with Tufts. Pilkington is the largest glass company in the world and has a special interest in the EOTC's research on Smart Glass™ technology.

AT&T Network Systems of North Andover, Mass., also has pledged its support as a corporate affiliate. The company is working with researchers at the center to improve fiber-optic links used in telephone lines.

A new corporate affiliate, Textron Inc. of Wilmington, Del., has pledged its support for EOTC. Textron is interested in the EOTC's work on the "smart sensor"—an electro-optical device that simulates how the eye tracks an object.

Sanders Associates of Nashua, N.H., renewed its corporate affiliate contract for the sixth year. Sanders employees are working at the center on non-linear optic research in conjunction with Mark Cronin-Golomb, associate professor of electrical engineering at Tufts. Cronin-Golomb's research also is supported by a grant from Litton/Itek Optical Systems of Lexington, Mass.

© Seth Resnick

Robert Gonsalves, director of EOTC, with a group of students.

Also sponsoring research at the center is Radiation Science of Newton, Mass. The company is supporting EOTC work to improve CAT-scan technology.

Draper Labs of Cambridge, Mass., is supporting the center for the second year and has awarded a fellowship to an EOTC graduate student covering tuition and a one-year stipend.

Ebara Research Co. of Japan is entering its second year as a member of the corporate affiliates program. The company is interested in the center's work on Smart Glass.™

For the fourth year, Hughes Aircraft Co. of Los Angeles is supporting the center. Hughes is also doing collaborative research with faculty at the EOTC.

Apollo/Hewlett Packard of Billerica, Mass., is supporting the EOTC's labs with computer work stations valued at $100,000. Other corporate affiliates supplying equipment to the center include GTE Laboratories of Waltham, Mass.; Newport Research Corp. of Fountain Valley, Calif.; Research Systems of Boulder, Colo.; and Digital Equipment Corp. of Maynard, Mass.

Last September, the EOTC moved from Halligan Hall to Tufts' new Science and Technology Center. During the same weekend that dedication ceremonies were held for the building (Nov. 3-4), the EOTC hosted its first workshop in the new center.

The Workshop on Lasers and Electronics for engineering faculty was jointly sponsored by Tufts and the Laser Institute of America. Part of the International Congress on the Applications of Lasers and Electro-Optics (ICALEO), held in Boston the first week of November, the workshop gave faculty from 25 colleges and universities up-to-date information and experimental skills for use in lab courses.

Topics covered in the two-day workshop included Fourier optics, thin films, nonlinear optics, computer-generated holograms and lasers.

Pamela Benson ■

At 75, Brooks still sways science policy

During the last 40 years—perhaps the most dynamic in the history of science—Harvey Brooks has been an observer and key player in the emerging field of science public policy. He has witnessed everything from the spread of nuclear power plants in the '60s to the spread of recycling plants in the '90s.

But encouraging as the environmental movement is, Brooks sees a future fraught with challenges for science policymakers.

"The big issues in the future will certainly be the management of global environmental problems: How can you manage the environment in a way that doesn't destroy economic growth?

"We also have to face a future world with 10 billion people in it. (Global population is now 5.2 billion.) There's a growing gap between the affluent countries, whose populations are growing slowly or remain static, and the poor countries, whose populations are exploding," Brooks said. "Whether the world can survive this problem is the big question. Nobody believes we can close the gap just by transferring the present technologies of the industrial world to the Third World. Even if that were possible, the environment couldn't stand it."

On Oct. 27, Harvard University held a symposium to mark Brooks' 75th birthday. Though Brooks' scientific work has focused on solid state physics, nuclear engineering and underwater acoustics, he is best known for his work on domestic and international policy in energy and the environment and the support of research and technology.

Brooks, emeritus professor at Harvard's Kennedy School of Government and the Division of Applied Sciences, is a Tufts trustee emeritus and chairman of the university's Board of Overseers for Engineering.

At the symposium, Brooks' colleagues fondly described him as the scholar who, having come to a sound opinion on a public policy issue, knows how to bring about change by joining—or forming—the right committee.

He has exhibited this talent for 40 years. In the 1950s, Brooks chaired the Undersea Warfare Committee of the National Research Council and sat on the Advisory Committee on Reactor Safeguards with the U.S. Atomic Energy Commission. During the Eisenhower, Kennedy and Johnson administrations, he served on the President's Science Advisory Committee. In the 1960s, he was a member of the National Science Board and chaired the Committee on Science and Public Policy of the National Academy of Sciences. In the 1970s, he chaired the Commission on Sociotechnical Systems of the National Research Council and served on the Joint U.S.-U.S.S.R. Commission on Scientific and Technological Cooperation.

Though he is now officially retired, Brooks continues to teach and remains a force in the science and public policy arena. Currently, he is a member of the United Nations Advisory Committee on Science and Technology for Development, and he only recently stepped down as chairman of the U.S. Committee for the International Institute for Applied Systems Analysis. In several committees of the National Academy of Engineering, he is studying the role of technology in U.S. economic competitiveness, and, through a research program at the Kennedy School, he is studying U.S. management of technologies that have both military and civilian applications—so called dual-use technologies.

Harvey Brooks

"We're interested in the question of what leadership the government should take in supporting and fostering civilian technologies of value to business and industry," Brooks said.

As a Tufts trustee from 1981 to 1987, Brooks was a strong advocate of President Jean Mayer's program to create engineering centers of excellence as a way to strengthen existing engineering programs and promote expansion into new areas.

"Dr. Brooks has been a particularly effective trustee in support of faculty because of his own background as an academic with Harvard University," said Joseph Lambert, Tufts' overseer and secretary of the corporation. Brooks was vice chairman of Tufts' academic affairs committee while he served as a trustee, and also chaired the Engineering Visiting Committee, the precursor to Tufts' Board of Overseers for Engineering, which he now chairs.

"We congratulate Harvey Brooks on his 75th birthday," said Frederick C. Nelson, dean of Tufts' College of Engineering. "He brings to the role of chairman of the Board of Overseers for Engineering his *extraordinarily* international perspective on science and technology. He has a special concern not just for the nuts-and-bolts of technology, but for technology's effects on society and the policy issues that emanate from it. He has had a broadening influence on the kinds of questions and issues on which the overseers advise me."

Diane R. Krieger ■

Robots will help disabled perform common tasks

A design breakthrough by a Tufts engineer has brought the personal-care robot—a mechanical, table-top arm that could be used by disabled people for tasks such as brushing hair—one step closer to reality.

William Crochetiere, professor of engineering design, has come up with a concept that represents a significant improvement in the control of a robot by a disabled user.

The way robot arms are currently manipulated, he said, can be compared with trying to draw a circle on an Etch-A-Sketch. It's difficult to create an arc with controls that move a device straight up and down and back and forth.

Changing the function of a dial so that it controls motion along an arc is the principle behind Crochetiere's approach to controlling the robot.

Unlike the two dials on an Etch-A-Sketch, a robot arm requires the equivalent of six dials to locate the robot hand and point it in the right direction. Controlling these six dials simultaneously is very difficult, but Crochetiere's proposed scenario would require the disabled user to manipulate the equivalent of only two dials at a time.

Task-related motions of the arm could include moving a comb toward the head and sweeping it through the hair and other everyday activities that would increase the independence of disabled users.

Determining the relationship between a given motion, such as following the curvature of the head, and the corresponding robot joint motions involves very complex geometry. Crochetiere reported his findings at the 13th annual meeting of the Rehabilitation Engineering Society of North America, held in Washington, D.C., where his work was recognized as among the three best presentations in rehabilitation robotics.

His formula involves breaking the grooming task down into several steps. First, the user has the robot arm reach toward an implement and grasp it. She then has the arm approach her head. Using "sweep mode," the arm runs a comb or brush through the user's hair. The sequence could be repeated on another swatch of hair.

Mark Morelli

William Crochetiere fine-tunes a robot arm.

A model representing Crochetiere's idea in three dimensions looks like three moveable joints (similar to the shoulder, elbow and wrist of a human arm) protruding from a sphere representing the human head. This anchoring of the arm constrains the possible range of movement, simplifying the computations needed to perform the task.

"It is also necessary to be able to control the force exerted by the arm," Crochetiere said, which is his next project. And although robot arms are based on the look and function of the human arm, Crochetiere said, "assistive machinery of the future for the disabled or industry might not look human at all and serve its purpose better."

Deborah Halber ■

Shushing a jumbo jet's whoosh

Something as simple as placing little triangular tabs on the inside of a nozzle may make it possible for jumbo jets to operate more quietly and for combustion to take place more efficiently, a Tufts engineer has found.

Chris Rogers, assistant professor of mechanical engineering, is using lasers, water tunnels and a supersonic wind tunnel at aircraft manufacturer McDonnell Douglas' plant to analyze the way a jet of air or water emerges from a nozzle.

He has discovered that if a little triangular tab, called a delta wing, is placed inside the nozzle at a certain angle, the resulting jet flow mixes faster and is quieter. The method works especially well for extremely fast jet streams, such as those in airplane exhaust pipes, Rogers said. His work may make it possible for aircraft manufacturers to retrofit planes inexpensively and substantially reduce the amount of noise created during take off and landing.

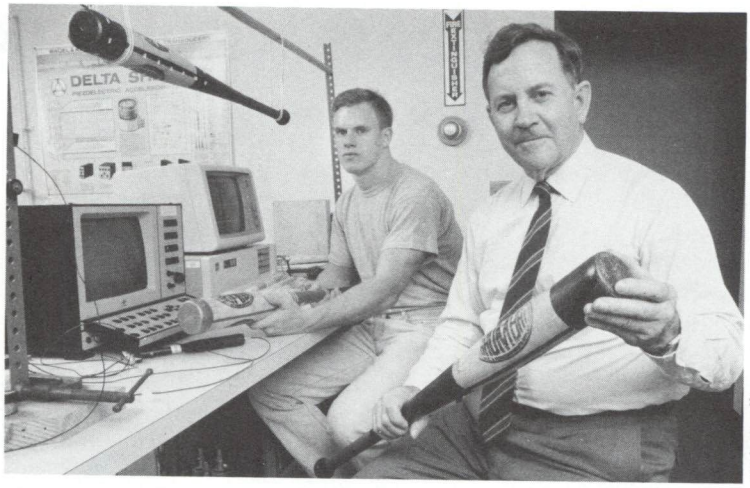
Because his work also analyzes the amount of air that mixes with substances such as fuel in a fuel-injection system, it also has implications for improving fuel efficiency.

"Depending on where you place (the delta wings), you can change the amount of mixing (of air and fuel, for example) that is taking place and vary the noise generated," Rogers said.

The laboratory where Rogers does his work is outfitted with a huge tank through which a dyed jet of water is sprayed. A laser is used to make the dyes fluorescent. This allows researchers to see the jet and measure its velocity.

When placed inside a nozzle at a certain angle, the delta tabs create a small vortex or whirlpool behind the tab. By changing the angle, the vortex can be made stronger. Rogers' current research focuses on where to place the tabs inside the nozzle, because even a slight difference in angle can make a large difference in sound and mixing.

Deborah Halber ■



Mark Morelli

Robert Collier (right) and graduate student Paul Dresens grip test models of the new Baum bat.

Engineers take a swing at bat

Members of Tufts' baseball team were recently enlisted by the mechanical engineering department to test bats made of a patent-pending new wood composite.

Field research on the composite's performance has compared it to that of standard hardwood and aluminum bats. In preliminary tests, the performance of the composite bat compares favorably to that of aluminum bats with more hits and greater distances.

The bat, the invention of Michigan entrepreneur Steve Baum, is made of a high-tech wood composite similar to materials used for aerospace applications.

The stiffness, strength and vibration characteristics of different types of bats are being tested in Tufts' laboratories. In field tests, researchers are measuring the bat's acoustics — the quality of the sound the bat makes when it comes in contact with the ball. Acoustics is the specialty of Robert Collier, professor of mechanical engineering, who is leading the project with graduate students Paul Dresens and Michael Kratochwill, who play on Tufts' baseball team.

Hardwood bats have changed since the days of Babe Ruth, who is said to have swung a much heavier bat, 50 ounces, compared to today's 31- to 36-ounce bats. Professional players go through almost 100 hardwood bats a year because of breakage. And 15 years after unbreakable aluminum bats were introduced, three out of four bats sold are aluminum. But aluminum is very different from hardwood, so the search is on to find a composite that performs like the real thing.

On an unseasonably warm afternoon this winter, Collier set up an experiment on a Tufts baseball diamond. Team members hit balls pitched at 75 mph from a pitching machine with the new Baum bat, aluminum bats and professional hardwood bats. Then the players were asked to evaluate the way the bats felt and how the ball flew off the sweet spot, the best place to hit the ball.

The reviews by the players and coach were positive. The ball "explodes" off the bat with greater velocity, the coach said of the Baum bat.

The nice, sharp crack of a hardwood bat is important to people who play and watch baseball, Collier said, and is quite different from the high-pitched, ringing sound of an aluminum bat. Frequency analysis shows that the new wood composite bat has the same "signature" as hardwood.

"If an aluminum bat can be certified, it seems that this wood composite would meet the criteria set by players and baseball organizations. Our research is helping provide the data needed to support such decisions and lead to improved bats," Collier said.

Deborah Halber ■

Seven Tufts students win Draper Fellowships

Marking the third year in a growing association between The Charles Stark Draper Laboratory and Tufts' College of Engineering, the laboratory has awarded Draper Fellowships to seven Tufts engineering graduate students. The students are David Coppeta, Peter Kazlas, Arthur Zemke, Stuart David, Anne Marie Biernacki, Nicholas Katis and Scott Reitsma.

As Draper Fellows, students receive approximately $20,000—the cost of a year's tuition and a stipend equal to Tufts' own research assistantships. In exchange, students work on projects of interest to Draper Laboratory.

"What we're looking for is the innovation and energy that comes with student involvement in the lab," said John Sweeney, Draper Laboratory's director of education. "Tufts has proved to be a valuable source of talented engineers."

Students also benefit. As Draper Fellows, they get a chance to work on their projects in a non-academic setting.

• Peter Kazlas, E90, is investigating the advantages and limits of binary-optics technology, with specific application to automatic target recognition systems. Binary optics uses VLSI fabrication processes, allowing researchers to design custom optical elements in the same way that they design computer chips. "In the future, binary optics will make optical systems more compact, more feasible, and will enhance system performance," Kazlas said.

• Nicholas Katis, a Draper Fellow for the second year, is developing an automated fabrication process for optical couplers—devices that allow the coherent splitting and combining of light in optical fibers. Couplers play a critical role in fiber-optic sensors, instrumentation and communications systems. Katis plans to study couplers' applications in biomedical sciences.

• Anne Marie Biernacki, G90, a doctoral student in electrical engineering, is also a Draper Fellow for the second year. She is working on a hybrid digital/coherent optical processing system that lets scientists measure an object's phase. Measurement of the phase, which contains important information about thickness, index of refraction and time or motion changes, is currently lost in the imaging process. "I am using devices that exploit the real-time holographic capabilities of electro-optic crystals to solve a problem that previously was regarded as a computer-simulation problem," Biernacki said.

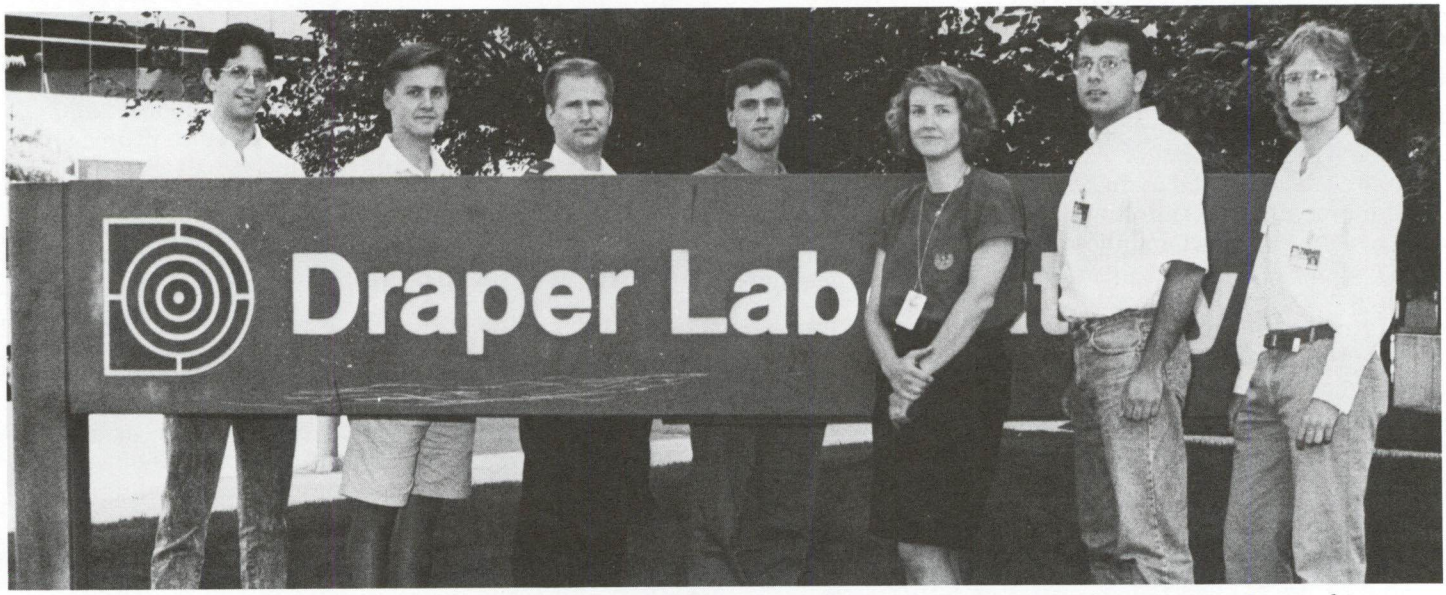
• David Coppeta, E90, is studying how optical processing systems can be applied to pattern recognition and tracking tasks.

• Scott Reitsma, E86, G90, is a doctoral student working in computational fluid dynamics. As a Draper Fellow, he is searching for a time-accurate solution of the Navier-Stokes equation for nearly incompressible laminar flows. Several methods already exist to solve this problem in steady-state flows, but few can accommodate variation in time. By developing a time-accurate solution, Reitsma hopes to obtain complex acoustic information.

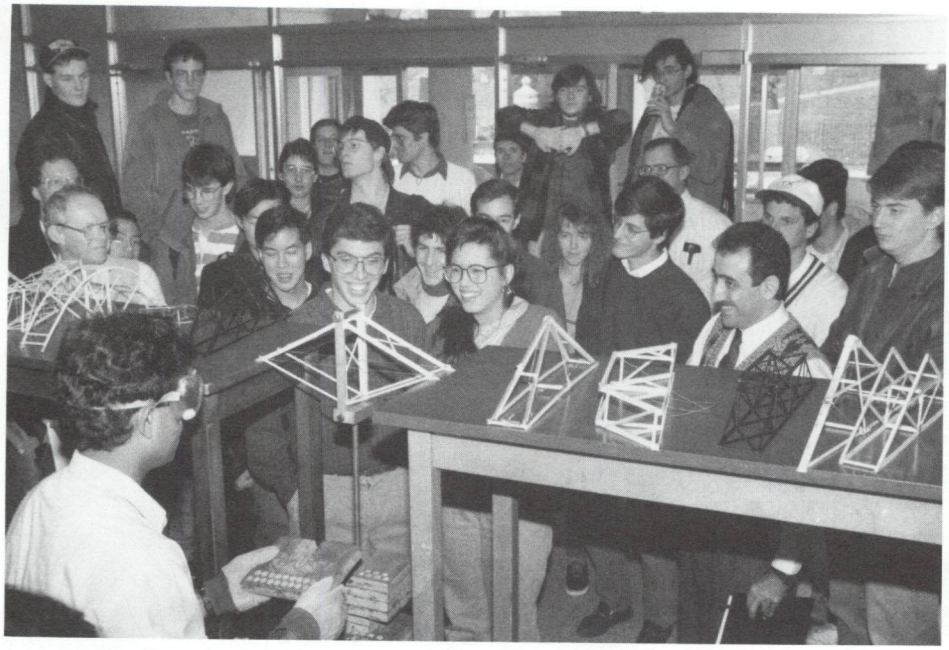
"Charles Stark Draper, our founder, felt that hands-on engineering work was an essential part of an engineering education," Sweeney said. Draper Laboratory employs roughly 200 students, including undergraduates in co-op programs, from four institutions: MIT, Boston University, Northeastern University and Tufts. According to Sweeney, many of these students end up coming to work for Draper Laboratory after they graduate.

Draper Laboratory, once a unit of MIT, has been an independent nonprofit research and development institute since 1973.

Diane R. Krieger ■



Tufts' Draper Fellows, from left, David Coppeta, E90, Peter Kazlas, E90, Arthur Zemke, Stuart David, Anne Marie Biernacki, G90, Nicholas Katis and Scott Reitsma, E86, G90.



Anna Jensen, E92, and Rob Becker, E91, watch as teaching assistant Suresh Babu adds another weight to their bridge's load. The team's diamond-shaped entry tied for first place in the aesthetics category and won third place in both of the other categories.

Patrick Johnson, E92, steadies his team's bridge while Masoud Sanayei, assistant professor of civil engineering, carefully attaches the steel-weight anchor device.

Student contest bridges gap between theory and practice

Working in pairs, 42 civil engineering students designed and built structurally sound, miniature balsa wood bridges as their final projects for a structural analysis course. In a contest on Dec. 3, the 21 bridges were tested and judged in three categories: maximum bridge capacity, maximum efficiency (bridge weight/capacity ratio) and aesthetics.

"I gave them 20 feet of balsa wood, 40 inches of steel wire, four 1/2-inch-square aluminum plates and some wood glue. Then I asked them to build the best bridge they could," said Masoud Sanayei, assistant professor of civil engineering, who teaches the course. "In a way, this resembles actual practice, because no matter what you build, you always have limited time, limited material, limited money and limited knowledge."

Typically, the model bridges were about 15 inches long, five to seven inches high and two to five inches wide. To test their strength, Sanayei suspended steel weights from each bridge, adding to the total load until the bridge would collapse.

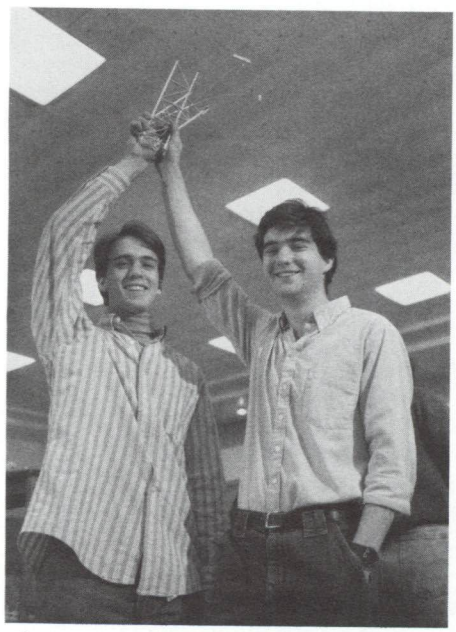
"These bridges can carry something in the order of 1,600 times their weight," Sanayei said. "That is the magic of civil engineering: If you put these balsa wood pieces together side-by-side, they might not even support 10 pounds in compression, but with good planning and careful analysis, they can carry much more."

The first prize in the maximum capacity category went to Chris D'Annunzio, A91, (an art history major), and Jon McFarland, E91, whose 1.2 ounce triangle-shaped bridge sustained a 121-pound load. The team also took second place in the bridge weight/capacity ratio category.

"The problem was finding a way to strengthen the balsa, which is very soft. We solved this by making I-beams from the wood," D'Annunzio said. "Then, because the bottom part of the bridge was under the most tension, we decided to build it entirely from wire. This kept the diagonal members of the triangle from pushing out."

Robert Kefalas, E92, and Christopher Price, E92, won first place in the weight/capacity ratio category, and they finished second in the maximum capacity category. Four teams were tied for first place in the aesthetics category.

Diane R. Krieger ■

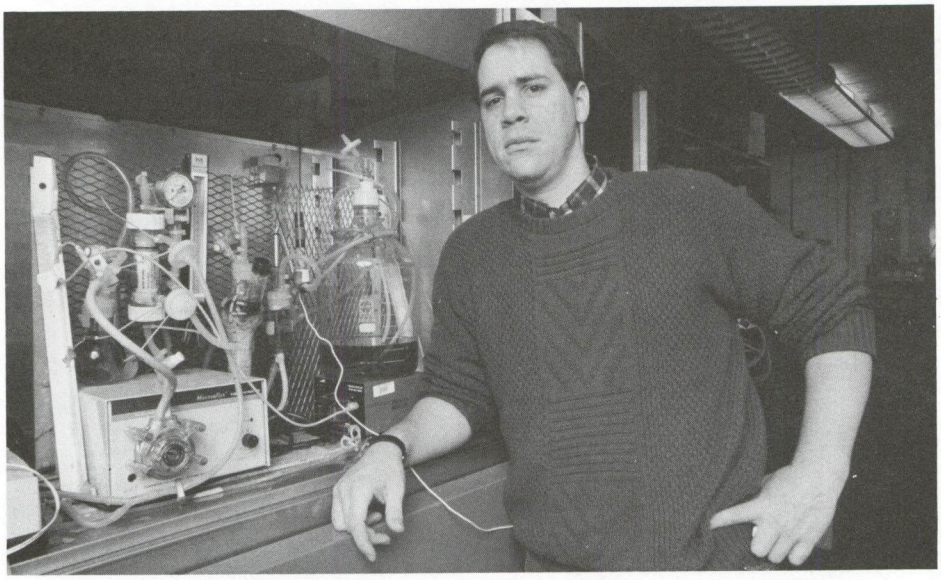


Chris D'Annunzio, A91, and Jon McFarland, E91, hold up in triumph their now-shattered winning entry.

Photography by J. D. Sloan

STUDENTS

Cultivating cells on polyester



Mark Morelli

Daniel Baker with a prototype of the bioreactor in which he grows cells that cling to polyester fabric fibers.

As any backyard gardener can tell you, it takes a mighty long time to grow ivy on a stone wall—decades and then some.

To the people in the pharmaceutical industry, cultivating cells for vaccines is, in some respects, similar to waiting for ivy to grow. It doesn't take decades to do, but the process that produces a liter of usable cell culture requires a bioreactor system as large as a refrigerator. The larger the bioreactor, the more cells it produces.

Daniel J. Baker, a master's degree student in chemical engineering at Tufts, is developing a method of growing more cells in a smaller space—in a bioreactor system the size of a large breadbox—that could signal less expensive vaccines for hepatitis, measles and polio.

Baker's secret is using non-woven polyester fabric (the same material that lines disposable diapers) as an attachment surface for the cells. Because the substance is made up of a lattice work of thousands of tiny fibers per square inch of fabric, there is an immense surface area on which cells can grow.

Going back to the ivy-on-the-brick-wall analogy, Baker compares the procedure to a gardener erecting a trellis next to a brick wall. The climbing plants now have a surface to cling to, and growth improves proportionately.

In the lab, Baker's procedure involves suspending many small discs of polyester fabric in a solution of cell-nurturing liquid. The solution is contained in a bioreactor system that provides food, removes wastes, recirculates the solution and monitors acidity, oxygen content and temperature.

In a paper presented at the annual meeting of the American Chemical Society in Washington, D.C., Baker said his process produced 2 to 10 times as many cells (more than 10 million cells per cubic centimeter of culture) as conventional processes that do not use polyester.

In recent lab trials, Baker has increased the yield to 23 million cells per cubic centimeter, and he sees the potential in future trials to increase the capacity of the system even more.

Baker, originally from Allentown, Pa., is working with Ana C. Lages, research associate at Tufts' Biotechnology Engineering Center, and Martin V. Sussman, professor of chemical engineering, who discovered the use of polyester non-woven fabrics as support matrices for human cell culture while at the Weizman Institute of Science in Rehovot, Israel.

Jay Chrepta ■

ALUMNI

Mark your calendar

Save the date! The departments of the College of Engineering are hosting reunions for their alumni this spring. All alumni will receive invitations and detailed programs in the mail. Mark your calendar and plan to attend.

Electrical Engineering
Sat., March 23
For information, call (617) 381-3217.

Chemical Engineering
Sat., April 6
For information, call (617) 381-3900.

Civil Engineering
Sat., April 13
For information, call (617) 381-3211.

Mechanical Engineering
Fri., April 26
For information, call (617) 381-3239.

Job fair offered to Tufts alumni

Do you have job openings that you would like to fill with Tufts alums? Are you considering changing jobs or careers in the near future?

On May 2, 1991, Tufts, with seven other area colleges, will host a job fair for alumni with at least one year of work experience. The fair will be held from 5 to 8 p.m. at the Hynes Convention Center in Boston and is open only to alumni from the eight schools. In addition to meeting corporate representatives from all over the Northeast, there will be seminars on topics such as resume writing and interviewing skills.

Call the Tufts Alumni Office at (617) 381-3577 inside Massachusetts, or 1-800-THE ALUM from outside Massachusetts for more information.

Remember knickers?

A lot more than the preferred pant length has changed at Tufts between the time these two photos were taken in front of East Hall.

For one, when Donald Mitchell, E30, Paul Giblin, A30, and Edward McCaul, E30, mugged the camera as Tufts undergraduates in 1930, East Hall was not a classroom and office building but their dormitory, and the price per room for the academic year ranged from $35 to $70.

There was a reservoir and a golf course on campus, and all the College of Engineering classrooms and offices were in the Bromfield-Pearson building (currently home to the math department).

Engineering students in 1991 may take classes in optical electronics and laser systems, but engineering students of the '20s like Mitchell and McCaul took courses on such hot topics as steam and railroad engineering, refrigeration and telephone and telegraph systems.

Time has marched well over half a century between the first photo and the second, taken last year at the Class of 1930's 60th reunion, but one thing has remained constant through the decades: the friendship of these three men.

"We've all kept in touch over the years and enjoy each other's company now as we did then," McCaul said.

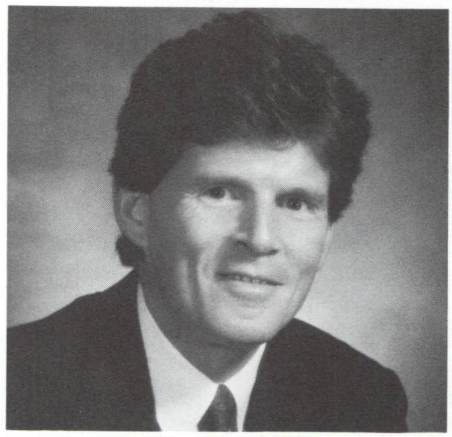
Pamela Benson ■

1930

1990

Roommates Donald Mitchell, E30, Paul Giblin, A30, and Edward McCaul, E30, pose before East Hall as students in 1930 and, again, as alumni during their 60th reunion in 1990.

Stone & Webster names Tufts alum president of environmental division



Joseph L. Petrillo, E68, G70

Joseph L. Petrillo, E68, G70, has been named president of Stone & Webster Environmental Services, a division of the Boston-based Stone & Webster Engineering Corp. that employs more than 1,500 technical and engineering experts in environmental services.

Petrillo, who joined Stone & Webster in 1968, specializes in environmental issues as they relate to conventional and advanced energy technologies; refineries, petrochemical and chemical complexes; pulp and paper mills; and municipal water and wastewater treatment facilities. Since coming to the firm, he has directed environmental restoration programs at U.S. Department of Energy and Department of Defense facilities and served as an environmental consultant to Stone & Webster's clients in Canada, Mexico, the United Kingdom, Italy, New Zealand, Egypt, Pakistan, Taiwan and the People's Republic of China.

Stone & Webster provides environmental services to federal, state and municipal agencies, electric and gas utilities and industrial and manufacturing companies. The company's current projects include the Boston Harbor cleanup, New York City's sludge management program, the Tennessee Gas Pipeline Company's projects to bring new natural gas supplies to the Northeast and various hazardous waste management projects across the nation.

Astill retires after 44 years at Tufts

continued from p. 1

realistic—he tends to see things in sensible proportion."

Astill, 67, who was associate dean of the college from 1980 to 1990, retired in December. He has contributed his human touch to the engineering college for almost as long as anyone there can remember. Astill said he often thought he would have liked to be a newspaper reporter or an actor. In high school, he wrote numerous stories and was editor of the yearbook. Influenced by a professor of journalism in college, he wrote frequently for local newspapers. He recalls a profile of the college janitor he once wrote, and how appreciative the man was when it was published in the local paper.

His thespian abilities surfaced when, about 30 years ago, a friend got him involved in community theater in Winchester, where he lives. Astill made a name for himself locally doing character roles such as the cemetery lot salesman in "Send Me No Flowers" and Teddy in "Arsenic and Old Lace." Eventually, the extension of his activities to other local drama groups and dinner theater in Boston became too time-consuming.

Instead of pursuing a career in journalism or theater, Astill brought his personable outlook to engineering at Tufts.

His foray into engineering was almost accidental. He and a friend who lived next door in Westerly, R.I., decided to give the field a try at the University of Rhode Island. Astill stuck with it, and after a brief stint in automotive engineering, his career has centered mostly around Tufts.

The College of Engineering in the post-World War II days when Astill arrived attracted mostly commuter students who received an intensely practical education. There were no graduate students and little research, but Astill was one of the few to become an important researcher, said Frederick C. Nelson, dean of the College of Engineering and a longtime friend and colleague of Astill's.

Astill saw—and helped—the college grow into an internationally recognized and respected institution. He believes that one of his most important contributions to education at Tufts was the development of the exchange program between Tufts and the University of Sussex in England that has benefited dozens of students since Astill helped create it in 1971.

Mark Morelli

Kenneth N. Astill

He also helped focus attention on a fluid mechanics phenomenon called Taylor vortex flow, which occurs between two concentric cylinders. Astill co-organized the first meeting on the subject at the University of Leeds in England in 1979, attended by about 20 reseachers. Subsequent gatherings mushroomed into international conferences with 70 to 80 participants.

Astill has taught several generations of mechanical engineering students everything from fluid mechanics, the focus of his graduate work at Harvard and MIT, to numerical methods, which in the early '60s offered students their first and often only opportunity to work with a digital computer. The university's first computer occupied an entire classroom in Anderson Hall and was primitive by today's standards and much more difficult to program.

In the late '50s and '60s, engineering education became much more science-oriented. More recently, the trend is toward a heavier emphasis on design. Astill put it this way: "Through these changes in engineering education, I have seen Tufts evolve into the sort of institution I always hoped it would become, thanks greatly to the leadership of President Jean Mayer and Fred Nelson. The College of Engineering has a well-balanced curriculum, able students at the undergraduate and graduate levels, a faculty with healthy research interests and an international reputation."

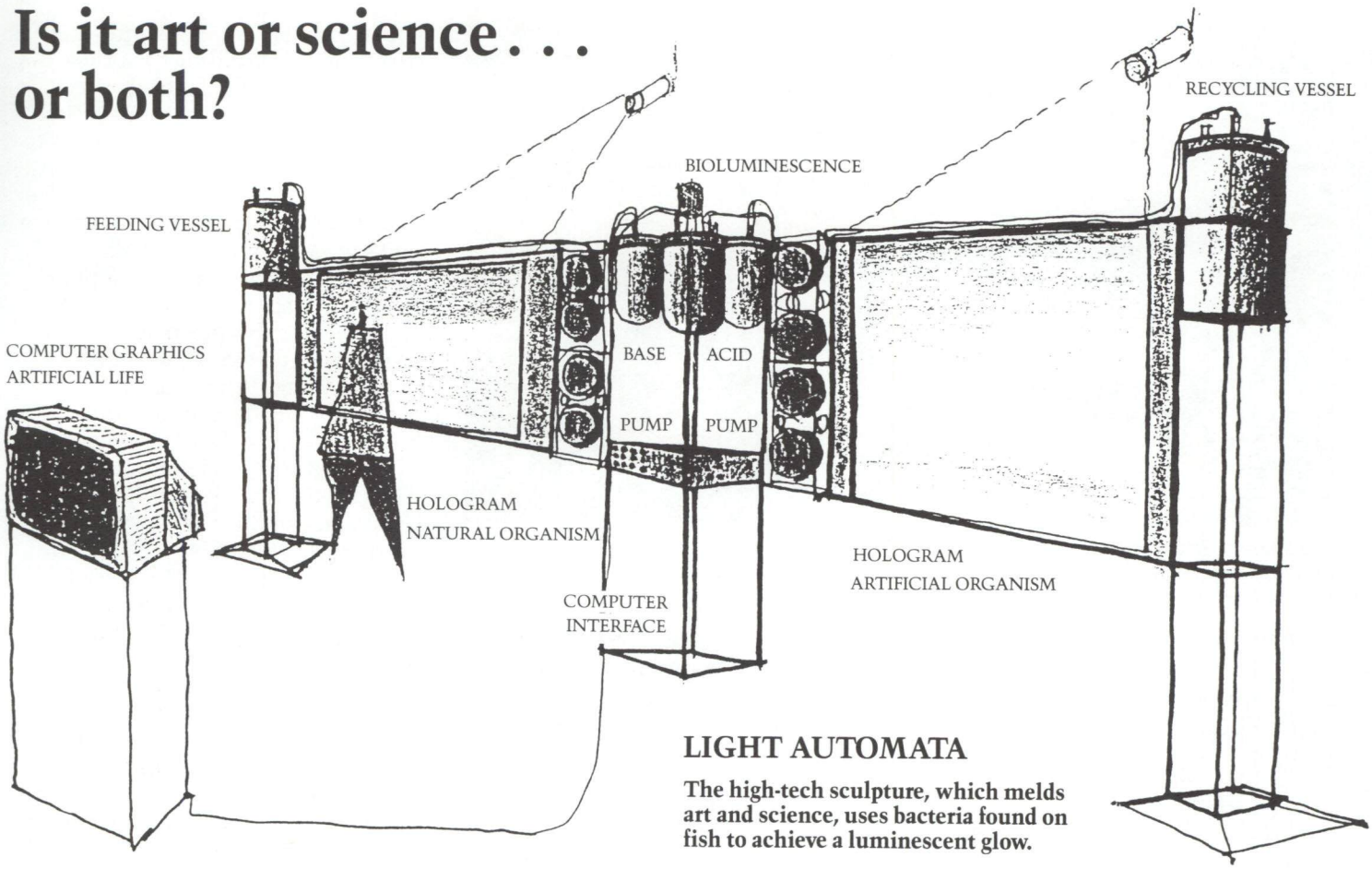
One of Astill's students went on to become Tufts' dean of engineering. Ironically, when Nelson was ready to graduate from Tufts in 1954, he hadn't really considered graduate work in engineering. Astill gently prodded him toward graduate education, for which Nelson is still grateful. "In retrospect, it was one of the best decisions I made," he said. "I'm not sure I was alone in the category of students that Ken gently pushed in that direction. It's a measure of what Tufts used to be and I hope still is—a place where the interaction between students and faculty results in people changing the direction of their lives."

Astill sees his retirement as an opportunity to make way for his younger colleagues, whose energy and creativity he admires. His familiar figure will be visible in Anderson Hall for some time to come, because he is running a mechanical engineering laboratory course with Vincent Miraglia, laboratory coordinator for Bray Laboratory. As for the rest of his time, he intends to see friends ("The people I know here and friends in Winchester are very important to me," he says), play golf and tennis (once his recently broken right wrist is fully mended) and relax at his vacation home in the scenic corner of Rhode Island where he grew up.

Retirement will provide a chance for Astill to change focus from the technical to the personal. It will probably be an easy transition.

Deborah Halber ■

Is it art or science . . . or both?



LIGHT AUTOMATA

The high-tech sculpture, which melds art and science, uses bacteria found on fish to achieve a luminescent glow.

A Tufts biotechnology researcher recently assisted an artist who is creating a high-tech sculpture that will include a self-sustaining system of living organisms that glow in the dark.

"Light Automata"—a large, ambitious environmental sculpture that will consist of holograms, a computer and a bioreactor housing a bacterial culture—is the brainchild of Jose Wagner Garcia, a Brazilian architect and artist who is a research fellow at MIT's Center for Advanced Visual Studies.

Ana Lages, a research associate at Tufts' Biotechnology Engineering Center, helped Garcia create the conditions that will allow a strain of deep-sea bacteria, when agitated, to steadily produce a milky, ethereal glow of light in a variety of colors—yellow, bluish-green and white.

"Light Automata" will be exhibited at MIT, Tufts and elsewhere upon its completion this year.

Lages helped Garcia develop a suitable artificial environment bacteria that will grow steadily and have a luminescent glow. She said they are using *Photobacterium Phosphorium*, bacteria from a deep-sea ecosystem that is found on fish and has a symbiotic relationship with the ocean's flora and fauna.

Garcia said that the sculpture will be the first in a series that explores the relationship between live and artificial systems.

"I believe that in the not-too-distant future, the distinction between real life and artificial life will become fuzzy enough to force us to conceptually redefine all parameters, properties and conditions currently associated with the term 'life,'" Garcia said.

The sculpture will consist of two glass pillars containing a nutrient fluid that will circulate to the bioreactor in which the bacteria grow. Between the pillars, there will be two panels with holograms of three-dimensional images of individual bacteria. The bioreactor will be suspended between the panels. The holograms are being developed in conjunction with the MIT Media Lab.

Sensors attached to the fermenter will record changes in the temperature, chemical composition and aeration of the bacterial environment. These changes will be depicted on the computer screen in real time. Viewers may be able to interact with the sculpture through the computer, possibly by altering the properties that affect the bacteria's light emission. The computer set up involves collaboration with Fluid Management Systems of Watertown, Mass.

Garcia, who came to the United States from Brazil last winter, said his country does not have the equipment and technology for him to create a work of this nature. "It is my hope that this and other projects will generate new ideas and concepts for the deeper exploration of the interface between art and science," Garcia said.

Deborah Halber ■

Steely resolve brings students victory

Members of Tufts' bridge-building team climb on their winning entry in the annual Northeastern Bridge Building Competition, held at the University of Massachusetts at Amherst last fall.

The Tufts team suffered a minor medical emergency in the first few seconds of the annual Northeastern Bridge Building Competition—one team member cut herself on a piece of steel while assembling the bridge—but in the end, the six-member team emerged victorious, winning three of the competition's six first-place awards.

"Given the rigid constraints of the contest, the students did an exceptional job and came up with a very novel design," said Richard Vogel, associate professor of civil engineering at Tufts and faculty adviser to the student team.

The event was held Nov. 3 at the University of Massachusetts at Amherst. It was the first year that Tufts' student chapter of the American Society of Civil Engineers participated.

Weighing in at a mere 249.5 pounds, the Tufts bridge took first place in the lightest total weight category.

"The closest thing to our bridge was 302 pounds. It wasn't the type of steel we used but the configuration that made our bridge so light. We also used pipe where everybody else used angles (steel sections rolled into an L-shape)," said Tufts team member Greg Imbaro, E94.

In a total of 55 "person" minutes (five students building the bridge in 11 minutes), the Tufts bridge also was constructed in the shortest time.

"The pipe sections were our key to speed. We just used Allen wrenches to tighten our connections, while the other teams used crescent wrenches and socket sets," Imbaro said.

Because Tufts secured first place in both the speed and weight categories, it was the automatic winner in the most economical category, which averaged the two.

Other categories in the bridge-building contest evaluated capacity, aesthetics and efficiency (best capacity-to-weight ratio). Tufts took third place in the efficiency and aesthetics categories.

"But we thought nothing else looked anything like or nearly as good as our bridge," said team member Robert Becker, E91.

Sponsored jointly by the ASCE and the American Institute of Steel Construction, the competition was designed to give students hands-on experience with steel, construction planning and practice and teamwork.

Other colleges represented at this year's competition were Norwich University, the University of Vermont, Union College and the University of Massachusetts at Amherst. Next year, eight teams are expected to enter the competition to be held at Tufts.

Pamela Benson ■

ENGINEERING NEWS

Tufts University
College of Engineering
Medford, Massachusetts 02155

NONPROFIT ORG.
U.S. POSTAGE
PAID
BOSTON, MASS.
PERMIT NO. 1161

TUFTS

Recycled Paper

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION DOCUMENT NUMBER: 9121502

****

FROM: NELSON, Frederick C.: TUFTS UNIVERSITY

TO: DR. BROMLEY

DATE OF CORRESPONDENCE: 05/20/91

SUBJECT: REGRET FOR ANY INCONVENIENCE THE CANCELLATION OF THE SCIENCE & TECHNOLOGY DINNER PLANNED FOR MAY 4 MAY HAVE CAUSED.

****

ASSIGNED TO:

ACTION REQUIRED:

****

SENDER'S DUE DATE: OSTP DUE DATE:

DATE COMPLETED:

****

COPIES TO: D. Allan Bromley

****

WHITE HOUSE TRACKING #: CONTACT PERSON:

REMARKS:

DATE RECEIVED: 05/23/91 FILE: P- INVITATION-SPEECH [redacted]

9121502

RECEIVE

91 MAY 23 AM :

OFFICE OF THE DIRECTOR

TUFTS UNIVERSITY

College of Engineering
Office of the Dean

May 20, 1991

Dr. D. Allan Bromley
Assistant to the President
for Science & Technology
Old Executive Office Building
Washington, DC 20500

Dear Dr. Bromley:

Thank you for your willingness to address the Science & Technology Dinner which Tufts University had planned for May 4 at the Plaza in New York. We considered your presence and remarks to be the centerpieces of the entire event.

Thus, we were thoroughly disappointed when a number of events conspired which forced Tufts to postpone the occasion. Mr. and Mrs. Richardson, President Mayer, and I anticipate the dinner to be rescheduled to a date six to eight months hence.

They join me in expressing regret for any inconvenience which our cancellation might have caused. In addition, we all ask your indulgence in hopes that once our plans for the rescheduled event are firm, we can review them with you and again invite your participation.

I extend best wishes to you and continued success in your contributions to the country.

Sincerely yours,

FC Nelson

Frederick C. Nelson
Dean of Engineering

/mp

cc: Mr. & Mrs. D. Kenneth Richardson

Medford, Massachusetts 02155
617 381-3237

TUFTS WINTER 1991

ENGINEERING NEWS

Tufts welcomes high-tech at Sci-Tech

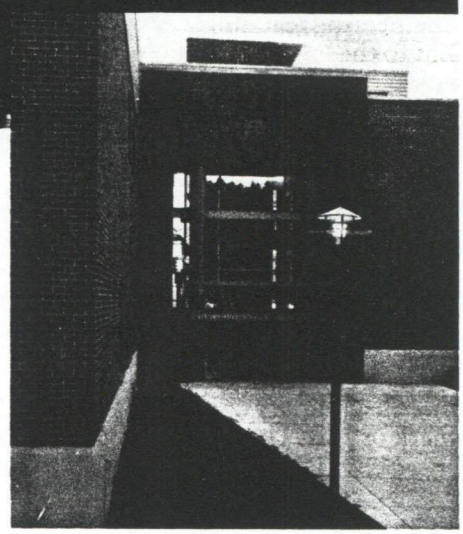
A sustained commitment to research and development is needed to restore the nation's economic strength, U.S. Energy Secretary Adm. James D. Watkins told 400 invitees at the dedication of Tufts' Science and Technology Center Nov. 3.

"Unless we better link basic research activities to national goals, we assuredly will not achieve one of the most important of these—namely economic competitiveness.

"The center you are dedicating today at Tufts demonstrates your commitment to these principles," Watkins said.

The $13.3 million, 89,000 square-foot center on Tufts' Medford/Somerville campus houses the College of Engineering's Laboratory for Materials and Interfaces and Electro-Optics Technology Center, which have both framed research to meet the current and future needs of American business and industry.

The new Science and Technology Center, founded in part by a $10 million grant from the Department of Energy under the sponsorship of U.S. Rep. Edward J. Markey (D-Mass.), is also a national model for retrofitting commercial buildings to make them energy conserving.



J. D. Sloan

Above: At the dedication, Dean Frederick C. Nelson greeted honored guests (from left) Constance Rogers Richardson, D. Kenneth Richardson, Secretary James D. Watkins and Sheila Watkins. In back is Anthony Cortese, Dean of Environmental Programs. Right: Main entrance to the Science and Technology Center.

The center contains more than $500,000 worth of energy-saving features from a heat recovery system to a variable air volume handling

continued on p. 4

Astill retires

Farewell to a man of many talents

People in Winchester, Mass., still remember Kenneth N. Astill as Paul Revere.

Actually, they remember him as a statue of Revere. Astill once gamely covered himself in bronze makeup to play the statue, complete with pigeons on his head. Leaving the pedestal and the pigeons, he continued as master of ceremonies in a show sponsored by a volunteer organization.

An ability to make people laugh is one of the traits that has made Astill, professor of mechanical engineering at Tufts, one of the most endearing figures around the College of Engineering for the past 44 years.

"He has a terrific sense of humor," said Allan M. Cormack, University Professor of Physics, who often shares a morning cup of coffee with Astill in Anderson Hall. "He's also very

continued on p. 14

WHAT'S INSIDE

Sent to you with the compliments of

Frederick C. Nelson
Dean of Engineering
Tufts University

THE WHITE HOUSE

WASHINGTON

July 9, 1991

Dear Dean Nelson:

Many thanks for your letter of May 20 which I am very belatedly answering because I have been on travel status for much of the intervening period.

It was thoughtful of you to write concerning the postponed dinner originally scheduled for May 4th at the Plaza in New York.

Once you and your colleagues fix on possible alternate dates I would be happy to try to fit one of them into my schedule if that remains your wish.

With all best wishes,

Sincerely yours,

D. Allan Bromley
The Assistant to the President
for
Science and Technology

Professor Frederick C. Nelson
Dean of Engineering
Tufts University
Medford, Massachusetts 02155

"INVITATION FOR DR. BROMLEY"

TYPE: INVITATION-SPEECH DOCUMENT NUMBER: 9121545

****

SPEECH: YES NO

FROM: ROSSITER, Bryant: CHEMRAWN VII

DATE OF EVENT: 12/05/91

LOCATION OF EVENT: BALTIMORE, MARYLAND

TIME OF EVENT:

SUBJECT: INVITATION TO PARTICIPATE IN THE CHEMRAWN VII WORLD CONFERENCE ON THE CHEMISTRY OF THE ATMOSPHERE, AS A PLENARY PRE-DINNER SPEAKER.

****

RSVP: 06/12/91

CONTACT PERSON:

CONTACT NUMBER:

****

INVITATION ACCEPTED? YES NO

****

COPIES TO: ENVIRONMENT

REMARKS:

CLOSED

DATE OF LETTER: 05/22/91 DATE RECEIVED: 05/29/91

FILE: p- INVITATION-SPEECH

THE WHITE HOUSE

WASHINGTON

July 24, 1991

Dear Bryant:

Thank you for inviting me to be a speaker at the CHEMRAWN Conference scheduled to be held in Baltimore on December 2-6, 1991. I apologize for the much belated response.

With the understanding that it is always possible that Presidential scheduling may force a change in my plans, I would be delighted to accept your invitation. December 2 at 9:30 a.m. would work best for my schedule. I hope that all will go as planned.

I appreciate your thinking of me and look forward to joining you.

Sincerely yours,

D. Allan Bromley
The Assistant to the President
for
Science and Technology

Dr. Bryant W. Rossiter
CHEMRAWN VII
American Chemical Society
Room 205
1155 16th Street, Northwest
Washington, D.C. 20036

912545

IUPAC

CHEMRAWN VII
WORLD CONFERENCE ON
THE CHEMISTRY OF THE ATMOSPHERE:
ITS IMPACT ON GLOBAL CHANGE

Co-sponsors:
International Union of
Pure and Applied Chemistry

American Chemical Society

Baltimore, Maryland
December 2-6, 1991

May 22, 1991

Please reply to:
25662 Dillon Road
Laguna Hills, Ca 92653

RECEIVED
91 MAY 29 A9:30
OFFICE OF THE
DIRECTOR

Dr. D. Allan Bromley
Assistant to the President
For Science and Technology
The White House
1600 Pennsylvania Avenue
Washington, D.C. 20500

Dear Allan:

You may recall that we corresponded earlier concerning the possibility that President Bush might serve as the Key Note Speaker for CHEMRAWN VII, "The World Conference on the Chemistry of the Atmosphere:Its Impact on Global Change," scheduled for December 2-6, 1991 at Baltimore, Maryland. We still hold hope for the possibility that the President might participate and will renew our invitation, if you feel it is appropriate, ten to twelve weeks in advance of the Conference as suggested in Joseph W. Hagin II letter to me of October 4, 1989. In the meantime, planning for the Conference is progressing well and we expect to make a significant contribution to a dialog that will help you, your colleagues in Washington, and decision makers from abroad to chart a wise and cost-effective course in a very difficult and emotional field.

Today, I am writing on behalf of Dr. Robert E. Sievers, Conference Chairman, and my colleagues who have the responsibility to draft recommendations from the Conference, to invite you to participate as a Plenary Pre-Dinner speaker on Thursday Evening, December 5, 1991. Your comments would provide a crucial input to the Conference and will appear verbatim in the "Perspectives and Recommendations." Similar publications from previous CHEMRAWN conferences have given important policy and technical guidance to members of the United States Congress, key U.S. industrial decision makers, academic and government scientists, public interest groups, and their counterparts in other nations.

I realize that in extending invitations to you and the President that we may be asking for more than is possible. This is something that might have to be worked out at your level. What is important is that we not lose your

sound, science-based views for solving broad technical, economic and political problems relating to the environment and global climate change.

Your consideration of our invitation will be greatly appreciated.

Sincerely yours,

Bryant

Bryant W. Rossiter
CHEMRAWN VII

cc. Dr. D.A. Henderson
Dr. Robert E. Sievers

THE WHITE HOUSE
WASHINGTON

August 24, 1989

Dear Bryant:

Many thanks for your letter of August 16th.

I shall be happy to recommend to President Bush that he consider giving the keynote address at CHEMRAWN VII because I do believe it to be one of the very important scientific activities of the year. Whether he would be able to follow through, you will realize of course, depends on matters outside of all our control, but I know that he would be interested in the possibility.

Your comments regarding Nyle Brady are very much to the point. I got to know Nyle quite well over the years while I served as chairman -- and indeed still do -- of the American side of the Indo-U.S. Bilateral Science and Technology Initiative set up by Indira Gandhi and Ronald Reagan in 1982 and subsequently renewed on a periodic basis.
I shall make a point of recommending Nyle's reappointment because it would indeed be most unfortunate to lose his talents prematurely.

Many thanks for alerting me to these matters. I would again congratulate you on the remarkable standard of excellence that you have achieved for the CHEMRAWN series and I will look forward to the proceedings of CHEMRAWN VII.

With all best wishes,

Sincerely yours,

Allan

D. Allan Bromley
Assistant to the President
for
Science and Technology

Dr. Bryant W. Rossiter
Senior Vice President
ICN Pharmaceuticals, Incorporated
3300 Hyland Avenue
Costa Mesa, California 92626

THE WHITE HOUSE

WASHINGTON

October 4, 1989

Dear Dr. Rossiter:

Thank you for your invitation for the President to give the keynote address at the CHEMRAWN VII Conference, to be held in Baltimore, Maryland, May 20-25, 1991.

We appreciate your extending this opportunity. We hope you will understand we are unable to make a commitment for the President this far in advance. In order not to delay your planning, we suggest you proceed with your program not counting on his acceptance. If you wish, you may then feel free to renew your invitation closer to the date -- perhaps ten to twelve weeks in advance -- for consideration at that time.

With best wishes,

Sincerely,

Joseph W. Hagin

JOSEPH W. HAGIN II
Deputy Assistant to the President
for Appointments and Scheduling

Dr. B. W. Rossiter
Senior Vice President
ICN Pharmaceuticals, Inc.
3300 Hyland Avenue
Costa Mesa, CA 92626

Second Circular

CHEMRAWN VII

WORLD CONFERENCE ON THE CHEMISTRY OF THE ATMOSPHERE: ITS IMPACT ON GLOBAL CHANGE

Preliminary Program & Call For Papers

December 2–6, 1991
Baltimore, Maryland, USA

Sponsored by The International Union of Pure and Applied Chemistry
Co-sponsored by The American Chemical Society
in association with The National Academy of Science, The Third World Academy of Science, and the U.S. Environmental Protection Agency

PURPOSE

The earth's atmosphere is a key component of the global commons. The responsibility falls to all mankind to preserve the virtues and augment the bounties of the commons. Chemistry can play a creative role in bringing about better environmental quality. This conference will differ from others by endeavoring to assess the latest scientific understandings and translate these into policy recommendations that will alter beneficially the future actions of governments, corporations, and individuals.

PROGRAM

MONDAY EVENING, DECEMBER 2, 1991

Registration • Reception

TUESDAY, DECEMBER 3, 1991

Atmospheric Chemistry and Global Change

D. L. Albritton (NOAA, Aeronomy Laboratory, USA)
E. P. Blanchard (Du Pont, USA)
G. M. Hidy (Electric Power Research Institute, USA)
V. A. Koptyug (USSR Academy of Sciences, USSR)
C. H. Krauch (Chemische Werke Hüls AG, Germany)
A. P. Mitra (Council of Scientific & Industrial Research, India)
M. Oppenheimer (Environmental Defense Fund, USA)

WEDNESDAY, DECEMBER 4, 1991

Stratospheric Ozone Depletion

G. Brasseur (National Center for Atmospheric Research, USA)
H. Johnston (University of California, Berkeley USA)
R. Jones (Cambridge University, England)
G. Mégie (Université Paris, France)
M. J. Molina (Massachusetts Institute of Technology, USA)
F. S. Rowland (University of California, Irvine, USA)
I. Shankland (Allied-Signal Inc., USA)
S. Solomon (NOAA, Aeronomy Laboratory, USA)
R. C. Worrest (U.S. Environmental Protection Agency, USA)

Methods of Measurement of Atmospheric Trace Species

E. V. Browell (NASA, Langley, USA)
D. H. Ehhalt (KFA, Julich, Germany)
H. I. Schiff (York University, Canada)
S. Slanina (ECN, Petten, The Netherlands)
V. E. Zuev (Institute of Atmospheric Optics, USSR)

THURSDAY, DECEMBER 5, 1991

Global Warming: The Greenhouse Effect

R. J. Charlson (University of Washington, USA)
R. J. Cicerone (University of California, Irvine, USA)
V. Ramanathan (Scripps Institute of Oceanography, USA)
X. J. Zhou (Academy of Meteorological Science, China)

Tropospheric Build-up of Oxidants

H. Akimoto (National Institute for Environmental Studies, Japan)
D. V. Bates (University of British Columbia, Canada)
D. Kley (KFA, Julich, Germany)
S. C. Liu (NOAA, Aeronomy Laboratory, USA)
G. S. Samuelsen (University of California, Irvine, USA)

Acid Generation in the Troposphere: Acid Rain

J. Ando (Chuo University, Japan)
T. E. Graedel (AT&T Bell Laboratories, USA)
Ø. Hov (University of Bergen, Norway)
T. C. Hutchinson (University of Toronto, Canada)
S. A. Penkett (University of East Anglia, England)
H. Rodhe (University of Stockholm, Sweden)

FRIDAY, DECEMBER 6, 1991

Future Actions Committee Discussions and Recommendations

This session will be organized by the CHEMRAWN VII Future Actions Committee Chairman J. W. Birks, Program Chairman J. Calvert, Vice Chairman and CHEMRAWN Committee Representative R. Pariser, and General Chairman R.E. Sievers

CHEMRAWN VII ORGANIZING COMMITTEE

R. E. Sievers (General Chairman); R. Pariser (Vice Chairman & CHEMRAWN Committee Representative); J. W. Birks (Future Actions Chairman); J. Calvert (Program Chairman); T. E. Graedel (Posters Chairman); C. Ponnamperuma (Third World Chairman); W. E. Wilson (Workshop Chairman); D. B. Ruddy (American Chemical Society Representative); R. M. Barkley, N. Brady, E. E. Ferguson, B. W. Rossiter and W. G. Schneider (Advisors)

IUPAC sponsorship implies that entry visas will be granted to all bona fide chemists provided application is made not less than three months in advance. If a visa is not granted one month before the meeting, the IUPAC Secretariat should be notified without delay by the applicant.

FUTURE ACTIONS COMMITTEE

J. W. Birks (University of Colorado, USA, Chairman); D. L. Albritton (NOAA, Aeronomy Laboratory, USA); P. J. Crutzen (Max Planck Institute for Chemistry, Germany); R. A. Duce (University of Rhode Island, USA); A. H. Ehrlich (Stanford University, USA); K. Fuwa (Japan Environmental Agency); M. L. Good (Allied Signal Inc., USA); A. Hayes (ICI Agrochemicals, England); B.W. Karrh (Du Pont, USA); M. Kassas (Cairo University, Egypt); V. A. Koptyug (Presidium of Academy of Sciences, USSR); J. E. Lovelock (Coombe Mill, England); G. Mégie (Université Paris, France); M. J. Molina (Massachusetts Institute of Technology, USA); L. Nondek (Water Research Institute, Czechoslovakia); M. Oppenheimer (Environmental Defense Fund, USA); J.W.M. la Rivière (International Council of Scientific Unions, France); B. W. Rossiter (Eastman Kodak, retired, USA); H. I. Schiff (York University, Canada); A. Salam (International Centre for Theoretical Physics, Italy); M. S. Swaminathan (India); X. Tang (Beijing University, Beijing, China); C. Tickell (UK Mission to the United Nations); D. Wyrsch (CIBA-GEIGY, Limited, Switzerland)

THE FOLLOWING ORGANIZATIONS HAVE GENEROUSLY CONTRIBUTED OR PLEDGED SUPPORT TO CHEMRAWN VII:

• American Cyanamid Company • ARCO Chemical Company • BASF Corporation • Dow Chemical, USA •
• E. I. du Pont de Nemours & Company • Ethyl Corporation • Fiat, USA, Inc. •
• Hercules Incorporated • Hoechst Celanese Corporation • ICI Americas, Inc. • Eastman Kodak Company •
• Monsanto • Nissan Motor Company, Ltd. •National Atmospheric and Oceanic Administration •
• Olin Corporation • PPG Industries, Inc. • Sony Corporation • Texaco, Inc. • Toyota Motor Corporation •
• Union Carbide Corporation • United Technologies • U.S. Environmental Protection Agency •

Instructions for student registrants:

A limited number of reduced-fee registrations are available for full-time students (pre-doctorate). Written applications for these partial scholarships should be received by the CHEMRAWN VII Secretariat by August 1, 1991 and should be endorsed by the student's supervisor on university letterhead stationery. Students are encouraged to present a poster paper.

(To be filled in by Committee)
Paper number as listed on program _____

CHEMRAWN VII

Abstract Form

A. TITLE OF PAPER: _____

B. SUBJECT AREA (See List): _____

C. AUTHOR(S):

D. TELEPHONE, TELEX, AND/OR FACSIMILE NUMBERS:

E. WORK PERFORMED AT: _____

F. ABSTRACT (150 words maximum see sample on reverse side):

☐ Application for Travel Grant

PLEASE MAIL UNFOLDED TO ELIMINATE REPRODUCTION PROBLEMS

CHEMRAWN VII

December 2-6, 1991 ✪ Baltimore, Maryland - USA

Preliminary Registration Form • Print or type all information

☐ Prof. ☐ Dr. ☐ Mr. ☐ Mrs. ☐ Ms. Name _____

Title _____ Affiliation _____

Address _____

City _____ State/Zip _____ Country _____

Phone _____ Fax/Telex _____

Please check if you would like further information:

____ Please send further information on the training workshop being arranged at the area Training Center by the U.S. Environmental Protection Agency.

Mail completed form to: CHEMRAWN VII Secretariat, c/o American Chemical Society, 1155 16th Street, N.W., Room 205, Washington, D.C. 20036-4899 USA FAX: (202) 872-6128/PHONE: (202) 872-6286 (3/91)

SAMPLE ABSTRACT FORM & INSTRUCTIONS FOR CHEMRAWN VII

Use the form on the reverse side to provide the following information.

A. TITLE OF PAPER

Use capital and small letters for the benefit of the editors.

B. CONFERENCE SUBJECT AREAS

- •Instruments and Techniques for Atmospheric Chemistry
- •Chemistry of the Urban Atmosphere
- •Chemistry of the Remote Atmosphere
- •Chemistry of the Stratosphere
- •Chemistry of Clouds and Precipitation
- •Biogeochemical Processes
- •Inventories and Budgets
- •Reaction Kinetics and Mechanisms
- •Global Scale Data and Models
- •Chemistry and Physics of Atmospheric Aerosols
- •Paleoatmospheric Chemistry
- •Interactive Chemistry of the Atmosphere and Oceans

C. AUTHOR(S)

Given name first, family name next (IN CAPITAL LETTERS) with name of presenter underlined

D. TELEPHONE, TELEX, AND/OR FACSIMILE NUMBERS

E. WHERE REPORTED WORK WAS PERFORMED

F. ABSTRACT

(See sample at right for instructions on typing abstract)

(To be filled in by Committee)
Paper number as listed on program _____

CHEMRAWN VII

Abstract Form • Example only

A. TITLE OF PAPER: Northern Hemisphere Ozone Depletion

B. SUBJECT AREA (See List): Chemistry of the Stratosphere

C. AUTHOR(S): Dr. Thomas Smith,
Georgia Tech, Box 999, Atlanta, GA 62214-1234 USA

D. TELEPHONE, TELEX, AND/OR FACSIMILE NUMBERS:
(404) 999-9998

E WORK PERFORMED AT: Georgia Tech

F. ABSTRACT (150 words maximum see sample on reverse side):

☐ Application for Travel Grant

PLEASE MAIL UNFOLDED TO ELIMINATE REPRODUCTION PROBLEMS

START THE ABSTRACT TITLE HERE USING CAPITAL LETTERS. Follow with author's names, full business address. Underline presenter's name. Start third line and any subsequent lines in the heading, if needed, just inside the blue line at left.

Leave a space between heading and abstract proper. Indent as shown for paragraph. Keep all lines as wide as possible without touching the blue lines at either side. Short lines create extra pages and add to publication expense. Avoid them where possible. Keep the text in one paragraph. If literature citations are needed, insert them in parentheses and not as footnotes. Credits, if any, should be added at the end of the abstract, but not as a new paragraph. If structures or other forms of illustration are used, drawings should be part of the overall abstract, not submitted separately. Use an electric typewriter, with carbon ribbon, if possible, and a type size to give 90 characters (letter plus spaces) per 7-1/2 inch (190mm) line. Before submitting your abstract, check format, nomenclature, and spelling. Make sure that erasures do not show. Abstracts will not be retyped, but will be reproduced photographically. Please mail the abstract unfolded.

TRAINING WORKSHOP TO BE SPONSORED BY THE U.S. EPA

A two-week training workshop will be arranged by the Office of Research and Development of the United States Environmental Protection Agency (U.S. EPA). The workshop will be held at the Area Training Center at Rutgers University, New Brunswick, New Jersey, just prior to the CHEMRAWN VII Conference. It will be structured around two of EPA's standard training courses: 1) Atmospheric Sampling and, 2) Quality Assurance for Air Pollution Measurement Systems. Much of the material in these courses is applicable to both health-related and global-climate pollutants. Laboratory work includes sampling and analysis of fine, coarse and respirable particles. The participants will be introduced to new, simple, passive techniques for monitoring ozone and other gaseous pollutants. The training program will include instruction in the use of simple models to predict ozone. Scientists from several agencies will discuss ways for developing countries to participate in research and monitoring related to global warming and stratospheric ozone destruction. This workshop will provide an excellent opportunity for young chemists from around the world to interact with experts in the field of atmospheric chemistry. It is open only to CHEMRAWN VII registrants.

MEETING ANNOUNCEMENT/CALL FOR PAPERS

The third and final circular, including registration and hotel information, will be mailed in September, 1991. To receive the final circular, please complete and return the preliminary registration form. Hotel rooms have been set aside, at reduced rates, for conference attendees and a social program will be offered for accompanying guests. Detailed information will be available in the final circular. Some financial assistance may become available to support travel to the conference for scientists from developing countries. Funds are also being raised to enable scientists from developing countries to attend a training workshop which will be held immediately preceding CHEMRAWN VII. To receive further information on the EPA workshops check the box on the preliminary registration form.

DEADLINE

The deadline for receipt of abstracts is May 30, 1991.

INFORMATION REQUIRED

The camera-ready 150-word original on the Conference Abstract Form plus one copy. Authors must also submit one copy of a long abstract of 500 to 1,000 words plus critically important tables, graphs, and figures to assist the referees who will evaluate contributed papers.

MAILING INFORMATION

Completed Abstract Form (and long abstract) should be mailed to:

CHEMRAWN VII
American Chemical Society
1155 Sixteenth Street, N.W.
Washington, D.C. 20036-4899
USA

OFFICIAL LANGUAGE

The official language of the conference for both abstracts and poster presentations is English.

World Conference on
The Chemistry of the Atmosphere:
Its Impact on Global Change

One of a continuing series devoted to
Chemical Research Applied to World Needs

December 2–6, 1991
Baltimore, Maryland, USA

IUPAC

CHEMRAWN VII

Preliminary Program & Call for Papers

CHEMRAWN VII SECRETARIAT
American Chemical Society
Room 205
1155 16th St., N.W.
Washington, DC 20036-4899
U.S.A.

CHEMRAWN: Chemical Research Applied to World Needs

"INVITATION FOR DR. BROMLEY"

TYPE: INVITATION-SPEECH DOCUMENT NUMBER: 9121512

****

SPEECH: YES NO

FROM: GURUSWAMY, Lakshman D.: UNIVERSITY OF ARIZONA

DATE OF EVENT: 01/17/92

LOCATION OF EVENT: TUCSON, ARIZONA

TIME OF EVENT:

SUBJECT: INVITATION TO PRESENT A KEYNOTE PAPER AT THE CONFERENCE ON ENERGY AND THE ENVIRONMENT: INTERSECTING GLOBAL ISSUES.

****

RSVP: 06/07/91

CONTACT PERSON:

CONTACT NUMBER:

****

INVITATION ACCEPTED? YES NO

****

COPIES TO: ENVIRONMENT

REMARKS:

CLOSED

DATE OF LETTER: 05/17/91 DATE RECEIVED: 05/28/91

FILE: P- INVITATION-SPEECH

THE UNIVERSITY OF
ARIZONA
College of Law
TUCSON ARIZONA
Tucson, Arizona 85721
(602) 621-1373
FAX (602) 621-9140

May 17, 1991

The Honorable D. Allan Bromley
Assistant to the President for
Science and Technology
The White House
Washington, D.C. 20500

Dear Dr. Bromley:

CONFERENCE ON ENERGY AND THE ENVIRONMENT:
INTERSECTING GLOBAL ISSUES
JANUARY 17-18, TUCSON, ARIZONA, USA

I am writing to invite you to present a keynote paper at a major scholarly conference on energy and the environment to be held in Tucson, Arizona, from January 17-18, 1992. A Preliminary Notice is enclosed.

The conference will analyze prominent themes about the environment/energy interface generated by the negotiations for a world climate treaty regulating carbon dioxide emissions. The themes also presage those to be canvassed at the Earth Summit in June 1992. Might you be interested in delivering the first keynote speech on January 17, titled: "Should We Stabilize or Curtail Carbon Dioxide Emissions?" Keynote speakers are expected to submit a paper at least one month before the conference. We will, of course, be happy to pay for your travel and stay in Tucson, and offer you a small honorarium of $1,000.

You will see from the announcement that we have drawn up a viable conceptual framework, and have invited other eminent scholars to participate in the conference. A number of them have already accepted our invitation. The conference will be followed by a national television program based on the "Advocates." You may, however, notice that your name does not now appear in the Preliminary Announcement. Please allow me to explain this omission. This was due to the fact that an interdisciplinary committee which selected the speakers did not expect the conference would be of sufficient importance to attract your participation. Quite to the contrary, it now appears, based on reports in The New York Times and conversations with other participants, that the issues being canvassed at the conference are engaging your attention. You would both illuminate the

issues and laud the conference by presenting the first keynote speech.

The University of Arizona is a "Research 1" university in the USA, and has numerous established interdisciplinary research programmes dealing with global change. The city of Tucson is surrounded by mountains, and is a very beautiful winter resort.

Governor Symington and Senator McCain will be writing to you in support of this invitation. We are all excited at the prospect of having you here, and I look forward to hearing from you.

Sincerely Yours,

Lakshman D. Guruswamy
Professor of Law

LDG:jr
enc.

Preliminary
Announcement

ENERGY AND THE ENVIRONMENT: INTERSECTING GLOBAL ISSUES

January 17 & 18
1992

College of Law

THE UNIVERSITY OF
ARIZONA
TUCSON ARIZONA

with

Udall Center for Public Policy & College of Engineering

D. THE ENERGY ENVIRONMENT INTERFACE

ONE (1) KEYNOTE PAPER

William D. Ruckelshaus, Former Administrator, EPA., OR
James Schlesinger, Former Secretary, Department of Energy, OR
Gro Harlem Brundtland, Prime Minister of Norway

DISCUSSANTS

Lakshman Guruswamy: Professor of Law, University of Arizona
Donald Elliott, Professor of Law, Yale University; General Counsel, EPA.

E. IS THE CUTTING DOWN OF CARBON DIOXIDE ECONOMICALLY VIABLE FOR POOR DEVELOPING COUNTRIES?

ONE (1) KEYNOTE PAPER

Jose Goldemberg (Secretary for Science and Technology, Government of Brazil)
Amulya K.N. Reddy (Indian Institute for Science)

DISCUSSANTS

Developing Countries: Malta; Bangladesh; Egypt

F. DECISIONMAKING IN THE FACE OF UNCERTAINTY

ONE (1) KEYNOTE PAPER

William Reilly, Administrator, EPA., OR
Harvey Brooks, Professor, Kennedy School of Government, Harvard University

TWO (2) DISCUSSANTS

William Rodgers, Professor of Law, University of Washington
Victor Baker, Regents Professor of Geosciences, University of Arizona
Stuart Eizenstat, Lecturer, Kennedy School of Government, Harvard University
Private Practice, Washington D.C.

ENERGY AND THE ENVIRONMENT: INTERSECTING GLOBAL ISSUES

"In crisis there is opportunity"

The prospect of a world climate treaty, under which emissions of carbon dioxide are stabilized and then reduced, crystallizes the complicated and difficult questions we confront. Caught in a vise, the United States and the international community, struggle to avoid making an almost impossible choice between material prosperity and a clean environment.

Cheap energy, and energy driven technology, have ushered us into realms of prosperity unparalleled in the history of the world. At the same time, fossil fuels, that provide this energy, are held responsible for our environmental degradation. Fossil fuels have caused diverse forms of air pollution, acid rain, and urban smog. It is alleged that global warming should be added to this list. When carbon loaded fossil fuels like coal and oil are burned they yield energy and carbon dioxide. Since carbon dioxide is the most important of the trace gases held responsible for global warming, fossil fuels are accused of causing adverse climatic change.

To what extent should we abandon our reliance on fossil fuels in the face of the environmental evidence? Are we willing to pay the staggering price of reducing coal and oil in the absence of viable alternatives? On the other hand, should not the cost of the Gulf war be internalized in calculating the true cost of oil? Will the reduction of emissions lead to the development of alternative fuels or the crippling of economic growth? Are we, as the U.S. and the USSR suggest, engaged in the folly of killing phantom dragons at enormous costs? Is there a middle way of sustainable development that could steer us between the extremes of a pristine environment and unbridled, uconscionable development? At the Earth Summit in 1992, world leaders will be asked to choose the middle way of sustainable development. Is this wise or practicable? How may such policies be implemented?

These are among the hard questions, that will exercise this two day scholarly con ference. The conference will invite the most eminent scholars, thinkers and policymakers in the world to present papers on the various questions raised. The proceedings will be published in the Arizona Journal of International and Comparative Law. These papers will be further edited and developed into a book that will constitute a creative and definitve benchmark in the formulation of energy and environmental policy in these areas.

OPENING ADDRESS

Maurice Strong, Secretary General, United Nations Conference on Environment and Development.

THEMES

A. *SHOULD WE STABILIZE OR CURTAIL CARBON DIOXIDE EMISSIONS?*

ONE (1) KEYNOTE PAPER

Richard Lindzen, Professor, Massachusetts Institute of Technology, OR
George Kukla, Professor, Columbia University, OR
Patrick Michaels, Professor, University of Virginia

TWO (2) DISCUSSANTS

Stephen H. Schneider, National Center for Atmospheric Research
James Hansen, Goddard Institute for Space Studies
Carl Sagan, Professor, Department of Astronomy, Cornell University
Robert E. Dickinson, Professor, University of Arizona

FOCUS OF DISCUSSION

- **YES;** because there is strong evidence that carbon dioxide is responsible for global warming, and the adverse effects of such global warming are very serious.
- **NO;** either because the evidence is deficient or the effects of carbon dioxide are benign.

B. *SHOULD WE CURTAIL CARBON DIOXIDE EMISSIONS IN THE ABSENCE OF ALTERNATIVE FUELS?*

ONE (1) KEYNOTE PAPER

Senator Albert Gore, OR
Claudine Schneider, OR
Senator Timothy Wirth, OR
Jessica Mathews, World Resources Institute, OR
Daniel Evans, Former Governor and Senator, Seattle, Washington

THREE (3) DISCUSSANTS

Ralph D'Arge, Professor of Economics, University of Wyoming, OR
James Porteba, Professor of Economics, Massachusetts Institute of Technology
Blair Bower, Conservation Foundation
Another

FOCUS OF DISCUSSION

- **YES;** the price of fossil fuels is too high and emission limitations will lead to the adoption of fuel efficiencies and the development of other fuels.
- **NO;** the cost of such reduc tions are staggeringly high, and there are no satisfactory alternatives.

C. *IS IT MORE PRUDENT TO CONCENTRATE ON THE EFFECTS AND NOT THE CAUSES OF GLOBAL WARMING?*

ONE (1) KEYNOTE PAPER

Bruce Babbit, Former Governor, Arizona, OR
Daniel Evans, Former Governor and Senator, Seattle, Washington

THREE (3) DISCUSSANTS

Peter Gleick, Pacific Institute for Studies in Development, Environment and Security
Ian Burton, International Federation of Institutes for Advanced Study
B. Fischoff, Professor, Carnegie Mellon University, OR
P. Slovic, Professor, University of Oregon
Julian Simon, Professor, University of Maryland

FOCUS OF DISCUSSION

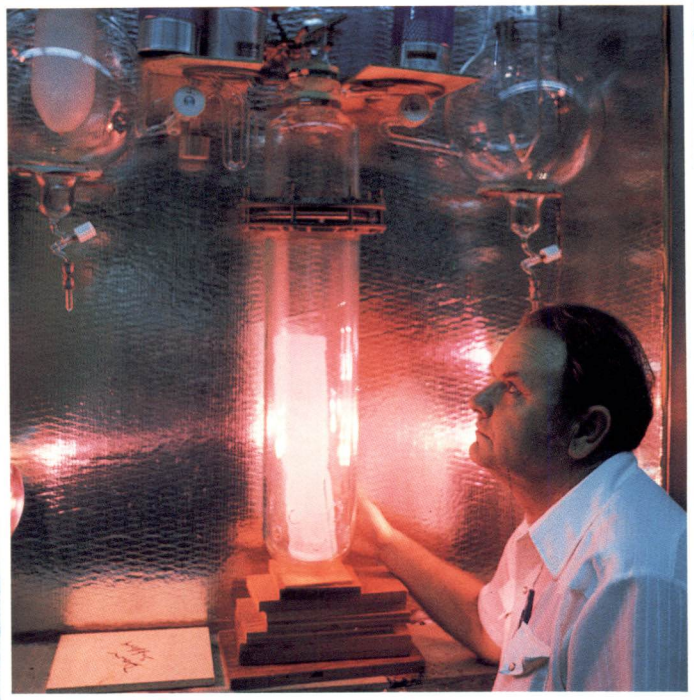
- **YES;** it is more sensible and economically viable to deal with effects by crop adaptation and building sea walls rather than dealing with causes - i.e., reduction of trace gases.
- **NO;** Causes not effects should be dealt with, because we do not know what the real effects might be.
- The need to deal with effects should be seen as complementary and not as an alternative to action dealing with causes.

over

FALL–WINTER 1990 VOLUME 7, NUMBER 1

REPORT ON RESEARCH

GLOBAL CLIMATE CHANGE

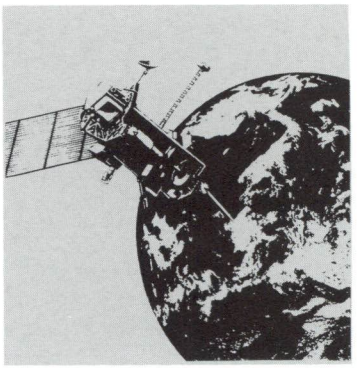


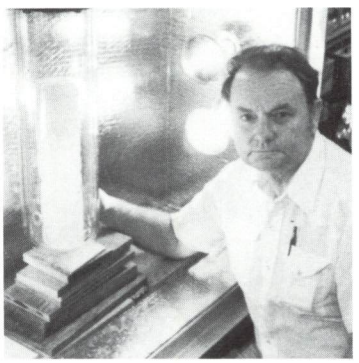
THE UNIVERSITY OF
ARIZONA
TUCSON ARIZONA

REPORT ON RESEARCH
GLOBAL CLIMATE CHANGE

THE UNIVERSITY OF ARIZONA
TUCSON, ARIZONA
FALL–WINTER 1990
VOLUME 7, NUMBER 1

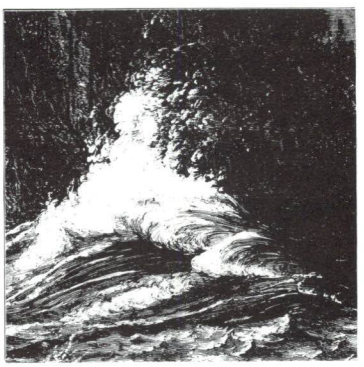
CONTENTS





COVER:

Alexander T. Wilson demonstrates the apparatus he built to sublimate Polar ice cores to extract and measure their carbon dioxide content.
Photo by Lori Stiles



Introduction

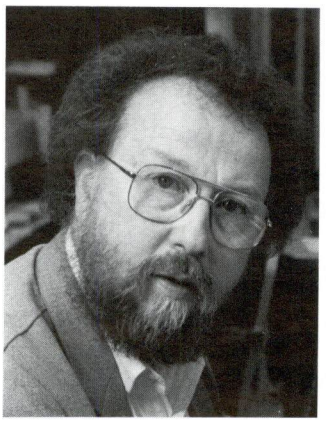
We — humanity — may have enough environmental muscle to change the climate of our planet. It is very possible that we have already started this process, but we do not yet understand our life support system well enough to know where our actions will lead. It is this realization, that we are 'strong in the arm but weak in the head' when it comes to looking after our global environment, that has jolted governments around the world into concern about global change. There is fear of the consequences of a possible massive and rapid global warming, and of other effects such as a weakening of the screen of ozone in the upper atmosphere that protects life from damage by ultraviolet light.

It is clear from this that we need a much better understanding of how our life support system works. In particular, we must look at the way its major components are linked, at a global scale. These include the atmosphere, the oceans, the ice of high latitudes and elevations, the land and the living world. A framework for doing this is provided by the emerging discipline of Earth System Science, in which the kind of integrated approach to the study of a planet, developed in the exploration of the Solar System, is applied to the third planet, our home.

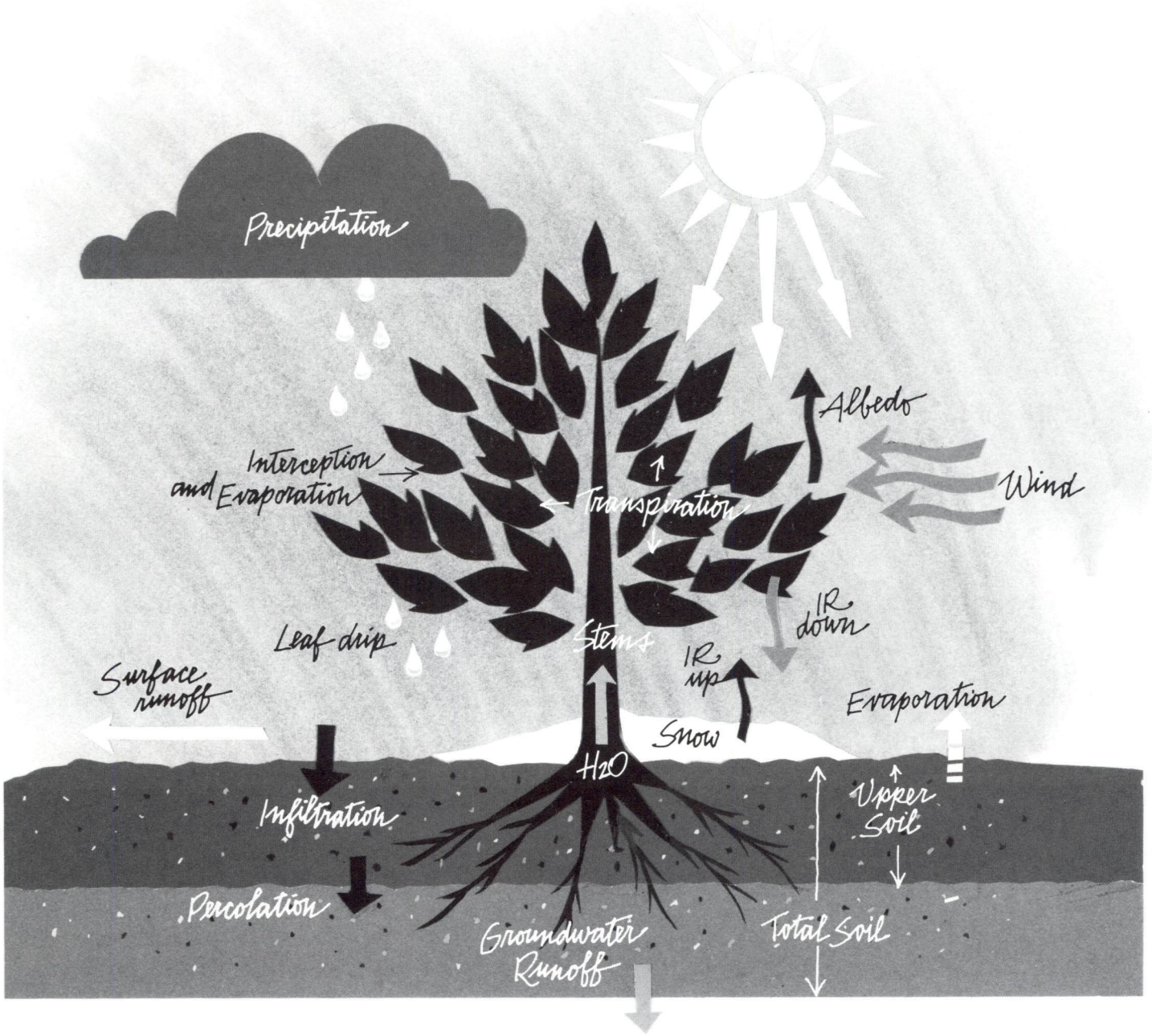
Researchers here have been engaged for many decades in the study of the processes linking the components of the Earth System, its history over all time scales, and the development of techniques for monitoring its vital signs. Some of The University of Arizona's most distinctive programs, for example the Institute of Atmospheric Physics, the Laboratory of Tree-Ring Research, and the Department of Hydrology and Water Resources, have played a leading role in this, along with departments such as Geoscience and Physics. An extraordinary wealth of talent has been involved, from graduate students to several members of the National Academies of Science and Engineering. More recently, scientists at the UA have been playing an important part in the development of Earth System Science, the science of global change. Faculty from several departments have been involved in the planning and design of both the United States Global Change research program, a billion-dollar federal effort, and the multinational International Geosphere-Biosphere Program. Arizona has no national laboratories, and few federal research facilities. If our state is to participate in the national and international global change research efforts, the universities must play the major role.

In this issue of Report on Research we introduce you to some of the ongoing projects at The University of Arizona in Tucson that are part of these programs. You will notice that, as is often the case with truly innovative work, global change research cannot be contained within the boundaries of existing academic disciplines. Global change projects typically involve scientists from more than one department and often more than one college. I hope you will also gain a sense of the urgent curiosity that drives our research. The best motivation for doing science is a compulsive wish to know and understand how and why things work.

This is almost always linked with an equally compulsive urge to share our findings with others, especially our students. In all the great universities of the world, scientists and scholars are engaged in both these pursuits, advancing knowledge and sharing it, in an inextricable mixture of research and teaching. At an early stage in the development of the Arizona Research Laboratories' Global Change Division, an entity established to stimulate and facilitate global change research, a proposal emerged for the development of courses on global change. The first was offered, most successfully, in Spring 1990, and several others are being offered this academic year. This, coupled with The University of Arizona faculty's achievements in global change research, led to our being one of five universities selected to take part in a NASA - funded curriculum project. We will cooperate with NASA and the other universities in the consortium in the development of graduate and undergraduate courses in Earth System Science. A key feature of this will be a course for freshmen not majoring in science, in which senior NASA scientists as well as UA faculty will participate. These citizens of the 21st century will be able to get news directly from the scientific front-line that will enable them to make educated choices in their economic and political life. I hope this issue of Report on Research will give you some idea of the understanding and stimulation we hope to transmit to them.



Malcolm K. Hughes, Ph.D.
Professor of Dendrochronology
Director of the Laboratory
of Tree-Ring Research,
and Director of the ARL
Global Change Division.



Understanding Global Change

To R.E. Dickinson, the real question of global climate warming is not if it is occurring, but to what extent. Dickinson's research has to do with land surfaces and how they interact with the atmosphere to produce changes in the Earth's climate.

"The atmosphere puts precipitation and net radiation onto the land. The land responds by developing temperature, which depends on the various energy balance processes," he says.

One of those processes, and one which Dickinson says is extremely important to the understanding of global change, is "evapotranspiration," or the movement of water from the Earth to the atmosphere through plant life. While water finds its way back to the atmosphere through plants, so does carbon in the atmosphere find its way back to the earth.

But to understand the effect of the Earth's vegetation, or biomass, on global change, one must first understand what global change really is, and the effect humans have on their environment.

"Global change (is the) broad background of geological processes against which human activities are embedded," Dickinson explains.

But now, within this century, changes caused by the

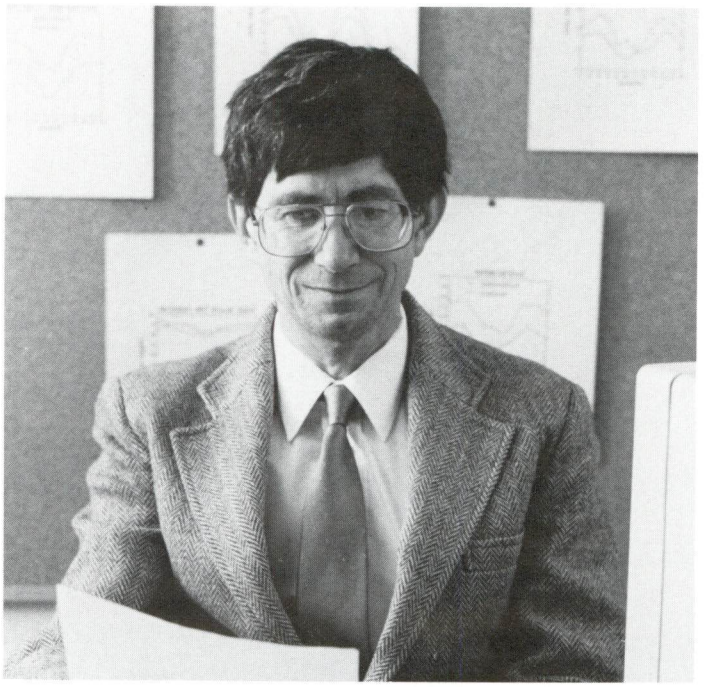
"The problem of greenhouse warming is that the carbon we add to the atmosphere will take hundreds of years to go away once we put it in, so in our lifetime it's irreversible."

activities of people are occurring faster than the geological processes of the Earth. For instance, the use of fossil fuels has skewed what is called the "carbon cycle." As humans burn fossil fuels for heating, cooling and transportation, the end result is the freeing of carbon from where it is trapped in the Earth, and releasing it into the atmosphere.

About five times 10 to the ninth power (five billion tons per year) of excess carbon are released into the atmosphere, but only three billion tons stay there. The rest goes into the ocean and other reservoirs. "And this is a result of human activity," Dickinson says.

But, Dickinson points out that there is 100 times as much carbon as that captured in the biological reservoirs of the Earth, and 20 times more than that taken out annually by the natural processes of trees and vegetation and then put back into the atmosphere by the death and decay of the vegetation.

Though the amount of increase by human activity is relatively small in comparison with that turned over by the Earth's natural processes, Dickinson believes the changes created by human activity have serious and long-term implications.



Robert E. Dickinson

The carbon introduced into the atmosphere by human activity has resulted in the start of a process that will warm the Earth's atmosphere.

"The problem of greenhouse warming is that the carbon we add to the atmosphere will take hundreds of years to go away once we put it in, so in our lifetime, it's irreversible," he says.

"But the temperature of the atmosphere won't rise until the first couple hundred meters (in depth) of the ocean warm up. It takes from 30-50 years for a warming today to heat up the ocean," he says.

To better understand the processes involved, much of his work is in the development of a climate model.

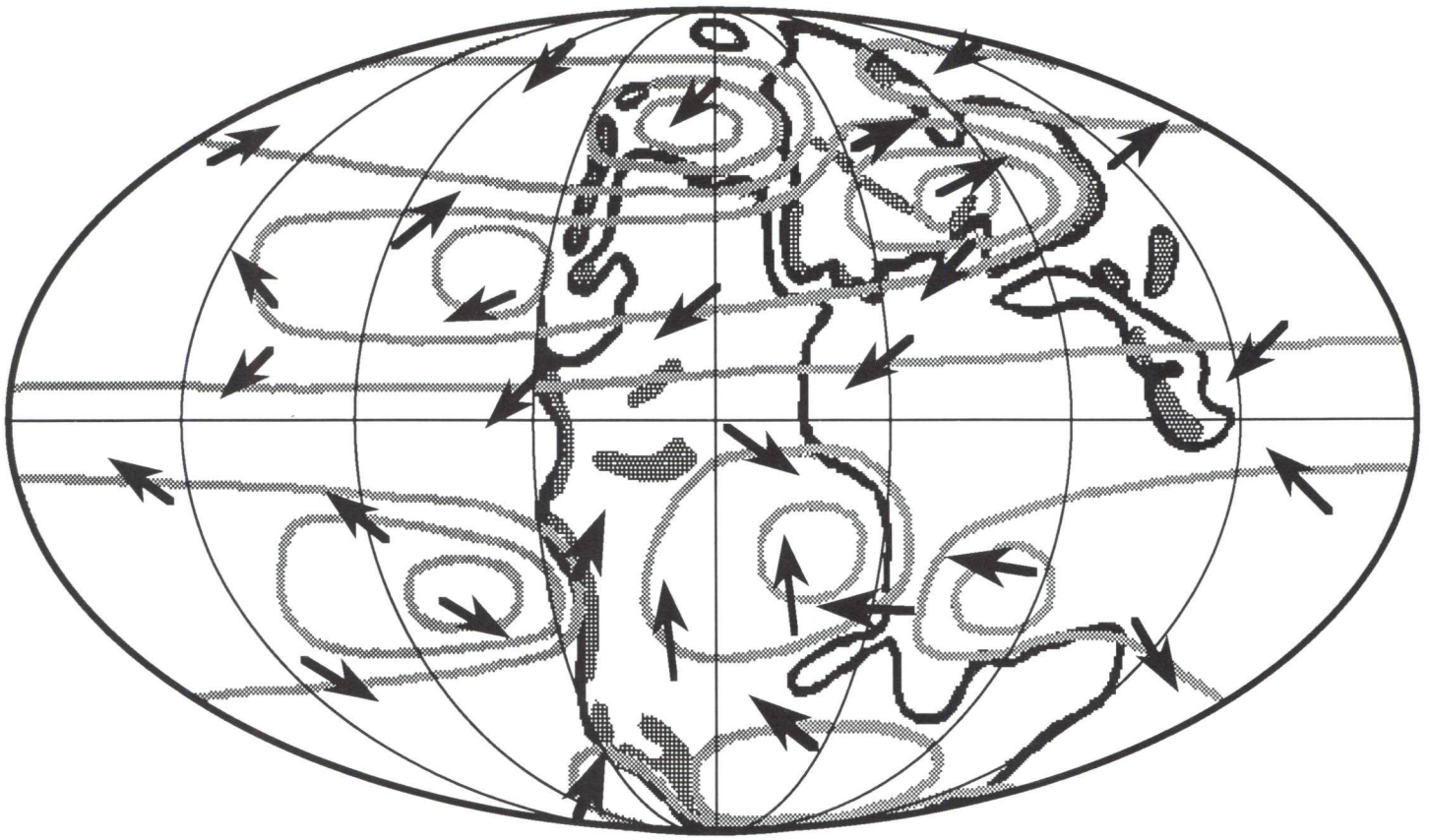
"For my own specialty, I am concerned about land surface processes and how they work in a climate model. "Evapotranspiration, or the moving of water, is a very important energy balance process. A lot of my work is concerned with how vegetation participates," he says.

"What I'm trying to model (deals with) vegetation, leaves. Water goes up through (plant) stems to 'stomates' in the leaves. The stomates control how much water gets out at the same time carbon comes in. We model the movement of water through the stomates. We also model the reverse process of carbon dioxide coming into the plant. (Then we) try to figure for the whole global surface area that is covered by vegetation." he says.

To Dickinson, global warming issues fit in quite nicely with energy conservation issues. He says the use of solar and other non-fossil-based energy could slow the changes being caused by burning fossil fuels, which he labels as "dangerous." "There is much more future in various sources such as solar or burning wood. If you grow wood and burn it, that's sort of no gain of carbon in the atmosphere," he says.

"People worry about nuclear energy because of possible catastrophic events that have a very low probability of occurring. "I don't advocate nuclear energy, but people don't realize the serious health effects of fossil energy, which are greater than those posed by nuclear.

by Dennis St. Germaine



Climate Modeling

New research at The University of Arizona is beginning to show how much climate fluctuated in Earth's ancient history.

While Earth has been much warmer and much colder than today, in the most general aspects of atmospheric circulation, climate patterns have not changed all that much through time, says UA geoscientist Judith Totman Parrish. "There have been ice age and greenhouse times, but no complete reorganization of climate systems, despite all these big fluctuations," Parrish says. "That's sort of comforting, in a way, from the point of view of society."

Parrish is documenting what climate was like in the past. She says her research is beginning to show that the largest climate changes have occurred because of continental drift.

One of her particular interests is the early Mesozoic, when most of Earth's land mass existed in a single, giant continent — Pangea — that stretched from the North to the South Pole. "That geography almost certainly created very strange and extreme climatic conditions," says Parrish, "especially extreme 'continentality.' Chicago for example has a much more extreme climates than San Francisco (both cities are about 40 degrees north of the Equator). In a continent the size of Pangea, continentality must have really been something."

Two different, and still unproven, climate models recently came up with an unsettling picture of what climate on Pangea may have been like. Both models predicted fluctuations of monthly mean temperatures from summer to winter of almost 100 degrees in the interior of the continent. (Tucson typically varies 7-32 degrees Fahrenheit by comparison, a 25 degree spread.) If those models hold up, Parrish says paleontologists will almost certainly have to rethink their notions of how reptile and dinosaur physiology dealt with such extremes.

Parrish also does research primarily in northern Alaska, and she has shown that during the middle of the Cretaceous Period, about 90 million years ago, the mean annual temperature in the Arctic was about 10 degrees Celsius, similar to western Oregon today. The Cretaceous fossils Parrish is investigating are located at 68 degrees latitude, but when the plants grew, the site was at 85 degrees north, close to the

"Because we are trying to make policy decisions based on model predictions, we want those models to be as robust as possible. One way to make sure the models work is to get them to simulate past climates that we know were very different from ours...."

North Pole. This coming summer, she will check preliminary evidence that suggests that several million years later the region may have been even warmer, as warm as 13 degrees Celsius.

Tree rings in fossil wood and the leaves of angiosperms, plants that flower and grow seeds, are the main lines of evidence in Parrish's work in Alaska. She says that for reasons not yet fully understood, a very good empirical relationship exists between leaf morphology, overall vegetation, mean annual temperature and mean annual range of temperature. "We have been applying these methods, which were determined from modern floras, back to floras in the Cretaceous and the results make sense in terms of temperatures we get worldwide for that time," she says. Parrish's goal is documenting a latitudinal temperature gradient for that time in North America.

Parrish's research has direct ties to industry. "I got into paleoclimatology because ancient climate patterns and ocean current patterns have played a big role in determining the distribution of petroleum source rocks, the fine-grained rocks where petroleum is generated before it moves to the more porous rock that it is pumped from. In order to understand the role of climate, I had to do some paleoclimate modeling. The models turned out to be useful for other kinds of studies, too, so I've done some work on the distribution of coal, phosphate, chert and some similar rock used in industrial filters.

"We are still trying to understand the climate system. One of the ways we can test climate models is to throw some really extreme cases at them. If we have a time in Earth history when polar temperatures were, on average, 20 degrees Celsius warmer than now, and if we can get the models to come up with the same kinds results, then we have some idea of how the system works. But if we throw an extreme case at it and the model blows up, then we know it may be tuned too much to present conditions, which is what most models were built for.

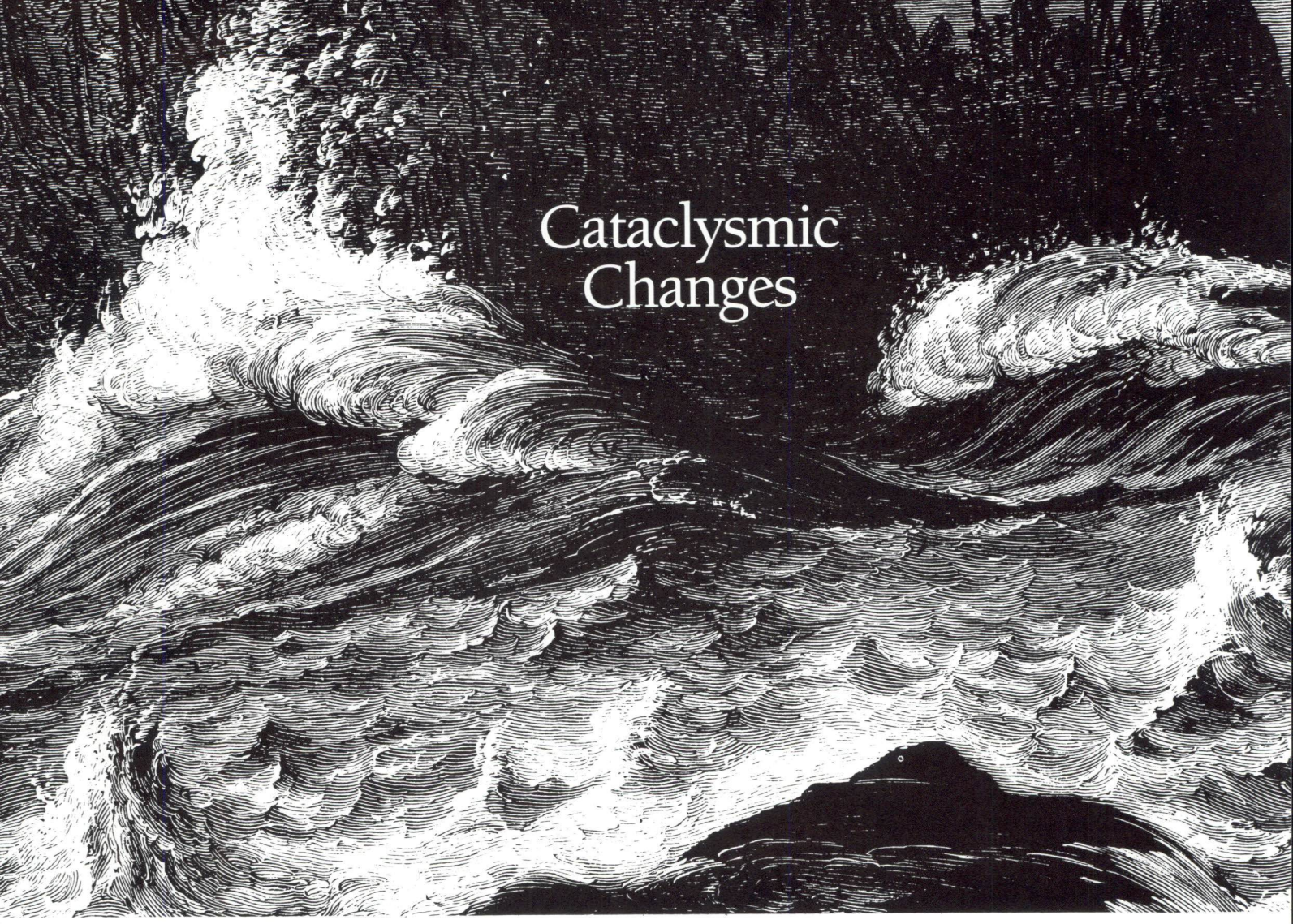
"Because we are trying to make policy decisions based on model predictions, we want those models to be as robust as possible. One way to make sure the models work is to get them to simulate past climates that we know were very different from ours. If the models can handle those conditions, that is if they can successfully replicate the patterns we see in the geologic record, then they are truly modeling climate dynamics."

This spring, Parrish will travel to Australia and New Zealand to look for fossil equivalents in the Southern Hemisphere of plants she has found in Alaska and Canada. "In Victoria, there is a high-latitude dinosaur site where the vegetation just predates the arrival of angiosperms. We have that transition on the North Slope of Alaska. We are hoping maybe we can start reading out the climate from the pre-angiosperm vegetation, which until now has been, in the minds of paleoclimatologists, a kind of homogeneous mess for about 60 million years. Well, we know it couldn't have been *that* homogeneous. It's just that no one has been able to tackle the problem of interpreting climates from the geologic record.

"That's one of the things we're trying to do."

by Jeff Harrison

Judith Parrish



Cataclysmic Changes

We can't understand global change while ignoring nature's most spectacular events of the past — the very rare but real cataclysms that have left their mark on the landscape.

Yet, says UA geosciences and planetary sciences Regents Professor Victor R. Baker, many undervalue an adolescent science called "cataclysmic geomorphology." It is the study of the rarest and most intense processes that shape the surface of the Earth.

Baker is a pioneer in the field. His more than 20-year search of the geological record for cataclysmic droughts, landslides, earthquakes, volcanic eruptions, windstorms, seismic seawaves or "tsunamis" and floods has taken him from the Pacific Northwest and the American Southwest to India, Australia and beyond. The physical evidence argues that nature's intense cataclysms can change the global system as drastically as do long, slow, gradual geologic processes, he finds.

"One reason I focus on catastrophic events is because in these events there is a warping of time. The power of energy expenditure that nature tends to spread uniformly over long periods is concentrated instantaneously," Baker says. His specialty is studying ancient cataclysmic floods. Among other contributions, he and his students have developed techniques and tools for measuring and analyzing the size and frequency of paleofloods. Learning to interpret the natural phenomena has been a very humbling experience, he says.

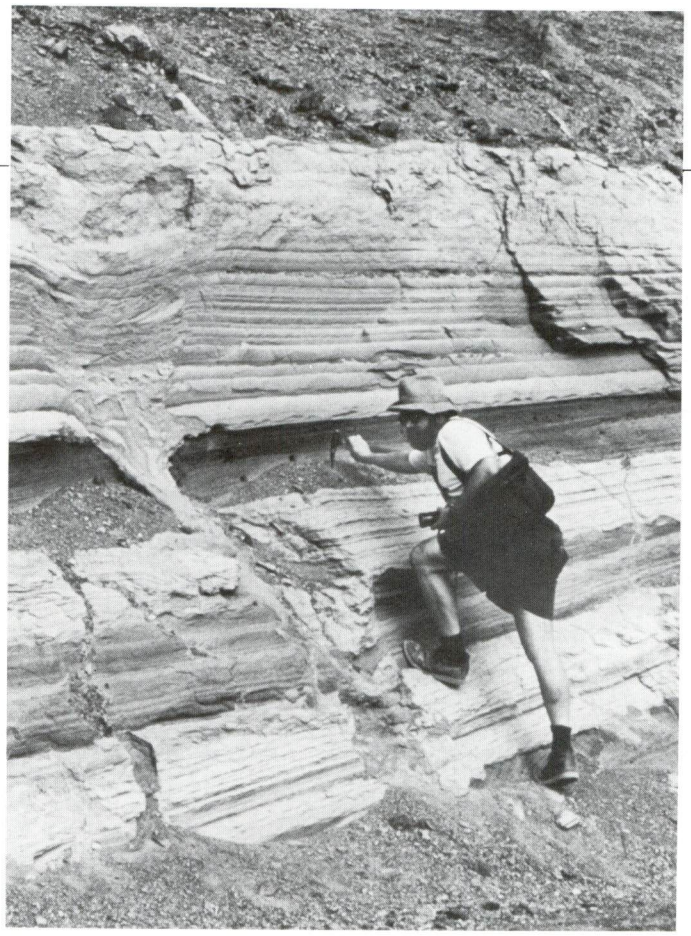
Baker has studied the mightiest freshwater floods known on Earth, the Missoula floods that ravaged the Pacific Northwest between 17,000 and 12,000 years ago. These were created when advancing glacial ice dammed the Columbia Basin River drainage until the whole unstable business eventually gave way. Baker calculates that the late Pleistocene glacial Lake Missoula released a gargantuan deluge 30,000 times as powerful as flooding produced by the Amazon, the world's largest river. Peak discharges reached between 15 million and 17 million cubic meters of water per second, churning up house-sized boulders and carving great cataracts, potholes and grooves into the bizarre landscape today called the Channeled Scabland.

More important to global change scholars, however, are the cataclysmic floods that have recurred over the last few thousand years. Water, Baker notes, is one of the most sensitive measures of past climate change in the global system. He and his current and former students have studied scores

of such cataclysmic paleoflood sites around the world. Studying Earth's landscapes for evidence on the location, size and frequency of past great floods ultimately might lead to the discovery of global-scale change mechanisms.

"One of the things we've been trying to do is look for places where the natural system acts as a faithful recorder of past cataclysmic floods, because we would like to see if these natural recording sites scattered around the world give some pattern or pulse to these catastrophic events," Baker says. "Are these completely random, as some theorists have thought, or are they clustered in time? And if they are clustered, is there some kind of climatic, global mechanism that clusters them? If there is a clustering system, that could be very profound for the future of global change. A clustering of catastrophies could have overwhelmingly disruptive influences, may be much more devastating on society than progressive temperature increases, for example."

The American Southwest has proved an excellent natural site for this work. Baker and his students have found it possible to accurately gauge the sizes and ages of paleofloods in bedrock gorges where sand and silt deposits were dumped in pockets of slackwater by torrential flows centuries and millennia ago. They also discovered that irrigation canals constructed by Hohokam Indians in central Arizona in prehistoric times are filled with flood deposits. These record a monster flood around 1,100 years ago and an interval of unusually large floods during the last 400 years.



Victor R. Baker reconstructs the size of a cataclysmic flood at the Channeled Scabland of eastern Washington state. The flood is the largest seen in Earth's geologic record. It occurred between 18,000 and 12,000 years ago. (Photo by Jim E. O'Connor.)

Preliminary results from an analysis of many southwestern paleoflood records show that large floods over the last 1,000 to 2,000 years — including 19th century through present — do cluster into discrete time periods. Climate change — perhaps changing tropical monsoon patterns in the Southwest — are likely the cause, they say.

To really understand the relationship between flooding and climate, Baker and other UA paleoflood researchers would like to study their record in the context of other records of past southwestern environment compiled by UA and other scientists who analyze fossil plant pollen, tree rings and packrat middens. (UA scientists analyze the seeds, leaves and other macrofossil remains in packrat "middens." Middens are piles of debris that packrats collect and horde in dry caves, where the material becomes cemented by the animals' urine and can remain preserved for thousands of years.)

Catastrophic paleoflood studies are necessary if we are to discover how Earth's water system works, Baker says. Scientists study the past — which is the only record of reality that we have — to learn what

Mars

A team of UA planetary scientists has a new theory to explain past environmental change on Mars. It is cause for hope, they say, that scientists similarly can discover the mechanisms of environmental change on Earth.

Victor R. Baker, Robert G. Strom, Steven K. Croft, Virginia C. Gulick, Jeffrey S. Kargel and Goro Komatsu say that the seemingly nonsensical evidence of extraordinary flooding on Mars strongly suggests an absolutely bizarre, if naturally feasible, mechanism of global Martian environmental change.

According to previously known scientific evidence,

"Real discovery is being delighted when we find something that violates our preconceptions so that we have to improve our conceptions of how the world works."

floods far more powerful than any known on Earth flowed over Mars billions of years ago. Nearly all the water-carved channels and valleys appear to be very old, having formed in the first billion years of the planet's history. That seems to make sense, theorist agree, because early Mars had a thicker atmosphere that might have been able to rain.

What conventional theory doesn't explain is why some of the youngest valleys on the planet — those near active volcanoes — so obviously appear to have been formed by water. Modern climate on Mars is too cold and dry for active water flow. The modern atmosphere has less than one one-hundredth the pressure of that on Earth, so what water could have washed over Mars to create such features so recently?

Any way you look at the known evidence, it fits together to suggest this, the UA scientists say: The northern hemisphere of Mars was not once, as has been previously thought, but repeatedly, inundated by ocean. Intense periods of volcanic activity triggered each episode of catalcysmic ocean formation. And each time it appeared, "Oceanus Borealis," as they call it, had an immediate impact on climate: Water that evaporated from the ocean and carbon dioxide released from the melting polar ice cap warmed the climate of Mars just as the burning of fossil fuels causes a global warming of Earth. That is, Martian floods induced a cataclysmic warming. Martian climate became relatively warm and wet, and glaciers formed in the highlands and southern hemisphere of the planet.

Through time, the ocean gradually evaporated or froze, returning the planet to its cold, dry climate, the conditions we see on Mars today. During these epochs, the water on Mars is trapped as ground ice in underground permafrost. "This idea completely changes how we view Mars," Baker says. "We feel we have found a way to make sense out of what seemed to be perplexing problems of past environmental change on the planet. We have a new confidence on how Mars works as a planet, how its water-related systems have evolved through time.

"We need a similar confidence for Earth. Rather than idealized future 'scenarios' given to us by computers, we need an understanding of how the whole planet works. If we can figure it out for a slightly smaller, slightly colder version of Earth known as Mars, that process of common sense should allow us the same revelation about Earth and its global changes."

by Lori Stiles

is actually possible in nature. But there is a human tendancy to idealize how nature works that makes scientists, who are after all people, forget that "Nature is the one that should be telling us how it works, not the other way around."

He worries that too many global change scientists are seduced, pressured or funded into constructing complex computer models designed to predict the future. Such models are endowed with the modelers' built-in idealized theories of what the future will be. They aren't structured to best test all the real-world possibilities nature suggests. Theoretical models are very necessary and powerful tools scientists need to test their ideas of how natural phenomena might be related, but prediction is not their end result, Baker says.

"There's a grand myth that science will deliver a perfect prediction of what the future will be. The enterprise of designing for control of the future is engineering, not science. The two are necessary and complementary, but they are not the same thing. Science isn't the deluding of ourselves that we know how the world works and that we can predict the future. If one makes a discovery in one's theoretical model, one is only discovering idealizations which may have no relation to anything. We are overly infatuated with our logical structures.

"Real discovery is being delighted when we find something that violates our preconceptions so that we have to improve our conceptions of how the world works. We have to let things blow our minds. Our minds have to be boggled, stimulated; it's one of the things that attracted me to studying catastrophes in the first place. Science, for me, is an enterprise that attempts to make common sense out of natural phenomena. It offers a truer understanding of reality that we can act upon without fear in shaping our future."

Flood studies typically focus on only small or medium-sized events measured and recorded by modern scientific instruments. One reason researchers have been reluctant to study nature's cataclysms is that they are individual, unique, "messy" events that don't fit any general picture. Generalizing and extrapolating from only modern-day, common and average-sized events gives a false picture of how floods work in the real world, Baker says, and that's dangerous for practical reasons.

Cataclysmic floods are very rare, but they do happen. They must be considered when designing dams, nuclear facilities, hazardous waste storage sites and other kinds of projects where the consequences of design failure are so great that the risks must be considered. Hydrologists in China, India and Australia use paleoflood data in planning large dams, for example. In the U.S. they do not.

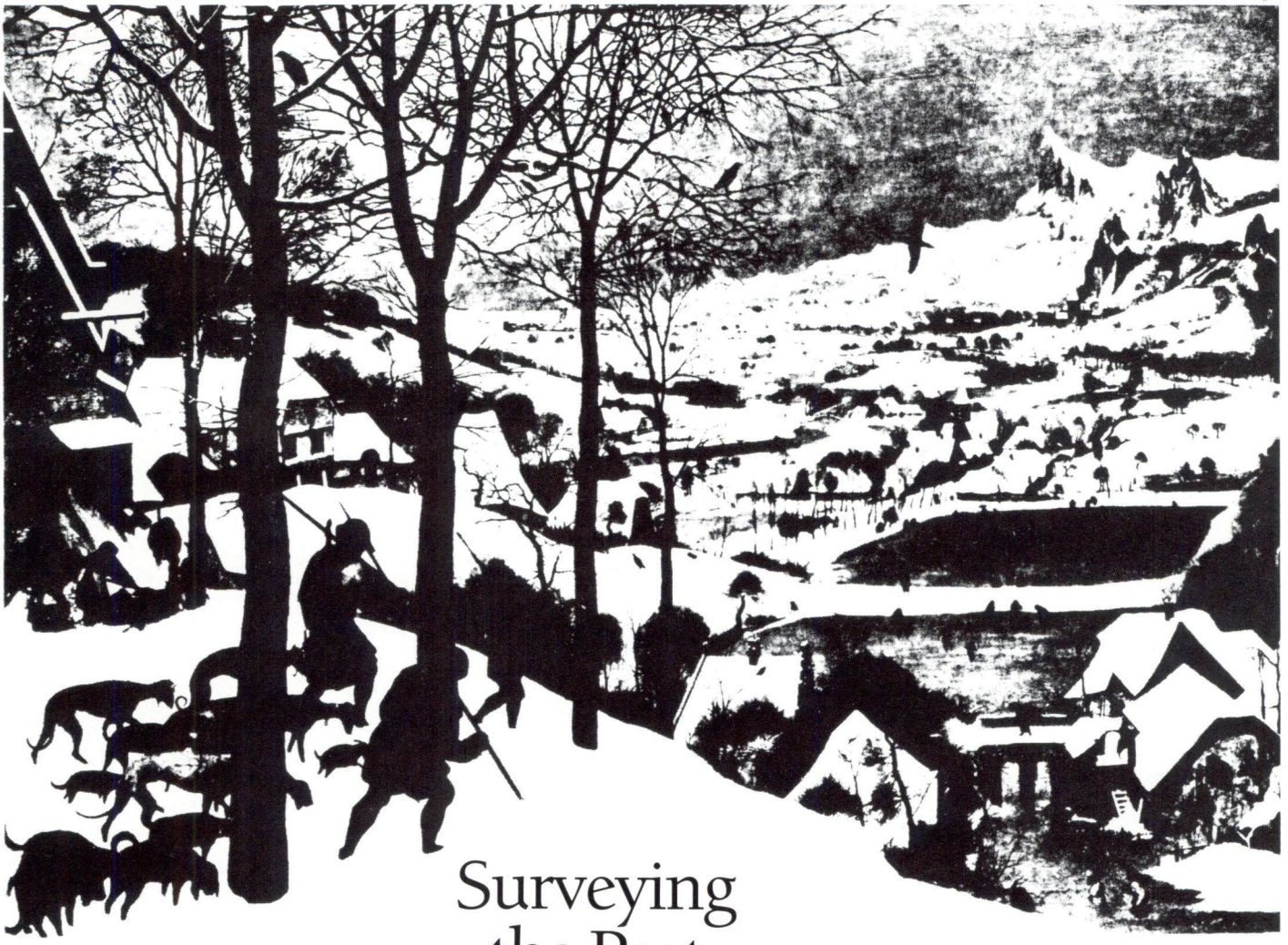
"As human societies become increasingly complex, as populations expand from safe places into hazardous sites, cataclysms that once seemed local and unimportant have the ability to disrupt global transportation, communication, information and other complicated, vulnerable systems," he says. "Natural hazards which previously affected only outlying communities in a drastic way now have the potential of affecting the whole interaction on the planet."

Victor R. Baker

Part of the reason the U.S. science community has neglected serious study of cataclysmic floods, Baker suggests, has to do with the history of Western science.

Throughout the 19th century, the study of extraordinary floods was regarded as a "somewhat disreputable scientific activity," he explains. The great geologists of the 18th-19th centuries — James Hutton, John Playfair and Charles Lyell — countered the thinking of 17th-18th century scientists who tried to interpret features in the geological landscape as evidence of biblical catastrophes. Lyell and others successfully propounded a new concept of gradualism, the idea that land features develop slowly through time by orderly processes. Since then, geologists who argue cataclysmic origins for certain land features have seen their ideas downplayed or even dismissed altogether.

by Lori Stiles



Surveying the Past

During the last two millenia, two time periods stand out that may help global change researchers in their efforts to understand the dynamics of our climate and how its changes have impacted life on Earth.

"What we hope to do eventually is a year-by-year and season-by-season picture of the world's climate change for the last 2,000 years," says Professor Malcolm Hughes, director of The University of Arizona Tree Ring Laboratory and one of six researchers from across the country involved in a study titled "Analysis of Recent and Rapid Climate Change (ARRCC)."

The two periods are the "Little Ice Age," from about A.D. 1450 to 1890, and "the Medieval Warming Epoch," lasting from about A.D. 800 to 1300.

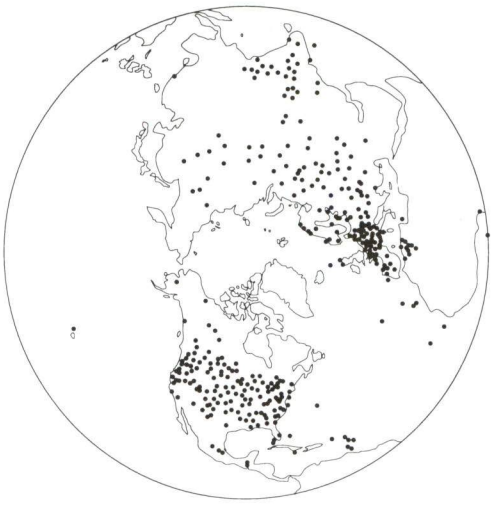
"The idea of those two periods very largely comes from records in northwest Europe and to a lesser extent from North America," Hughes says. The records, though sparse, come from varied and surprising sources.

Hughes cites classical paintings from late in the 17th century — thought to be the "depths" of the Little Ice Age — that depict ice fairs and frozen canals. There is also some recorded evidence from that period that indicates the advance of European glaciers. "One inference you can draw from that is that it was cooler then," Hughes says. He says it is alleged in the scientific community that the world was cooler by about one degree Celsius.

Evidence indicating the Medieval Warming Epoch include information unearthed by Professor Hubert Lamb, director emeritus of climate research at the University of East Anglia. Lamb analyzed reports dating from 12th and 13th century Europe that recorded crop successes, failures and prices. In his research, Lamb found grape-growing terrain where such crops had not been grown in modern times until the last few years, says Hughes.

"Tree rings are going to provide the spine for the study. There are a lot more of them than any other record."

1850's temperature recording sites



1890 temperature recording sites.

Another bit of evidence pointing to a warming in the Ninth and 10th centuries comes from Lamb's research of early Viking settlements in Iceland and Greenland. "Conditions were good enough for the Vikings to actually make voyages and establish Iceland and Greenland settlements," Hughes says.

But pinpointing the cooling and warming periods through such sketchy evidence is dangerous, Hughes notes.

"The tendency has been to assume that these phenomena are global in extent. There is a little bit of evidence that they are global, . . . but people assumed they are global and went on to seek explanations. We think it's rather dangerous at this point, so ARRCC is collecting global records from those periods to see the broader picture," Hughes says.

He says conflicting evidence found in different locations must be resolved.

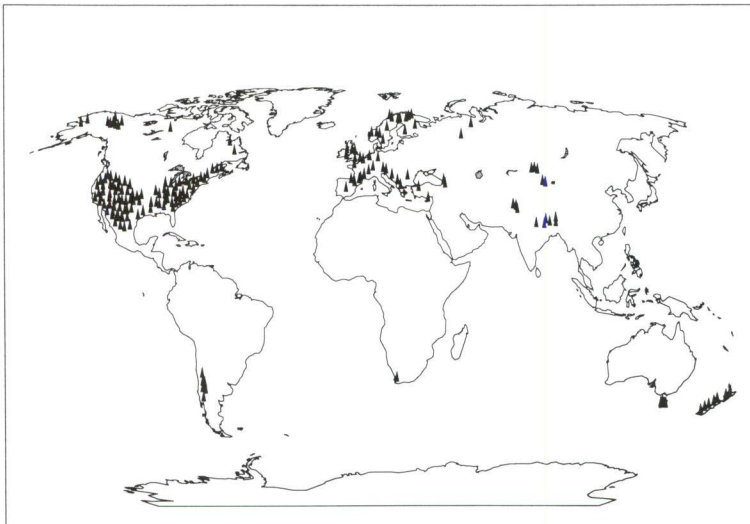
Another UA researcher, Don Graybill, has compiled tree ring records from the Polar Ural Mountains in the Soviet Union, above 65 degrees north, that make a case for cooling during the Little Ice Age, but other records from Scandanavian countries seem to indicate that it was not cooler. Still other bits of tree-ring evidence from the Sierra Nevada Mountain Range in California show cooling during that period.

"We have phenomena popping up in different intensities in different parts of the world during that few hundred years," Hughes says.

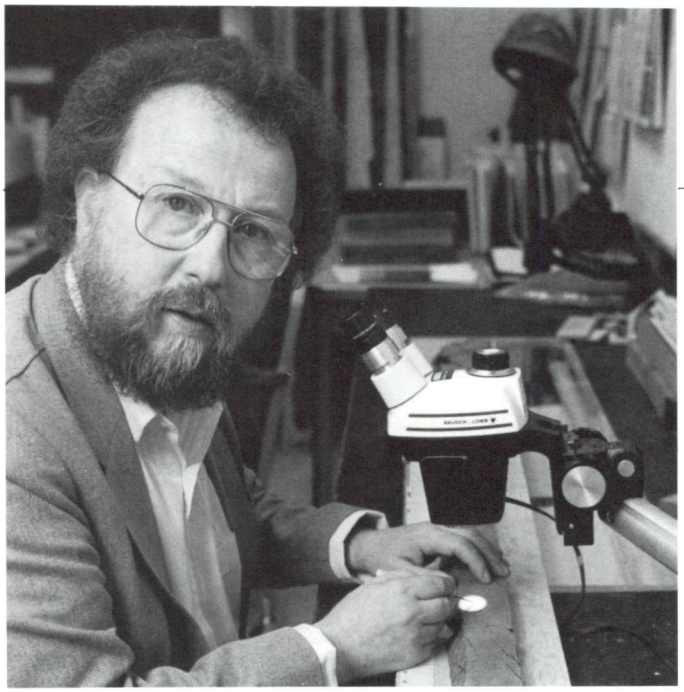
If indeed the data Hughes and his colleagues on the ARRCC project are collecting bear out the notion that the two periods' weather trends encompassed the globe, the experiment will expand to involve many more people and a larger time span.

Hughes compares earlier studies to the exploration of a continent by early adventurers. They performed preliminary work much the same as Lewis and Clark performed when they mapped the Louisiana Territory.

"It is the equivalent of people coming to a continent to gather some data. Then, when you send in a professional surveyor, you may get quite a different picture," he says.



Tree-ring series covering AD 1680–1715



Malcolm K. Hughes

To fill in the gaps, as a professional surveyor would, Hughes and colleagues are amassing data such as temperature records, records of rainfall, layered sediments of the world's oceans and ice cores from the frozen North and South Poles.

"Tree rings are going to provide the spine for the study. There are more of them than any other record of climate," he says.

"Once we get a better record, and are able to ask (the right) questions, maybe we will end up confirming that the Little Ice Age and the Medieval Warming Epoch were global. But until we have maps, it's of little value to do that," he says.

In addition, scientists know that some past temperature variations occured naturally, and did not signal any sweeping changes in the Earth's climate. The project should provide a better picture of historical variations than can be gleaned from records taken during the last 100 years, a period when such records became more comprehensive.

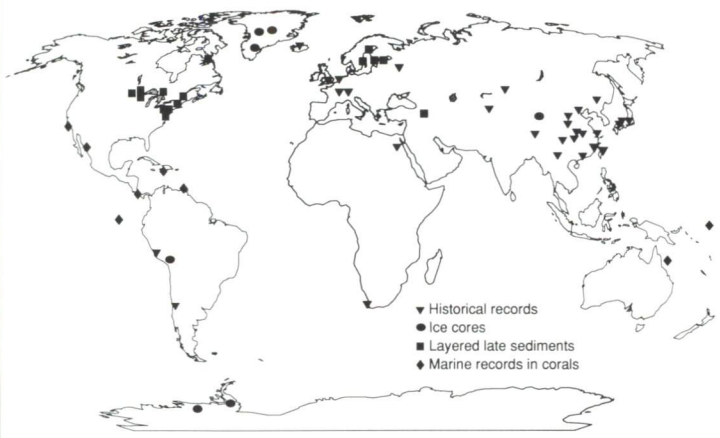
"We need to know the natural variations so we can tell what's unnatural (caused by human activity)," he says. "We are about as ignorant of the last millenium on this planet as we were 20 years ago about the Solar System.

Because Hughes' colleagues on the ARRCC team come from different institutions, they will conduct their own research in their own specialties, and conference periodically via a computer network.

"Hopefully, this group will discover many fascinating things during the course of the next 10 years that will be important to understanding what human induced changes are happening and how the 'greenhouse effect' works out and why," Hughes says.

Joining Hughes in the ARRCC project are Climatologist Ray Bradley, University of Massachusetts, Amherst; Gordon Jacoby of Columbia University, who will share tree ring investigations with Hughes; Jonathon Overpeck, of Columbia University who will study offshsore areas and lakes; Lonnie Thompson of Ohio State University, studying annual layers in glaciers in the Andes, northwest China and Tibet; and David Rind, a climate modeler with the National Aeronautics and Space Administration's Goddard Institute for Space Studies.

by Dennis St. Germaine



Other series covering AD 1680–1715

Frozen In Time

Alexander T. Wilson

A two-mile-long ice cube may help scientists figure out whether Earth is heating up.

It is actually a long cylinder, five inches in diameter, that a 100-foot-tall rig is drilling from the 10,000-foot top of the Greenland ice sheet straight to the bottom, which is not much above sea level.

Once cored, scientists will be able to study the history of climatic ups and downs recorded in the ice as though it were a time line.

Alexander T. Wilson, University of Arizona adjunct professor of geosciences, has gone to the site at the top of the Earth for two years running to help unplug history from this huge deep freeze.

His trip this year was cut short by Iraqi President Saddam Hussein; U.S. military aircraft, which shuttle scientists to the remote site, were pulled out of Greenland for assignment to the Middle East after Iraq invaded Kuwait.

"I was only able to be there for six weeks," says Wilson, who transports his precious ice-core samples back to Tucson, nervously, in ordinary picnic coolers. "When I left, the rig was down to about 350 meters (almost 1,150 feet)."

A major focus of the ice-core research is to try to discern what has triggered ice ages and warm periods in Earth's history. Scientists hope to find out how these phenomena have happened in the past so they can build computer models to try to predict what's ahead.

In particular, there is intense interest in developing a better understanding of the

"The Earth is a complex system, and it's simplistic to say, 'Well, carbon dioxide is increasing and it absorbs infrared and therefore the Earth is heating up.' Scientists can't really make predictions until they understand the underlying principles involved."

"greenhouse effect," a theory that a massive build-up of gases generated by modern man's fossil-fuel burning is drastically altering the composition of our atmosphere. Earth may be on the verge of becoming too hot for humans to continue business as usual — drying up the grain belt in the U.S. midwest or swimming pools in Los Angeles, for example. We may have to move farther north or south on the globe to be comfortable.

Wilson and two other University of Arizona scientists are interested in carbon dioxide locked in air bubbles in the Greenland ice.

The UA studies make up a part of the total Greenland Ice Sheet Project Two, sponsored by the National Science Foundation's Division of Polar Programs. GISP2, a five-year, $15 million coalition of 15 U.S. institutions, seeks to generate the longest, clearest record of global change ever compiled.

An ice sheet is essentially a circular glacier, Wilson says. Air on its permanently frozen surface becomes trapped when snowfall after snowfall accumulates in layers. Pressure from the top layers eventually compresses buried snowflakes into grains of ice. As the grains pack ever more tightly together, they encapsulate any air that happens to be between them.

These air bubbles serve as miniature time capsules. The deeper the ice, the older the captive air.

Carbon dioxide, a component of the air in the bubbles, comprises only about 0.03 percent of the complex mixture of gases that envelops Earth, but it plays an important role in sustaining life by trapping the sun's heat after it hits the planet's surface.

Carbon dioxide is causing alarm because researchers have established that carbon dioxide in today's atmosphere is higher than it has been for at least the last few million years. Today's level of 350 parts per million compares with 270 parts per million 150 years ago when the planet suddenly heated up and the "Little Ice Age" ended, a phenomenon that coincides with human agricultural and industrial activity starting in earnest.

The Soviets have reported ice-core evidence from the coldest spot on Earth, their Vostok station in Antarctica, that levels of atmospheric carbon dioxide have gone up during periods of global warming.

Some scientists argue, however, that the "greenhouse" idea is simplistic, that such fluctuations are normal over the long term.

For example, during the years from about 950 to 1350, which are known as the "Medieval Warming Epoch," the temperature of the globe rose by about 3 degrees Fahrenheit. European historical records show that the English grew grapes then, and wheat flourished halfway up Norway.

On the other hand, when the planet cooled only about 3 degrees Fahrenheit between 1350 and 1850, a period known as the "Little Ice Age," crops failed all across northern Europe.

A multitude of "forcing factors" may have prodded these changes, according to Austin Long, a University of Arizona professor of geosciences.

"The Earth is a complex system, and it's simplistic to say, 'Well, carbon dioxide is increasing, and it absorbs infrared, and therefore the Earth is heating up,'" Long says. "Scientists can't really make predictions until they understand the underlying principles involved."

Long, chief scientist for the UA's Laboratory of Isotope Geochemistry, is part of a GISP2 project that will compare carbon-12 and carbon-13 ratios in carbon dioxide from the Greenland ice to try to determine whether plant life in Earth's oceans contributes to massive shifts in the globe's weather patterns.

Long is interested in discerning whether the oceans' normal carbon-dioxide exchange with the atmosphere suddenly alters when some factor yet unknown triggers an ice age or warming period. He is working with Wilson on this five-year, $85,000-a-year study.

The discovery from ice-core studies already completed that levels of carbon dioxide in the atmosphere drop during ice ages and rise during warm periods startled scientists, Long says.

The difference suggests that carbon dioxide levels may be connected to global climate, he adds, but the connection may not be cause-and-effect: Both phenomena may be related to some process that can rapidly alter the distribution of carbon on Earth. One possible culprit, Long says, could be changes in oceanic circulation.

Carbon dioxide exchanges rapidly between the oceans and the atmosphere, Long says. Earth's oceans contain 60 times more carbon than the atmosphere, mostly because of the biological systems that live in them. Organisms near the oceans' surfaces convert carbon dioxide into organic matter by the process of photosynthesis. Some of the organisms produce shells, which convert carbon dioxide to calcium carbonate. After the organisms die, their remains sink from the surface to the depths, where they may be dissolved or oxidized back into carbon dioxide that dissolves in the water. Then, in full-circle pattern, the ocean currents return the carbon dioxide and nutrients to the surface.

"The trick was to sublime the ice in a glass vacuum system."

Oceanographers refer to this process as "biological pumping," says Long, who wants to test the hypothesis that the oceans leave more organic carbon at their depths in unoxidized form during cooling periods with his stable-isotope studies of the carbon-12 to carbon-13 ratio in carbon dioxide from the Greenland ice. If the theory is true, he says, he expects to find higher levels of carbon 13 in the samples.

"Exactly how such a dramatic switch might happen is subject to intense scientific effort and debate at this time," Long says. "Some recent work has demonstrated that there's a hemispherical difference in the atmospheric-carbon part of the carbon cycle at the present time, and we expect to be going into more detail on this by looking at Antarctic ice samples from the Soviets, comparing those trapped gases with Greenland gas."

Long and Wilson will begin making these assessments once their long-awaited, highly precise mass spectrometer specially designed to measure stable- isotope ratios in carbon dioxide and other light gases arrives this fall and is installed in a new laboratory in the basement of the Gould-Simpson Building.

Long's ability to do this study might never have materialized had Wilson failed to jerry-build an ingenious apparatus that separates carbon dioxide from the Greenland ice without allowing it to melt. It looks at first glance like a Rube Goldberg invention for mass producing iced lemonade.

Scientists such as Wilson and Long realized long ago that air trapped in polar ice offers one of the best records available for studying global climatic change, but they were stumped over how to get the gases out of the ice.

Studies such as Long's on the carbon-12 to carbon-13 ratio must be done with snow that has never melted, Wilson says.

The process of evaporating ice directly from its solid state to a gaseous state, without melting, is called sublimation. Polar ice has to be sublimed in order to extract carbon dioxide from it because the trapped air harbors a pollutant, calcium carbonate, that blows in with dirt particles over the Greenland ice sheet. If the ice cores were melted, carbonate would mix with the atmospheric carbon and skew studies such as those the UA researchers are conducting.

Researchers began trying to extract atmospheric gases from polar ice in the 1950s. The strongest report of success came from a Swiss group that spent years and about a million dollars on a method that involved crushing the ice, without melting, to release the trapped air. The process, however, had two drawbacks:

- It required 30 to 40 pounds of ice for each experiment, a huge amount of a precious commodity that is both expensive and difficult to retrieve from the polar regions.
- It failed to capture as much carbon dioxide as possible. The crushing process released only the gases trapped in bubbles and not all of the atmospheric gases that had penetrated the ice itself.

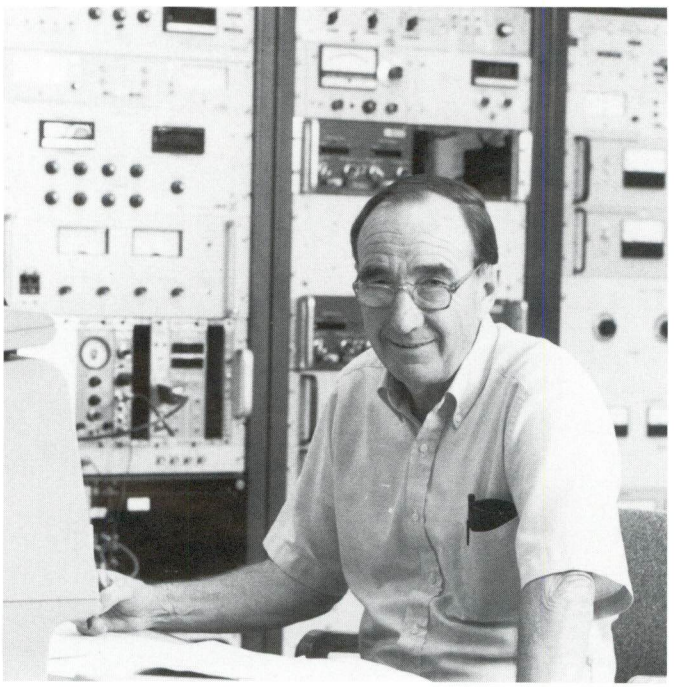
Wilson, a native of New Zealand and veteran of 12 research expeditions to Antarctica, fused his expertise in glacier phenomena, physical chemistry, radiocarbon dating and vacuum systems when he went to work on the problem. Eventually, his technique overcame both disadvantages inherent in the Swiss group's method.

Wilson credits recalling an incident that occurred during an Antarctic expedition as the spark that led to developing his successful method.

"We were drilling ice cores in the McMurdo dry valleys, and we just stood the cores up in a row outside our tent," he says. "Within a week, the ice would almost be gone from natural evaporation."

Voila. The Antarctic memory connected in Wilson's mind with another of his areas of expertise to trigger the solution.

"The trick was to sublime the ice in a glass vacuum system," Wilson says. "Also, if you use a glass vacuum system, you don't incorporate



Douglas J. Donahue

much contemporary carbon dioxide that's floating around in the air into it, because if you have such a little bit of carbon and get a little bit of modern stuff in there, it makes accuracy very uncertain."

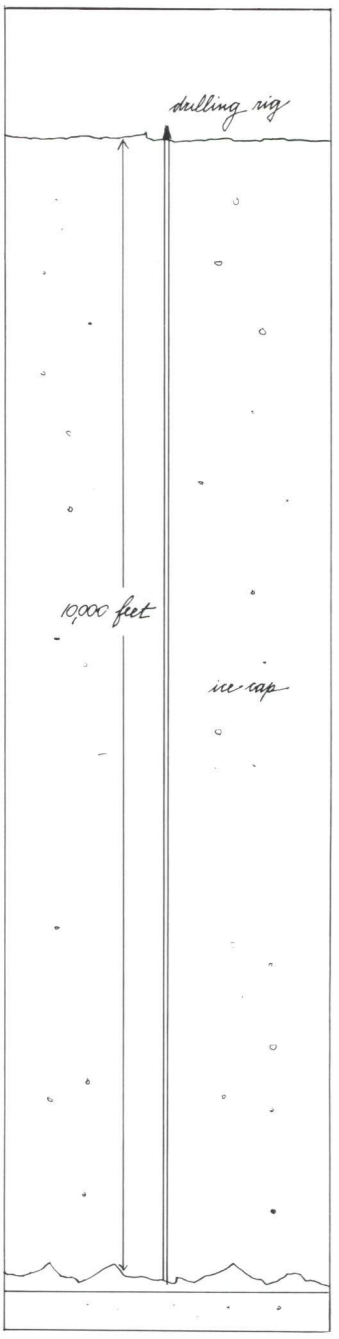
Scientific vacuum systems that could accommodate 3-foot by 5-inch samples of ice were nonexistent, so Wilson designed his own, using industrial equipment and glass components fabricated by UA glass blower Charles M. Amling.

The technique involves placing the ice core in a large glass tube, applying infrared heat from about six lamps — the kind that can be purchased at hardware or drug stores — and collecting water vapor and carbon dioxide sublimed from it in separate cold traps maintained at minus 80 degrees Celsius.

"One reason no one had done this before is they think subliming is a slow process," Wilson says, "but if we pour enough infrared radiation on it, then we get it very quickly."

Not only is all available carbon dioxide recovered from the ice cores in this process, Wilson says, but other atmospheric gases also may be trapped and made available for study.

"There are a lot of clever things you can do," Wilson says. "If you measure the volume of air (in each sample) compared to the weight of the ice, you can tell the altitude of the ice sheet. If you measure the volume of air and compare it to the volume of carbon dioxide, you can tell the concentration of carbon dioxide." Once the carbon dioxide has been extracted, Wilson puts it through a reaction process with zinc and iron to convert the gas to graphite, the soft, pure form of carbon most familiar to people as pencil lead. The samples are the size of a pencil dot.



Scale diagram of Greenland drilling rig.

These tiny samples then go to Douglas J. Donahue, a pioneer in accelerator radiocarbon dating and co-director of the University's National Science Foundation - Arizona Accelerator Facility for Radioisotope Analysis.

Donahue analyzes the carbon-14 content of the ice-locked atmosphere on the tandem accelerator mass spectrometer, TAMS, and pinpoints the age of ice-core samples.

Wilson is principal investigator on this five-year, $85,000-a-year GISP2 grant with Donahue.

"We've had to develop techniques to deal with these very small samples," Donahue says. "When we started, one milligram of carbon was considered a very small sample, and it was wonderful that we could do that. We now semiroutinely run samples of 50 to 100 micrograms, which is considerably smaller."

Wilson's apparatus allows them to retrieve sufficient carbon for TAMS to date from only 2.5 kilograms of ice.

Donahue says they plan to date ice-core samples back as far as radiocarbon dating allows, about 45,000 years, then use glaciological theory to extend the record back hundreds of thousands of years. The limit is set by the samples themselves: Their carbon content decreases by half every 5,700 years.

Samples from ancient ice ages may contain concentrations of carbon dioxide as low as 180 parts per million, which will force them either to process more ice to create larger samples or to figure out how to process even smaller samples on the accelerator, Wilson says.

by Marilyn Johnson

Answers From the Sea

Scientists at UA's visionary Environmental Research Laboratory have long viewed desert wastelands as lands of opportunity for feeding the growing world population. The off-campus, non-teaching department focuses on developing new environmentally sound and economical technologies for growing food, designing habitat and harnessing solar energy.

Now ERL scientists believe that some of their most important research will help answer one of the biggest global change problems we face: How can we clean the air of all the carbon dioxide pouring out of fossil-fuel-burning power plants and automobile tailpipes?

Over the past 12 years, ERL plant scientists have screened more than a thousand salt-tolerant plants, or halophytes, gathered in worldwide collecting expeditions, to develop choice wild desert species into new domestic crops for food, fodder and fuel. These crops are now farmed on desert sand irrigated directly with seawater in Mexico, the United Arab Emirates, Egypt and, at least until recently, Kuwait. ERL researchers concluded in a feasibility study last May that halophytes can do as much, perhaps more, than trees when it comes to pulling carbon from the atmosphere.

This year ERL launched two separate research projects to test the potential of halophytes for removing excess carbon from the air and storing it in organically poor desert soil. One project is on the Gulf of California coast in Mexico and is funded by the research arm of the U.S. electric power industry, the Electric Power Research Institute (EPRI) in Palo Alto, and by the Salt River Project, an Arizona utility and EPRI member. The other project is halfway around the world on the Persian Gulf and the Red Sea coasts of Saudi Arabia. It is funded by the kingdom's Royal Commission for Jubail and Yanbu. Jubail and Yanbu are new major industrial cities developed in the late 1970s, respectively, on the Persian Gulf and the Red Sea as national centers for the

petrochemical and secondary industries.

"Only 40 years ago, as a result of our use of energy, we put 6,000 billion tons of carbon dioxide into the air per year. Today, we put more than 25,000 billion tons of carbon dioxide into the air," says ERL director Carl N. Hodges. "We have forced the carbon cycle of the Earth's atmosphere out of balance. At the rate carbon dioxide is being added to the atmosphere now, we will double the carbon dioxide in the atmosphere by the year 2030."

He and Saudi officials recently agreed to establish two 15-acre halophyte farms at Jubail and Yanbu, farms that will grow to 150 acres, perhaps 1,500 acres, over the next four years. The farms will test the carbon-sequestering performance of halophytes on a large scale.

Carbon dioxide is called a "greenhouse" gas because it traps heat in the atmosphere, just as glass traps heat in a greenhouse. If rising levels of atmospheric carbon dioxide do result in a drastic warming of the Earth, as some scientists project, Hodges says, the consequences for humans would be disastrous. "A global warming of 4.5 degrees in only four to five decades would exceed the entire rise in temperature since the last ice age." It would result in reduced rainfall in many areas, and a possible dramatic rise of the oceans, which would flood cities on the world's coasts.

Carl Hodges

"Re-leafing" some of Earth with vast tree plantations could slow, but won't stop, the accumulation of carbon in the atmosphere, ERL botanist Edward P. Glenn and other ERL scientists concluded in the May feasibility study, "Seaweeds and Halophytes to Remove Carbon from the Atmosphere." Glenn headed that study, which was funded by EPRI and the Salt River Project, and he heads the 3- year followup laboratory and field project at Puerto Peñasco, Sonora, Mexico, to test two methods for planting halophytes to remove carbon from the air and store it in desert soil.

"You'd need three tons of biomass (plant material) per person, per year, for the next 200 years to take out the excess carbon that already has accumulated in our atmosphere, and that presents an incredible storage problem," Glenn says. There are about 200 years' worth of fossil fuels yet to be burned according to best estimates, and after about 200 years, the oceans begin to absorb the excess carbon dioxide, which explains the length of the problem, he adds. Until then, three tons of biomass per person, per year, is too much to use up, and would have to be somehow stored — if that much could be planted.

How much would have to be planted? Covering 15 states the size of Arizona, or the entire continent of Australia, with fast-growing trees would do it. But because trees mature after 20 to 30 years, and so end their usefulness as a "sink" for carbon, all that forest would have to be cut down and replanted every couple of decades.

Another major drawback: Land for tree plantations is land people want for cropland or pasture. "People are focusing on growing trees in the roughly two million square kilometers of tropical forest fallow," or land cleared by slash-and-burn agriculture that now is in various stages of regrowth, Glenn says. That much land would soak up about a third of the excess carbon in the atmosphere, but it's also just the amount of new modern farmland experts project will be needed in the next 30 years to support added world population.

The ERL scientists report it would be economically and technically feasible to plant halophytes on 17 percent of the world's coastal desert and 15 percent of Earth's inland salt desert — a total 1.3 million square kilometer area, or roughly the same amount of land environmentalists hope to plant in trees, the land needed to reduce a third of the annual excess carbon dioxide emissions. One big advantage is that land available for halophyte farming is now not wanted or used, Glenn says.

Another great advantage is halophytes are a potential carbon-recycling fuel. "These

plants are used as food and animal fodder, but their main use is they can directly replace fossil fuel. That's the main use for any biomass crop, because it overcomes the storage problem. When you burn biomass, you release carbon dioxide into the air, but it's a kind of 'current accounts' way of making electricity," Glenn explains. Which is why responsible members of the utility industry — those represented in EPRI and in the Salt River Project who sponsor research on climate change and the greenhouse effect — are interested, he adds.

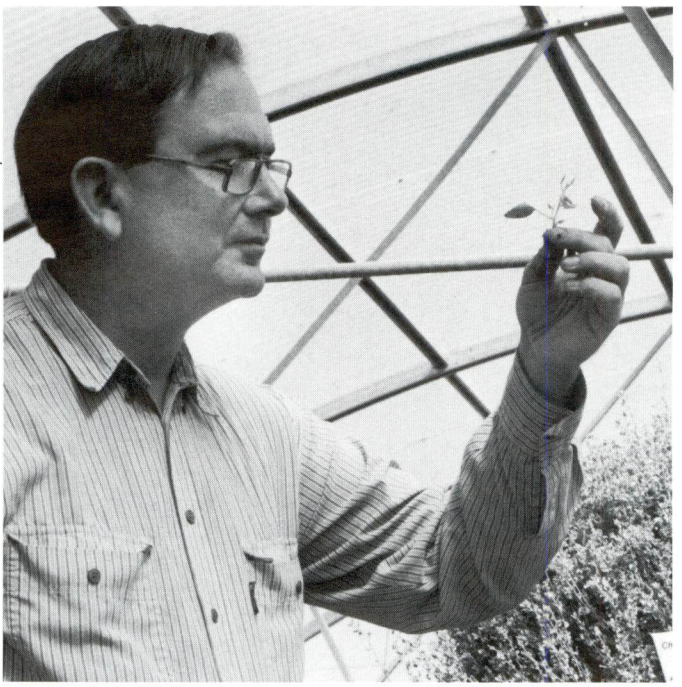
"Say you've got a halophyte farm that takes 10 tons of carbon out of the air. It's hauled to the electric generating plant, burned, and puts the same 10 tons of carbon back into the atmosphere. The next year, when you repeat that procedure, you are recycling that 10 tons of carbon between the atmosphere and the farm, then the power plant and the atmosphere, so you're not adding an extra burden of carbon to the atmosphere over time. Coal took 200 million years to produce. Burning it in just a few years does add that burden to the atmosphere."

Glenn and others at ERL calculate that a typical large-scale coal-burning power plant that now burns 100 percent coal could, with only minor modifications, instead burn two-thirds coal and one-third halophytes for fuel for a 25 percent net savings in carbon dioxide emission.

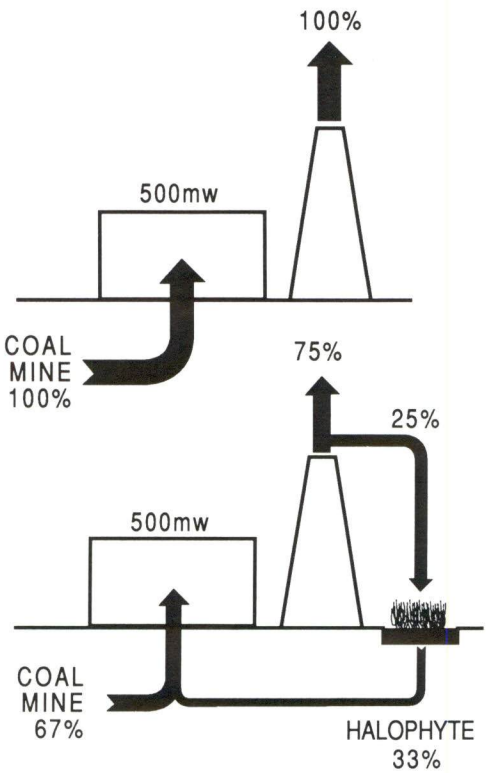
Glenn says their new study with halophytes at ERL greenhouses in Tucson and at an acre field site at Puerto Peñasco has added relevance to utilities in arid regions, where plentiful salty water and vacant desert land needed for halophyte farms so far have been regarded as liabilities. His team hopes to get enough information in the next three years to put a halophyte farm-power-generating utility system into operation.

Key questions they first need to answer in the field trials include the rates at which various halophytes fix carbon in plant tissue, how much carbon in that tissue is then stored in desert soil and how much is returned to the atmosphere, the net carbon-removal rate of different halophytes, whether carbon is stored more efficiently in dry or in seawater-irrigated desert, and the role of halophytes in fixing nitrogen in the soil. The lab experiments in Tucson are designed to answer how quickly these plants decompose in soils of different salinities and carbon levels.

Meanwhile, the ERL scientists are collaborating with scientists at the University Center for Atmospheric Research in Boulder, Colo., on proposals for future large-scale halophyte farms, farms large

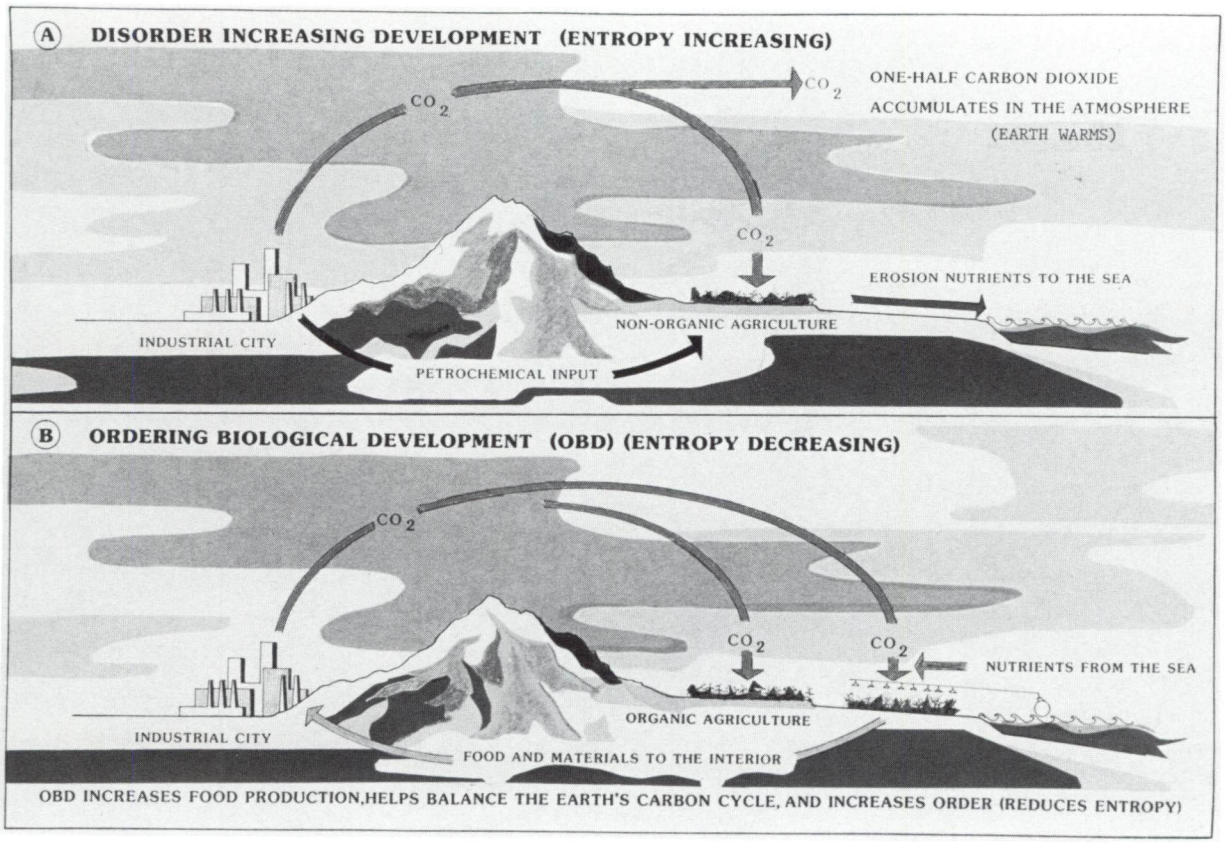


Edward Glenn



Schematic of two 500 MW power plants, one fueled with coal alone and the other with a 2:1 mixture of coal and halophyte biomass. The coal — halophyte plant results in 25% less carbon in the atmosphere due to the recycling of carbon back into biomass.

"Only 40 years ago, as a result of our use of energy, we put 6,000 billion tons of carbon dioxide into the air per year. Today, we put more than 25,000 billion tons of carbon dioxide into the air. We have forced the carbon cycle of the Earth's atmosphere out of balance."



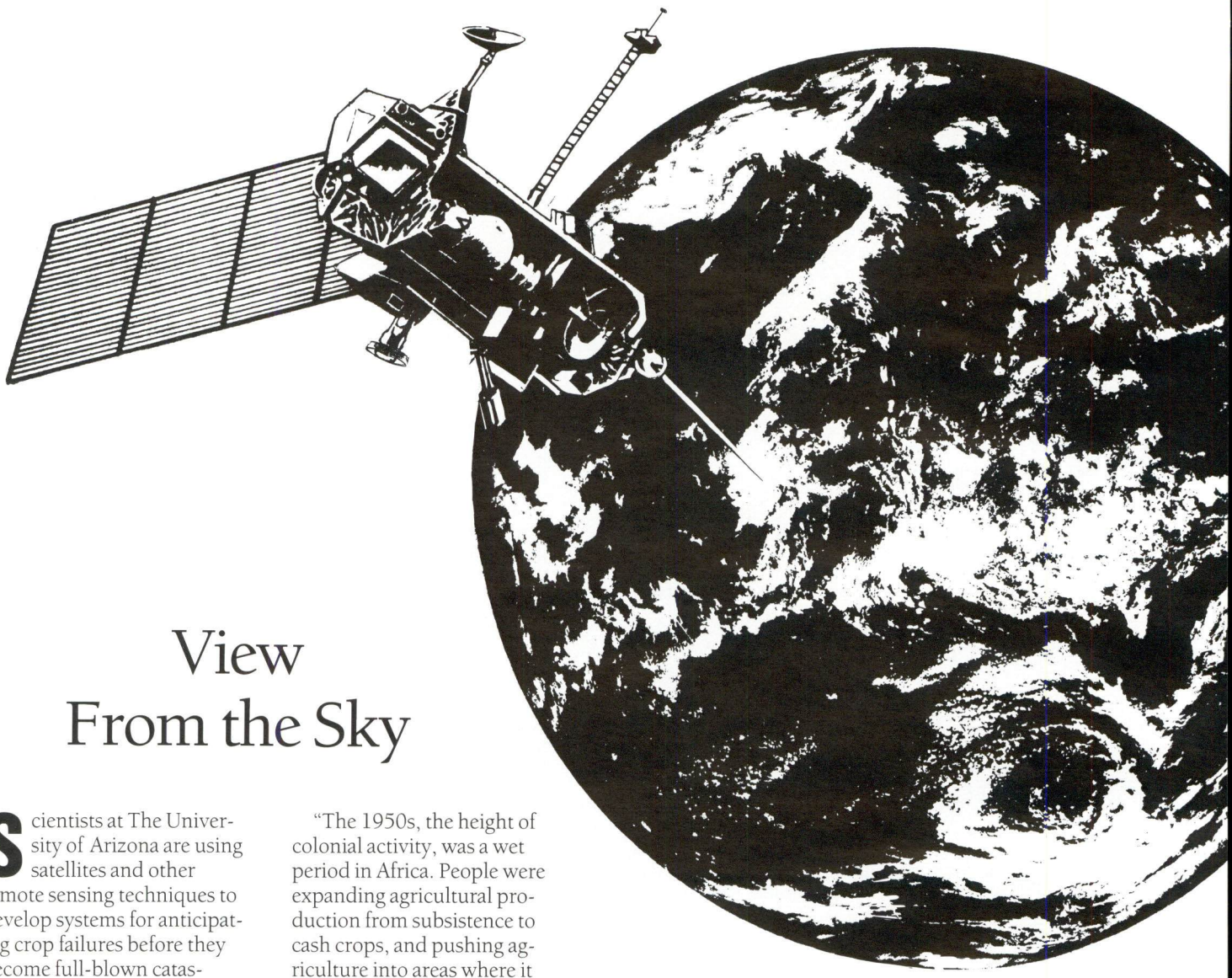
enough to test a predicted "greening effect" on local climate. A leading UCAR scientist has modeled the effect of planting strips of vegetation on the desert and theorized the result is increased rain.

"There's plenty of moisture in the air over a coastal desert, but there's nothing to help make it rain. The idea is that strips of vegetation with bare desert in between would create convective cells that would take that moisture-laden air high enough for clouds to form and rain. It's not just a wild idea — there are places where this happens naturally."

He adds, "It's just as likely that this optimistic scenario will happen as some of the pessimistic scenarios will happen. They're all just projections," Glenn says. "You can make the case that if you plant halophytes to absorb carbon in the atmosphere to help solve the greenhouse effect, and build up the carbon in the soil as you get rid of the carbon in the air, over years of growing you will create local rainfall, and when it starts to rain, you can reclaim that soil for freshwater agriculture."

Desiccated Africa, with all its salty deserts, would be an ideal site for this project, Glenn says. That's a future story, though.

by Lori Stiles



View From the Sky

Scientists at The University of Arizona are using satellites and other remote sensing techniques to develop systems for anticipating crop failures before they become full-blown catastrophes. The same studies might also help show whether land use patterns affect climate.

The immediate goal is predicting famine early enough to avoid the kind of devastation much of Africa has experienced during the past decade.

Charles F. Hutchinson, associate director of the UA Office of Arid Lands Studies, says Africa has been a "hot spot" of famine-related research.

"The 1950s, the height of colonial activity, was a wet period in Africa. People were expanding agricultural production from subsistence to cash crops, and pushing agriculture into areas where it probably didn't belong. This may sound vaguely familiar if you remember the Dust Bowl in the United States in the 1930s.

"The 1960s, when countries were gaining independence, was not great for rainfall. By the 1970s we saw the great droughts begin, with the worst coming in 1983.

Hutchinson says the drought of 1983-84 was the worst in a century, and caught disaster relief agencies by surprise. Their response was heartfelt and well-meaning, but slow.

The U.N. Food and Agriculture Organization (FAO) has been working on early warning systems since 1975. Early attempts took a balance sheet approach, estimating crop production, food on hand and food imports on the supply side, and measuring against demand to know how much grain to import.

The system has problems. Gathering production data is difficult since countries have their own reasons for overestimating or underestimating crop size.

Accurate population data are also difficult to come by, so understanding either the supply or the demand side is problematic.

In 1985, the U.S. Agency for International Development began its Famine Early Warning System (FEWS) to look at the Sahel region. What FEWS had that FAO did not was a satellite component report of what growing conditions were like on the ground.

"It isn't forecasting weather," says Hutchinson. "FEWS tries

Charles F. Hutchinson

Down To Earth

"We use remote sensing as a tool for ground sampling," Charles F. Hutchinson, the associate director of the Office of Arid Lands Studies at The University of Arizona.

"In the kind of work we do in assessing rangeland and agricultural resources, at some point you have to go on the ground and see what's happening.

"We can draw large, broadbrush units with satellite data, refine those data with video or 35 mm photography from an airplane, depending on what our needs are, and then send a guy to sample where we need samples."

Hutchinson says the idea that satellites can see just about everything in detail from space is a little exaggerated. "Birds," as they are informally referred to, are invaluable tools in studying climate change, but they have their limitations.

One is estimating biomass on the Earth's surface. Scientists use satellite data to estimate biomass, and Hutchinson says a frequently used technique is calculating a ratio between reflectance in the red part of the light spectrum against the infrared part of the spectrum.

Plants absorb red light to use in photosynthesis, so in that band plants appear dark and soil appears bright. Plants also reflect in the infrared band, much more than the green band, but since human eyes are not sensitive to infrared, what we see is green.

The remote sensing scientist computes the ratio by dividing the value for red into the infrared — the higher the number, the more vegetation on the ground.

There are exceptions.

One can be found near Tucson, close to the twin cities of Nogales, Ariz., U.S.A. and Nogales, Son., Mexico.

Hutchinson recently finished a study of the rangeland within ten kilometers of the international border at Nogales. The study was designed to measure the impact of a fence built 75 years ago to separate the two countries.

Hutchinson assumes that when the fence was built, the border was an artificial delineation, and had no effect on climate or land use.

Today, however, an infrared photograph from space shows two distinct vegetation patterns, separated by a line that corresponds precisely to the border.

From far away, the grass appears greener on the Mexican side. During the growing season, the Sonoran side appears much more photosynthetically active than the Arizona side.

The paradox becomes evident when you observe the region from the ground.

Hutchinson says the to project what the harvest is likely to be. It tracks data over the current growing season, looking at precipitation values over ten day periods (called decades).

"Using water balance models to estimate the amount of water available for plant growth, you look at what has happened in the period.

"From that, you can produce a kind of generalized crop condition assessment, and make predictions on whether it is going to be a good season or a bad season based only on precipitation data," he says.

Cumulative data can be used to show where the current growing season is compared to last year or other years.

In addition to FEWS, the Dutch government started their own project, the Africa Real Time Environmental Monitoring Using Imaging Satellites, or ARTEMIS.

"ARTEMIS began producing data sets for the entire African continent, including vegetation index images, cold

"Can land use influence climate? We're finding out that it does."

cloud duration images derived from a meteorological satellite, and estimated number of rainfall days based on cold cloud duration," says Hutchinson.

ARTEMIS has also begun shipping its data to the Global Informational Early Warning System (GIEWS), which is looking at global climate models.

The problem, says Hutchinson, is that the people at GIEWS do not have the technical capability to handle the volumes of data that ARTEMIS dumps on them.

"The poor devils at GIEWS are under the gun to publish reports every two weeks, when others only have to do reports every month or even three months.

"Generally, they are economists or food security experts. They are not computer jocks, or remote sensors or meteorologists."

Frustration levels rose on both sides. ARTEMIS protested that GIEWS was ignoring perfectly good data. GIEWS complained that they did not have the time to make sense of it all.

"We came along, worried about this problem that there are about seven different software packages GIEWS analysts need to do their job, including Word Perfect, Lotus, data base management, map data, map graphics, and so on.

"When you have that many software packages, you also have geometrically larger numbers of file transfer routines to move data between the packages. You have to move data, for example, from Lotus into the geographic information system to make a map.

"We figured there were about 100 different file transfer routines they would need. Between the 100 file transfer routines and the seven software packages and all the files they were creating, it was obvious they weren't going anywhere.

Our proposal was to create a work station geared to their specific needs."

Hutchinson succeeded in selling the idea to FAO and is just now finishing the design phase. The fun and challenging part, he says, is actually building the system, which will be located in Rome.

"Up until now, it sounds like a straightforward data processing job that you hire a couple of programmers to do.

"The problem is no one knows yet how to use these data in a useful, consistent and scientific way. There is going to be a substantial amount of research in establishing the best way to use these data. People are still debating whether or not this is the best way to do it."

by Jeff Harrison

canopy in Mexico during the season is two or three inches above the surface, and only covers between 30 and 40 percent of the ground.

On the Arizona side, the coverage is nearly 100 percent and the canopy is almost a meter off the ground.

"What we learned was the Mexican side appears greener because you can see it growing at the surface.

"The Arizona side is a perennial grass that grows, puts out leaves, and at the end of the season, dies. At the beginning of the next growing season, there is a brown canopy. The plants green up underneath all this stuff, but you can't see it. And, as it turns out, there is a great deal more biomass on the Arizona side."

Water, he says, is another key factor.

Both sides still receive about the same amount of rainfall. A significant amount of what falls on the Arizona side is absorbed by the plants and is cycled back to the atmosphere.

Rainfall on the Sonoran side largely runs off into the Santa Cruz River Basin and into Arizona.

"Can land use influence climate?" asks Hutchinson. "We're finding that it does.

"The result may be small, and locally it may have some significance. It can be as much as four degrees Centigrade warmer in Sonora.

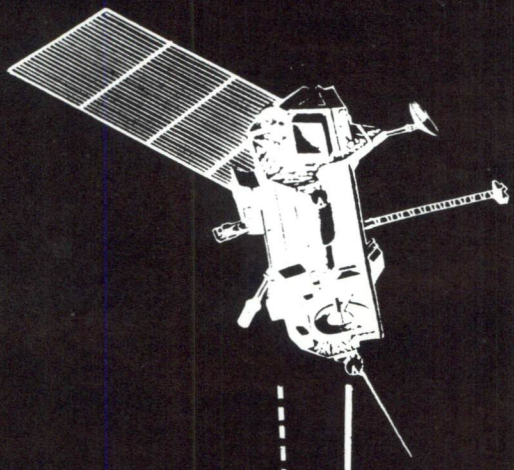
"This is all rangeland, so it is based on the number of animals running on it. The Sonoran side is overstocked by as much as 200 percent.

"The Arizona side is underutilized. The land is in private ranches and the ranchers are very prudent managers."

Hutchinson has submitted a proposal to the National Aeronautics and Space Administration (NASA) to work with the UA tree ring laboratory on earlier records.

Hutchinson surmises that if these changes existed, they probably happened 1840-90, when herds were increasing in Arizona and removing a lot of vegetation. It is possible, he says, there might be a signal in the tree ring record toward an increase in temperature.

by Jeff Harrison



EOS Earth Observing System

Anyone who has peered into a petri dish and watched once-thriving bacteria pay the ultimate price for a dirty environment squirms a bit when conversation turns to global change.

Is our own little petri dish, circling its tiny yellow sun, in similar trouble? What are the ultimate effects of greenhouse gases, acid rain, deforestation, and ozone holes?

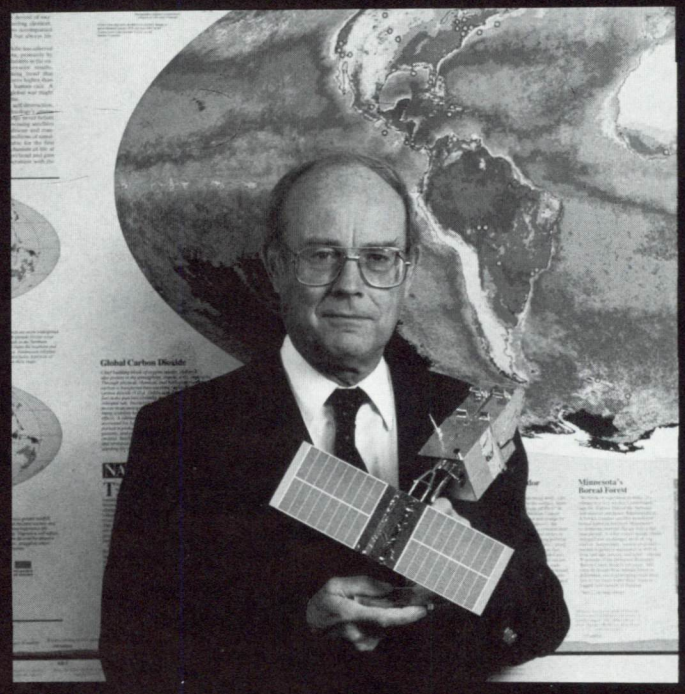
So far, it's anyone's guess. Despite our sophisticated technology, scientists have been unable to accurately predict the consequences of human actions on the rate of global change, the magnitude of that change or when it might happen.

They just don't have the data.

Which is the reason NASA and its international partners plan to launch six Earth Observing System (EOS) satellites beginning in 1998. Present plans call for two series of polar-orbiting platforms: EOS-A and EOS-B. The 15-year observational period will be achieved by using three identical satellites per series, each having a five-year flight.

When these high-tech birds begin sending data back to Earth, University of Arizona scientists will play a big role. With world-class expertise in optics, remote sensing, and hydrology, UA researchers sit at the hub of scientific disciplines that fit well into the EOS project.

— Philip N. Slater, of the Optical Sciences Center and chairman of the UA Committee on Remote Sensing, is an expert in calibration of remote sensing instruments, and one of the key people NASA turns to for such work. He is work-



Philip N. Slater

"What we get from remote sensing at this point are electromagnetic signals. The question is, 'What do these little wiggly lines mean in terms of soil moisture, canopy, vegetation cover and topographic features?' We want to get the algorithms that convert these signals into useful information in place before the first launch."

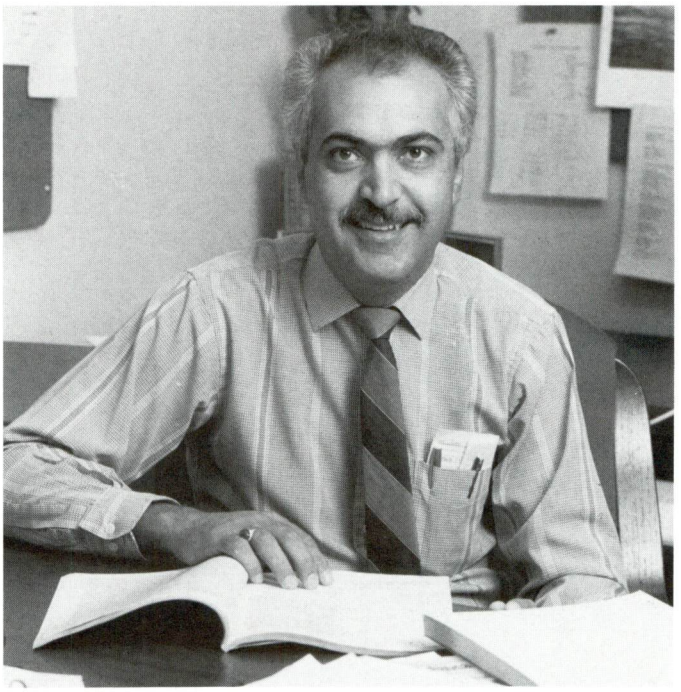
ing on two of the instruments that will ride the spacecraft.

— Alfredo Huete, of soil and water science, is working on the portion of the project dealing with the interactions between vegetation, soil, and organic carbon.

— Benjamin M. Herman, of UA's Institute of Atmospheric Physics, will be studying atmospheric gases.

— The National Academy of Science's Committee on Global Change has identified climate and hydrologic systems as the most important area of study that EOS will undertake, and UA is particularly well suited to provide vital expertise in this area.

The UA Department of Hydrology and Water Resources, founded in 1961, was one of the first of its kind in the world, and has continued to be a leader in the study of hydrology, particularly of arid regions. Department head Soroosh Sorooshian and Professor Robert E. Dickinson head two of the 28 interdisciplinary teams NASA has appointed to analyze data from the spacecraft. Dickinson (who came to UA only this fall with a triple appointment in hydrology, atmospheric sciences and the Laboratory for Tree Ring Research) heads the a project for the National Center for Atmospheric



Soroosh Sorooshian

Research that will use EOS data for modeling on global and regional scales.

Another hydrology department researcher, Roger C. Bales, is working with a group from the University of California at Santa Barbara on EOS observations of alpine watersheds, snow cover, and the bio-geochemical interactions of mountainous regions.

Much EOS work will focus on water because the redistribution of heat that governs the Earth's climate depends largely on the transport, evaporation, condensation, and freezing of water, as well as the role water plays in trapping radiation that warms the Earth. Water also governs the location and level of agriculture, energy production, and industry.

Although EOS is not scheduled to fly until 1998, scientific work on the project already is underway, Sorooshian explained.

His group has started flying remote sensing instruments on various aircraft. Researchers on this project are taking no chances on another Hubble Space Telescope debacle. "We want to see how we can calibrate the information we get from the remote sensing instruments to what we see on the ground," he said.

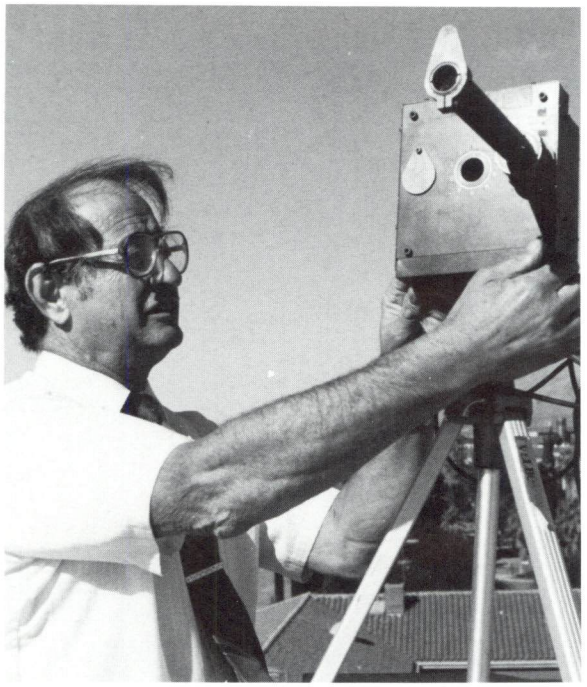
For these calibration experiments, the instruments are being flown over the Walnut Gulch experimental watershed, operated by USDA's Agricultural Research Service. This area is filled with gauges that measure rainfall, stream flow, soil moisture, and other factors that influence the hydrologic cycle.

"What we get from remote sensing at this point are electromagnetic signals," Sorooshian said. "The question is, 'what do these little wiggly lines mean in terms of soil moisture, canopy, vegetation cover, and topographic features?' We want to get the algorithms that convert these signals into useful information in place before the first launch."

Sorooshian noted that much of this calibration effort is being coordinated by Adjunct Assistant Professor David Goodrich, David Woolhiser, Huete and many graduate students. Goodrich and Woolhiser are employees of the Agricultural Research Service.

Once the satellites begin sending back data, Sorooshian's group will focus first at the watershed level to be sure everything is working well. Then they will move on to larger and larger areas, constantly tweaking their models to be sure they accurately represent the real world as the scale increases.

Meanwhile, a group of French scientists will be doing



Benjamin M. Herman

similar work top-down, starting with a large area of northern Africa, and then focusing in on ever-smaller areas. "We hope that our results will closely correlate as we meet in the middle," Sorooshian said.

EOS is a big, expensive project slated to cost $17 billion by the year 2000. The instrument-packed platform, longer than the Hubble scope, will weigh 7,700 pounds and will provide 3.2 kilowatts of power to the payload.

The project is not without its detractors, who think it's too big, too complex and too costly, particularly in view of the top-to-bottom scrutiny of NASA in the wake of Hubble and repeated shuttle breakdowns. Budget director Dick Darman, for instance, has privately called EOS "the $34 billion thermometer."

"I think this criticism is a healthy process," Sorooshian said. "It keeps the project planners alert, to be sure they have covered every angle."

But, he added, there are good reasons for the project to be a big one, for all the instruments to be together. Gathering the data at the same time from the same point is vital, he said. This allows data to be compared and shared between experiments because it is not subject to errors that would be introduced by gathering it in different places at different times. "From a scientific point of view, it is wise to get as many of the instruments as you can on a single platform so the information flows together," he said.

Separate spacecraft dedicated to a single facet of the problem are not likely to come up with the answers needed, Sorooshian added. "When we talk about hydrology in the EOS era, it is no longer a discipline in itself," he said. "We have to look at its interlinkage with the carbon cycle, the bio-geochemical cycle, the nitrogen cycle. These things are all tied together. You cut down vegetation, and you affect the hydrologic cycle. But cutting the vegetation is part of the bio-geochemical cycle."

Although the sensors and spacecraft are sophisticated and complex, the project is made up of proven technologies, which means that EOS will not be a major engineering experiment like the Hubble was.

"We have quite a lot of experience with this type of mission, Sorooshian said. "We have had the LANDSAT satellites, the French have had SPOT, and spy satellites have capabilities beyond both of those. It is a proven technology."

Scientists hope it is a technology that will give us a view of our blue-green petri dish from the outside, and, perhaps, the knowledge to constructively guide its future.

by Ed Stiles

EOS at Work

The Earth constantly communicates information about its changing surface with either reflected or emitted energy. Remote sensing expert Alfredo Huete is part of a global effort to better understand what the planet is saying.

Huete, a University of Arizona associate professor of soil and water science, is one of more than 500 scientists participating in the National Aeronautics and Space Administration's 15-year Earth Observing System (EOS) mission to monitor the Earth's environment. NASA selected Huete and six other UA researchers in March 1989 to participate in the mission.

Huete is principal investigator on a project to develop more accurate and reliable means of interpreting data that will be transmitted by various sensors on EOS' four Earth-orbiting platforms.

"Information from the surface of the Earth comes in the form of reflected energy from the sun, or through emitted energy, such as temperature," Huete says. "Images from satellite data are two-dimensional representations of the watts of energy that hit

"Information from the surface of the Earth comes in the form of reflected energy from the sun or through emitted energy such as temperature. Images from satellite data are two-dimensional representation of the watts of energy that hit satellite sensors from a particular location on Earth."

satellite sensors from a particular location on Earth."

Satellite sensors are equipped with filters that allow them to "see" the visible, infrared, thermal and microwave portions of the electromagnetic spectrum. The information is digitized, radioed back to Earth in pixels, the tiny elements that make up the image produced by a television camera, and converted into various geophysical maps.

But "when you are getting an energy measurement from each of these pixels, it's never just from plants or soil alone," Huete says. "It's a mixed signal from both plants and soil. You want to be able to manipulate the data so that you either extract the vegetation-reflected signal or the soil-reflected signal. If you want to know how much water is being transpired from the vegetation surface, you have to eliminate the soil effect and vice-versa."

His place on the EOS mission is due largely to the SAVI he developed.

The Soil-Adjusted Vegetation Index is a refined version of a long-used method of interpreting satellite data to measure vegetation density. He spent about four years showing that the Normalized Difference Vegetation Index, or NDVI, needs to be improved. NDVI provides a distorted image of vegetation activity because it responds to the soil signal as well as that of the vegetation. This kind of fine-tuning of satellite information will be critical to the efficiency of MODIS, the sensor Huete will be using on the EOS project. MODIS, the Moderate Resolution Imaging Spectrometer, will determine tropical deforestation, the effects of acid rain, the process of land degradation and the distribution of phytoplankton in the oceans.

Alfredo Huete

"When NASA launches its satellites in 1998," Huete says, "all the equations, computer code and programs have to be implemented so, rather than turning raw data over to the scientific community, NASA will be able to produce maps that will indicate vegetation activity on any part of the planet. We're making sure we have all this dirty work completed before the launch."

The EOS project now is in its first year. This "definition period" is spent in meetings with team members, other teams and writing funding proposals.

Huete says NASA is stressing that team members be able to validate their work.

"Once the instruments are in space, we will need to know if they are giving accurate information," he says. "So, in the next six months, the MODIS team will be concentrating on finding test sites where we can do ground-based validation of the satellite system."

One test site has been established in Niger, West Africa, where, due to its particular sensitivity to environmental changes, numerous international research projects already are in place.

Huete will spend the summer of 1992 in Niger coordinating preliminary work.

"Everything will be set up as if we were going to go through the whole ground validation of the satellite system," he says. "We'll set up a weather station and measure soil moisture, vegetation production, evapotranspiration and land temperature. Then, using the satellites already in space, we'll try to simulate what the MODIS sensor will do under a series of worse-case scenarios that should tax the system to its limit."

Ideally, the MODIS team would like to establish 20 ground-based test sites around the world, but budget realities will probably allow for just six or seven sites.

Huete also is a co-investigator on another EOS project with UA hydrologist, Soroosh Sorooshian. Sorooshian's project will examine the hydrology and climate in arid and semiarid lands.

by Jan McCoy

Statistics and Data

Statistics can prove to be as vital as sunscreen in Arizona — or only as suggestive as a bikini.

The level of usefulness often hinges as much on the data provided the statistician as on the need for information that provokes the research.

In the case of acid rain and questions about how it affects the environment, the need to know is crucial. Acid rain results from heavy sulfur emissions emitted by power plants and heavy industries. The emissions react in the atmosphere to produce precipitation with high levels of acid. Acid rain can kill fish, plants and trees.

Donald E. Myers, University of Arizona mathematics professor, conducts geostatistical research on acid rain for the U.S. Environmental Protection Agency.

Questions abound around the issue. In Myers' case, the EPA wants to know about patterns in the way acid rain affects lakes. The EPA initiated a national water survey in 1983 to assess the chemistry of lakes across the United States. The survey was part of a National Acid Precipitation Assessment Program conducted from 1980 to this year. The sweeping program, mandated by Congress, was carried out by a number of federal agencies, including the EPA.

Myers and 11 graduate students have been working on a segment of that study, trying to ascertain statistically whether there are clusters of similarity in the chemistry of lakes considered highly susceptible to acid-rain pollution. They have recently completed one segment, a study of lakes in the Adirondack Mountains in northeastern New York.

For the eastern-lakes survey, Myers and his students ascertained that out of 26 interrelated chemical factors that could influence acidity of the water, the "acid neutralization factor," or amount of bicarbonate in samples, proves most important. It helps predict whether other chemicals characteristic of a lake affected by acid rain will appear in the water.

This finding surprised them, Myers says, since pH normally is used to indicate acidity. But the chemists will have to deal with why this is so, he adds, because "the data doesn't provide that kind of information."

Levels of acid neutralization factor also help predict whether nearby lakes have been affected by acid rain, Myers says.

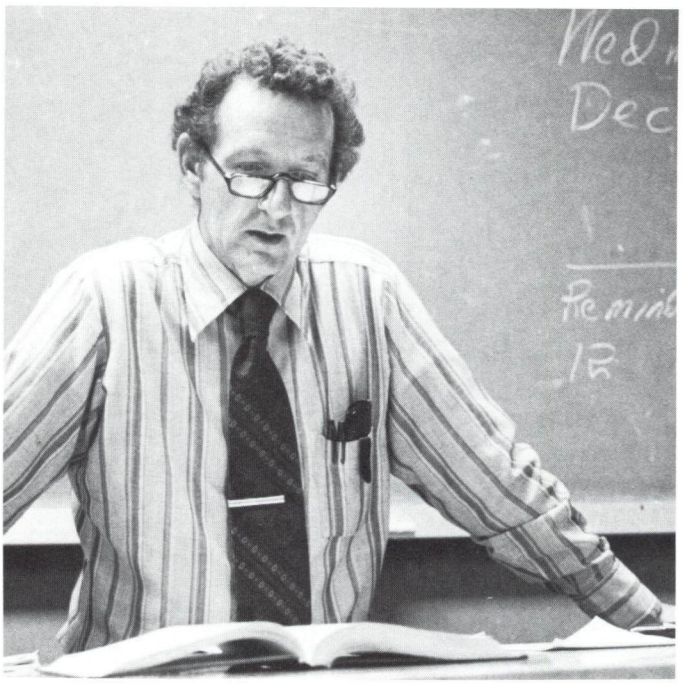
Geostatisticians deal with data that is located in space, Myers says, so they have to delve into a variety of subject areas to do their work.

"I'm not a chemist, a soil physicist, a geologist or a hydrologist," he says, "but I've had to learn the language and terminology of these fields."

Myers currently is working on two other environmental studies: a survey of the extent to which humans have accumulated toxic substances that may be byproducts of pesticides or herbicides in their bodies; and an analysis of tree-ring data and drought cycles.

Myers says he expects to continue working on the EPA acid-rain study; the next phase covers lakes in the western United States.

by Marilyn Johnson



Donald E. Myers

From Research To Teaching

As the interdisciplinary field of "Earth Systems Sciences" emerges as a focus of scientific research and inquiry, several scientists at The University of Arizona are forecasting the need for both more scientists and an informed non-scientific public.

To that end, a team headed by UA tree ring scientist Lisa Graumlich has devised an interdisciplinary curriculum that will give undergraduate and graduate students an opportunity to learn more about Earth System Sciences.

"This course work represents truly interdisciplinary cooperation," Graumlich says. It represents scientists from hydrology, soil sciences, geosciences, atmospherics and the Laboratory for Tree Ring Research

Graumlich, along with UA scientists Robert E. Dickinson, atmospheric physics; Dara Entekhabi, hydrology and water resources; Alfredo Huete, soil and water science; Malcolm Hughes, director of the Laboratory for Tree Ring Research; Judith Totman Parrish, geosciences; and Soroosh Sorooshian, head of hydrology and water resources; prepared a proposal for funding accepted by the Universities Space Research Association (USRA), sponsored by the U.S. National Aeronautics and Space Administration.

The UA proposal was one of five selected for funding out of 26 reviewed by USRA.

In the spring of 1989 the UA Coordinating Committee on Global Change began developing several Earth system science courses. More are in the planning stages. The first course offered was "Global Change," taught by Graumlich. It was offered in spring 1990, and the second course, "Monitoring Biosphere Processes," taught by Huete, was started in the fall 1990 semester.

Graumlich describes her course as being for "a broad range of students who have varying fields of expertise."

"The course is structured so that initially I give a number of lectures presenting basic concepts. As the course proceeds the students interact in such a way that they share knowledge from their respective disciplinary backgrounds. The multi-disciplinary exchange increases the breadth of the course's content and exposes students to a wealth of ideas and approaches," Graumlich says.

Parrish started an honors seminar in the fall 1990 titled "Hot and Cold, Wet and Dry, Climate and Earth History." Dickinson, Sorooshian and Hughes will conduct a graduate seminar in Earth System Science beginning in spring 1991. A survey course for both science and non-science majors, "Global Change and Earth Systems," is in the planning stages. Huete, Entekhabi and Parrish will teach the course.

Lisa Graumlich

Graumlich describes Earth Systems Science as "an emerging way of studying the entire Earth system by seeking to understand the interrelationships between its component parts and the nature of its variability on all timescales".

For example, discussions on the nature of climate and vegetation change in the arid Southwest might include a discussion of how changes in vegetation alter the albedo or reflectivity of the land surface which in turn affects the climate of the land surface.

Vegetation change also affects the patterns of rainfall infiltration leading to changes in soil moisture and changes in stream channel morphology and these changes in climate and soil moisture can result in further changes in vegetation. Environmental systems often exhibit such complex feedbacks whereby a change in one part of the system affects another part of the system which in turn causes changes in the original variable. Such feedbacks exist on a multitude of temporal and spatial scales and represent one of the biggest challenges in the effort to understand and model Earth systems.

Those changes in turn may have feedback effects that may further alter both climate and vegetation, Graumlich says.

"What happens in class is (students) try to develop models for how all these systems work together. It is very important to try to determine how sensitive a system is. In other words, what is the degree to which a change in one component changes another component?," she asks.

by Dennis St. Germaine

Directory:

Charles M. Amling
Research Glass Blower
Chemistry
621-3463

Victor R. Baker, Ph.D
Geosciences and Planetary Sciences
621-6003

Roger C. Bales, Ph.D
Department of Hydrology and Water Resources
621-7113

Steven K. Croft, Ph.D
Senior Research Associate
Lunar and Planetary Laboratory
621-6963

Robert E. Dickinson, Ph.D
Atmospheric Sciences
Institute of Atmospheric Physics
621-2810

Douglas J. Donahue, Ph.D
Physics
Co-director, UA office, National Science Foundation
Arizona Accelerator Facility for Radioisotope Analysis
621-2480

Dara Entekhabi Ph.D.
Hydrology and Water Resources
621-8787

Edward P. Glenn III, Ph.D
Environmental Research Laboratory
741-1990

David Goodrich, Ph.D
USDA Agricultural Research Service
670-6481

Lisa J. Graumlich, Ph.D.
Tree Ring Laboratory
621-6465

Donald A. Graybill Ph.D.
Tree Ring Laboratory
621-2945
621-2191

Virginia C. Gulick,
Jeffrey S. Kargel,
Goro Komatsu,
Graduate students,
Lunar and Planetary Laboratory
621-6963

Benjamin M. Herman, Ph.D
Atmospheric Sciences
Institute of Atmospheric Physics
621-6846

Carl N. Hodges
Director, Environmental Research Laboratory
741-1990

Alfredo R. Huete, Ph.D
Soil and Water Science
621-3228

Malcolm K. Hughes, Ph.D.
Director, Tree Ring Laboratory
Coordinating Committee on Global Change Chair
621-2191

Charles F. Hutchinson, Ph.D.
Associate Director, Office of Arid Lands
621-7896

Austin Long, Ph.D
Geosciences
Laboratory for Isotope Geochemistry
621-8888

Donald E. Myers, Ph.D
Department of Mathematics
621-6859

Judith Totman Parrish Ph.D.
Geosciences
621-4595 or
621-6024

Philip N. Slater, Ph.D
Optical Sciences Center
Chairperson, UA Committee on Remote Sensing
621-4242

Soroosh Sorooshian, Ph.D
Head, Dept. of Hydrology and Water Resources
621-7120

Robert G. Strom, MS
Lunar and Planetary Laboratory
621-2720

Alexander T. Wilson, Ph.D
Geosciences
621-2117

David Woolhiser, Ph.D
USDA Agricultural Research Service
670-6481

Summary of Support Received

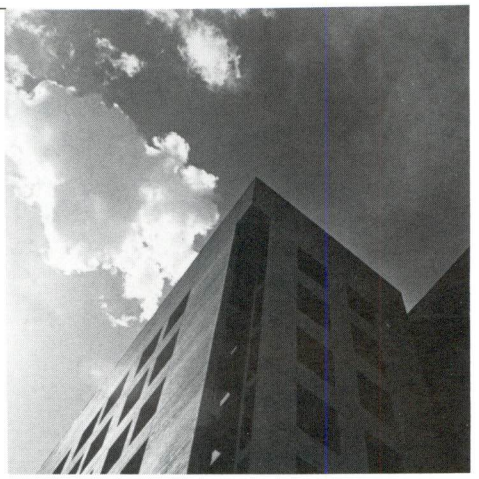
Fiscal Year July 1, 1989 to June 30, 1990	
Instruction	$ 6,464,511
Research	149,400,326
Public Service	3,798,516
Academic Support	5,525,311
Student Services	8,842,590
Institutional Support	611,568
Total	**$174,642,822**

Support Totals by College, Faculty and Administrative Division

College / Department	*Instruction*	*Research*	*Public Service*	*Academic Support*	*Student Services*	*Institutional Support*	*Total Amount*
Agriculture, College of							
AG Experiment Station Research		6,803					6,803
Agricultural Economics Research	8,500	193,375		5,951			207,826
Agricultural Education	777			398			1,175
Agricultural Education Research	2,945	22,246					25,191
Agricultural Engineering		322,077					322,077
Agriculture Administration	10,000	22,397		16,055	10,156		58,608
Agriculture Development					13,273		13,273
Animal Sciences Research		1,083,958		120,050		10,000	1,214,008
Arboretum Affairs		78,574	108,500				187,074
Arid Lands Studies	800	1,176,915				1,000	1,178,715
Biochemistry — College of Agriculture		173,906					173,906
Cooperative Extension Service		11,997					11,997
County Office — Pima			164,000				164,000
County Office — Pinal		9,700					9,700
County Office — Yuma		5,450					5,450
Entomology Public Service			27,000				27,000
Entomology Research		1,019,371			1,164		1,020,535
Family and Consumer Resources	96,562	361,304	1,000				458,866
Family and Consumer Resources Extension		51,665					51,665
International Programs		1,489,641					1,489,641
Maricopa Agricultural Center		262,649	1,625				264,274
Natural Resources Rural Devel — Public Service		28,000					28,000
Nutrition and Food Science Research		504,138					504,138
Plant Pathology Research		266,410		800			267,210
Plant Sciences Public Service		84,820	4,000				88,820
Plant Sciences Research		1,797,229		250	1,422		1,798,901
Renewable Natural Resources Research		1,525,909		250			1,526,159
Safford Farm Rsch		200					200.00
Soils and Water Science Research		522,210					522,210
Veterinary Science		1,000,051					1,000,051
Yuma Agriculture Center		29,700		100			29,800
Yuma Farm		12,025					12,025
Agriculture, College of	119,584	12,062,720	306,125	143,854	26,015	11,000	12,669,298
Architecture, College of		127,739		18,453	7,000	32,000	185,192
Arts & Sciences Administration				8,000			8,000

Support Totals by College, Faculty and Administrative Division

College / Department	*Instruction*	*Research*	*Public Service*	*Academic Support*	*Student Services*	*Institutional Support*	*Total Amount*
Business and Public Administration	500	2,026,586	24,854	110,260	74,277		2,236,477
Education, College of	1,402,404	1,006,216	26,622	533	9,690		2,445,465
Engineering and Mines, College of							
Aerospace / Mechan Engr		1,334,024		5,400	27,000		1,366,424
Chemical Engineering		205,055		11,960	14,875		231,890
Civil Engr / Engr Mechan		962,167		3,200			965,367
Elec / Computer Engr	2,500	3,556,046		284,948	24,500	25,000	3,892,994
Engineering Experiment Station		2,741,480		25,365	600		2,767,445
Engr / Mines Coll Admin		188,000		334,500	58,849		581,349
Hydrology / Water Res		1,341,380		5,310			1,346,690
Materials Sci / Engr		1,231,008		59,828			1,290,836
Mining / Geological Engr	602	1,019,476		9,681	947		1,030,706
Nuclear / Energy Engr		296,811					296,811
Systems / Indus Engr		503,542					503,542
Water Resources Research Center		106,316		184	2,000		108,500
Engineering and Mines, College of	3,102	13,485,305		740,376	128,771	25,000	14,382,554
Fine Arts, Faculty of			7,000	190,771		3,550	201,321
General Departments							
Intercollegiate Athletics				625,757	63,664		689,421
Military Aerospace						315	315.00
Graduate College		167,300			118,710		286,010
Humanities, Faculty of	491,970		367,835	1,105		7,500	868,410
Law, College of				57,507			57,507
Medicine, College of	2,365,869	49,625,475	856,601	2,075,873	63,538	42,230	55,029,586
Nursing, College of	19,344	1,268,600		67,373			1,355,317
Office of the VP for Business Affairs			170,838	5,125		1,225	177,188
Pharmacy, College of	10,000	3,038,205	9,500	62,688	12,000		3,132,393



Support Totals by College, Faculty and Administrative Division

College / Department	*Instruction*	*Research*	*Public Service*	*Academic Support*	*Student Services*	*Institutional Support*	*Total Amount*
Sciences, Faculty of							
Atmospheric Physics, Institute of		342,607		22,500			365,107
Biochemistry Main Campus		1,966,174		1,636			1,967,810
Chemistry	222,168	5,044,778	11,299	12,325			5,290,570
Computer Science		2,168,487			51,300		2,219,787
Ecology and Evolutionary Biology		958,650		2,361			961,011
Flandrau Planetarium			18,765			25,000	43,765
Geosciences		1,840,485		31,197	10,000		1,881,682
Lunar and Planetary Laboratory	40,130	9,955,133		125			9,995,388
Mathematics	242,435	1,265,752		186	7,000		1,515,373
Microbiology / Immunology Main Campus		363,236					363,236
Molecular / Cellular Biology Main Campus		1,319,027		15,413			1,334,440
Multiple Mirror Telescope Observatory		372,910					372,910
Physics	170,411	2,632,016					2,802,427
Sciences Faculty Administration				144			144.00
Speech and Hearing Sciences	306,177	1,140,047		52			1,446,276
Steward Observatory	440,875	18,662,030				37,364	19,140,269
Tree Ring Laboratory		322,140		495		4,610	327,245
Senior VP for Academic Affairs & Provost							
Academic Computing				37,036			37,036
Arizona State Museum		308,444		4,275			312,719
Art Museum		3,985	65,410	3,200			72,595
Centr for Computing / Info Tech				20,379		4,000	24,379
Exercise and Sport Sciences	33,747	1,286,988	2,000	1,445			1,324,180
Health Education					4,050		4,050
Library		9,000	155,111	149,367			313,478
Media and Instructional Services			1,512,669				1,512,669
Medical Technology Program		40,000		50			40,050
Optical Sciences Center	28,994	9,009,381		19,000	8,300		9,065,675
School of Health Related Professions		56,694		34,395			91,089
Technical Services			26,118				26,118
Udall Center		131,000					131,000
University Press				500			500.00
Social / Behavioral Sciences, Faculty of							
American Indian Studies	11,996						11,996
Anthropology		330,667		3,361	11,700	401	346,129
Bur. Applied Research in Anthropology		292,204		100			292,304

Support Totals by College, Faculty and Administrative Division

College / Department	*Instruction*	*Research*	*Public Service*	*Academic Support*	*Student Services*	*Institutional Support*	*Total Amount*
Center for Middle Eastern Studies	137,842			36,100			173,942
Communication		321,159		9,000			330,159
Geography and Regional Development		6,099					6,099
Graduate Library School		21,342					21,342
History			500	50			550.00
Journalism				21,691	1,000		22,691
Latin American Area Center	63,429						63,429
Linguistics	169,963						169,963
Mexican American Studies	132,606	26,210	225				159,041
Oriental Studies		85,044		37,000			122,044
Philosophy		24,704					24,704
Political Science		47,576					47,576
Psychology		1,045,777	63,257				1,109,034
Russian and Soviet Studies		117,242		2,607			119,849
Social and Behavioral Sciences Admin				1,000			1,000
Social / Behavioral Sciences Research Institute		62,004		9,990			71,994
Sociology		138,946					138,946
Southwest Studies Center						198	198.00
Women's Studies	30,965	6,400		4,950	2,000		44,315
Social / Behavioral Sciences, Faculty of	546,801	2,525,374	63,982	125,849	14,700	599	3,277,305
Vice President Undergraduate Affairs						6,000	6,000
Vice President Planning and Budgeting				15,517		13,845	29,362
Vice President Research	20,000	4,782,842			22,764		4,825,606
Vice President Student Affairs		30,000	9,800	921	4,117,070		4,157,791
Vice President University Relations & Development							
Community and Public Service		40,000	1,225				41,225
Cultural Affairs, Office of			162,762				162,762
Development Office		15,000		919,268	4,103,741	397,330	5,435,339
GRAND TOTALS	**6,464,511**	**149,400,326**	**3,798,516**	**5,525,311**	**8,842,590**	**611,568**	**174,642,822**

Credits

Published by
Office of the Vice President
for Research
Michael A. Cusanovich,
vice president for research and
dean of the graduate college

Charles A. Geoffrion,
associate vice president for research

Editorial inquiries and comments should be sent to:
Editor, Report on Research
Office of Public Information
The University of Arizona
Tucson, Arizona 85721
(602) 621-1877

Editor:
Dennis D. St.Germaine
Manager, University Publications:
Office of Public Information

Writers:
Lori Stiles,
Office of Public Information
Jeff Harrison,
Office of Public Information
Dennis D. St.Germaine,
Office of Public Information
Ed Stiles,
College of Engineering and Mines
Marilyn Johnson,
Faculty of Science
Jan McCoy,
Agricultural Communications

Design:
Lee Barker, UA Graphic Services

Photography:
Bill Keller, UA Graphic Services
Lori Stiles,
Office of Public Information

Vice President for Research
601 Administration Building
The University of Arizona
Tucson, Arizona 85721

Address Correction
Requested

Nonprofit Org.
US Postage
PAID
Permit No. 190
Tucson, Arizona

THE WHITE HOUSE

WASHINGTON

June 4, 1991

Dear Professor Guruswamy:

Thank you for your letter of May 17, 1991, inviting me to give the opening address at your Conference on Energy and The Environment: Intersecting Global Issues scheduled for January 17-18, 1992. I apologize for the much belated response.

As much as I would like to join you at the conference, I have a long-standing commitment on those dates, so I must regretfully decline.

I appreciate your thinking of me and would like to offer my best wishes for a successful conference.

Sincerely yours,

D. Allan Bromley
The Assistant to the President
for
Science and Technology

Professor Lakshman D. Guruswamy
College of Law
The University of Arizona
Tucson, Arizona 85721