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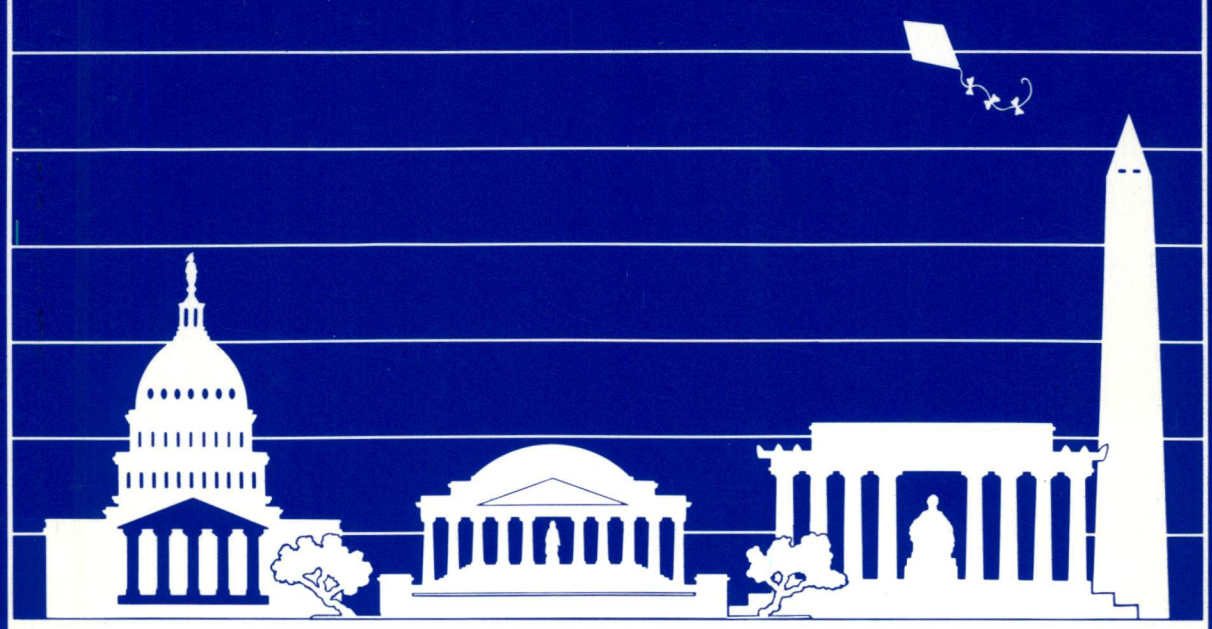
AAAS ★ 91

The AAAS Annual Meeting

PROGRAM

WASHINGTON, DC

14–19 February 1991





Welcome to the AAAS Annual Meeting

Welcome to the 157th annual meeting of the American Association for the Advancement of Science!

The original 1848 constitution of the AAAS specified the objects of the Association to be

> ... by periodical and migratory meetings, to promote intercourse between those who are cultivating science in different parts of the United States; to give a stronger and more general impulse, and a more systematic direction to scientific research in our country; and to procure for the labor of scientific men, increased facilities and a wider usefulness.

Subsequent amendments have modernized the language of our constitution, of course, including the outmoded gender reference. Nonetheless, these 143-year-old words still seem a rather apt description of our purposes in coming together here in our nation's capital. Our "periodical and migratory meetings" have brought us to Washington, DC, for many reasons, a particularly appropriate place to pursue the objects of our Association. The universities, industrial research centers, and government laboratories and agencies of the Middle-Atlantic region house a large population of "those who are cultivating science," some by doing it and some by guiding and supporting it. It is certainly a place to debate science policy issues, in search of "a stronger and more general impulse, and a more systematic direction." And "increased facilities," or to pursue "wider usefulness" for our work through technology transfer, in the interests of economic competitiveness or national security.

We are convened at a glorious but oddly unsettling time for American science. Our nation is supporting our work at unprecedented levels, financially at least. Our exploration of Vannevar Bush's "endless frontier" continues to reveal wonders at a dizzying rate. Through the eyes of one instrument, we are examining in great detail the geology of Venus. Through others, we are now able to see and manipulate single atoms and molecules arranged on solid surfaces or suspended in space. We have developed awesome capabilities for analyzing and manipulating the molecular essence of life itself. And our capacity for dealing with the fundamental stuff of science, information, continues to advance exponentially. The excitement of our calling still attracts some of the most able of our young. We regularly share in and often dominate the annual Nobel sweepstakes. In short, things are just great in American science!

And yet — something seems awry. There just doesn't seem to be enough money to allow us to pursue all the good ideas we have. Our time-honored ways of deciding who gets what money there is don't seem to work as well as they use to. Despite our scientific triumphs, our nation seems to be lagging in the race to turn them to her own technological and economic advantage. Our accustomed status as world leaders in science appears to be eroding, as we watch growing legions of better-funded foreign competitors from our unaccustomed viewpoints as citizens of the world's leading debtor nation. Media reports containing the word "scientific" seem to follow it with the word "fraud" with distressing frequency. We watch our colleagues aging, we observe the uncomprehending stares of the students in our classes, and we wonder where our successors in the grand endeavor of science will come from. In short, things are pretty bad in American science!

Which is it, then? Are American science and technology faring well or poorly? In this not-so-simple world, the answer is probably "Both!" And in that apparent contradiction lie many critically important issues of national policy. What better place in which to debate them than our nation's capital? What better venue in which to debate them than the annual meeting of the AAAS, the only association that brings together the full array of participants and observers of that glorious adventure called science?

Welcome, then, to this AAAS annual meeting and to the contests of ideas and views it is intended to foster. We are all indebted to the many AAAS members and staffers who have made it possible and to the chairmen for this meeting, Robert McC. Adams, Secretary of the Smithsonian Institution, Franklyn Jennifer, President, Howard University, and Norman Augustine, CEO, Martin Marietta Corporation, who have greatly helped in ensuring the successful community outreach of the meeting. Special thanks go to Richard Nicholson, Executive Officer of the AAAS, and to Arthur Herschman, Head of the Meetings Office. Welcome also to Washington, and the nonscientific delights it offers.

DONALD N. LANGENBERG
President
American Association for the Advancement of Science

Co-Chairmen's Welcome to Washington, DC

Welcome to the Nation's Capital and the 157th Annual Meeting of the AAAS. As we move further into the 1990s, these are exciting times in Washington, DC, as new leadership and challenges emerge in science, science education, and science policy. This evolving climate calls for new and different action from the scientific enterprise. The AAAS meeting is the perfect forum for reflecting on lessons learned, new frontiers to pursue, and science's relationship to larger societal needs.

A wide array of scientific concerns will be addressed in the 200-plus symposia, workshops, technical sessions, seminars, short courses, and poster sessions being presented by scientists and other speakers from around the world. A new feature of this year's meeting is the Employment Exchange where recruiters from corporations, government agencies, and colleges and universities will review resumes and interview candidates.

As a way of involving the Greater Washington, DC, community in the meeting, a variety of activities are planned for schools and the general public. High school students participate in a one-day mini-version of the AAAS meeting that includes plenary lectures, small group sessions, demonstrations, and conversations with scientists. Schools and the general public are invited to participate in a variety of science-related events offered by science museums, federal agencies, colleges and universities, professional associations, and local businesses.

We would also like to invite you to explore the unique features of this historic city — the monuments and the national treasures housed both in museums and other federal buildings.

We extend to you our warm wishes for both a pleasant and enjoyable stay in the Nation's Capital.

Robert McC. Adams
Secretary
Smithsonian Institution

Franklyn Jennifer
President
Howard University

Norman Augustine
Chief Executive Officer
Martin Marietta Corporation

Mark Your Calendar

For the next AAAS Annual Meeting



AAAS☆92 Chicago

6–11 February 1992

Hyatt Regency Chicago

American Association for the Advancement of Science

1991 AAAS Annual Meeting Program

157th National Meeting ★ Washington, DC ★ 14–19 February 1991

Edited by Arthur Herschman
and Susan M. O'Connell

American Association for the Advancement of Science
1333 H Street, NW, Washington, DC 20005

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Standards of Conduct

On 14 April 1978, the AAAS Board of Directors adopted the following position statement regarding standards of conduct at AAAS meetings:

The Board takes it for granted that all who attend the Annual Meetings of the Association will conduct themselves with consideration for others and with particular consideration for those who generously give their time and thought to the sessions. Differing opinions will continue to be heard and respected.

We recognize that there are areas of science that are both controversial and troubling. The Annual Meeting can serve as an effective forum to consider such issues, so long as procedures of orderly debate and fairness are followed. But discourtesy and abusive behavior have no place in the Annual Meeting. When excesses occur they do great injury to the Association and to the process of discussion. They cannot be condoned.

No Smoking Rule

On 30 December 1971, the AAAS Counsil adopted a motion requesting that persons in attendance refrain from smoking at Council meetings and at scientific and public sessions. We ask all who attend this meeting to comply with this ruling.

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1993 (159th): 11–16 February, Boston
1994 (160th): 18–23 February, San Francisco
1995 (161st): 16–21 February, Atlanta

You may contribute to the Program of the Chicago Meeting by proposing a symposium, technical session, or workshop. Forms are available in the AAAS headquarters office (Lanai Suite 152, First Level, Sheraton Washington Hotel).

RECIPIENTS OF AAAS AWARDS AND PRIZES PRESENTED AT THE 1991 ANNUAL MEETING

AAAS PHILIP HAUGE ABELSON PRIZE

The Honorable George E. Brown, Jr., for a career of distinguished public service and leadership in support of long-range planning and investment in basic research and education for science and technology.

AAAS PRIZE FOR BEHAVIORAL SCIENCE RESEARCH

Bruce P. Dohrenwend, Itzhak Levav, Patrick E. Shrout, Sharon B. Schwartz, Guedalia Naveh, Bruce G. Link, Andrew E. Skodol, and **Ann Steuve,** for their paper "Socioeconomic Status and Psychiatric Disorders: A Test of the Social Causation–Social Selection Issue."

AAAS NEWCOMB CLEVELAND PRIZE

Margaret J. Geller and **John P. Huchra,** for "Mapping the Universe," published in *Science,* 17 November 1989.

AAAS HILLIARD RODERICK PRIZE IN SCIENCE, ARMS CONTROL, AND INTERNATIONAL SECURITY

Wolfgang K. H. Panofsky, for his effective use of technical knowledge to clarify policy options related to such issues as the Strategic Defense Initiative, the testing of nuclear weapons, and the verification of arms control treaties.

AAAS SCIENTIFIC FREEDOM AND RESPONSIBILITY AWARD

Adrian R. Morrison, for his dedicated promotion of the responsible use of animals in research and his courageous stand in the face of great personal risk against attempts to curtail animal research essential to public health.

AAAS–WESTINGHOUSE AWARD FOR PUBLIC UNDERSTANDING OF SCIENCE AND TECHNOLOGY

William L. Rathje, for innovative contributions to public understanding of science and its societal impacts, and for demonstrating through his "Garbage Project" how the scientific method can document problems and identify solutions.

AAAS–WESTINGHOUSE SCIENCE JOURNALISM AWARDS

Daily Newspapers with circulation of 100,000 or more: **Charles W. Petit,** for "Battle to Save the Rain Forest," published in the *San Francisco Chronicle,* 25–28 September and 1 October 1989.

Newspapers with circulation under 100,000: **Lawrence Spohn,** for "The Grand Voyage," published during June, August, September, and October 1989.

General Circulation Magazine: **Michael D. Lemonick, Philip Elmer-DeWitt, J. Madeleine Nash,** and **Christopher Redman,** for "Smash: The Ultimate Quest," published in *Time,* 16 April 1990.

Radio: No award given.

Television: **Larry Engel, Thomas Lucas,** and **Paula Apsell,** for "Hurricane!" a NOVA program broadcast on the Public Broadcasting Service, 7 November 1989.

WILLIAM D. CAREY AWARD LECTURE

John Brademas, for his outstanding career as a public servant and educational leader during which he has advanced the cause of educational reform and academic research.

JOHN P. McGOVERN AWARD LECTURE IN THE BEHAVIORAL SCIENCES

Shosaku Numa, for his pioneering application of molecular biological techniques to the study of neurobiology.

AAAS Meeting at a Glance

The number preceding each session title refers to the category to which the session is assigned (see Sessions by Category). The numbers in the right-hand column refer to the pages in the *Program* where each activity is described.

Summaries of individual session papers and of individual Poster Session papers are provided in a separate book, *Abstracts of Papers.*

Audiotaping is planned for sessions marked with an asterisk.

Thursday, 14 February

10:00 am–8:00 pm Registration
[SW/Atrium]

8:30 am–5:00 pm Board of Directors
Closed business meeting [SW/Nathan Hale] 103

Thursday Morning Program

8:30 am Short Courses
(Additional registration fee required)

C-1. Sophisticated Uses of Simple Computers *(Session 1)* [SW/Wisconsin] 8
C-2. Computers in Medical Imaging and Graphics *(Session 1)* [SW/Kansas] 8

Thursday Afternoon Program

2:30 pm Short Courses

C-1. Sophisticated Uses of Simple Computers *(Session 2)* [SW/Wisconsin] 8
C-2. Computers in Medical Imaging and Graphics *(Session 2)* [SW/Kansas] 8

Thursday Evening Program

8:30 pm Plenary Lecture

* L-1. ***Keynote Address:***
Invited Speaker: George H. W. Bush *(President of the United States)* [SW/Sheraton Ballroom] 1

9:30 pm–10:30 pm First Night Mixer
[SW/Cotillion Foyer]

Friday, 15 February

7:30 am–5:30 pm Registration
[SW/Atrium]

8:00 am–6:00 pm Employment Exchange
[SW/Exhibit Hall B]

10:00 am–4:00 pm *SB&F* Science Film Festival
[SW/Atrium Room 1] 106

Friday Morning Program

8:30 am Symposia

* 10-1. The Frontiers of the Physical Sciences: 1991 *(Session 1)* [OS/Hampton] 11
11-2. Computer Virus Legislation: Problems and Pitfalls [OS/Executive] 12
12-1. Energy R&D Policy in the United States [OS/Congressional] 15
* 13-1. Seventy-five Years of General Relativity [OS/Diplomat] 19
* 15-3. Impacts of the Climate During the 1980s in the United States [OS/Ambassador] 25
16-3. Science in Africa: Achievements and Prospects *(Session 1)* [OS/Blue Room] 29
* 22-8. The Control of Infectious Diseases: New Aspects of Vaccines [SW/Cotillion South] 42
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24-1. Economically Useful Plants for Developing Countries: From Research to Market [SW/Annapolis] 46
25-2. Defining Ecosystem Health: Science, Economics, or Ethics? *(Session 1)* [SW/Richmond] 51
* 26-3. DNA-based Identification Systems, Issues in Application [SW/Arlington] 57
* 27-5. Cognitive Aging Among Intellectually Able Individuals: Patterns, Precursors, and Implications [SW/Alexandria] 60
* 31-1. Indigenous Peoples and the Rain Forest: Science, Marketing, and Human Rights *(Session 1)* [SW/Holmes] 66
32-1. Scientific and Technical Personnel: Issues for the 1990s *(Session 1)* [SW/Idaho] 69
34-1. Systematic Economic Analysis: Policy on Monopoly and Competition [SW/Wisconsin] 74
35-3. Soviet Politics and National Security Policy [SW/Dover] 80
36-1. Policy Issues in Science and Technology *(Session 1)* [SW/Colorado] 83
36-4. Conflict Between National and International Roles of Universities [SW/Kansas] 85
38-1. Cross-national Perspectives on the Public Understanding of Science *(Session 1)* [SW/Rockville] 92
39-5. Mathematics and Mathematics Education: Beyond Reports *(Session 1)* [SW/Wilmington] 99

Hotel Key
OS = Omni Shoreham SW = Sheraton Washington

8:30 am Technical Session

37T-4. Technical Change and the State in the 20th Century: Case Studies [SW/Vermont] 92

8:30 am Workshop

38W-3. Scientist-Teacher Partnerships in Middle School Science and Technology Education [SW/Woodley] 97

Friday Afternoon Program

1:00 pm Plenary Lectures

* L-2. "The Human Genome Project and HUGO" Speaker: Sir Walter Bodmer *(Director of Research, Imperial Cancer Research Fund)* [SW/Washington Ballroom] 1

* L-3. "A Perspective on the Federal Role in Science and Technology" Speaker: George E. Brown, Jr. *(U.S. House of Representatives)* [SW/Sheraton North Ballroom] ... 1

2:30 pm Symposia

* 10-1. The Frontiers of the Physical Sciences: 1991 *(Session 2)* [OS/Hampton] 11

* 11-1. Global Initiatives in High-performance Computing and Networking *(Session 1)* [OS/Empire] 11

* 12-3. Scientific Advances in Emerging Solar Energy Technologies [OS/Congressional] 16

* 13-2. Elementary Particle Physics: Present Status and Future Prospects [OS/Diplomat] 19

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* 16-1. Making Informed Decisions for Planet Earth: The Role of Satellite Observations *(Session 1)* [OS/Ambassador] 27

16-3. Science in Africa: Achievements and Prospects *(Session 2)* [OS/Blue Room] 29

16-5. What Are the Effects of Human Activity on the Global Ecosystem? [OS/Palladian] 30

* 21-1. The Revolution in Developmental Biology *(Session 1)* [OS/Sheraton South] 37

* 22-3. Molecular Determinants of Human Cancers [SW/Cotillion North] 40

* 22-6. Prospects for Immunocontraception [SW/Cotillion South] 41

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* 24-4. Pest Resistance to Control Tactics: Impact on Sustainable Pest Management [SW/Annapolis] ... 48

25-2. Defining Ecosystem Health: Science, Economics, or Ethics? *(Session2)* [SW/Richmond] 51

* 30-1. The Anthropology of Science and Scientists *(Session 2)* [SW/Sheraton North] 65

* 31-1. Indigenous Peoples and the Rain Forest: Science, Marketing, and Human Rights *(Session 2)* [SW/Holmes] 66

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* 37-4. Creative Couples and Gender Complementarity: Cross-disciplinary Perspectives [SW/Kansas] 90

38-1. Cross-national Perspectives on the Public Understanding of Science *(Session 2)* [SW/Rockville] 92

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Grand Opening and Welcoming Reception [SW/Exhibit Hall C]

6:00 pm–8:00 pm Business Meeting

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6:00 pm–8:00 pm Section Business Meetings

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L—History and Philosophy of Science [OS/Chairman's Room] 104

M—Engineering [SW/Vermont] 104

Q—Education [SW/Wisconsin] 104

U—Statistics [SW/Woodley] 105

W—Atmospheric and Hydrospheric Sciences [OS/Conference Room 863] 105

8:30 pm Plenary Lecture

* L-4. "Results from the Hubble Telescope" Speaker: Riccardo Giacconi *(Director, Space Technology Institute)* [SW/Sheraton Ballroom] 1

Saturday, 16 February

7:30 am–5:30 pm Registration

[SW/Atrium]

8:30 am–6:00 pm Employment Exchange

[SW/Exhibit Hall B]

8:30 am–5:00 pm Business Meeting

Committee on Scientific Freedom and Responsibility [OS/Council] 103

9:00 am–3:00 pm AAAS☆91 Exhibition

[SW/Exhibit Hall C]

10:00 am–4:00 pm *SB&F* Science Film Festival

[SW/Atrium Room 1] 106

Saturday Morning Program

8:30 am Seminar
(Additional registration fee required)

* S-1. The Neurosciences: Challenges for the '90s *(Session 1)* [SW/Cotillion Ballroom North] 7

8:30 am Symposia

* 11-1. Global Initiatives in High-performance Computing and Networking *(Session 2)* [OS/Empire] 11

* 14-1. Cosmology: Our Knowledge of the Universe [OS/Diplomat] 22

* 16-1. Making Informed Decisions for Planet Earth: The Role of Satellite Observations *(Session 2)* [OS/Ambassador] 27

16-4. Science, Technology, and Third World Economic Security *(Session 1)* [OS/Palladian] 30

17-5. Cleaning Up the Mess at the DOE Nuclear Weapons Complex [OS/Executive] 32

* 21-1. The Revolution in Developmental Biology *(Session 2)* [SW/Sheraton South] 37

* 22-5. The Progesterone Antagonist RU-486: Science and Science Policy *(Session 1)* [SW/Cotillion South] ... 41

* 23-2. AIDS: Scientific Research and Public Policy [SW/Baltimore] 44

24-2. Advancing Biotechnology: International Issues Regarding Biosafety Policy and Practice *(Session 1)* [SW/Annapolis] 47

* 25-6. Stakes in the Tropical Forests *(Session 1)* [SW/Richmond] 53

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* 30-1. The Anthropology of Science and Scientists [SW/Sheraton *(Session 2)* North] 65

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34-7. Systems Perspective for the Quality of Health Care [SW/Arlington] 77

* 35-1. Defense Technology and Policy After the Cold War *(Session 1)* [SW/Dover] 79

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36W-2. Communicating with Policymakers: Strategies for Scientists and Engineers [SW/Cabinet] 88

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[SW/Exhibit Hall C]

12:15 pm–2:15 pm Biomedical Sciences

[SW/Exhibit Hall C]

Saturday Afternoon Program

12 noon–1:00 pm Open Forum

AAAS Science and Engineering Fellowship Program [SW/Colorado] 105

12 noon–2:00 pm Business Meeting

Association for Puerto Ricans in Science and Engineering [OS/Forum] 103

12 noon–2:00 pm Section Business Meetings

E—Geology and Geography [OS/Caucus] 104

T—Information, Computing and Communication [OS/Conference Room 763] 105

1:00 pm Plenary Lectures

* L-5. *John P. McGovern Lecture*
"Insights into the Function of Neurotransmitter Receptors and Ionic Channels"
Speaker: Shosaku Numa *(Professor, Depts. of Medical Chemistry and Molecular Genetics, Kyoto University)*
[SW/Washington Ballroom] 1

* L-6. "Molecular Robots"
Speaker: Elias J. Corey *(Professor, Dept. of Chemistry, Harvard University)*
[SW/Sheraton North Ballroom] 2

2:30 pm Seminar

* S-1. The Neurosciences: Challenges for the '90s *(Session 2)* [SW/Cotillion Ballroom North] 7

2:30 pm Symposia

* 11-1. Global Initiatives in High-Performance Computing and Networking *(Session 3)* [OS/Empire] 11
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* 13-6. Status of High-temperature Superconductivity [OS/Diplomat] 20
* 16-1. Making Informed Decisions for Planet Earth: The Role of Satellite Observations *(Session 3)* [OS/Ambassador] 27
16-4. Science, Technology, and Third World Economic Security *(Session 1)* [OS/Palladian] 30
17-4. Assessing the Impacts of Nuclear Waste Facilities: The State of the Art Updated [OS/Executive] 32
* 21-2. New Perspectives on Cellular Signaling [SW/Sheraton South] 38
* 22-5. The Progesterone Antagonist RU-486: Science and Science Policy *(Session 2)* [SW/Cotillion South] ... 41
23-1. Consequences of HIV/AIDS in Eastern Africa [SW/Baltimore] 43
24-2. Advancing Biotechnology: International Issues Regarding Biosafety Policy and Practice *(Session 2)* [SW/Annapolis] 47
* 25-1. Inheritance of Acquired Characteristics: Evolutionary Origins of New Significant Traits [SW/Arlington] 51
* 25-6. Stakes in the Tropical Forests *(Session 2)* [SW/Richmond] 53
* 27-2. A Critical Examination of the Concept of Critical Periods [SW/Alexandria] 59
* 30-1. The Anthropology of Science and Scientists *(Session 3)* [SW/Sheraton North] 65
* 31-3. The Evolution of Deception: A Biocultural Approach [SW/Holmes] 67
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* 35-1. Defense Technology and Policy After the Cold War *(Session 2)* [SW/Dover] 79
* 37-2. Metaphors and Models in the Brain Sciences: Historical Perspectives [SW/Kansas] 89
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2:30 pm Workshop

36W-1. Government Hearings and Expert Witnesses: Giving Effective Testimony [OS/Cabinet] 87

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Y—General Interest in Science and Engineering [SW/Colorado] 105

8:30 pm Plenary Lecture

* L-7. "Science and Technology in Developing Countries" **Speaker:** José Goldemberg *(Secretary of State for Science and Technology, Government of Brazil)* [SW/Sheraton Ballroom] 2

Sunday, 17 February

7:30 am–5:30 pm Registration

[SW/Atrium]

8:30 am–6:00 pm Employment Exchange

[SW/Exhibit Hall B]

9:00 am–3:00 pm AAAS☆91 Exhibition

[SW/Exhibit Hall C]

10:00 am–4:00 pm *SB&F* Science Film Festival

[SW/Atrium Room 1] 106

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8:30 am Seminar

* S-1. The Neurosciences: Challenges for the '90s *(Session 3)* [SW/Cotillion Ballroom North] 7

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* 13-7. Current Directions in Musical Acoustics [OS/Congressional] 21

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* 16-2. Humankind in Global Change: Indicators and Prospects *(Session 1)* [OS/Ambassador] 27

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* 22-4. The Aging and Cancer Interface: Multidimensional Research Perspectives [SW/Cotillion South] 40

* 23-4. The Father and the Fetus: Facts and Fallacies [SW/Baltimore] 44

* 24-3. Biological and Biotechnological Alternatives to Chemical Insecticides *(Session 1)* [SW/Annapolis] .. 48

* 26-1. Alternative Approaches to Clinical Trials in AIDS: Ethics and Methodology *(Session 1)* [SW/Arlington] 56

* 27-6. Cults and the Courts: Use of "Brainwashing" Theory by Expert Witnesses [SW/Alexandria] 61

* 30-1. The Anthropology of Science and Scientists *(Session 4)* [SW/Sheraton North] 65

* 33-1. Drugs, Crime, and Violence: What Do We Know? [SW/Warren] 72

34-2. Frontiers of Research in Experimental Economics [SW/Wisconsin] 75

* 35-1. Defense Technology and Policy After the Cold War *(Session 3)* [SW/Dover] 79

36-3. Organization for Science and Technology in the Executive, Legislature, and Judiciary *(Session 1)* [SW/Colorado] 84

* 37-1. The Beginning and the End of the World: Historical Perspectives [SW/Kansas] 88

38-4. Science and the Media: Information Controls and Reporting of Science [SW/Rockville] 94

8:30 am Technical Sessions

12T-3. Changing Lives: New Technology for People with Disabilities [SW/Holmes] 18

24T-4. Value-added Products from Agriculture [SW/Vermont] 50

25T-3. Tropical Biology: Historical Perspectives and Contemporary Issues [SW/Richmond] 55

32T-1. Science Policy for Women in Science: Lessons from Historical and Contemporary Case Studies [SW/Idaho] 70

8:30 am Workshop

38W-2. Progress in Public Understanding of Science *(Session 1)* [SW/Woodley] 97

Sunday Poster Session

11:45 am–2:15 pm The Neurosciences: Challenges for the '90s

[SW/Exhibit Hall C]

Sunday Afternoon Program

12 noon–2:00 pm Section Business Meetings

J—Psychology [OS/Forum] 104

S—Pharmaceutical Sciences [OS/Presidential] 105

1:00 pm Plenary Lectures

* L-8. "The Grand Challenges of Computational Science" **Speaker:** Larry L. Smarr *(Director, National Center for Supercomputing Applications, University of Illinois)* [SW/Washington Ballroom] 2

* L-9. ***George Sarton Memorial Lecture*** "The Complexion of Scientific Communities" **Speaker:** Kenneth Manning *(Professor of the History of Science, MIT)* [SW/Sheraton North Ballroom] ... 2

2:30 pm–4:00 pm Open Hearing on Resolutions

Committee on Council Affairs [SW/Idaho] 103

2:30 pm Seminar

* S-1. The Neurosciences: Challenges for the '90s *(Session 4)* [SW/Cotillion Ballroom North] 7

2:30 pm Symposia

11-5. Scientific Communications in a Changing World *(Session 2)* [OS/Empire] 13

12-4. Engineering in Japan [OS/Congressional] 16

13-5. Mathematics in the Materials Sciences [OS/Hampton] 20

14-3. The Human Exploration of Space *(Session 2)* [OS/Diplomat] 22

* 15-1. Human Response to Sea-Level Rise *(Session 1)* [OS/Capitol] 24

* 16-2. Humankind in Global Change: Indicators and Prospects *(Session 2)* [OS/Ambassador] 27

18-2. Science for the Naked Eye; or, The Physics of Everyday Experience, XVIII *(Session 2)* [SW/Sheraton South] 33

* 22-1. New Molecular Insights into "Old" Genetic Diseases [SW/Cotillion South] 39

* 24-3. Biological and Biotechnological Alternatives to Chemical Insecticides *(Session 2)* [SW/Annapolis] .. 48

25-5. Seeds Since Columbus: Crop Germplasm of the Americas [SW/Richmond] 53

* 26-1. Alternative Approaches to Clinical Trials in AIDS: Ethics and Methodology *(Session 2)* [SW/Arlington] 56

* 27-4. Current Conceptions of Intelligence [SW/Alexandria] 60

31-5. The Deterioration of Human Health in Economic and Political Development: From Ancient Egypt to 20th-century United States [SW/Sheraton North] 68

* 33-5. Mental Health and Violence [SW/Warren] 74

34-6. Mineral Resources and the Changing International Economy of the '90s [SW/Wisconsin] 77

* 35-1. Defense Technology and Policy After the Cold War *(Session 4)* [SW/Dover] 79

36-3. Organization for Science and Technology in the Executive, Legislature, and Judiciary *(Session 2)* [SW/Colorado] 84
37-5. AAAS in Public Affairs, 1848–1975 [SW/Kansas] 90
38-3. Science for the Nonscience Major [SW/Holmes] .. 94
39-2. S&T Education: State Models of Reform [SW/Wilmington] 98

2:30 pm Technical Sessions

15T-3. Global Change and the Carbon Cycle in Terrestrial Ecosystems [OS/Executive] 26
17T-2. Proof of Environmental and Natural Resource Damages in Litigation [OS/Calvert] 33
34T-2. Ecological Economics [SW/Vermont] 78
36T-2. Risk Perception and Public Policy [OS/Cabinet] .. 86

2:30 pm Workshop

38W-2. Progress in Public Understanding of Science *(Session 2)* [SW/Woodley] 97

Sunday Evening Program

6:00 pm–8:00 pm Business Meeting

National Network of Minority Women in Science [SW/Colorado] 103

8:30 pm Plenary Lecture

* L-10. ***AAAS President's Lecture***
"Science, Slogans, and Civic Duty"
Speaker: Donald N. Langenberg *(Chancellor, University of Maryland)* [SW/Sheraton Ballroom] .. 3

9:30 pm AAAS President's Reception

[SW/Washington Ballroom]

Monday, 18 February

7:30 am–5:30 pm Registration

[SW/Atrium]

9:00 am–5:30 pm Employment Exchange

[SW/Exhibit Hall B]

9:00 am–3:00 pm AAAS☆91 Exhibition

[SW/Exhibit Hall C]

10:00 am–4:00 pm *SB&F* Science Film Festival

[SW/Atrium Room 1] 106

Monday Morning Program

8:00 am–12 noon AAAS Council Meeting

[SW/Delaware] 103

8:30 am Seminar

* S-1. The Neurosciences: Challenges for the '90s *(Session 5)* [SW/Cotillion Ballroom North] 7

8:30 am Symposia

11-3. Information Technology in Support of Research: What Your National Libraries Are Doing [OS/Embassy] 13
11-4. Can Electronic Publishing Solve the Science Library Crisis? [OS/Executive] 13
* 13-4. Chemistry Rediscovers Materials Science *(Session 1)* [OS/Hampton] 20
14-4. The Rationale for Human Exploration of Mars [OS/Diplomat] 23
* 15-1. Human Response to Sea-Level Rise *(Session 2)* [OS/Capitol] 24
* 16-2. Humankind in Global Change: Indicators and Prospects *(Session 3)* [OS/Ambassador] 27
17-2. Science: A Basis for Environ mental Policy? [OS/Congressional] 31
18-1. Chemistry Is Fun! [SW/Sheraton South] 33
18-3. Science, Technology, Intelligence, and Espionage [SW/Cotillion South] 34
23-5. Challenges to Dentistry for the '90s [SW/Baltimore] 45
25-3. Strategic Approaches to Conserving Genetic Resources in Natural Habitats [SW/Richmond] ...52
25-7. Science and Management of Large Marine Ecosystems *(Session 1)* [SW/Annapolis] 54
* 26-4. Scientists' Responsibilities When Research Is Socially Sensitive and Liable to Misinterpretation [SW/Arlington] 58
* 27-1. Reassessing Freud and Psychoanalysis [SW/Alexandria] 59
* 31-4. Ethnography of Drug Use in Traditional Modern Societies *(Session 1)* [SW/Holmes] 68
34-4. Technology Transfer from the University or National Laboratory to the Marketplace *(Session 1)* [SW/Wisconsin] 76
36-5. Making Witnesses out of Wizards: Bringing Oz into the Courtroom [SW/Colorado] 85
37-3. Mathematics in Times of Social Upheaval [SW/Kansas] 89
* 38-2. Animals in the K–12 Classroom [SW/Warren] 93
39-7. Science and Mathematics Curriculum Reform: How Do They Relate? [SW/Rockville] 100

8:30 am Technical Sessions

15T-2. Earthquake Prediction and Validation [OS/Calvert] 26
32T-2. Voting: Mathematical Foundations and Political Reality [SW/Idaho] 71
35T-2. Fissile Materials fron Nuclear Arms Reductions: A Question of Disposition [SW/Vermont] 83
36T-3. Allocating Public Funds for Science: Practice and Possibilities [OS/Cabinet] 86

11:30 am–12:30 pm Open Forum

Committee on Science, Arms Control, and National Security [SW/Vermont] 105

Monday Poster Sessions

9:45 am–11:45 am Physical Sciences; Environment; Ecology

[SW/Exhibit Hall C]

12:15 pm–2:15 pm Social and Behavioral Sciences

[SW/Exhibit Hall C]

Monday Afternoon Program

1:00 pm Plenary Lectures

* L-11. "Cosmology: Some New Developments and Problems"
Speaker: Fang Li Zhi *(Royal Society Guest Research Fellow, Institute of Astronomy, Cambridge University)* [SW/Washington Ballroom] 3

* L-12. ***William D. Carey Lecture:***
"American Science in the 21st Century: Prospects and Problems"
Speaker: John Brademas *(President, New York University)* [SW/Sheraton North Ballroom] 3

2:30 pm Seminar

* S-1. The Neurosciences: Challenges for the '90s *(Session 6)* [SW/Cotillion Ballroom North] 7

2:30 pm Symposia

11-6. Mathematics in the Public Policy Arena [SW/Colorado] 14

* 13-4. Chemistry Rediscovers Materials Science *(Session 2)* [OS/Hampton] 20

14-2. Adverse Environmental Threats to Astronomy [OS/Diplomat] 22

* 15-1. Human Response to Sea-Level Rise *(Session 3)* [OS/Capitol] 24

* 16-2. Humankind in Global Change: Indicators and Prospects *(Session 4* [OS/Ambassador] 26

17-1. The Role and Responsibilities of Scientists and Engineers in Environmental Debates [OS/Executive] 30

* 20-1. Consciousness in Life [SW/Sheraton South] 37

22-2. Gene Therapy: Scientific Prospects and Societal Implications [SW/Cotillion South] 40

25-7. Science and Management of Large Marine Ecosystems *(Session 2)* [SW/Annapolis] 54

* 26-2. Ethical and Clinical Issues in Carrier Screening for Cystic Fibrosis [SW/Arlington] 57

27-8. Evolution of Cognitive Functions in Ecological-cultural Context [SW/Alexandria] 62

* 31-4. Ethnography of Drug Use in Traditional and Modern Societies *(Session 2)* [SW/Holmes] 68

34-4. Technology Transfer from the University or National Laboratory to the Marketplace *(Session 2)* [SW/Wisconsin] 76

* 35-5. Chemical and Biological Weapons: Elimination or Proliferation? [SW/Dover] 81

* 35-7. Scientific Approaches to the Study of International Conflict Resolution [SW/Vermont] 82

* 35-8. Technology and Military-Civilian Conversion in the Soviet Union [SW/Warren] 82

39-6. NSF-supported Innovations in Undergraduate Education [SW/Rockville] 99

39-8. The Progress and Impact of Project 2061 [SW/Wilmington] 100

2:30 pm Technical Sessions

15T-1. Impacts of Climate in Regions of the United States [OS/Calvert] 25

21T-1. New Interactions Between Topology and Science [SW/Idaho] 38

23T-3. Improving Drug Development and Regulation via Pharmacokinetic/Pharmacodynamic Procedures [SW/Baltimore] 46

25T-4. Advances in Zoo Biology and Conservation [SW/Richmond] 56

36T-4. Knowledge Synthesis: An Ethical Imperative for Policy Development [OS/Cabinet] 87

37T-1. Beyond Historical Impressionism: Testing Theories of Scientific Change [SW/Kansas] 91

38T-1. Advocacy Journalism: Reporting on Sustainable Development [SW/Woodley] 95

38T-3. Satellite Delivery of Education: From Elementary School to the Working World [OS/Embassy] 96

Monday Evening Program

8:30 pm Plenary Lecture

* L-13. "Biomedical Research"
Speaker: Louis W. Sullivan *(Secretary, U.S. Department of Health and Human Services)* [SW/Sheraton Ballroom] 3

Tuesday, 19 February

8:00 am–12 noon Registration

[SW/Atrium]

Tuesday Morning Program

8:30 am Symposia

* 13-3. Quantum Mechanics of Single Atoms [OS/Diplomat] 19

* 14-5. Science with the Hubble Space Telescope [OS/Palladian] 23

* 16-2. Humankind in Global Change: Indicators and Prospects *(Session 5)* [OS/Ambassador] 26

17-3. Is Superfund Working? [OS/Hampton] 31

22-7. Development of Medications for the Treatment of Brain/Behavior Disorders [SW/Cotillion South] ...42

* 25-4. Nonrandom Evolution: Matter, Life, Mind [SW/Arlington] 52

* 27-7. Fragrance Research: Effects of Fragrances on Behavior, Mood, and Physiology [SW/Alexandria] 61

* 35-4. Implications of Proliferating Advanced Weaponry: Nuclear, Chemical, Missile, and Naval Forces [SW/Annapolis] 81

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8:30 am Technical Sessions

11T-2. Stereo Computer Imaging and Analysis in Science [OS/Executive] 15
12T-2. Geophysical Imaging Systems: From Medical Microcosm to Outer Space [OS/Congressional] .. 18
21T-2. National and International Efforts in Plant Genome Mapping [SW/Idaho] 39
23T-1. Balance and "Dizziness": Assessment and Rehabilitation [SW/Baltimore] 45
25T-2. Ecosystem Perspectives of Multiple-use Management [SW/Richmond] 55
31T-1. Uses of Light Stable Isotopes in the Natural and Social Sciences [SW/Holmes] 69
33T-1. Rural Development Aspects of Recreation Enterprises [SW/Warren] 74
36T-1. Improving the Functioning of Government Agencies [OS/Caucus] 86
37T-2. Neurobiology and Narrative: The Novels and Essays of Walker Percy, M.D. [SW/Kansas] 91

8:30 am Workshops

32W-1. Women of Science: Secrets to Success [SW/Wisconsin] 71
37W-1. Science in National Life: A Videohistory Workshop [SW/Colorado] 92
38W-4. Project 2061: What Can We Expect People to Learn About the Nature of Science? [SW/Rockville] 97

Tuesday Afternoon Program

1:00 pm Plenary Lecture

* L-14. Topic to be announced
Speaker: James D. Watkins *(Secretary, U.S. Department of Energy)* [SW/Sheraton North Ballroom] 3

2:30 pm Symposia

* 16-2. Humankind in Global Change: Indicators and Prospects *(Session 6)* [OS/Ambassador] 26
* 26-5. International Aspects of Ethical and Social Issues in Human Genome Research [SW/Arlington] 58

2:30 pm Technical Sessions

11T-1. Robotics and Mathematics [OS/Executive] 15
13T-1. Revisionist Kinetics: New Views of Nature's Throttle [OS/Capitol] 21
23T-2. Firearm Injury Prevention: Scientific and Public Policy Directions [SW/Baltimore] 45
24T-3. Bovine Somatotropin: Biotechnology Product and Social Issues in the U.S. Dairy Industry [SW/Vermont] 49
25T-1. Policy Issues in Coastal Zone Management [SW/Richmond] 54
27T-1. Cognitive Equilibrium [SW/Alexandria] 62

Sessions by Category

I. Physical Sciences & Technology

General Physical Science and Technology

* 10-1. The Frontiers of the Physical Sciences: 1991 *(Fri. 15, am/pm; OS/Hampton)* *11*

Computing; Communications

* 11-1. Global Initiatives in High-performance Computing and Networking *(Fri. 15, pm; Sat. 16, am/pm; OS/Empire)* *11*

11-2. Computer Virus Legislation: Problems and Pitfalls *(Fri. 15, am; OS/Executive)* *12*

11-3. Information Technology in Support of Research: What Your National Libraries Are Doing *(Mon. 18, am; OS/Embassy)* *13*

11-4. Can Electronic Publishing Solve the Science Library Crisis? *(Mon. 18, am; OS/Executive)* *13*

11-5. Scientific Communications in a Changing World *(Sun. 17, am/pm; OS/Empire)* *13*

11-6. Mathematics in the Public Policy Arena *(Mon. 18, pm; SW/Colorado)* *14*

11T-1. Robotics and Mathematics *(Tue. 19, pm; OS/Executive)* *15*

11T-2. Stereo Computer Imaging and Analysis in Science *(Tue. 19, am; OS/Executive)* *15*

Energy; Technology

12-1. Energy R&D Policy in the United States *(Fri. 15, am; OS/Congressional)* *15*

12-2. Energy Technologies for Developing Countries *(Sat. 16, pm; OS/Congressional)* *16*

* 12-3. Scientific Advances in Emerging Solar Energy Technologies *(Fri. 15, pm; OS/Congressional)* *16*

12-4. Engineering in Japan *(Sun. 17, pm; OS/Congressional)* *16*

12T-1. The Interaction of Science and Engineering in the Modern Age *(Sat. 16, am; OS/Congressional)* *17*

12T-2. Geophysical Imaging Systems: From Medical Microcosm to Outer Space *(Tue. 19, am; OS/Congressional)* *18*

12T-3. Changing Lives: New Technology for People with Disabilities *(Sun. 17, am; SW/Holmes)* *18*

Physics; Chemistry

* 13-1. Seventy-five Years of General Relativity *(Fri. 15, am; OS/Diplomat)* *19*

* 13-2. Elementary Particle Physics: Present Status and Future Prospects *(Fri. 15, pm; OS/Diplomat)* *19*

* 13-3. Quantum Mechanics of Single Atoms *(Tue. 19, am; OS/Diplomat)* *19*

* 13-4. Chemistry Rediscovers Materials Science *(Mon. 18, am/pm; OS/Hampton)* *20*

13-5. Mathematics in the Materials Sciences *(Sun. 17, pm; OS/Hampton)* *20*

* 13-6. Status of High-temperature Superconductivity *(Sat. 16, pm; OS/Diplomat)* *20*

* 13-7. Current Directions in Musical Acoustics *(Sun. 17, am; OS/Congressional)* *21*

13T-1. Revisionist Kinetics: New Views of Nature's Throttle *(Tue. 19, pm; OS/Capitol)* *21*

Astronomy; Planetary Science

* 14-1. Cosmology: Our Knowledge of the Universe *(Sat. 16, am; OS/Diplomat)* *22*

14-2. Adverse Environmental Threats to Astronomy *(Mon. 18, pm; OS/Diplomat)* *22*

14-3. The Human Exploration of Space *(Sun. 17, am/pm; OS/Diplomat)* *22*

14-4. The Rationale for Human Exploration of Mars *(Mon. 18, am; OS/Diplomat)* *23*

* 14-5. Science with the Hubble Space Telescope *(Tue. 19, am; OS/Palladian)* *23*

Geoscience; Climate

* 15-1. Human Response to Sea-Level Rise *(Sun. 17, pm; Mon. 18, am/pm; OS/Capitol)* *24*

15-2. Coastal Erosion Zone Management *(Fri. 15, pm; OS/Capitol)* *24*

* 15-3. Impacts of the Climate During the 1980s in the United States *(Fri. 15, am; OS/Ambassador)* *25*

15T-1. Impacts of Climate in Regions of the United States *(Mon. 18, pm; OS/Calvert)* *25*

15T-2. Earthquake Prediction and Validation *(Mon. 18, am; OS/Calvert)* *26*

15T-3. Global Change and the Carbon Cycle in Terrestrial Ecosystems *(Sun. 17, pm; OS/Executive)* *26*

Global Change

* 16-1. Making Informed Decisions for Planet Earth: The Role of Satellite Observations *(Fri. 15, pm; Sat. 16, am/pm; OS/Ambassador)* *27*

* 16-2. Humankind in Global Change: Indicators and Prospects *(Sun. 17, am/pm; Mon. 18, am/pm; Tue. 19, am/pm; OS/Ambassador)* *27*

16-3. Science in Africa: Achievements and Prospects *(Fri. 15, am/pm; OS/Blue Room)* *29*

16-4. Science and Technology, and Third World Economic Security *(Sat. 16, am/pm; OS/Palladian)* *30*

16-5. What Are the Effects of Human Activity on the Global Ecosystem? *(Fri. 15, pm; OS/Palladian)* *30*

Environment

17-1. The Role and Responsibilities of Scientists and Engineers in Environmental Debates *(Mon. 18, pm; OS/Executive)* *30*

17-2. Science: A Basis for Environmental Policy? *(Mon. 18, am; OS/Congressional)* 31
17-3. Is Superfund Working? *(Tue. 19, am; OS/Hampton)* 31
17-4. Assessing the Impacts of Nuclear Waste Facilities: The State of the Art Updated *(Sat. 16, pm; OS/Executive)* 32
17-5. Cleaning Up the Mess at the DOE Nuclear Weapons Complex *(Sat. 16, am; OS/Executive)* 32
17T-1. Meta-analysis and Risk Assessment: A Tool for the 90s? *(Fri. 15, pm; OS/Calvert)* 32
17T-2. Proof of Environmental and Natural Resource Damages in Litigation *(Sun. 17, pm; OS/Calvert)* 33

Popular Science

18-1. Chemistry Is Fun! *(Mon. 18, am; SW/Sheraton So.)* 33
18-2. Science for the Naked Eye; or, The Physics of Everyday Experience, XVIII *(Sun. 17, am/pm; SW/Sheraton So.)* 33
18-3. Science, Technology, Intelligence, and Espionage *(Mon. 18, am; SW/Cotillion So.)* 34

II. Life Sciences &Technology

General Life Sciences and Technology

* 20-1. Consciousness in Life *(Mon. 18, pm; SW/Sheraton So.)* 37

Molecular & Cellular Biology

* 21-1. The Revolution in Developmental Biology *(Fri. 15, pm; Sat. 16, am; SW/Sheraton So.)* 37
* 21-2. New Perspectives on Cellular Signaling *(Sat. 16, pm; SW/Sheraton So.)* 38
21T-1. New Interactions Between Topology and Science *(Mon. 18, pm; SW/Idaho)* 38
21T-2. National and International Efforts in Plant Genome Mapping *(Tue. 19, am; SW/Idaho)* 39

Medical Sciences

* 22-1. New Molecular Insights into "Old" Genetic Diseases *(Sun. 17, pm; SW/Cotillion So.)* 39
22-2. Gene Therapy: Scientific Prospects and Societal Implications *(Mon. 18, pm; SW/Cotillion So.)* 40
* 22-3. Molecular Determinants of Human Cancers *(Fri. 15, pm; SW/Cotillion No.)* 40
* 22-4. The Aging and Cancer Interface: Multidimensional Research Perspectives *(Sun. 17, am; SW/Cotillion So.)* 40
* 22-5. The Progesterone Antagonist RU486: Science and Science Policy *(Sat. 16, am/pm; SW/Cotillion So.)* 41
* 22-6. Prospects for Immunocontraception *(Fri. 15, pm; SW/Cotillion So.)* 41
22-7. Development of Medications for the Treatment of Brain/Behavior Disorders *(Tue. 19, am; SW/Cotillion So.)* 42
* 22-8. The Control of Infectious Diseases: New Aspects of Vaccines *(Fri. 15, am; SW/Cotillion So.)* 42
* 22-9. Scientific and Statistical Inferences in Modeling Animal Research *(Fri. 15, am; SW/Baltimore)* 43

Health Care & Policy

23-1. Consequences of HIV/AIDS in Eastern Africa *(Sat. 16, pm; SW/Baltimore)* 43
* 23-2. AIDS: Scientific Research and Public Policy *(Sat. 16, am; SW/Baltimore)* 44
23-3. Modeling the Geographic Diffusion of the AIDS Epidemic *(Fri. 15, pm; SW/Baltimore)* 44
* 23-4. The Father and the Fetus: Facts and Fallacies *(Sun. 17, am; SW/Baltimore)* 44
23-5. Challenges to Dentistry for the '90s *(Mon. 18, am; SW/Baltimore)* 45
23T-1. Balance and "Dizziness": Assessment and Rehabilitation *(Tue. 19, am; SW/Baltimore)* 45
23T-2. Firearm Injury Prevention: Scientific and Public Policy Directions *(Tue. 19, pm; SW/Baltimore)* 45
23T-3. Improving Drug Development and Regulation via Pharmacokinetic/Pharmacodynamic Procedures *(Mon. 18, pm; SW/Baltimore)* 46

Agriculture

24-1. Economically Useful Plants for Developing Countries: From Research to Market *(Fri. 15, am; SW/Annapolis)* 46
24-2. Advancing Biotechnology: International Issues Regarding Biosafety Policy and Practice *(Sat. 16, am/pm; SW/Annapolis)* 47
* 24-3. Biological and Biotechnological Alternatives to Chemical Insecticides *(Sun. 17, am/pm; SW/Annapolis)* 48
* 24-4. Pest Resistance to Control Tactics: Impact on Sustainable Pest Management *(Fri. 15, pm; SW/Annapolis)* 48
24T-1. The Economic Potential for Aquaculture in the United States *(Sat. 16, am; SW/Vermont)* 49
24T-2. Knowledge-based Systems in Agriculture: A Developmental Perspective *(Fri. 15, pm; SW/Vermont)* 49
24T-3. Bovine Somatotropin: Biotechnology Product and Social Issues in the U.S. Dairy Industry *(Tue. 19, pm; SW/Vermont)* 49
24T-4. Value-added Products from Agriculture *(Sun. 17, am; SW/Vermont)* 50

Ecology; Evolution

* 25-1. Inheritance of Acquired Characteristics: Evolutionary Origins of New Significant Traits *(Sat. 16, pm; SW/Arlington)* 51
25-2. Defining Ecosystem Health: Science, Economics, or Ethics? *(Fri. 15, am/pm; SW/Richmond)* 51
25-3. Strategic Approaches to Conserving Genetic Resources in Natural Habitats *(Mon. 18, am; SW/Richmond)* 52

* 25-4. Nonrandom Evolution: Matter, Life, Mind *(Tue. 19, am; SW/Arlington)* 52

25-5. Seeds Since Columbus: Crop Germplasm of the Americas *(Sun. 17, pm; SW/Richmond)* 53

* 25-6. Stakes in the Tropical Forests *(Sat. 16, am/pm; SW/Richmond)* 53

25-7. Science and Management of Large Marine Ecosystems *(Mon. 18, am/pm; SW/Annapolis)* 54

25T-1. Policy Issues in Coastal Zone Management *(Tue. 19, pm; SW/Richmond)* 54

25T-2. Ecosystem Perspectives of Multiple-use Management *(Tue. 19, am; SW/Richmond)* 55

25T-3. Tropical Biology: Historical Perspectives and Contemporary Issues *(Sun. 17, am; SW/Richmond)* 55

25T-4. Advances in Zoo Biology and Conservation *(Mon. 18, pm; SW/Richmond)* 56

Biomedical Ethics

* 26-1. Alternative Approaches to Clinical Trials in AIDS: Ethics and Methodology *(Sun. 17, am/pm; SW/Arlington)* 56

* 26-2. Ethical and Clinical Issues in Carrier Screening for Cystic Fibrosis *(Mon. 18, pm; SW/Arlington)* 57

* 26-3. DNA-based Identification Systems: Issues in Application *(Fri. 15, am; SW/Arlington)* 57

* 26-4. Scientists' Responsibilities When Research Is Socially Sensitive and Liable to Misinterpretation *(Mon. 18, am; SW/Arlington)* 58

* 26-5. International Aspects of Ethical and Social Issues in Human Genome Research *(Tue. 19, pm; SW/Arlington)* 58

Psychology; Neurobehavior

* 27-1. Reassessing Freud and Psychoanalysis *(Mon. 18, am; SW/Alexandria)* 59

* 27-2. A Critical Examination of the Concept of Critical Periods *(Sat. 16, pm; SW/Alexandria)* 59

27-3. Critical Periods in Second Language Acquisition *(Sat. 16, am; SW/Alexandria)* 59

* 27-4. Current Conceptions of Intelligence *(Sun. 17, pm; SW/Alexandria)* 60

* 27-5. Cognitive Aging Among Intellectually Able Individuals: Patterns, Precursors, and Implications *(Fri. 15, am; SW/Alexandria)* 60

* 27-6. Cults and the Courts: Use of "Brainwashing" Theory by Expert Witnesses *(Sun. 17, am; SW/Alexandria)* 61

* 27-7. Fragrance Research: Effects of Fragrances on Behavior, Mood, and Physiology *(Tue. 19, am; SW/Alexandria)* 61

27-8. Evolution of Cognitive Functions in Ecological-cultural Context *(Mon. 18, pm; SW/Alexandria)* 62

27T-1. Cognitive Equilibrium *(Tue. 19, pm; SW/Alexandria)* 62

III. Social Sciences &Science Policy

General Social Sciences and Policy

* 30-1. The Anthropology of Science and Scientists *(Fri. 15, pm; Sat. 16, am/pm; Sun. 17, am; SW/Sheraton No.)* 65

Anthropology; Archaeology

* 31-1. Indigenous Peoples and the Rain Forest: Science, Marketing, and Human Rights *(Fri. 15, am/pm; SW/Holmes)* 66

31-2. Evolutionary Interrelationships Between Technology, Language, and Social *Behavior (Sat. 16, am; SW/Holmes)* 67

* 31-3. The Evolution of Deception: A Biocultural Approach *(Sat. 16, pm; SW/Holmes)* 67

* 31-4. Ethnography of Drug Use in Traditional and Modern Societies *(Mon. 18, am/pm; SW/Holmes)* ... 68

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Mathematical Connections

The National Council of Teachers of Mathematics
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Plenary Lectures

L-1. *Keynote Address*

Invited Speaker: **George H. W. Bush** *(President of the United States of America)*

8:30 pm / Thu / 14 Feb Sheraton / Sheraton Ballroom

Presiding: Richard C. Atkinson *(Chancellor, Univ. of California—San Diego, La Jolla, CA, and Chairman of the Board, AAAS)*

L-2. The Human Genome Project and HUGO

Speaker: **Sir Walter Bodmer** *(Director of Research, Imperial Cancer Research Fund, London, UK)*

1:00 pm / Fri / 15 Feb Sheraton / Washington Ballroom

Presiding: Victor A. McKusick *(Johns Hopkins Univ. School of Medicine, Baltimore, MD, and Chair, AAAS Section N)*

The major chronic diseases of our time — including cancer — all have important genetic components. Cancer itself is essentially a genetic disease at the level of the cell as it progresses from the normal to the cancerous state. The biotechnology revolution — which enables us to clone and sequence any desired part of the total human DNA, its genome — has made available an unlimited source of genetic variation that provides the essential basis for the analysis of genetic factors influencing disease as well as normal variation between individuals. This is the basis on which the genes for cystic fibrosis and muscular dystrophy were identified and how mutations in critical genes involved in common cancers have been found.

The human genome project, whose aim is to map and eventually sequence the whole human genome, will provide not only the basis for dealing with diseases in the next century and for the pharmaceutical industry of the future but will also tell us about our origins and our evolution. It will in addition be valuable for agriculture and for understanding other species and the general problem of biological variability in the natural world.

The challenge to the scientific community is to collaborate to achieve this basic goal quickly and effectively. That is the purpose for which HUGO, the Human Genome Organization, was established. The members of HUGO are those who are active throughout the world in work on the human genome project and who support HUGO as the organization for achieving worldwide collaboration in this most exciting collaborative project ever in biological and medical research. The scientists have a responsibility to explain the science and its potential to the public, thereby enabling rational discussion of the ethical, legal, and social issues raised by the coming revolution in our knowledge of our genomes.

L-3. A Perspective on the Federal Role in Science and Technology

Speaker: **George E. Brown, Jr.** *(Member, U.S. Congress, and Chairman, House Committee on Science, Space, and Technology)*

1:00 pm / Fri / 15 Feb Sheraton / Sheraton No. Ballroom

Presiding: Philip H. Abelson *(Science Advisor, AAAS, Washington, DC)*

L-4. Results from the Hubble Telescope

Speaker: **Riccardo Giacconi** *(Director, Space Technology Institute, Baltimore, MD)*

8:30 pm / Fri / 15 Feb Sheraton / Sheraton Ballroom

Presiding: Raymond E. White *(Steward Observatory, Univ. of Arizona, Tucson, AZ, and Chair, AAAS Section D)*

L-5. *John P. McGovern Lecture:* Molecular Insights into the Function of Neurotransmitter Receptors and Ionic Channels

Speaker: **Shosaku Numa** *(Professor, Depts. of Medical Chemistry and Molecular Genetics, Kyoto Univ. Faculty of Medicine, Kyoto, Japan)*

1:00 pm / Sat / 16 Feb Sheraton / Washington Ballroom

Presiding: Katrina L. Kelner *(Senior Editor,* Science *Magazine, AAAS, Washington, DC)*

Neurotransmitter receptors and ionic channels are membrane proteins essential for neural signaling. Cloning and sequencing of cDNAs have revealed the primary structures of different families of

receptors and channels, i.e., a neurotransmitter-gated channel (nicotinic acetylcholine receptor); voltage-gated channels (sodium channel and calcium channel); a cyclic, nucleotide-gated channel (cyclic GMP-gated channel); an intracellular membrane channel (calcium release channel); and a G-protein–coupled receptor (muscarinic acetylcholine receptor). Expression of the cloned cDNAs yields functional receptors and channels. The structural basis for the function of neurotransmitter receptors and ionic channels has been investigated by the combination of recombinant DNA techniques and electrophysiological measurements; wild-type and specifically mutated proteins produced by cDNA expression have been analyzed for functional properties. The main findings obtained concern the identification of a channel-forming region of the nicotinic acetylcholine receptor, the identification of a voltage-sensing segment responsible for activation of the sodium channel, the functional role of the skeletal muscle slow calcium channel in excitation-contraction coupling, and the molecular basis of the functional heterogeneity of the muscarinic acetylcholine receptor.

L-6. Molecular Robots

Speaker: **Elias J. Corey** *(Professor, Dept. of Chemistry, Harvard Univ., Cambridge, MA)*

1:00 pm / Sat / 16 Feb Sheraton / Sheraton No. Ballroom

Presiding: George S. Hammond *(Chair, AAAS Section C)*

L-7. Science and Technology in Developing Countries

Speaker: **José Goldemberg** *(Secretary of State for Science and Technology, Government of Brazil, Brasilia, Brazil)*

8:30 pm / Sat / 16 Feb Sheraton / Sheraton Ballroom

Presiding: Richard Getzinger *(Director, Directorate for International Programs, AAAS, Washington, DC)*

The role of science and technology in promoting economic progress in industrialized countries is well understood. Science and technology are the basis of innovations that keep modern societies in motion. In the developing countries, their role is reduced or absent, since most of the activities are based on either very rudimentary technology or on imported finished products (or the machinery needed to produce them). In the industrialized countries, the general view is that there is no reason for a continued search for innovations that reduce universities to training and vocational schools.

This lecture will show that, within given contexts, enlightened political leadership can promote growth and flourishing of the universities and use of their graduates as a dynamic forces for development of the country. The example of Japan, which in the last century was converted into a first-class world power country on the basis of a successful educational effort, can be repeated.

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L-8. The Grand Challenges of Computational Science

Speaker: **Larry L. Smarr** *(Director, National Center for Supercomputing Applications, Univ. of Illinois, Champaign, IL)*

1:00 pm / Sun / 17 Feb Sheraton / Washington Ballroom

Presiding: Linda C. Smith *(Associate Professor of Library and Information Science, Univ. of Illinois, Urbana, IL, and Chair, AAAS Section T)*

The 1980s saw a historical transformation in the university community's participation in high-performance computational science and engineering. Two initiatives by the National Science Foundation creating the four supercomputing centers and NSFNET have greatly increased the pool of academic researchers who are using supercomputers. During the next five years, the federal government's High-Performance Computing Program will create a national information infrastructure with a bandwidth one thousand times that available today on the Internet. In addition, the program foresees the development of supercomputers one thousand times faster than those available today. Thus, we are at a turning point in our ability to attack the grand challenges of computational science — problems that have either a large impact on society or on our basic research knowledge base.

I will review some of the critical technology trends in desktop computers, scientific visualization, networking, and supercomputers that are creating unprecedented opportunities for large-scale collaborative computational efforts to be developed on a national and international basis. Examples will be drawn from grand challenges in materials science, biology, atmospheric and environmental sciences, and astrophysics.

L-9. *George Sarton Memorial Lecture:* The Complexion of Scientific Communities

Speaker: **Kenneth Manning** *(Professor of the History of Science, MIT, Cambridge, MA)*

1:00 pm / Sun / 17 Feb Sheraton / Sheraton No. Ballrm

Presiding: Edwin T. Layton, Jr. *(Dept. of Mechanical Engineering, Univ. of Minnesota, Minneapolis, MN, and Chair, AAAS Section L)*

Scientific communities can be characterized by and studied through their diversity. This diversity is observed along a number of lines, including national origin, class, religion, race, and gender. The composition of scientific communities shifts and evolves over time in interesting ways — propelled by complex political and social trends, shaped by the ebb and flow of circumstance rather than by any linear progression.

This lecture will trace and portray the composition of scientific communities from the perspective of diversity. How have individuals from certain social, religious, ethnic, racial, and national groups entered the scientific profession? In what ways has the scientific community adapted to changes in the composition — and the complexion — of its members? What are the tensions and conflicts involved, and how have they been resolved? To what extent is diversity a medium of enrichment within science?

Comparisons will be drawn with other professional groups. The lecture will focus particularly on 19th- and 20th-century scientific communities, especially the inclusion of African-American and other minority scientists.

L-10. *AAAS President's Lecture:* Science, Slogans, and Civic Duty

Speaker: **Donald N. Langenberg** *(Chancellor, Univ. of Maryland System, Adelphi, MD, and President, AAAS)*

8:30 pm / Sun / 17 Feb Sheraton / Sheraton Ballroom

Presiding: Leon M. Lederman *(Director Emer., Fermi National Accelerator Lab., Batavia, IL, and President-Elect, AAAS)*

Among the less-satisfying "benefits" that science and technology have brought us are the 15-second sound bit, the photo op, and a concommitant trend toward characterization of complex societal issues in terms of slogans, buzz words, and simplistic images. We are beset with rhetoric about "competitiveness," "environmental crises," "educational reform," "accountability," "no new taxes," "save the whatevers," and much more. Perception displaces reality and emotions overpower thought. Though few major public issues lack significant scientific or technological elements, American scientists and engineers seldom play central roles in their public debate. When they do, their positions often appear to be shaped by the special interests of their own community. Though it may be that the fundamental values of science are intrinsically incompatible with more effective participation by scientists and engineers in the rough-and-tumble of Realpolitik, the urgency of the problems confronting humanity argues for stronger infusion of precisely those values into public debate. The time has come for scientists and engineers to embrace an enlarged conception of their civic duty and to engage themselves more vigorously in public life.

L-11. Cosmology: Some New Developments and Problems

Speaker: **Fang Li Zhi** *(Royal Society Guest Research Fellow, Institute of Astronomy, Cambridge Univ., Cambridge, UK)*

1:00 pm / Mon / 18 Feb Sheraton / Washington Ballroom

Presiding: Robert A. Frosch *(Vice President, General Motors Corp., General Motors Research Labs., Warren, MI, and Member, AAAS Board of Directors)*

The Big Bang model of the universe has had a first verification from particle physics. The cosmological prediction of the number of neutrino types is precisely consistent with that given by accelerator experiments. This result is also strengthening the conclusion that the dark matter in the universe should be nonbaryonic. However, despite many candidates for such nonbaryonic particles being proposed, no one has evidence of their existence. Some new discoveries on the large-scale structure of the universe — such as large-scale motion and periodicity of galaxy distribution — seem to give a more hazy scene of the problem of dark matter.

L-12. *William D. Carey Lecture:* American Science in the 21st Century: Prospects and Problems

Speaker: **John Brademas** *(President, New York Univ., New York, NY)*

1:00 pm / Mon / 18 Feb Sheraton / Sheraton No. Ballrm

Presiding: Richard S. Nicholson *(Executive Officer, AAAS, Washington, DC)*

L-13. Biomedical Research

Speaker: **Louis W. Sullivan** *(Secretary, U.S. Dept. of Health and Human Services, Washington, DC)*

8:30 pm / Mon / 18 Feb Sheraton / Sheraton Ballroom

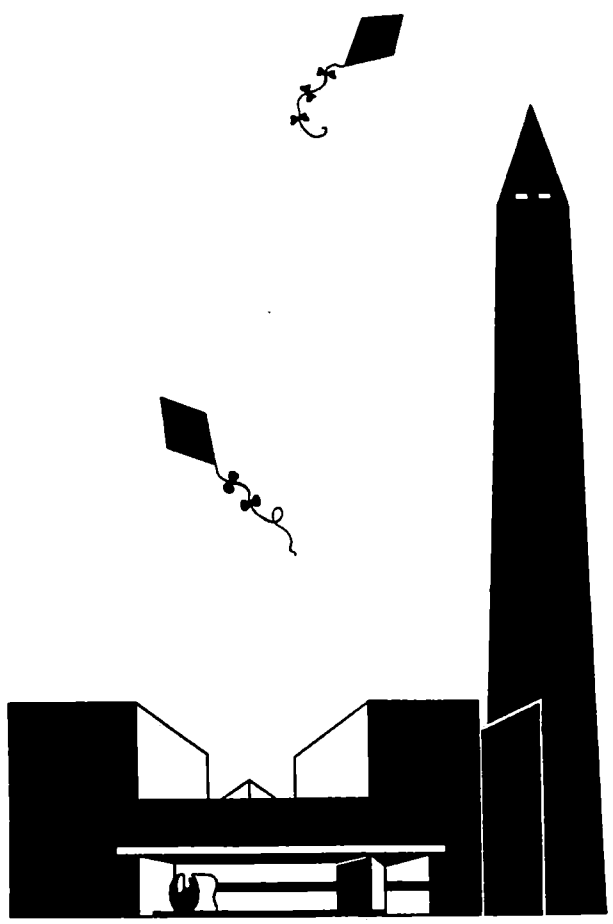
Presiding: Florence P. Haseltine *(National Institutes of Health, Bethesda, MD, and Member, AAAS Board of Directors)*

L-14. Topic to be announced

Speaker: **James D. Watkins** *(Secretary, U.S. Dept. of Energy, Washington, DC)*

1:00 pm / Tue / 19 Feb Sheraton / Sheraton No. Ballrm

Presiding: Leon M. Lederman *(Director Emer., Fermi National Accelerator Lab., Batavia, IL, and President-Elect, AAAS)*



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A bimonthly publication, this journal is a vehicle for concisely and authoritatively written critical discussions of recent important developments in toxicology. Each article conveys the author's personal comments and point of view. From time to time, comments on topical conferences will be included. Although contributors are solicited by the editors, readers are invited to suggest topics.

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Seminar and Short Courses

Seminar

S-1. The Neurosciences: Challenges for the 1990s

Organized by: Katrina Kelner *(Senior Editor,* Science *Magazine, AAAS, Washington, DC)*

8:30 am / Sat / 16 Feb Sheraton / Cotillion Ballrm No.

Stimulus-Transcription Coupling in Neuronal Cells

Presiding: James I. Morgan *(Dept. of Neuroscience, Roche Institute of Molecular Biology, Nutley, NJ)*

Inducible Proto-oncogenes in the Nervous System
James I. Morgan

Regulation of Neuronal Gene Expression by Depolarization
Michael Greenberg *(Dept. of Microbiology, Harvard Medical School, Boston, MA)*

Pleasure, Pain, and Proto-oncogenes
Michael J. Iadarola *(Neurobiology and Anesthesia Branch, National Institute of Dental Research, National Institutes of Health, Bethesda, MD)*

NGF Induces Transcription of Genes Encoding Zinc-finger Proteins
Jeffrey Milbrandt *(Dept. of Pathology, Washington Univ. School of Medicine, St. Louis, MO)*

2:30 pm / Sat / 16 Feb Sheraton / Cotillion Ballrm No.

Structure and Function of Potassium Channels

Presiding: Arthur M. Brown *(Professor and Chairman, Dept. of Physiology, Baylor College of Medicine, Houston, TX)*

A Minimalist Potassium Channel
Arthur M. Brown

Molecular Studies of Voltage-gated Potassium Channels
Lily Y. Jan *(Professor, Dept. of Physiology, Univ. of California, San Francisco, CA)*

Structure-Function Correlations in a Family of Rat Brain Potassium Channels
Walter Stühmer *(Max Planck Institute, Göttingen, FRG)*

Biophysical and Molecular Mechanisms of Potassium Channel Gating
Richard W. Aldrich *(Associate Professor, Dept. of Neurobiology, Stanford Univ. School of Medicine Stanford, CA)*

8:30 am / Sun / 17 Feb Sheraton / Cotillion Ballrm No.

Olfaction and Taste

Presiding: Gordon M. Shepherd *(Professor, Section of Neuroanatomy, Yale Univ. School of Medicine, New Haven, CT)*

From Ions and Molecules to Perception and Cognition
Gordon M. Shepherd

Molecular Mechanisms of Transduction in Olfaction: A Model for Receptor-Ligand Signaling Systems
Stuart Firestein *(Dept. of Neuroanatomy, Yale Univ. School of Medicine, New Haven, CT)*

Long-term Potentiation and Serial Memory Processing in the Olfactory Hippocampal Circuit
Gary S. Lynch *(Professor, Center for Neurobiology of Learning, Univ. of California, Irvine, CA)*

The Initial Events in Taste Transduction
Stephen D. Roper *(Dept. of Anatomy/Neurobiology, Colorado State Univ., Fort Collins, CO)*

Sensory Coding of Gustatory Information
David V. Smith *(Dept. of Otolaryngology, Univ. of Cincinnati, Cincinnati, OH)*

2:30 pm / Sun / 17 Feb Sheraton / Cotillion Ballrm No.

Activity-dependent Plasticity in Development and Learning

Presiding: Carla J. Shatz *(Professor, Dept. of Neurobiology, Stanford Univ. School of Medicine, Stanford, CA)*

Long-term Potentiation: A Cellular Model for Learning
Roger A. Nicoll *(Dept. of Pharmacology, Univ. of California School of Medicine, San Francisco, CA)*

Mechanisms for Use-dependent Synaptic Plasticity in the Developing and Mature Visual Cortex
Wolf Singer *(Dept. of Neurophysiology, Max Planck Institute, Frankfort, FRG)*

Regulation of Synapse Stabilization by Regulation of a Receptor System
Martha Constantine-Paton *(Professor, Dept. of Biology, Yale Univ., New Haven, CT)*

Spontaneous Activity and the Patterning of Connections in Fetal Development
Carla J. Shatz

8:30 am / Mon / 18 Feb Sheraton / Cotillion Ballrm No.

Cognitive Processes

Presiding: Larry Squire *(Veterans Administration Medical Center, San Diego, CA)*

Memory: Brain Systems and Cognition
Larry Squire

Attentional Control of Visual Perception: Cortical and Subcortical Mechanisms
Robert Desimone *(Laboratory of Neuropsychology, National Institute for Mental Health, National Institutes of Health, Bethesda, MD)*

Components of High-level Vision: A Cognitive Neuroscience Analysis
Stephen Kosslyn *(Associate Professor, Dept. of Psychology, Harvard Univ., Cambridge, MA)*

Neural Circuits That Mediate Perceptual Judgements of Motion Direction
William T. Newsome III *(Dept. of Neurobiology, Stanford Univ. School of Medicine, Stanford, CA)*

2:30 pm / Mon / 18 Feb Sheraton / Cotillion Ballrm No.

Molecular Basis of Neurological Disease

Presiding: Joseph B. Martin *(Office of the Dean, Univ. of California School of Medicine, San Francisco, CA)*

Molecular Genetic Approaches to Identification of Mutant Genes in Neurological Disorders
Joseph B. Martin

Molecular Genetics Retinoblastoma
Thaddeus P. Dryja *(Dept. of Ophthalmology, Massachusetts Eye and Ear Infirmary, Boston, MA)*

Neuronal Polarity and Microtubule System: A Target of Alzheimer's Pathology
Kenneth S. Kosik *(Center for Neurologic Diseases, Brigham and Women's Hospital, Boston, MA)*

Molecular Biology and Genetics of Prions Causing Neurodegeneration
Stanley B. Prusiner *(Dept. of Neurology, Univ. of California School of Medicine, San Francisco, CA)*

Neuroscience promises to yield answers to some of biology's most interesting questions in the next several decades. By the year 2020 we may understand the basis of perception and consciousness; we may be able to explain how we learn and remember; we may know how the millions of intricate connections of the brain are made and how the brain has such an enormous computational capacity.

The advances in the neurosciences that have sparked the hope that we may answer these questions have been largely initiated by the revolution in our understanding of the molecular basis of genetics. Molecular biology has enabled elucidation of the primary structure of ion channels, which has allowed exciting investigations into the molecular basis of electrophysiological phenomena. It has also promoted investigation into how the electrical excitability of neurons can control neuronal gene expression and into the genetic basis of neurological and psychiatric disease. These advances and others have changed our perceptions of what is possible to understand.

This three day symposium will present work in six areas of the neurosciences that we believe are at the forefront of the field and are making fundamental contributions to our appreciation of the big, unanswered questions in neurobiology. Distinguished researchers will present their current work; each session will allow the registrant to get a good overview of that part of neuroscience and see what the exciting advances are in that area.

[**Cosponsor:** AAAS Section G.]

Short Courses

C-1. Sophisticated Uses of Simple Computers

Organized by: **Jack M. Wilson** *(Professor of Physics and Director of the Anderson Center, Rensselaer Polytechnic Institute, Troy, NY)*, and **Rolf M. Sinclair** *(Program Director, Physics Division, National Science Foundation, Washington, DC)*

8:30 am / Thu / 14 Feb Sheraton / Wisconsin

Presiding: Jack M. Wilson and Rolf M. Sinclair

New Minds for Old
Jerry Pournelle *(President, Jerry Pournelle Associates, Studio City, CA)*

The Comprehensive Unified Physics Learning Environment
Edward F. Redish *(Professor of Physics, Univ. of Maryland, College Park, MD)*

Catalyst-Computers in Chemistry Education
Joe Lagowski *(Editor,* Journal of Chemical Education, *and Professor, Univ. of Texas, Austin, TX)*

The Power of the Visual Image
Donna Cox *(Associate Director for Education, National Center for Supercomputer Applications, Urbana, IL)*

Using Mathematics in Scientific Research
Kevin McIssac *(Applications Manager, Wolfran Research, Champaign, IL)*

2:30 pm / Thu / 14 Feb Sheraton / Wisconsin

Presiding: Jack M. Wilson and Rolf M. Sinclair

The program will combine a morning session of speakers with an afternoon session of workshops. The morning session will consist of five talks that will cover topics in the use of small computers to solve and prepare students to solve sophisticated problems in research. These will include discussions of specific examples. The afternoon session will consist of hands-on treatment of these examples, with some of the speakers as coaches and consultants.

The session includes nationally known speakers with a variety of perspectives on these activities. Pournelle will give a view of the future. Redish and Lugowski will speak on two large collaborations in physics and chemistry, respectively, that are designed to bring computing into the mainstream of the undergraduate and graduate curriculum. They will address the issues of what tools physicists and chemists need and how we should expect our students to acquire facility with these tools. Cox will speak from her perspective at the

supercomputing center, and McIssac will review sophisticated software tools for simple computers.

[**Sponsors:** AAAS Section B; American Association of Physics Teachers; American Physical Society. **Cosponsors:** AAAS Sections A, C, T, and U; American Statistical Association; Institute for Mathematical Statistics.]

C-2. Computers in Medical Imaging and Graphics

Organized by: **Robert S. Ledley** *(Professor, Physiology and Biophysics, Georgetown Univ. Medical Center, Washington, DC)*

8:30 am / Thu / 14 Feb **Sheraton / Kansas**

Presiding: Robert S. Ledley

Digital Fluoroscopy Update
Klemens H. Barth *(Professor, Dept. of Radiology, Georgetown Univ. Medical Center, Washington, DC)*

Stereo 3-D Imaging
Robert S. Ledley

Use of Cross-sectional Imaging (Computer Tomography and Ultrasound) in the Performance of Interventional Procedures in the Abdomen
Peter R. Mueller *(Head, Abdominal and Interventional Radiology, Massachusetts General Hospital, Boston, MA)*

Advances in Computerized Imaging Techniques in the Practice of Invasive and Interventional Cardiology
Gary S. Ledley *(Assistant Professor, Division of Cardiology, Albert Einstein Medical Center, Philadelphia, PA)*

Multimodality Imaging: Challenges for Resource Allocation and Health Care Delivery
David J. Goodenough *(Professor, Radiology, George Washington Univ., Washington, DC)*

2:30 pm / Thu / 14 Feb **Sheraton / Kansas**

Presiding: Robert S. Ledley

Bioimaging at the Microscopic Level
Edmund M. Glaser *(Professor of Physiology, Univ. of Maryland School of Medicine, Baltimore, MD)*

Real-Time Imaging and ECG Gaiting with MR
Robert J. Herfkens *(Associate Professor of Radiology, Stanford Univ. School of Medicine, Stanford, CA)*

International Image Compression Standards and Medical Applications
Gregory K. Wallace *(Manager, Multimedia Workstations Advanced Development, Digital Equipment Corp., Littleton, MA)*

Recent Advances in Diagnostic Medical Image Storage
Robert Hindel *(Manager, Advanced Planning, Philips Medical Systems, Shelton, CT)*

Endoluminal Ultrasound
Barry B. Goldberg *(Director, Division of Diagnostic Ultrasound, and Professor of Radiology, Thomas Jefferson Univ., Philadelphia, PA)*

Imaging plays a central role in the practice of medicine. Imaging methods now pervade all aspects of medicine, including diagnosis, prognosis, and aids to treatment. All areas of the body have been imaged, and such images have revolutionized many medical specialties. Such imaging almost invariably involves computer methods and computer controls. New modalities, methods, and techniques are constantly appearing, and the field of medical imaging and graphics is experiencing almost explosive growth.

This short course will discuss new imaging modalities in medicine. Speakers will discuss imaging components of interventional procedures as used by cardiologists and pulmonary and other specialists. Consideration will be given to the modern technology that is and will be utilized in the future in medical imaging. Finally, the problem of archiving and retrieving medical images will be discussed, and instruments enabling such archiving and retrieval will be described.

[**Sponsor:** Computerized Medical Imaging Society. **Cosponsor:** AAAS Section T.]



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I

Physical Sciences & Technology

10. General Physical Sciences and Technology

10-1. Frontiers of the Physical Sciences: 1991

Organized by: **Rolf M. Sinclair** *(Program Director, Physics Division, National Science Foundation, Washington, DC)*

8:30 am / Fri / 15 Feb **Omni Shoreham / Hampton**

Presiding: Rolf M. Sinclair

Large Telescopes of the Future
J. Roger P. Angel *(Professor of Astronomy, Univ. of Arizona, Tucson, AZ)*

Enzyme Mimics
Ronald Breslow *(Professor of Chemistry, Columbia Univ., New York, NY)*

The Laser Interferometer Gravity Wave Observatory: Opening a New Frontier in Astrophysics
Rochus Vogt *(Director, L.I.G.O, California Institute of Technology, Pasadena, CA)*

2:30 pm / Fri / 15 Feb **Omni Shoreham / Hampton**

Presiding: Rolf M. Sinclair

Arranging Points on a Sphere
Neil J.A. Sloane *(Research Staff, AT&T Bell Laboratories, Murray Hill, NJ)*

Volcanoes Under the Sea: The Last Frontier of Global Vulcanology
Katharine V. Cashman *(Assistant Professor of Geology, Princeton Univ., Princeton, NJ)*

Toward a Science of Storm-scale Weather Prediction
Kelvin Droegemeier *(School of Meteorology, Univ. of Oklahoma, Norman, OK)*

This session will explore the limits of our current understanding of the physical sciences — where knowledge and speculation end — and will suggest what some of the next advances may be. The presentations are intended for a general audience.

[**Sponsors:** AAAS Sections A, B, C, D, E, and W.]

11. Computing; Communications

11-1. Global Initiatives in High-performance Computing and Networking

Organized by: **Gligor A. Tashkovich** *(MBA Degree Candidate, Cornell Univ., Ithaca, NY)*, **Bonnie C. Carroll** *(Secretariat Director, Commerce, Energy, NASA, NLM, Defense Information Managers [CENDI], Oak Ridge, TN)*, and **Lawrence A. Lee** *(Executive Director, North Carolina Supercomputing Center, Research Triangle Park, NC)*

2:30 pm / Fri / 15 Feb **Omni Shoreham / Empire**

Developments in High-performance Computing

Presiding: Gligor A. Tashkovich

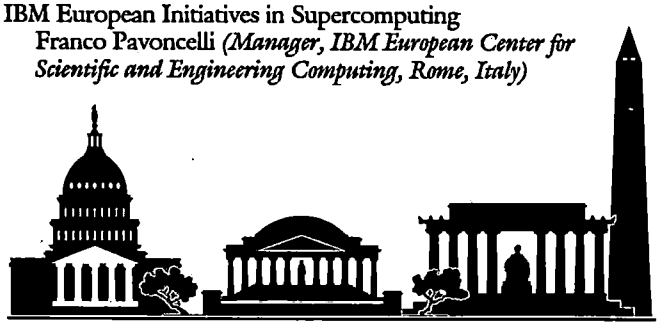
The Grand Challenges in Supercomputing
John W.D. Connolly *(Director, Center for Computational Sciences, Univ. of Kentucky, Lexington, KY)*

Building upon the 1985 NSF Advanced Scientific Computing Initiative
Elizabeth C. Schermerhorn *(Deputy Director, Northeast Parallel Architectures Center, Syracuse Univ., Syracuse, NY)*

The NSF Supercomputer Centers as a Catalyst for Change
Lawrence L. Smarr *(Director, National Center for Supercomputing Applications, Univ. of Illinois, Champaign, IL)*

Supercomputing for Science-based Economic Development
Lawrence A. Lee

IBM European Initiatives in Supercomputing
Franco Pavoncelli *(Manager, IBM European Center for Scientific and Engineering Computing, Rome, Italy)*



8:30 am / Sat / 16 Feb **Omni Shoreham / Empire**

National and International Network Developments

Presiding: Gligor A. Tashkovich and Bonnie C. Carroll

NREN (National Research and Education Network) Initiatives at the NSF
Stephen Wolff *(Division Director, Networking Communications Research and Infrastructure, National Science Foundation, Washington, DC)*

EASInet: European Networks and Connections to the United States
Herbert F. Budd *(Director, Numerically Intensive Computing, IBM Europe, Paris, France)*

Network Infrastructure: The Electronic Library and the Knowbot
Robert E. Kahn *(President, Corp. for National Research Initiatives, Reston, VA)*

Social and Behavioral Issues in Network Development
Charles W. McClure *(Professor, School of Information Studies, Syracuse Univ., Syracuse, NY)*, Ann Bishop *(Ph.D. Candidate, School of Information Studies, Syracuse Univ., Syracuse, NY)*, and Phil Doty *(Ph.D. Candidate, School of Information Studies, Syracuse Univ., Syracuse, NY)*

Legal, Regulatory, and Pricing Issues in Network Development
Brian Kahin *(Director, Information Infrastructure Project, JFK School of Government, Harvard Univ., Cambridge, MA)*

2:30 pm / Sat / 16 Feb **Omni Shoreham / Empire**

HPC-NREN Applications

Presiding: Bonnie C. Carroll

The Electronic Superhighway System: A National Vision
Albert Gore, Jr. *(U.S. Senate, Washington, DC)*

High-performance Computing: The Real Customers
Alvin Trivelpiece *(Director, Oak Ridge National Laboratory, Oak Ridge, TN)*

Biomedical Applications of a National Electronic Superhighway
Donald A.B. Lindberg *(Director, National Library of Medicine, Bethesda, MD)*

Project 2061: Status of Efforts to Connect Higher Education and K–12 to the National Networking Matrix
Kenneth M. King *(President, EDUCOM, Washington, DC)*

A Resource for Small Business
Joshua I. Smith *(CEO and Chairman, Maxima Corp., Rockville, MD)*

A Step Towards Implementing the Vision
Allan H. Weis *(President and CEO, Advanced Network and Services, Inc., Elmsford, NY)*

Science is being revolutionized by very powerful computers that continue to be interconnected both domestically and internationally. The first session of this three-part symposium will examine the state of supercomputing in America and abroad. How has the 1985 NSF Advanced Scientific Computing Initiative increased America's ability to be more efficient and more competitive with other nations? What are the challenges that we hope supercomputers can meet for us? How can the Phase II NSF centers and the increasing number of state and industry-supported centers act as a catalyst for change? This session will close with a special presentation on what is happening throughout Europe, with a highlight on IBM's involvement in various initiatives.

Next, the significance of national and international networks will be discussed. An overview of the state of domestic and European networks will be presented, followed by a look at some of the services offered. How to develop a network will be considered next, and research sponsored by the Office of Technology Assessment on the social, behavioral, and ethical considerations in the design of the National Research and Education Network (NREN) will be presented. Topics to be discussed include the impact of scientific norms on the use of the network and policy questions arising in the design and development of the network. This will be followed by a discourse on the legal, regulatory, and pricing issues therein.

The last session will analyze various applications juxtaposing high-performance computing and networking. For example, both the Office of Science and Technology Policy and the Senate Subcommittee on Science, Technology, and Space (through the efforts of Senator Albert Gore, Jr.) have been promoting a national resource network supported by high-performance computing centers. The third session will demonstrate that these national efforts are not being conducted in a vacuum, but rather have the potential to affect the way that research and business are done. This symposium will explore these concepts, technologies, visions, and opportunities that underlie these national efforts and will look at the objectives and the potential for developing the national program.

[**Sponsors:** AAAS Sections G, M, and T. **Cosponsors:** AAAS Sections A and B; AAAS Pacific Division; AAAS Office of Information Systems and Services.]

11-2. Computer Virus Legislation: Problems and Pitfalls

Organized by: **Anne Wells Branscomb** *(Attorney, Harvard Univ., Cambridge, MA)* and **Mark S. Frankel** *(Program Director, Scientific Freedom, Responsibility, and Law, AAAS, Washington, DC)*

8:30 am / Fri / 15 Feb **Omni Shoreham / Executive**

Presiding: Anne Wells Branscomb

What's Up on the Hill: Looking Ahead
Craig Schiffries *(AAAS Congressional Fellow, Subcommittee on Technology and Law, Senate Committee on the Judiciary, Washington, DC)*

Drafting State Legislation: Coping with Computer Viruses
Phyllis L. Kahn *(State Representative, Minnesota House of Representatives, St. Paul, MN)*

Good and Bad Viruses and How to Tell the Difference
John F. Shoch *(General Partner, Asset Management Co., Palo Alto, CA)*

Bugs and Bugaboos: Concerns of the Software Industry
Ronald J. Palenski *(Vice President and General Counsel, ADAPSO, The Computer Software and Services Industry Association, Arlington, VA)*

Hardening the Hardware: The Limits of Technological Fixes
Oliver R. Smoot *(Executive Vice President, Computer and Business Equipment Manufacturers Association, Washington, DC)*

The Robert Morris Case
David Geneson *(Attorney, Hunton and Williams, Washington, DC)*

This symposium will review existing and proposed federal and state legislation designed to cover computer viruses and other rogue computer programs. Included will be the views of (1) the prosecutor of Robert T. Morris of the Internet worm, (2) a state senator from Minnesota who shepherded new legislation to cover viruses through the Minnesota legislature in 1989, (3) a computer scientist from Xerox Parc laboratories who conducted experiments with beneficial uses of viruses, and (4) the general counsels of the two industry groups with great interest in the threats to their members from too-stringent laws or threats to their customers from too-lenient laws. The emphasis will be on ways in which lawyers and scientists can cooperate to assist in drafting laws to curtail miscreant behavior without jeopardizing the utility and openness of computer networks.

[**Sponsor:** AAAS-ABA National Conference of Lawyers and Scientists. **Cosponsors:** AAAS Sections T and X.]

11-3. Information Technology in Support of Research: What Your National Libraries Are Doing

Organized by: **Linda C. Smith** *(Associate Professor of Library and Information Science, Univ. of Illinois, Urbana, IL)* and **Elliot R. Siegel** *(Assistant Director for Planning and Evaluation, National Library of Medicine, NIH, Bethesda, MD)*

8:30 am / Mon / 18 Feb **Omni Shoreham / Embassy**

Presiding: Elliot R. Siegel

Outreach Through Technology
Elliot R. Siegel

Visiting the Virtual Library
Daniel R. Masys *(Director, Lister Hill National Center for Biomedical Communications, National Library of Medicine, NIH, Bethesda, MD)*

Access to Biotechnology Information
Dennis A. Benson *(Chief, Information Resources Branch, National Center for Biotechnology Information, National Library of Medicine, NIH, Bethesda, MD)*

The Role of Laserdisc Technology in Agriculture
Alan Fusonie *(Head, Special Collections, National Agricultural Library, Beltsville, MD)*, Ron Young *(Visual Information Assistant, National Agricultural Library, Beltsville, MD)*, and Richard Myers *(National Archives and Records Administration, Washington, DC)*

Bringing the Library of Congress to Its Off-site Users
Suzanne Thorin *(Chief, General Reading Rooms Division, Library of Congress, Washington, DC)*

This symposium will highlight projects under way at the three national libraries (Library of Congress, National Library of Medicine, and National Agricultural Library) to apply various information technologies to improve access to information. Speakers from the National Library of Medicine will survey projects including outreach through technology, electronic imaging, and biotechnology information access. Speakers from the National Agricultural Library and the National Archives and Records Administration will consider the role of laserdisc technology in agriculture. The speaker from the Library of Congress will describe how the library is providing improved access to its collections for off-site users.

[**Sponsor:** AAAS Section T.]

11-4. Can Electronic Publishing Solve the Science Library Crisis?

Organized by: **H.H. Barschall** *(Professor of Physics. Univ. of Wisconsin, Madison, WI)*

8:30 am / Mon / 18 Feb **Omni Shoreham / Executive**

Presiding: H.H. Barschall

Electronic Publishing from a Publisher's Point of View
Stuart Rothenstein *(Publications Administration Director and Programs Technologist, The Institute of Electrical and Electronics Engineers, Inc., Piscataway, NJ)*

Research and Development in Electronic Publishing
Martin J. Dillon *(Director, Office of Research, OCLC, Dublin, OH)*

Electronic Publishing: An Economic View
Malcolm Getz *(Associate Provost for Information Services and Technology, Vanderbilt Univ., Nashville, TN)*

When Will Electronic Information Systems Replace Printed Journals?
Stewart C. Loken *(Director, Information & Computing Sciences Division, Lawrence Berkeley Laboratory, Univ. of California, Berkeley, CA)*

The rapid increase in volume and cost of science serials has resulted in a crisis for most science libraries, which are no longer able to maintain the subscriptions researchers need. Many scientists think that this crisis can be resolved by replacing the printed material with electronic information systems. This symposium will examine how realistic this expectation is. The presentations include a summary of current research and development in electronic information systems. Presentations by a scientist, by the director of a research library, and by a publisher will discuss the scientific, economic, and practical aspects of the transition from paper to electronic publishing and will include discussions of the experiences with journals on CD-ROM and some future plans of publishers of scientific journals.

[**Sponsor:** AAAS Section T.]

11-5. Scientific Communications in a Changing World

Organized by: **Bonnie C. Carroll** *(Secretariat Director, Commerce, Energy, NASA, NLM, Defense Information Managers [CENDI], Oak Ridge, TN)*

8:30 am / Sun / 17 Feb **Omni Shoreham / Empire**

Scientific Communications and Research Productivity

Presiding: Bonnie C. Carroll

Scientific and Technical Information and National Competitiveness: A Government Policy Perspective
Nancy Mason *(Deputy Under Secretary for Technology, U.S. Dept. of Commerce, Washington, DC)*

The Scientific and Technical Information Infrastructure: Perspective of the National Science Foundation
F. Karl Willenbrock *(Assistant Director for Scientific,*

Technological, and International Affairs, National Science Foundation, Washington, DC)

Information Technology and the Conduct of Research: The User's View
Donald N. Langenberg *(Chancellor, Univ. of Maryland System, Adelphi, MD)*

STI as an Integral Part of the R&D Process: An STI Manager's Perspective
Joseph G. Coyne *(Manager, OSTI, U.S. Dept. of Energy, Oak Ridge, TN)*

Information Resource Management: A Competitive Edge
Barbara Mihalas *(Director of Data Management Prototype Project & Research Scientist, NCSA/Beckman Institute, Urbana, IL)*

2:30 pm / Sun / 17 Feb **Omni Shoreham / Empire**

Issues and Challenges for Scientific Communications

Presiding: Jane Bortnick *(Assistant Chief, Science Policy Research Division, Library of Congress, Congressional Research Service, Washington, DC)*

Collaborative Research and Proprietary Interests
Keith W. McHenry *(Senior Vice President, Technology, AMOCO Corp., Chicago, IL)*

Impact of National Security Control on Scientific Communications
Deborah Runkle *(Senior Program Associate, AAAS, Washington, DC)*

Intellectual Property Law and Scientific Communications
Gerry J. Elman *(Patent Attorney, Elman & Wilf, Media, PA)*

The Pitfalls of Intellectual Property
Art Kleiner *(Writer, Belmont, MA)*

Electronic Watermarks: Toward a Technological Solution to the Problem of Intellectual Property
Paul Levinson *(President, Connected Education, Inc., Bronx, NY)*

Our national competitive strength lies in our high-technology and knowledge-based industries. These are, in turn, heavily dependent on the effectiveness and productivity of our research efforts. Information technology and the way we apply it to the management of our research programs and everyday work routines can have a profound impact on the conduct and productivity of research. The average scientist spends more time in dealing with the results of research and in the communication of research and management information than in the actual conduct of new research itself. From a federal perspective, it has been shown that as much as one-fifth of an agency's R&D budget is spent on information- and communication-related activities. The implications of this are enormous. If one wants to have an impact on researcher productivity, one must place considerable emphasis on the areas with the biggest potential: the information and communication processes.

AAAS☆91 Exhibition
Sheraton Washington, Exhibit Hall C
Hours: *Fri/6pm-8pm, Sat-Mon/9am-3pm*

The first part of this symposium will deal with the relationship between scientific communications and research productivity from various vantage points, including government policy, scientific and technical information management, and producer and user perspectives. Part II will discuss the issues and challenges that affect the communication process. Issues include those resulting from new government, academic, and industrial collaborative research relationships, the continuing debate on national security restrictions versus free flow of information, and the implications that new technological developments have had on intellectual property rights.

[**Sponsors:** AAAS Section T; AAAS Committee on Scientific Freedom and Responsibility. **Cosponsors:** AAAS Section X; AAAS Southwestern and Rocky Mountain Division.]

11-6. Mathematics in the Public Policy Arena

Organized by: **Mary Beth Ruskai** *(Professor, Dept. of Mathematics, Univ. of Lowell, Lowell, MA)*, **Mary W. Gray** *(Professor of Mathematics and Statistics, American Univ., Washington, DC)*, and **Jill P. Mesirov** *(Director, Mathematical Sciences Research, Thinking Machines Corp., Cambridge, MA)*

2:30 pm / Mon / 18 Feb **Sheraton / Colorado**

Presiding: Mary Beth Ruskai

Public Policy Aspects of Statistics: An Application to the Study of Complex Salary Structure
Mary W. Gray

The Wavelet Revolution in Mathematics and Signal Processing
Ingrid C. Daubechies *(Member of Technical Staff, AT&T Bell Laboratories, Murray Hill, NJ)*

Human-Computer Collaboration
Barbara J. Grosz *(Professor, Division of Applied Sciences, Harvard Univ., Cambridge, MA)*

Calculating Fractal Dimensions and Invariant Measures
Fern Y. Hunt *(Professor, Dept. of Mathematics, Howard Univ., Washington, DC)*

Covergence Analysis for Simulating Flow in Root-Soil Systems
Mary F. Wheeler *(Professor, Dept. of Mathematics, Rice Univ., Houston, TX)*

Within the field of mathematics, increasing emphasis has been placed on applications in recent years without, however, specific attention to the impact that these applications might have upon public policy decisions. Both in order to increase public awareness of the real-world importance of mathematics and to make practitioners more cognizant of the policy implications of their work, this symposium will focus on applications of mathematics in areas of particular relevance to public policy.

Among the areas to be discussed are forensic statistics, signal processing and image reconstruction, communication aspects of artificial intelligence, mathematical models of biological systems, and modeling of underground fluid flow. Although it is clear that many social scientists use applications of the mathematical sciences in policy research, the speakers will be mathematicians whose work has public policy implications. The emphasis will be on the scientific content of the work, particularly new methodologies, but consideration will also be given to the policy implications.

[**Sponsor:** AAAS Section A. **Cosponsors:** AAAS Sections U and X; Institute of Mathematical Statistics; Conference Board of the

Mathematical Sciences; American Mathematical Society; Mathematical Association of America; Society for Industrial and Applied Mathematics; Association for Women in Science.]

Technical Sessions

11T-1. Robotics and Mathematics

Organized by: **Bhubaneswar Mishra** *(Assistant Professor, Courant Institute of Mathematical Sciences, New York Univ., New York, NY)*

2:30 pm / Tue / 19 Feb **Omni Shoreham / Executive**

Presiding: Bhubaneswar Mishra

Robotics as an Influence on Computer Science
Jacob T. Schwartz *(Professor, Courant Institute of Mathematical Sciences, New York Univ., New York, NY)*

Toward a Science of Robot Planning and Control
Daniel E. Koditscheck *(Associate Professor, Center for System Science, Electrical Engineering, Yale Univ., New Haven, CT)*

The Mathematics of Grasping
Bhubaneswar Mishra

Geometric Phases, Optimal Control, and Space Robotics
P. S. Krishnaprasad *(Professor, Electrical Engineering Dept. and Systems Research Center, Univ. of Maryland, College Park, MD)*

The goal of robotics is the mechanization of that elementary "operative" intelligence that allows a human being to interact unthinkingly with a complex natural world. The mechanization of the necessary cognition, perception, and manipulation processes demands a thorough understanding of the ambient physics and its mathematical formulation. Studies of manipulation deal with the strategies necessary to control a moving object through a three-dimensional world, where the moving object must avoid contact with other objects (motion planning), make contact with other objects and move them (grasping and dexterous manipulation), or move while maintaining contact with other objects (nonholonomic motion planning). The key mathematical ingredients span a large range of disciplines: algebraic geometry, differential geometry, combinatorial geometry, and topology. The techniques developed here have various other applications (e.g., nonlinear control theory, dynamical systems, and solid modeling).

In this symposium, four researchers in robotics will cover topics in motion planning, grasping, and space robotics. The discussion will be kept at a level appropriate for a general audience.

[**Sponsors:** AAAS Section A; Institute of Electrical and Electronics Engineers. **Cosponsors:** AAAS Sections M and T.]

11T-2. Stereo Computer Imaging and Analysis in Science

Organized by: **Robert S. Ledley** *(Professor, Physiology and Biophysics, Georgetown Univ. Medical Center, Washington, DC)*

8:30 am / Tue / 19 Feb **Omni Shoreham / Executive**

Presiding: Robert S. Ledley

Basic Concepts of Stereo Imaging
Robert S. Ledley

Stereo Volumetric Echocardiograms
J. F. Greenleaf *(Professor of Biophysics, Biodynamics Research Unit, Mayo Clinic, Rochester, MN)*

Brain Cortical Surface: Quantitative Heritability Analysis
Michael W. Vannier *(Professor of Radiology, Mallinckrodt Institute of Radiology, St. Louis, MO)*

Stereo Computer Imaging and Analysis in Science
Boyd MacNaughton, Jr. *(Program Manager, Tektronix, Inc., Beaverton, OR)*

Real-time, Four-dimensional Imaging of Living Organ Systems
James V. Jester *(Associate Professor, Center for Sight, Georgetown Univ., Washington, DC)*

Stereo Electron Imaging and Reconstruction of Thick Biological Preparations
Lee D. Peachey *(Professor, Dept. of Biology, Univ. of Pennsylvania, Philadelphia, PA)*

One of the most highly developed functions of the human brain is the assessment of three-dimensional (3-D) space using stereo image pairs. That is, the brain merges a right-eye image with a left-eye image to sense three dimensions. Stereo displays are available using a combination of Polaroid eyeglasses and a liquid crystal monitor overlay that can present alternating left-eye and right-eye images, each at up to 60 frames per second. Because the displays are driven from a computer, 3-D cursors can be programmed to appear to move in 3- D space. The 3-D cursor can be either a single spot, a segment of a deformable surface, or a volume such as a sphere. Stereo 3-D applications will be demonstrated in CT, medical ultrasound, confocal microscopy, and electron microscopy during the session. Many more application areas will be discussed.

[**Sponsors:** AAAS Section M; Computerized Medical Imaging Society. **Cosponsors:** AAAS Sections R and T.]

12. Energy; Technology

12-1. Energy R&D Policy in the United States

Organized by: **H.M. Hubbard** *(Executive Vice President, Midwest Research Institute, Golden, CO)*, **Robert W. Fri** *(President and Senior Fellow, Resources for the Future, Washington, DC)*, and **Barbara Farhar** *(Senior Social Scientist, Solar Energy Research Institute, Washington, DC)*

8:30 am / Fri / 15 Feb **Omni Shoreham / Congressional**

Presiding: J. Michael Davis *(Assistant Secretary for Conservation and Renewable Energy, U.S. Dept. of Energy, Washington, DC)*

The U.S. National Energy Strategy
Linda G. Stuntz *(Deputy Under Secretary, Office of Policy, Planning, and Analysis, U.S. Dept. of Energy, Washington, DC)*

U.S. Science and Technology Policy; What Priority for Energy R&D?
Rodney W. Nichols *(Senior Scholar, The Carnegie Corp. of New York, New York, NY)*

Congressional Perspective on Energy R&D
Ben S. Cooper *(Senior Professional Staff, Committee on Energy and Natural Resources, U.S. Senate, Washington, DC)*

Industry Perspective on Energy R&D Policy
Daniel A. Dreyfus *(Vice President, Gas Research Institute, Washington, DC)*

Economics, Environment, and Energy R&D Priorities
Robert W. Fri

While it may be an overstatement to say that energy and the environment will be the dominant public concerns in the 20th century's last decade, they will certainly be among the most important. These concerns, along with issues of competitiveness in an increasingly global economy, will strongly influence U.S. science and technology policy. This symposium will present a variety of perspectives on the appropriate energy R&D strategy for the United States.

[**Cosponsors:** AAAS Sections M and P; AAAS Southwestern and Rocky Mountain Division; AAAS Committee on Science, Engineering, and Public Policy.]

12-2. Energy Technologies for Developing Countries

Organized by: **William Fulkerson** *(Associate Director for Advanced Energy Systems, Oak Ridge National Laboratory, Oak Ridge, TN)* and **Mark D. Levine** *(Leader, Energy Analysis Program, Lawrence Berkeley Laboratory, Berkeley, CA)*

2:30 pm / Sat / 16 Feb Omni Shoreham / Congressional

Presiding: William Fulkerson and Mark D. Levine

The Brazilian Perspective: Technologies for Sustainable Development
José Goldemberg *(Secretary of State for Science and Technology, Government of Brazil, Brasilia, Brazil)*

The Chinese Perspective: Long-term Demand and Technology Choices
Yingzhong Lu *(Director, Institute for Technoeconomic and Energy Systems Analysis, Tsinghua Univ., Beijing, PRC)*

The Indian Perspective: Appropriate Energy Technologies
Amulya Kumar N. Reddy *(Professor, Dept. of Management Studies, Indian Institute of Science, Bangalore, India)*

The World Bank Perspective: Energy Technology Investments
Mohan Munasinghe *(Chief, Policy Research Division, World Bank, Washington, DC)*

The Global Energy Efficiency Initiative
Alvaro Umaña *(Minister of Natural Resources, Energy, and Mines, Government of Costa Rica)*

The energy choices made by developing nations will have growing environmental and economic ramifications for the United States and other industrialized nations. Clearly, as the economic gap between developing and industrialized nations narrows, an increasing share of the world's primary energy use will go to meet the needs of developing countries. This means at least three things to the United States: (1) energy use by developing nations, including use of fossil fuels, is likely to contribute significantly to the global buildup of greenhouse and ozone-depleting gases in the atmosphere; (2) energy use by developing nations is likely to contribute to rising pressures on world oil markets; and (3) developing nations will be an expanding market for energy technologies during a time when the United States is trying to improve its competitiveness in the world economy. Energy technology R&D can be an important part of the U.S. and industrialized nations' response to all three of these challenges. In particular, more energy-efficient technologies that are economical and much better nonfossil sources will be needed to moderate environmental and oil market pressures. These technologies should be engineered to meet the particular challenges of each developing country.

This symposium will explore these issues from various perspectives, including those of China, India, and Brazil. Speakers also will address different institutional views as represented by the U.S. National Energy Strategy, the World Bank, and U.S. AID.

[**Cosponsor:** AAAS Section M.]

12-3. Scientific Advances in Emerging Solar Energy Technologies

Organized by: **H.M. Hubbard** *(Executive Vice President, Midwest Research Institute, Golden, CO)*, **Robert L. San Martin** *(Deputy Assistant Secretary, Office of Conservation and Renewable Energy, U.S. Dept. of Energy, Washington, DC)*, and **Barbara Farhar** *(Senior Social Scientist, Solar Energy Research Institute, Washington, DC)*

2:30 pm / Fri / 15 Feb Omni Shoreham / Congressional

Presiding: Robert L. San Martin

Photon Conversion Processes
Arthur J. Nozik *(Senior Research Fellow, Solar Energy Research Institute, Golden, CO)*

Advances in Photovoltaic Solar Technology
Don L. Morel *(Professional Electrical Engineer, Univ. of South Florida, Tampa, FL)*

Characterization of Photovoltaic Materials
Lawrence L. Kazmerski *(Manager, PV Measurements and Performance Branch, Solar Energy Research Institute, Golden, CO)*

Development of Biomass Energy Crops
Lynn L. Wright *(Deputy Program Manager, Biomass Production Program, Oak Ridge National Laboratories, Oak Ridge, TN)*

Conversion of Lignocellulose to Fuels and Chemicals
Barbara J. Goodman *(Operations Manager, Solar Fuels Research Division, Solar Energy Research Institute, Golden, CO)*

Two of the most promising alternative energy supply options that are emerging from solar energy research over the past two decades are photovoltaics (the direct conversion of sunlight to electricity) and the possibility of producing liquid transportation fuels economically from energy crops by conversion of lignocellulose. This session will provide nonspecialists with an overview of progress in the field and of the scientific and engineering challenges that must be met if these technologies are to make major contributions towards meeting the world's energy needs in the 21st century.

[**Cosponsor:** AAAS Section M.]

12-4. Engineering in Japan

Organized by: **Robert S. Cutler** *(Consultant Advisor, Potomac, MD)*, **Ryo Hirasawa** *(Professor, Dept. of General Systems Studies, Univ. of Tokyo, Tokyo, Japan)*, and **Kazuhiko Kawamura** *(Professor, Management of Technology Program, Vanderbilt Univ., Nashville, TN)*

2:30 pm / Sun / 17 Feb Omni Shoreham / Congressional

Presiding: Robert S. Cutler

Introduction
H. Guyford Stever *(Former Foreign Secretary of the National Academy of Engineering)*

Engineering in Japan
Takashi Mukaibo *(President, National Academy of Engineering of Japan, and President, Japan Society for Science Policy and Research Management, Tokyo, Japan)*

Education in High Technology for Engineers in Japan
Yoshiharu Namba *(Professor, Dept. of Mechanical Engineering, Chubu Univ., Kasugai Aichi, Japan)*

Research and Engineering at Fuji Xerox and Xerox Corporation
William J. Spencer *(Group Vice President and Director of Research, Xerox Corp., Stamford, CT)* and Y. Ogawa *(Senior Managing Director, Fuji Xerox Co., Ltd., Tokyo, Japan)*

Reforms in Engineering Graduate Schools in Japan
Hiroyuki Yoshikawa *(Dean, Faculty of Engineering, Univ. of Tokyo, Tokyo, Japan)*

The Future of Engineering in Japan
Michiyuki Uenohara *(Executive Advisor, NEC Corp., Kanagawa, Japan)*

Discussants:
Jordan J. Baruch *(Consultant, Washington, DC)*, Hisashi Kobayashi *(Dean, School of Engineering and Applied Science, Princeton Univ., Princeton, NJ)*, and Rustum Roy *(Professor, Materials Research Laboratory, Pennsylvania State Univ., University Park, PA)*

Japan's recent technological achievements demonstrate that engineering in Japan differs from that in the United States. Moreover, the unique features of Japanese-style engineering are not well understood among American scientists and engineers. Since 1853, when Japan opened to Western civilization, the engineering profession has been regarded as an important national asset. However, university education alone does not provide enough technical "know-how" to perform the high-technology engineering that Japanese industry requires. Therefore, industrial companies provide postgraduate science and engineering education for their lifetime employees. And Japanese companies import patents and scientific research from abroad, improving each technology by adding Japanese innovations. Five speakers from Japan will present insider views on Japanese engineering education, research, and industrial practice. The symposium will also address issues regarding recent initiatives in both countries to promote precompetitive, generic research projects involving U.S. and Japanese engineers working jointly in Japanese laboratories or in American R&D consortia. A panel will comment on the presentations and attempt to relate Japanese-style engineering to changes emerging in American engineering education and in industrial research. In addition, the symposium will provide an opportunity for AAAS members to learn the firsthand experiences of colleagues recently returned from research assignments in Japanese laboratories.

[**Sponsors:** AAAS Section M; AAAS Directorate for International Programs. **Cosponsor:** AAAS Section K.]

Don't Miss the Exhibition

Come and meet representatives from more than 80 exhibiting organizations, including: *BIOCON, EDVOTEK, Oak Ridge Associated Universities, Research Biochemicals, Science by Mail/Boston Museum of Science, Space Telescope Science Institute, Waste Isolation Pilot Plant/ Westinghouse Electric Corp.*, and many others.

Sheraton Washington, Exhibit Hall C
Friday, 6pm-8pm; Saturday-Monday, 9am-3pm

Technical Sessions

12T-1. The Interaction of Science and Engineering in the Modern Age

Organized by: **Edwin T. Layton, Jr.** *(Professor, History of Science and Technology, Univ. of Minnesota, Minneapolis, MN)*

8:30 am / Sat / 16 Feb Omni Shoreham / Congressional

Presiding: Arthur P. Molella *(Chairman, Dept. of History of Science and Technology, National Museum of American History, Smithsonian Institution, Washington, DC)*

Dimensionality and the Scientific Transformation of Engineering
Edwin T. Layton, Jr.

Historical Analysis of Technological Rates of Improvement
John H. Lienhard *(M.D. Anderson Professor of Mechanical Engineering and History, Univ. of Houston, Houston, TX)*

From Wave Lines to Stream Lines: The Role of Engineering Science in Naval Architecture
David F. Channell *(Professor of Historical Studies, Univ. of Texas, Dallas, TX)*

Mapping Invention and Design: The Case of Bell, Edison, Gray, and the Telephone
W. Bernard Carlson *(Assistant Professor of Humanities, Univ. of Virginia, Charlottesville, VA)* and Matthew Mehalik *(Research Associate, Univ. of Virginia, Charlottesville, VA)*

A Cognitive Theory of Invention and Design
Michael E. Gorman *(Associate Professor of Humanities, Univ. of Virginia, Charlottesville, VA)*

Engineering became a scientific discipline as a result of its interaction with science in the 19th and 20th centuries. One result was an increase in engineering research and the institutions that supported this research. An important aspect of engineering research involved the development of scale-model experimentation and the casting of engineering theories as functions of dimensionless terms. One result of scientific engineering was an acceleration in the rate of technological improvement, especially after 1840. Engineering research led to the rise of engineering science, as exemplified by the work of J. Scott Russell and W.J.M. Rankine and the concepts of wave and stream lines. Science also influenced the processes of invention and design. Computer-based methods allow historians to map the differing cognitive processes employed in invention (e.g., among Alexander G. Bell, Thomas A. Edison, and Elisha Gray in the case of the telephone). New approaches to understanding invention and design have led to the study of the mental models used by inventors. These models are based on both scientific ideas and antecedent devices. The study of engineering research suggests both similarities and differences between engineering and scientific disciplines.

[**Sponsors:** AAAS Sections L and M. **Cosponsors:** AAAS Sections B and P.]

12T-2. Geophysical Imaging Systems: From Medical Microcosm to Outer Space

Organized by: **Anna C. Roosevelt** *(Director, Lower Amazon Project, Dept. of Anthropology, American Museum of Natural History, New York, NY)*

8:30 am / Tue / 19 Feb Omni Shoreham / Congressional

Presiding: Anna C. Roosevelt

Positron Emission Tomography in the Treatment of Parkinson's Disease
George Ricaurte *(Assistant Professor of Neurology, Johns Hopkins Univ. and Francis Scott Key Medical Center, Baltimore, MD)* and James Tetrud *(Director, California Parkinson's Foundation, San Jose, CA)*

Airborne Geophysical Surveys for Mining, Petroleum, and Groundwater Prospecting
William A. Sauck *(Senior Researcher, Dept. of Geology, Western Michigan Univ., Kalamazoo, MI)*

Imaging Past Environments of Northeastern Africa from Space
Farouk El-Baz *(Director, Center for Remote Sensing, Boston Univ., Boston, MA)*

Computerized, Solar-powered Geophysical Survey at Archaeological Sites in Brazil
Anna C. Roosevelt

Photogrammetry as a Tool for Archaeology: Resurrecting Archival 3-D Photographs and Documenting Cultural Heritage Resources
Lawrence G. Desmond *(Assistant Professor, Division of Social Sciences, Univ. of Minnesota, Morris, MN)*

Geophysical Survey in Underwater Archaeological Research
Larry E. Murphy *(Archaeologist, Submerged Cultural Resources Unit, National Park Service, Santa Fe, NM)*

Data Visualization and Image Processing for the Geosciences
T. H. Lee Williams *(Associate Dean of Geosciences, Univ. of Oklahoma, Norman, OK)* and Wes Lee Roberts *(Division of Geosciences, Univ. of Oklahoma, Norman, OK)*

Planetary Image Processing on Microcomputers
Robert G. Strom *(Professor, Dept. of Planetary Sciences, Univ. of Arizona, Tucson, AZ)*

Geophysical sensing methods have spread rapidly into many scientific fields and are being applied at all scales of phenomena. Microscopic pathological structures within the body can now be mapped and imaged for diagnostic purposes with methods such as positron emission tomography and magnetic resonance. The ancient structures and strata in the earth's geological and archaeological deposits can be detected with ground-probing measurements of electrical resistivity and conductivity, magnetism, seismic refraction, radio waves, and thermal patterning. Sonar, radar, and thermal sensing are also used for research in, on, and under the oceans. On a larger scale, a variety of sensors are used from airplanes and space vehicles to study the earth, the atmosphere, and astronomical phenomena.

In the past, the practical use of geophysical imaging methods for scientific and strategic research was hindered by the lack of electrically efficient instrumentation, unified automation, and effective software. Recently, rapid improvements have been made in these areas, but the benefits have not spread across disciplines. In this technical session, researchers in astronomy, geology, geophysics, geography, archaeology, and medicine will share recent advances in the use of geophysical imaging for research in their fields.

[**Sponsors:** AAAS Sections H and W. **Cosponsors:** AAAS Sections E and U; American Statistical Association; Institute of Mathematical Statistics.]

12T-3. Changing Lives: New Technology for People with Disabilities

Organized by: **Virginia W. Stern** *(Director, Project of Science, Technology and Disability, AAAS, Washington, DC)* and **Jan Galvin** *(Director, Rehabilitation Engineering Center, National Rehabilitation Hospital, Washington, DC)*

8:30 am / Sun / 17 Feb Sheraton / Holmes

Presiding: Virginia W. Stern and Jan Galvin

Flexible Reading Systems: Getting Technology into the Hands of the Disabled
James R. Fruchterman *(President, Arkenstone, Inc., Sunnyvale, CA)*

E-mail: A Tool for the Disabled Scientist and Student
J. Tilak Ratnanather *(Academic Fellow, City University-London, London, UK)*

Speaking for the Minority: An Overview of Speech-Processing Interfaces for People with Disabilities
Bosco Keown *(Associate Programmer, IBM United Kingdom Laboratories, Winchester, UK)*

Electroejaculation for Fertility Evaluation in Spinal Cord–Injured Men
S.W.J. Seager *(Director, Fertility Research Center, National Rehabilitation Hospital, Washington, DC)*

Summary of Lightweight Orthotic Brace Program
Moreno J. White *(Technical Director, Sparta, Inc., San Diego, CA)*

Applying Knowledge of the Rehabilitation Community to Urgent Problems of the Aging Community
Dennis R. La Buda *(President, Technology and Aging Group, Inc., Miami, FL)*

This technical session will include presentations on advanced technologies that are changing lives for people with disabilities. The speakers will discuss new developments that are affecting education, work environment, and personal life for individuals with a range of disabilities. These developments include optical scanning and flexible reading systems for people who are print impaired; composite materials that are lighter and stronger for individuals who use mobility aids and prostheses; electroejaculation techniques that make possible fertility in spinal cord–injured men; new developments in speech synthesis for people who cannot hear or speak; and use of electronic mail as an important communication technique for disabled scientists and students. This session will also include discussion of two current issues in the field of technology and disability: (1) how to design high technology so it is economically viable and can get into the hands of the people with disabilities who need it and (2) the issues involved in transfer of assistive technology from the rehabilitation community to promote independence, particularly in the home setting, of the elderly.

[**Sponsors:** AAAS Section M; AAAS Committee on Opportunities in Science; AAAS Directorate for Education and Human Resources Programs; Foundation for Science and the Handicapped. **Cosponsors:** AAAS Sections P and X.]

13. Physics; Chemistry

13-1. Seventy-five Years of General Relativity

Organized by: **Arthur B. Komar** *(Professor of Physics, Yeshiva Univ., New York, NY)*

8:30 am / Fri / 15 Feb **Omni Shoreham / Diplomat**

Presiding: Arthur B. Komar

Einstein's Theory of Gravitation: Historical Reflections
Peter G. Bergmann *(Professor of Physics, New York Univ., New York, NY)*

Nonlocal Variables for General Relativity
Ezra T. Newman *(Professor of Physics, Univ. of Pittsburgh, Pittsburgh, PA)*

Experimental Gravitation
Rainer Weiss *(Professor of Physics, MIT, Cambridge, MA)*

The Problem of Quantum Gravity: How to Finish the Revolutions of 20th-Century Physics
Lee Smolin *(Professor of Physics, Syracuse Univ., Syracuse, NY)*

In this anniversary year of Einstein's theory of gravitation, an overview of the many aspects of general relativity is presented. Topics covered include the historical roots of the theory, the current status of its experimental and observational confirmations, recent theoretical developments in classical gravitation theory, efforts to construct a quantum theory of gravitation, and perspectives for future developments both in theory and in experiment. Particular attention is drawn to the worldwide search for gravitational radiation.

[**Sponsor:** AAAS Section B. **Cosponsor:** AAAS Section L.]

13-2. Elementary Particle Physics: Present Status and Future Prospects

Organized by: **Paul H. Frampton** *(Professor, Dept. of Physics and Astronomy, Univ. of North Carolina, Chapel Hill, NC)*

2:30 pm / Fri / 15 Feb **Omni Shoreham / Diplomat**

Presiding: Paul H. Frampton

Overview of Theory
Paul H. Frampton

Future of High-energy Electron Physics
Burton Richter *(Director, Stanford Linear Accelerator Center, Stanford, CA)*

Status of Superconducting Super Collider
Roy Schwitters *(Director, Superconducting Super Collider Laboratory, Dallas, TX)*

Results from LEP and Future Plans
Samuel C.C. Ting *(Professor, MIT, Cambridge, MA)*

Important new data from electron-positron colliders, especially concerning the Z^0 boson and the number of light neutrinos, have been forthcoming from the LEP and SLC accelerators. The SSC is at the stage of beginning construction, and its planning is dominating the scene of future high-energy experiments. Larger electron-positron linear colliders are being seriously considered. It is an opportune time for a symposium to overview the status of present and future high-energy accelerators and to have a theorist discuss the most pressing issues in the fields. This is because after several years of relative stagnation (1984–89), elementary particle physics is now opening up the 1990s with exciting new data that are stimulating theory in new directions.

[**Sponsor:** AAAS Section B.]

13-3. The Quantum Mechanics of Single Atoms

Organized by: **Thomas Erber** *(Professor of Physics and Professor of Mathematics, Illinois Institute of Technology, Chicago, IL)*, and **D.J. Wineland** *(National Institute of Standards and Technology, Boulder, CO)*

8:30 am / Tue / 19 Feb **Omni Shoreham / Diplomat**

Presiding: Thomas Erber

Single-ion Cyclotron Resonance for Precision Mass Measurement
David E. Pritchard *(Professor of Physics, MIT, Cambridge, MA)*

Experiments at NIST with Stored Ions
Daniel J. Heinzen *(Research Scientist, National Institute of Standards and Technology, Boulder, CO)*

Nonclassical Light: The Extraordinary Radiation Properties of a Micromaser
Gerhard Rempe *(Millikan Research Fellow in Physics, California Institute of Technology, Pasadena, CA)*

Optical Spectroscopy of Single Ions: An Approach to the Ideal
Warren Nagourney *(Research Associate Professor of Physics, Univ. of Washington, Seattle, WA)*

The Quantum Mechanics of Single Atoms
Thomas Erber

During the last two decades, experimental techniques have advanced to the point where it is feasible to measure the magnetic moments, energy levels, and radiative transition rates of individual trapped objects such as electrons, ions, and even antimatter atoms. Among the practical benefits of these clean, albeit sophisticated, experiments are single-atom frequency standards of extremely high precision. These techniques have also made it possible to study the time evolution of quantum systems in unprecedented detail—for example, quantum jumps, single-atom masers, quantum chaos, and Zeno effects due to the interaction of the atom with the observer. Current results confirm that quantum mechanics can indeed be applied to single atoms, electrons, and similar isolated objects. However, the extent to which the theory provides a complete and exhaustive description of these elementary systems still leaves many questions. The most obvious ones concern the interpretation of probabilistic concepts — such as coherent superposition — in situations where only a single object is available for measurements. This symposium is intended to provide a review of the current experimental situation and also to highlight some of the basic theoretical issues.

[**Sponsor:** AAAS Section B.]

13-4. Chemistry Rediscovers Materials Science

Organized by: **George S. Hammond** *(Professor, Georgetown Univ., Washington, DC)*

8:30 am / Mon / 18 Feb **Omni Shoreham / Hampton**

Presiding: George S. Hammond

Architecture with Photopolymers
Douglas C. Neckers *(Distinguished Research Professor and Executive Director, Center for Photochemical Sciences, Bowling Green State Univ., Bowling Green, OH)*

New Inorganic-Organic Hybrid Materials by the Sol-Gel Approach
Garth L. Wilkes *(Professor of Chemical Engineering, Virginia Polytechnic Institute and State Univ., Blacksburg, VA)*

Are Liquid Crystals Ordered Reaction Media?
Richard G. Weiss *(Professor of Chemistry, Georgetown Univ., Washington, DC)*

Electrical Properties of Organic Solids
Dwaine O. Cowan *(Professor of Chemistry, Johns Hopkins Univ., Baltimore, MD)*

2:30 pm / Mon / 18 Feb **Omni Shoreham / Hampton**

Presiding: Richard G. Weiss

Theory of Extended Structures
Jeremy K. Burdett *(Professor of Chemistry and Associate Dean, Physical Sciences, Univ. of Chicago, Chicago, IL)*

Interstitial Synthesis: When Materials Are Born and the Unexpected Turns Up
John D. Corbett *(Professor, Ames Laboratory, Iowa State Univ., Ames, IA)*

From Chemistry to New Materials
Kenneth R. Poeppelmeier *(Professor of Chemistry, Northwestern Univ., Evanston, IL)*

Chemistry and Physics of Thin Films for Electronics
Eugene A. Irene *(Professor of Chemistry, Univ. of North Carolina, Chapel Hill, NC)*

The materials that go into working systems for many purposes must fulfill a host of property requirements — structural, electrical, thermal, and so on. For many applications, property retention over extreme ranges of temperature is critical, whereas for other uses, predictable changes of properties with changing temperature are the desideratum. The correlation of properties with structure and the synthesis of new materials having desired properties fall naturally within the realm of chemical science. However, the practice of those arts has in relatively recent times been the province of engineers, who have done a splendid job of developing the field. At the present time, chemists are turning their attention to materials with great vigor and are finding new and stimulating challenges therein. Perhaps the greatest leap for the chemist entering most materials research fields is the requirement to go beyond the concepts of molecular science to the supramolecular level. Molecular concepts have been a powerful driver, but huge molecules, mixtures thereof, and solids containing infinite networks of chemical bonds are the materials of greatest current interest. Fortunately, concepts of atoms and chemical bonds remain powerful tools in the models of materials science. The chemistry of some materials will be considered in this symposium.

[Sponsors: AAAS Sections B and C. **Cosponsor:** AAAS Section M.]

13-5. Mathematics in the Materials Sciences

Organized by: **David Kinderlehrer** *(Professor, Dept. of Mathematics, Carnegie Mellon Univ., Pittsburgh, PA)*

2:30 pm / Sun / 17 Feb **Omni Shoreham / Hampton**

Presiding: David Kinderlehrer

Frustrated Solids
Richard D. James *(Associate Professor of Aerospace Engineering and Mechanics, Univ. of Minnesota, Minneapolis, MN)*

Evolving Phase Boundaries
Morton E. Gurtin *(Professor of Mathematics, Carnegie Mellon Univ., Pittsburgh, PA)*

Extremal Microstructures: What Do We Know About Composites?
Robert V. Kohn *(Professor of Mathematics, Courant Institute of Mathematical Sciences, New York Univ., New York, NY)*

The Computation and Visualization of Defects and Microstructure
Mitchell Luskin *(Professor, Applied Mathematics, California Institute of Technology, Pasadena, CA)*

Since the mid-1980s, the growing alliance of nonlinear theory and analysis with scientific computation has led to significant advances in our understanding of modern materials like liquid crystals, shape-memory alloys, and composites. Chief among these are new ways of understanding defects and microstructure, with emphasis on how they arise, deform, and grow. A surprising consequence is the ability to predict detailed behavior at the microscopic level. With additional methods, one may proceed to a more macroscopic level.

This is an appropriate moment to discuss these advances before a general audience and to expose the issues, many unresolved, of the interplay of modern mathematical methods with the materials sciences. Two examples that help suggest the many flavors of recent efforts are the determination of stable defects in liquid crystals and the analysis of microstructure in shape memory and highly magnetostrictive materials. These unexpected and exciting developments have led to new research, even in related differential geometry. Computations confirm and enhance many predictions. Such computations, although difficult, assist in the determination of actual energy functions and lead to improvements in the materials.

[Sponsors: AAAS Sections A and G. **Cosponsor:** AAAS Section C.]

13-6. Status of High-temperature Superconductivity

Organized by: **William T. Oosterhuis** *(Manager, S&T Centers Development, Office of Science and Technology Centers, National Science Foundation, Washington, DC)*

2:30 pm / Sat / 16 Feb **Omni Shoreham / Diplomat**

Presiding: William T. Oosterhuis

The Report of the National Commission on Superconductivity
David W. McCall *(Chemical Director, AT&T Bell Laboratories, Murray Hill, NJ)*

Federally Funded Superconductivity Programs
Ted G. Berlincourt *(Director of Research and Laboratory Management, U.S. Dept. of Defense, Washington, DC)*

High T_c and High J_c in Oxide Superconductors
Paul C. W. Chu *(Professor of Physics and Director, Texas Center for Superconductivity, Univ. of Houston, Houston, TX)*

Experimental Results on the Nature of High-temperature Superconductivity and Unusual Normal State Properties
Miles V. Klein *(Professor of Physics and Director, Science and Technology Center for Superconductivity, Univ. of Illinois, Urbana, IL)*

Prospects for the Development of Conductors of High-temperature Superconductors
David C. Larbalestier *(Professor of Materials Science and Engineering, Univ. of Wisconsin, Madison, WI)*

This symposium will survey the current position of the United States with regard to recent developments in high-temperature superconductivity from the policy and the technical points of view. McCall, chairman of the National Commission on Superconductivity, will review the analysis of the U.S. posture in superconductivity and the recommendations made by the commission. Berlincourt will review the federal programs supporting superconductivity research, the trends in these activities, and gaps in the national effort. Chu will discuss the newest high-temperature superconductors, modifications to these materials, and efforts underway to find still other superconductors. He will also comment on the development of oxide superconductors with higher critical currents. Klein will discuss recent results that lead to an increased understanding of the superconductivity in these new materials. Larbalestier will discuss technical problems associated with synthesis and processing of these materials, problems that have been overcome recently, and barriers that still exist in the way of practical applications. These include low current densities, chemical stability, sensitivity to applied magnetic fields, flexibility of the conductors, and the ability to join the conductors.

[**Sponsor:** AAAS Section B.]

13-7. Current Directions in Musical Acoustics

Organized by: **Thomas D. Rossing** *(Dept. of Physics, Northern Illinois Univ., DeKalb, IL)*, **Logan Hargrove** *(Office of Naval Research, Washington, DC)*, and **Mark F. Hamilton** *(Dept. of Mechanical Engineering, Univ. of Texas, Austin, TX)*

8:30 am / Sun / 17 Feb Omni Shoreham / Congressional

Presiding: Thomas D. Rossing

Perceptual Segregation and Integration of Musical Tones
William Morris Hartmann *(Dept. of Physics, Michigan State Univ., East Lansing, MI)*

Sound Production in the Piano
Anders Askenfelt *(Dept. of Speech Communication & Music Acoustics, Royal Institute of Technology, Stockholm, Sweden)*

Aperiodicity in Oscillations of Musical Instruments
Robert T. Schumacher *(Dept. of Physics, Carnegie Mellon Univ., Pittsburgh, PA)*

Brass Instruments
Klaus Wogram *(Physicalisch-Technische Bundesanstalt, Braunschweig, Germany)*

Wind Instruments and Chaotic Dynamics
Douglas H. Keefe *(Systematic Musicology Program, School of Music, Univ. of Washington, Seattle, WA)*

Current Directions in Computer Music
Max V. Mathews *(Dept. of Music, Stanford Univ., Stanford, CA)*

Modes of Vibration and Sound Production in Percussion Instruments
Thomas D. Rossing

Musical acoustics is a broad interdisciplinary field that deals with the production, transmission, and perception of musical sound. In percussion instruments and in certain string instruments, the player supplies energy by striking or plucking the primary oscillator (string, bar, membrane, or plate), which in turn transmits energy to other parts of the instrument. Wind instruments, on the other hand, depend upon nonlinear feedback from the air column to the input control valve in order to generate sustained oscillations. Similar feedback exists in a bowed string instrument and, to a lesser extent, in the singing voice. In recent years, electronic musical instruments have developed to a high degree of sophistication, thanks to the digital computer. Equally exciting have been advances in our understanding of the perception of musical sound, an important target of recent research in the field of psychoacoustics. This symposium, organized under the auspices of the Acoustical Society of America, attempts to illustrate principles of production, transmission, and perception of sound by focusing on one area in acoustics that is of wide general interest.

[**Sponsors:** AAAS Section B; Acoustical Society of America. **Cosponsor:** AAAS Section J.]

Technical Session

13T-1. Revisionist Kinetics: New Views of Nature's Throttle

Organized by: **R. Stephen Berry** *(Professor, Dept. of Chemistry, Univ. of Chicago, Chicago, IL)*

2:30 pm / Tue / 19 Feb Omni Shoreham / Capitol

Presiding: R. Stephen Berry

Pictures of Missing Links: Quantum and Classical Visualizations of Reaction Dynamics
Peter G. Wolynes *(Professor, Dept. of Chemistry, Univ. of Illinois, Urbana, IL)*

Electron Transfer Within and Between Phases: Solvation, Tunneling, and Molecular Reactants
Michael John Weaver *(Professor, Dept. of Chemistry, Purdue Univ., West Lafayette, IN)*

Unexpected Throttles in Microscopic Reaction Kinetics
James T. Hynes *(Professor, Dept. of Chemistry, Univ. of Colorado, Boulder, CO)*

Activationless Chemical Reactions
Graham R. Fleming *(Professor, Dept. of Chemistry, Univ. of Chicago, Chicago, IL)*

Chemical kinetics, the study of rates and mechanisms of chemical reactions, has changed both technically and conceptually during the

past decade. Experimental probes now permit us to study reactions in time units of picoseconds and femtoseconds, the time scales for chemical bonds to break and re-form and for atoms to move from one place in a molecule to another. Computational tools of computer simulation allow us to inquire about the mechanisms of reactions heretofore thought too complex for anything but statistical analysis. Conceptual advances have revealed dependencies among rates and physical conditions that only the most daring thinkers had previously suspected and that have now been observed. This session will describe how such advances have changed perceptions — and maybe even changed paradigms — for the field of chemical kinetics.

[**Sponsor:** AAAS Section C.]

14. Astronomy; Planetary Science

14-1. Cosmology: Our Knowledge of the Universe

Organized by: **Martin Harwit** *(Director, National Air & Space Museum, Smithsonian Institution, Washington, DC)*

8:30 am / Sat / 16 Feb **Omni Shoreham / Diplomat**

Presiding: Martin Harwit

Observing the Universe Long Ago: The Cosmic Background Explorer
Michael G. Hauser *(Chief, Laboratory for Astronomy and Solar Physics, NASA/Goddard Space Flight Center, Greenbelt, MD)*

Motions of Galaxies and the Large-scale Structure of the Universe
Vera C. Rubin *(Staff Member, Dept. of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, DC)*

The Early Universe
Alan H. Guth *(Professor of Physics, MIT, and Harvard-Smithsonian Center for Astrophysics, Cambridge, MA)*

How Much Can We Learn About the Universe?
Martin Harwit

Viewed in visible light, our universe looks extremely lumpy, with matter concentrated into stars, galaxies, and aggregates of galaxies. Observed at millimeter wavelengths, in contrast, the universe appears remarkably uniform. While the observer's motion with respect to the universe can induce anisotropy, a framework exists in which deviations from isotropy and homogeneity at levels of one part in 10,000 already are observationally ruled out. This disparate appearance of the universe seen through different eyes is described by the first two speakers. The third speaker will discuss the theoretical framework within which these observations currently are viewed and detail the questions remaining unanswered. The final speaker explains that further complexities in the universe will be uncovered by additional observations based on technologies not yet invented.

[**Sponsors:** AAAS Sections B and D.]

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Exhibit Hall C: Fri/6pm-8pm, Sat-Mon/9am-3pm

14-2. Adverse Environmental Threats to Astronomy

Organized by: **David L. Crawford** *(Astronomer, National Optical Astronomy Observatories, Kitt Peak National Observatory, Tucson, AZ)*

2:30 pm / Mon / 18 Feb **Omni Shoreham / Diplomat**

Presiding: David L. Crawford

Introduction to the Issues
A.K. Dupree *(Senior Astrophysicist, Harvard-Smithsonian Center for Astrophysics, Cambridge, MA)*

Light Pollution: The Theft of the Night
David L. Crawford

Keeping the Radio Sky Quiet: Limited Future Options
P. A. Vanden Bout *(Director, National Radio Astronomy Observatory, Associated Universities, Inc., Charlottesville, VA)*

The Growing Threat of Orbital Debris
David L. Talent *(Principal Scientist, Lockheed-ESC, Solar System Exploration Dept., Houston, TX)*

Astronomical research, both ground based and in space, is seriously threatened by increasing adverse environmental impacts. Indeed, the public as a whole is losing the view of the universe experienced by our ancestors. Speakers at the session will summarize these rapidly increasing threats and discuss what can be done to minimize the problems.

[**Sponsor:** AAAS Section D.]

14-3. The Human Exploration of Space

Organized by: **Richard C. Hart** *(Space Studies Board, National Academy of Sciences/National Research Council, Washington, DC)*

8:30 am / Sun / 17 Feb **Omni Shoreham / Diplomat**

Presiding: Richard C. Hart

NASA's SEI Plans
Richard H. Truly *(Administrator, National Aeronautics & Space Administration, Washington, DC)*

SEI as a Goal of Space Research
Mark Albrecht *(Executive Secretary, National Space Council, Washington, DC)*

SEI Within the Context of a National Research Program
Robert E. Grady *(Associate Director for Natural Resources, Energy, and Science, Office of Management and Budget, Washington, DC)*

Congressional Views of SEI Plans
Albert Gore, Jr. *(Senator, U.S. Congress, Washington, DC)*

Roles and Responsibilities of the U.S. Space Research Community
Louis J. Lanzerotti *(Chairman, Space Studies Board, National Research Council, and AT&T Bell Laboratories, Murray Hill, NJ)*

2:30 pm / Sun / 17 Feb **Omni Shoreham / Diplomat**

Presiding: Richard C. Hart

SSB Study on Human Exploration
Noel W. Hinners *(Chair, SSB Task Group on Human Exploration, and Vice President for Strategic Planning, Martin Marietta Corp., Bethesda, MD)*

Issues in Life Science Research
Dennis L. Smith *(Chair, SSB Committee on Space Biology and Medicine, and Executive Vice Chancellor, Univ. of California, Irvine, CA)*

Planetary Exploration
Larry Esposito *(Chair, SSB Committee on Lunar and Planetary Exploration, Laboratory for Atmospheric and Space Physics, Univ. of Colorado, Boulder, CO)*

The Role of Solar and Space Physics in Space Exploration Initiative
Marcia Neugebauer *(Chair, SSB Committee on Solar and Space Physics, Jet Propulsion Laboratory, Pasadena, CA)*

Astronomy from a Lunar Base
Andrea K. Dupree *(Space Studies Board Member, Solar and Stellar Physics Division, Harvard-Smithsonian Center for Astrophysics, Cambridge, MA)*

This symposium will explore the national purpose underlying President Bush's stated goal of a long-term program of human exploration of space, the international implications, the place within the overall research goals of the nation, and the role of science in the Human Exploration Initiative (HEI). The first session will focus on the policy aspects of the HEI proposal, while the second will address the role of science within HEI. The latter session will present the results of a study presently under way by the Space Studies Board of the National Research Council. The purpose of this study is to identify the scientific information needed to successfully undertake a program of human exploration and also the science that would be enabled by such a program.

[**Sponsor:** AAAS Section E. **Cosponsors:** AAAS Sections B, D and M.]

14-4. The Rationale for Human Exploration of Mars

Organized by: **Louis Friedman** *(The Planetary Society, Pasadena, CA)*

8:30 am / Mon / 18 Feb **Omni Shoreham / Diplomat**

Presiding: Louis Friedman

Discussants:
Richard Garwin *(IBM Research Division, Thomas J. Watson Research Center, Schenectady, NY)*, Michael Carr *(U.S. Geological Survey, Menlo Park, CA)*, Michael Collins *(Washington, DC)*, and Robert Brown *(Space Telescope Science Institute, Baltimore, MD)*

President Bush's human space exploration initiative would establish a permanent presence by Americans on the moon and then send Americans on to Mars by 2019, the 50th anniversary year of the first Apollo moon landing. In his 1991 budget, the president proposed initial funds for studies and technology development and directed that early discussion begin with potential international partners in Europe, Japan, Canada, the Soviet Union, and other nations.

To date, only a cursory examination of why the United States should undertake such a large program has been made. It may be that the program will be the largest scientific/technology project in history. Cost estimates of up to $500 billion have been cited for a human space exploration initiative meeting the administration's goals. This would be a major demand on the discretionary part of the national budget and must be considered in the context of other national priorities. This session will provide an opportunity for in-depth examination, as well as for consideration of how rationale might relate to program objectives, technical approaches, milestones, international participation, scientific value, and value to U.S. science policy. The political and public perceptions will also be considered.

[**Sponsors:** AAAS Section D; The Planetary Society.]

14-5. Science with the Hubble Space Telescope

Organized by: **Eric Chaisson** *(Scientist, Space Telescope Science Institute, Baltimore, MD)* and **Colin Norman** *(Astronomer, Space Telescope Science Institute, Baltimore, MD)*

8:30 am / Tue / 19 Feb **Omni Shoreham / Palladian**

Presiding: Eric Chaisson

Early Results with the Wide Field Camera
James Westphal *(California Institute of Technology, Pasadena, CA)*

Early Results with the Faint Object Camera
F. Duccio Macchetto *(European Space Agency/Space Telescope Science Institute, Baltimore, MD)*

Early Results with the Goddard High-resolution Spectrograph
John Brandt *(Univ. of Colorado, Boulder, CO)*

Early Results with the Faint Object Spectrograph
Richard Harms *(Applied Research Corp., Landover, MD)*

Early Results with the High-speed Photometer
Robert Bless *(Washburn Observatory, Univ. of Wisconsin, Madison, WI)*

Early Results with the Fine Guidance Sensors
William Jeffreys *(Astronomy Dept., Univ. of Texas, Austin, TX)*

Discussants:
Albert Boggess *(Goddard Space Center, Greenbelt, MD)*, Riccardo Giacconi *(Space Telescope Science Institute, Baltimore, MD)*, Colin Norman, Robert O'Dell *(Rice Univ., Houston, TX)*, and Edward Weiler *(NASA Headquarters, Washington, DC)*

Despite a flaw in its optical system, the Hubble Space Telescope has begun to produce a steady stream of first-class, unique science. The vehicle is alive and well in low-earth orbit and, after a period of several months of orbital and science verification, has entered its

operational era. This symposium will (1) report on the status of the space telescope, including each of its science instruments; (2) report on and discuss a spectrum of early scientific results from the telescope; (3) disseminate and place into broad context the essence of the space telescope mission and the nature of its early results; (4) speak to the issue of the many varied benefits — intellectual, cultural, and educational — arising from the project; and (5) share with the audience a sampling of the future scientific goals and objectives for the space telescope.

15. Geoscience; Climate

15-1. Human Response to Sea-Level Rise

Organized by: **David R. Stoddart** *(Professor and Chairman, Dept. of Geography, Univ. of California, Berkeley, CA)* and **Joanna C. Ellison** *(Doctoral Student, Dept. of Geography, Univ. of California, Berkeley, CA)*

2:30 pm / Sun / 17 Feb **Omni Shoreham / Capitol**

Presiding: Robert J. N. Devoy *(Lecturer, Dept. of Geography, Univ. College, Cork, Ireland)*

Global Eustatic Sea-Level Changes: Causes, Trends, Perspectives
Nils-Axel Morner *(Professor, Paleogeophysics and Geodynamics, Stockholm Univ., Stockholm, Sweden)*

Human Response to Sea-Level Rise in Prehistoric and Historic Times
Michael J. Tooley *(Lecturer, Dept. of Geography, Univ. of Durham, Durham, UK)*

Sea-Level Rise and Small-Island States
David R. Stoddart

Sea-Level Rise and the Maldive Islands, Indian Ocean
Alisdair Edwards *(Lecturer, Dept. of Biological Sciences, Univ. of Newcastle upon Tyne, Newcastle upon Tyne, UK)*

Consequences of Sea-Level Rise in Bermuda
Joanna C. Ellison

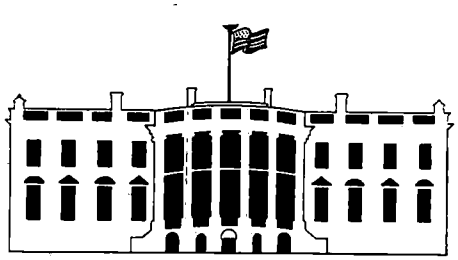
8:30 am / Mon / 18 Feb **Omni Shoreham / Capitol**

Presiding: Joanna C. Ellison

Social, Economic, and Political Projections in Small-Island States
Tim P. Bayliss-Smith *(Lecturer, Dept. of Geography, Univ. of Cambridge, Cambridge, UK)*

Consequences to Northwest Europe
Ian Shennan *(Lecturer, Dept. of Geography, Univ. of Durham, Durham, UK)*

Coastal Zone Management in The Netherlands
Robbert Misdorp *(Senior Scientist, Ministry of Transport and Public Works, The Hague, The Netherlands)*



Human Responses to Sea-Level Rise in the British Isles
Robert J. N. Devoy

Defense Against Sea-Level Rise, Venice, Italy
Paolo A. Pirazzoli *(Research Scientist, Laboratoire de Géographie Physique, Centre National de la Recherche Scientifique, Meudon-Bellevue, France)*

2:30 pm / Mon / 18 Feb **Omni Shoreham / Capitol**

Presiding: David R. Stoddart

Stabilization versus Retreat: New York and Eastern Mediterranean Examples
Victor Goldsmith *(Associate Professor, Dept. of Geology and Geography, Hunter College, City Univ. of New York, New York, NY)*

Future Sea-Level Rise in Chesapeake Bay: Implications for Shore Erosion and Marsh Loss in a Rapidly Urbanizing, Subsiding Coast
Michael S. Kearney *(Assistant Professor, Dept. of Geography, Univ. of Maryland, College Park, MD)*

Human Response to Sea-Level Rise: The Louisiana Experience
Denise J. Reed *(Research Scientist, Louisiana Universities Marine Consortium, Chauvin, LA)*

Human Response to Sea-Level Rise in Southeast Asia
Eric Bird *(Professor and Chairman, Dept. of Geography, Univ. of Melbourne, Melbourne, Australia)*

Sea-Level Rise in the Yellow River Delta: Implications and Response Strategies
Mei-e Ren *(Professor, Dept. of Geo and Ocean Sciences, Nanjing Univ., Nanjing, PRC)*

This symposium examines the social, economic, and political implications of societal responses to a projected sea-level rise anticipated to result from global warming and locally exacerbated by tectonic subsidence. Major impacts include coastal erosion, flooding of low-lying coastal areas, ecosystem disruption, probable population relocation, and attendant economic consequences. Societal responses of coastal communities, governments, and international agencies may include population relocation, sectorial economic adjustment, coastal defense and other engineering measures, and changes in wetland utilization and management. The treatment will be global, including both developing and developed nations, and will vary in scale from consideration of small-island oceanic states to that of densely populated deltaic lowlands in Asia and North America.

[**Sponsors:** AAAS Sections E and W. **Cosponsors:** AAAS Sections G, M, and X.]

15-2. Coastal Erosion Zone Management

Organized by: **Stephen P. Leatherman** *(Director and Professor, Laboratory for Coastal Research, Univ. of Maryland, College Park, MD)*

2:30 pm / Fri / 15 Feb **Omni Shoreham / Capitol**

Presiding: Stephen P. Leatherman and Mike Buckley

New Jersey's Rocks, Concrete, and Sand: Consequences of the Structured Shoreline Approach
Stewart Farrell *(Professor and Director, Coastal Research Center, Stockton State College, Pomona, NJ)*

Maintaining the Soft Interface: Florida's Commitment to Beach Nourishment
Robert Dean *(Graduate Research Professor, Dept. of Coastal and Oceanographic Engineering, Univ. of Florida, Gainesville, FL)*

Louisiana's Disappearing Shores: America's Coastal Erosion Hot Spot
Mark Byrnes *(Research Scientist, Louisiana Geological Survey, Louisiana State Univ., Baton Rouge, LA)*

California Sun, Surf, and Sand: The Myth and Reality of Shoreline Maintenance
Reinhard Flick *(Oceanographer, California Dept. of Boating and Waterways, Scripps Institution of Oceanography, La Jolla, CA)*

Living on the Edge: A Great Lakes Dilemma
William Wood *(Professor of Civil Engineering, Purdue Univ., West Lafayette, IN)*

Thirty of the nation's 50 states have coastlines on the Atlantic and Pacific Oceans, the Gulf of Mexico, and the Great Lakes. These 30 states contain approximately 85 percent of the nation's population; about half of this population resides in the coastal zone. Continued population growth is projected in the future, with a greatly increasing demand for beachfront development. At present, there is considerable public concern over coastal erosion, erosion control measures, and land use regulations. Coastal construction practices and governmental policies often have not reflected the risk and long-term cost of building along a retreating shoreline. A rich data set of historical shoreline positions exists for the U.S. coasts from which erosion rates can be determined. Coastal erosion is a national problem, and the U.S. Congress is considering the means to incorporate erosion information into the overall federal flood insurance program.

[**Sponsor:** AAAS Section E. **Cosponsor:** AAAS Section W.]

15-3. Impacts of the Climate During the 1980s in the United States

Organized by: **Stanley A. Changnon** *(Chief Emer., Illinois State Water Survey, Champaign, IL)*

8:30 am / Fri / 15 Feb **Omni Shoreham / Ambassador**

Presiding: Stanley A. Changnon

Major Climate Events of the 1980s in the United States
Thomas R. Karl *(Chief, Global Climate Laboratory, National Climatic Data Center, NOAA, Asheville, NC)*

How We Dealt with Climate Surprises of the 1980s
William E. Riebsame *(Director, Natural Hazards Center, Univ. of Colorado, Boulder, CO)*

Climate and Agricultural Comparative Advantage in the Western Corn Belt: Patterns and Prospects
William E. Easterling *(Fellow, Resources for the Future, Washington, DC)*

Agribusiness Use of Climate Information in the 1980s
Steven T. Sonka *(Professor of Agricultural Management, Univ. of Illinois, Champaign, IL)*

Can We Do Climate Impact Analysis?
Peter J. Lamb *(Professor, Depts. of Atmospheric Sciences and Geography, Univ. of Illinois, Champaign, IL)*

The 1980s were marked by a series of extreme climatic fluctuations unlike those of several prior decades. These included prolonged wetness during 1981–85, record droughts in 1987–89, and excessive storminess during the decade. The symposium will (1) describe these fluctuations, rate them in a historic context, and assess their causes; (2) define the major socioeconomic impacts that occurred in agriculture, water supply, and natural resources management; and (3) ascertain the effects on national and state policies, with particular reference to the global climate change issue. This interdisciplinary session will involve atmospheric scientists, economists, agricultural scientists, and geographers.

[**Sponsors:** AAAS Sections K and W. **Cosponsors:** AAAS Section E; AAAS Committee on Science, Engineering, and Public Policy.]

Technical Sessions

15T-1. Impacts of Climate in Regions of the United States

Organized by: **Stanley A. Changnon** *(Chief Emer., Illinois State Water Survey, Champaign, IL)*

2:30 pm / Mon / 18 Feb **Omni Shoreham / Calvert**

Presiding: Stanley A. Changnon

How Climate Affects Activities in the Southeastern United States
Peter J. Robinson *(Associate Professor, Dept. of Geography, Univ. of North Carolina, Chapel Hill, NC)*

An Assessment of the Impacts of Recent Climate Variability on the Northeast
Warren W. Knapp *(Director, Northeast Regional Climate Center, Cornell Univ., Ithaca, NY)*

Aspects of Soil Moisture in the Midwestern United States
Kenneth E. Kunkel *(Director, Midwestern Climate Center, Illinois State Water Survey, Champaign, IL)*

Regional Climate Center Monitors Weather Impacts on the High Plains
Kenneth G. Hubbard *(Director, High Plains Climate Center, Univ. of Nebraska, Lincoln, NE)*

Climate Issues in the Western United States
Kelly T. Redmond *(Regional Climatologist, Western Regional Climate Center, Reno, NV)*

Our Climate Is Perfect
Arnold Court *(Professor Emer. of Climatology, California State Univ., Northridge, CA)*

This session delves into the various aspects of the climate of the United States, focusing on its unique regional aspects and how these climates have affected man's activity and the environment. The varying climates of the United States are extreme, ranging from deserts to semitropical zones, and this variation has provided a unique set of effects on all human endeavors in the development of our nation. Understanding how climatic effects are measured and quantified has been difficult and will be explored in this session. The session will also examine the regional climate and what we know of its effects in the context of climate change. Attempting to develop a policy to deal with the potential future climate change belies an understanding of the current climate and the potential effects of

future climate on current activities. This session will attempt to put perspective on those aspects of the climate change issue. Speakers represent an interdisciplinary group of scientists, including geographers, atmospheric scientists, and economists.

[**Sponsor:** AAAS Section W. **Cosponsor:** AAAS Section E.]

15T-2. Earthquake Prediction and Validation

Organized by: **Paul Switzer** *(Professor, Dept. of Statistics, Stanford Univ., Stanford, CA)* and **Allan G. Lindh** *(Seismologist, U.S. Geological Survey, Menlo Park, CA)*

8:30 am / Mon / 18 Feb **Omni Shoreham / Calvert**

Presiding: Paul Switzer

Optimization in Earthquake Prediction
George M. Molchan *(Research Scientist, Institute of Earthquake Prediction Theory and Mathematical Geophysics, Moscow, USSR)*

Stochastic Models of Seismicity and Risk
David Vere-Jones *(Professor, Institute of Statistics and Operations Research, Victoria Univ., Wellington, New Zealand)*

Current Limits to Earthquake Forecasting
Stu T. Nishenko *(Seismologist, U.S. Geological Survey, Denver, CO)*

Probabilities of Earthquakes in the San Francisco Bay Region
Allan G. Lindh

Do Seismicity Patterns Predict California Mainshocks?
Mark V. Matthews *(Graduate Student, Dept. of Statistics, Stanford Univ., Stanford, CA)*

Discussants:
Volodya I. Keilis-Borok *(Director, Institute of Earthquake Prediction Theory and Mathematical Geophysics, Moscow, USSR)* and Bernard J. Minster *(Institute of Geological and Planetary Physics, Scripps Institute of Oceanography, La Jolla, CA)*

This technical session will provide a forum for statisticians and geophysicists working on empirical earthquake prediction to compare approaches and methodologies. In particular, it will allow Soviet workers to present their ongoing predictions from around the world and their published prediction from before the 1989 Loma Prieta earthquake. The session will contrast predictions that are specific in time and place — with probabilistic techniques that specify only probability density functions in space and time — with the Soviet techniques that are nonspecific in space but identify "alarm windows" or times of increased probability. All speakers will attempt to address the very difficult question of how such diverse predictions can be validated in a field where the prior historical data set is small, incomplete, and uncertain, and where the possibilities of doing controlled experiments are very limited. In particular, the question will be addressed whether, given the present level of the state of the art, probabilistic earthquake predictions should be considered statistically rigorous formulations, or be treated as subjectively derived "summaries of expert opinion."

[**Sponsor:** AAAS Section U. **Cosponsors:** AAAS Section E; American Statistical Association; Biometric Society; Institute of Mathematical Statistics.]



15T-3. Global Change and the Carbon Cycle in Terrestrial Ecosystems

Organized by: **Robert K. Dixon** *(Team Leader, Global Change Research Program, U.S. Environmental Protection Agency, Corvallis, OR)* and **David P. Turner** *(Project Leader, Global Change Research Program, NSI Technology Services, Inc., Corvallis, OR)*

2:30 pm / Sun / 17 Feb **Omni Shoreham / Executive**

Presiding: Robert K. Dixon

The Global Carbon Cycle
George M. Woodwell *(Director, Ecosystem Center of the Marine Biological Laboratory, Woods Hole, MA)*

Greenhouse-Gas–Induced Climatic Change
Michael E. Schlesinger *(Professor, Dept. of Atmospheric Science, Univ. of Illinois, Urbana, IL)*

Modeling the Role of Terrestrial Ecosystems in the Global Carbon Cycle
William R. Emanuel *(Senior Scientist, Environmental Science Division, Oak Ridge National Laboratory, Oak Ridge, TN)*

Response of Global Vegetation to Climate Change: Modeling Temporal Patterns
Allen M. Solomon *(Professor, School of Forestry and Wood Products, Michigan Technological Univ., Houghton, MI)*

Climatic Change and Disturbance Regimes: Carbon Flux to Atmosphere
Ronald P. Neilson *(Associate Professor, Dept. of General Science, Oregon State Univ., Corvallis, OR)*

CO_2 Fertilization: A Potential Negative Feedback on Rising CO_2
Bert G. Drake *(Staff Scientist, Smithsonian Environmental Research Center, Edgewater, MD)*

Reforestation to Mitigate Rising CO_2
Roger A. Sedjo *(Senior Fellow and Director, Forest Economics and Policy Program, Resources for the Future, Washington, DC)*

The accumulation of greenhouse gases (e.g., CO_2) in the atmosphere is predicted to alter global climate. General circulation model simulations of atmospheric chemistry and physics reveal a warming of the troposphere and changes in the amount and distribution of precipitation. The sources, sinks, and dynamics of greenhouse gases in the atmosphere and subsequent climatic change are influenced by the terrestrial biosphere. Responses and feedbacks of the biosphere to climatic change are significant. For example, the terrestrial biosphere is a substantial carbon pool and accounts for approximately 100 Gt carbon flux annually between terrestrial ecosystems and the atmosphere. In comparison, the annual flux of carbon from anthropogenic sources to the atmosphere is approximately 5Gt annually. Preliminary evidence suggests the terrestrial biosphere could be managed to reduce anthropogenic and biogenic emissions as well as to sequester greenhouse gases and mitigate global climatic change.

[**Cosponsors:** AAAS Sections C, E, and G.]

16. Global Change

16-1. Making Informed Decisions for Planet Earth: The Role of Satellite Observations

Organized by: **Philip H. Abelson** *(Science Advisor, AAAS, Washington, DC)*, **Gerald Soffen** *(National Aeronautic and Space Administration, Washington, DC)*, and **Paul F. Uhlir** *(Senior Program Officer, National Academy of Sciences, Washington, DC)*

2:30 pm / Fri / 15 Feb **Omni Shoreham / Ambassador**

Presiding: Philip H. Abelson

International Responses to Environmental Concerns
Robert A. Reinstein *(Deputy Assistant Secretary for Environment, Health, and Natural Resources, U.S. Dept. of State, Washington, DC)*

International Environmental Programs
S. Ichtiaque Rasool *(Director, International Geosphere-Biosphere Program Data and Information Systems Office, Paris, France)*

U.S. Global Change Research Program
Dallas Peck *(Director, U.S. Geological Survey, Reston, VA)*

Satellite Observations for Global Change Research
D. James Baker *(President, Joint Oceanographics Institute, Inc., Washington, DC)*

8:30 am / Sat / 16 Feb **Omni Shoreham / Ambassador**

Presiding: Gerald Soffen

What Are the Key Questions?
John A. Eddy *(Director, Office for Interdisciplinary Earth Study, University Corporation for Atmospheric Research, Boulder, CO)*

Physics
J. Michael Hall *(Director, Office of Global Programs, National Oceanographic and Atmospheric Administration, Washington, DC)*

Biology
Harold A. Mooney *(Professor, Dept. of Biological Sciences, Stanford Univ., Palo Alto, CA)*

The Data Management Challenge
Lisa R. Shaffer *(Senior Policy Scientist, The Earth Science Support Office, Washington, DC)*

Modeling and Prediction
Robert Dickenson *(Institute of Atmospheric Physics, Univ. of Arizona, Tucson, AZ)*

2:30 pm / Sat / 16 Feb **Omni Shoreham / Ambassador**

Presiding: Paul F. Uhlir

Integrating Diverse Data Sets for Policymakers
Jack R. Lousma *(President, Consortium for an International Earth Science Information Network, Ann Arbor, MI)*

Applications of Satellite Data and Information in the U.S.: Policy Formation and Land-Use Planning
James W. Merchant *(Associate Director, Center for Advanced Land Management Information Technologies, Univ. of Nebraska, Lincoln, NE)*

The Use of Satellite Observations for Improving Environmental Decisionmaking in Less-developed Countries
Jonathan T. Olsson *(Agency for International Development, Dept. of State, Washington, DC)*

The Role of Earth Observation Satellites in the Development and Enforcement of International Environmental Agreements
Paul F. Uhlir

The first session of this symposium will survey international policy responses to concerns about the environment. Speakers will describe international research programs that have been launched to measure environmental changes and address the status and objectives of the U.S. global change program. The session will also describe the kinds on information that have been provided by earlier and existing environmental satellites and then project what is expected from planned spacecraft.

A second session will be devoted to earth system science, beginning with an overview of the scientific questions that must be answered to provide relevant information for modelers and policymakers. The questions include physics- and biology-oriented matters and how satellite data are to be combined with ground-based observations to create a solid framework of information. Already a large amount of data has been accumulated. Enormous quantities will pour forth in the future. The successful management of related data and information systems will require solving challenging technical and policy issues. One speaker will survey the current status of modeling and prediction and indicate future trends and goals.

A final session will be devoted to potential use of satellite data by policymakers for responding to environmental changes. If the greenhouse effects are real and substantial, the economic stakes involved in countering them may be enormous. Who wins and who loses? How might applications of satellite data and information affect environmental management in the United States? How might satellite data be used in less developed countries? What might be the role of earth observation satellites in the development of international environmental agreements?

[**Sponsors:** AAAS Directorate for International Programs; Interciencia Association.]

16-2. Humankind in Global Change: Indicators and Prospects

Organized by: **Elizabeth J. Kirk** *(Senior Program Associate, Directorate for International Programs, AAAS, Washington, DC)* and **Thomas Malone** *(Scholar-in-Residence, St. Joseph College, West Hartford, CT)*

8:30 am / Sun / 17 Feb **Omni Shoreham / Ambassador**

Population Change: Present Indicators and Future Trends

Presiding: Robert Kates *(Director, Allen Shawn Feinstein World Hunger Program, Brown Univ., Providence, RI)*

Population Trends and Models
Paul Demeny *(Distinguished Scholar, The Population Council, New York, NY)*

National and Transnational Migration Patterns (Including Environmental Refugees)
Michael Teitelbaum *(Program Officer, Alfred P. Sloan Foundation, New York, NY)*

Changing Scales of Urbanization and Migration in the Third World
Sally E. Findley *(Associate Professor, Center for Population and Family Health, Columbia Univ., New York, NY)*

The Labor Force of the Future and the Role of Women in It: Current Trends and Future Prospects
Paul T. Schultz *(Director, Economic Growth Center, Yale Univ., New Haven, CT)*

Population, Production, and Consumption
William C. Clark *(The Kennedy School of Government, Harvard Univ., Cambridge, MA)*

2:30 pm / Sun / 17 Feb Omni Shoreham / Ambassador

Production: The Changing Resource Base

Presiding: Daniel Radell *(Professor and Interim Chairperson, Accounting and Administration Systems, Winston-Salem State Univ., Winston-Salem, NC)* and Alan Porter *(Professor, Dept. of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, GA)*

Production of Goods and Services: Towards a Sustainable Future
Robert Ayers *(Professor, Dept. of Engineering and Public Policy, Carnegie Mellon Univ., Pittsburgh, PA)*

The Environmental Impact of Production on Regions of the World: Distribution Issues in Human Settlement
Michaela Smith *(Secretariat of Commonwealth Science Council, London, UK)*

Biological Diversity and the Changing Resource Base
Thomas Lovejoy *(Assistant Secretary for External Affairs, Smithsonian Institution, Washington, DC)*

Technological Change and Global Change
Alan Porter

Fields, Fisheries, Grasslands, and Forests: Towards More Regenerative Systems
Kenneth Dahlberg *(Professor, Dept. of Political Science, Western Michigan Univ., Kalamazoo, MI)*

8:30 am / Mon / 18 Feb Omni Shoreham / Ambassador

Consumption: Trends and Trade-offs

Presiding: David Wiley *(Professor of Sociology and Director of African Studies Program, Michigan State Univ., East Lansing, MI)*

Population Tectonics of Energy Consumption
Barbara Boyle Torrey *(Chief, Center for International Research, U.S. Bureau of the Census, Washington, DC)*

How Much Is Enough? Consumption and Overconsumption
Alan Durning *(Senior Researcher, WorldWatch Institute, Washington, DC)*

The Political Economics of Environmental Problems and Policies
Allan Schnaiberg *(Professor, Dept. of Sociology, Northwestern Univ., Evanston, IL)*

The Effects of Global Change on Meeting Future Food Needs
Robert Chen *(Professor, World Hunger Project, Brown Univ., Providence, RI)*

2:30 pm / Mon / 18 Feb Omni Shoreham / Ambassador

Human Attitudes and Values Related to Global Change

Presiding: Dennis Pirages *(Professor, Dept. of Government and Politics, Univ. of Maryland, College Park, MD)*

Economic Values for a Sustainable Future
Peter Soderbaum *(Professor, Dept. of Economics, The Swedish Univ. of Agricultural Sciences, Uppsala, Sweden)*

Cultural Factors and Attitudes Towards Global Change
Lourdes Arzipe *(Professor, Centro Legionale Estudios, Universidad Autónoma de Mexico, San Angel, Mexico)*

Postmaterialism and Environmentalism: Persistence and Change
Ronald Inglehart *(Professor of Political Science, Univ. of Michigan, Ann Arbor, MI)*

Value and Attitude Change: Evidence from Eastern Europe and the Soviet Union
Ronald Hinckley *(Director, Office of Research, U.S. Information Agency, Washington, DC)*

Unnatural Selection: Industrial Values and the Future of Modernization
Dennis Pirages

8:30 am / Tue / 19 Feb Omni Shoreham / Ambassador

Human Institutions and Global Change: Roles and Challenges for the Future

Presiding: Harold Jacobson *(Director, Center for Political Studies, Institute of Global Research, Univ. of Michigan, Ann Arbor, MI)*

Intergovernmental Institutions
Peter Haas *(Assistant Professor of Political Science, Univ. of Massachusetts, Amherst, MA)*

International Nongovernmental Institutions
Helen Ingram *(Professor of Political Science and Director, Udall Center, Univ. of Arizona, Tuscon, AZ)*

National, State, and Local Institutions
Chad Alger *(Senior Faculty Associate and Acting Director of the University Center for International Studies, Ohio State Univ., Columbus, OH)*

International Collaboration in Science and Symbol, Myth, and Substance
Harold Jacobson and Roberta Balstad Miller *(Director, Division of Social and Economic Science, National Science Foundation, Washington, DC)*

International Scientific Organizations
Mary Martha Treichel *(Director, Committee on International Organizations and Programs, National Research Council, Washington, DC)*

2:30 pm / Tue / 19 Feb Omni Shoreham / Ambassador

Implications for the Natural and Social Sciences, Technology, and Society

Presiding: Richard Rockwell *(Staff Associate, Social Science Research Council, New York, NY)*

Implications for Science and Technology Policy
Robert W. Corell *(Assistant Director for Geoscience, National Science Foundation, Washington, DC)*

Implications for the Educational System
Allan Mazur *(Professor of Social Science, Syracuse Univ., Syracuse, NY)*

Implications for Interdisciplinary Research Agendas
Nazli Choucri *(Professor of Political Science and Associate Director, Technology and Development Program, MIT, Cambridge, MA)*

Implications for Linking Science to Policy
Richard H. Moss *(Lecturer, Public and International Affairs, Princeton Univ., Princeton, NJ)*

Developing Long-term Local, National, and International Policy Goals and Strategies for a Sustainable Planet
Dan Tunstall *(Senior Associate, World Resources Institute, Washington, DC)* and Janet Welsh Brown *(Senior Associate, World Resources Institute, Washington, DC)*

The Consortium of Affiliates for International Programs (CAIP) of the AAAS is sponsoring this three-day, six-session symposium that will focus on the fundamental forces driving global change and the implications of these for science, technology, and society over the next several decades. The purpose of the symposium is not to report trends and approaches to areas of global change but instead to focus the attention of scientists, technologists, policymakers, and grass-roots movements on exploring feasible resolutions of the problems at hand and on defining where science and technology have important roles to play.

The symposium is divided into six sessions: (1) Population Change: Present Indicators and Future Trends; (2) Production: The Changing Resource Base; (3) Consumption: Trends and Trade-offs; (4) Human Attitudes and Values Related to Global Change; (5) Human Institutions and Global Change: Roles and Challenges for the Future; and (6) Implications for the Natural and Social Sciences, Technology, and Society.

[**Sponsor:** AAAS Consortium of Affiliates for International Programs. **Cosponsors:** AAAS Section H; AAAS Committee on Science, Engineering, and Public Policy.]

16-3. Science in Africa: Achievements and Prospects

Organized by: **Amy Auerbacher Wilson** *(Director, Sub-Saharan Africa Program, Directorate for International Programs, AAAS, Washington, DC)*

8:30 am / Fri / 15 Feb **Omni Shoreham / Blue Room**

Presiding: Walter E. Massey *(Vice President for Research and for Argonne National Laboratory, Univ. of Chicago, Chicago, IL)*

Three Decades of Science: Quantum Achievements and the Context for Future Advances
Thomas R. Odhiambo *(President, African Academy of Sciences, and Director, The International Centre of Insect Physiology and Ecology, Nairobi, Kenya)*

The Potential of Endod, the Ethiopian Soapberry Plant, for Control of Schistosomiasis
Aklilu Lemma *(Deputy Director, International Child Development Centre, UNICEF, Florence, Italy)*

Understanding Hemoglobins and Sickle Cell Disease in the Progress Towards Therapy
Gabriel B. Ogunmola *(Professor of Chemistry, Univ. of Ibadan, Ibadan, Nigeria)*

The *Anopheles gambiae* Complex in West Africa
Yeya Ttiemoko Touré *(Director General, National Centre for Science and Technology Research, Bamako, Mali)*

Discussant:
C. J. Chetsanga *(Dean of Science, Univ. of Zimbabwe, and Chairman, Research Council of Zimbabwe, Harare, Zimbabwe)*

2:30 pm / Fri / 15 Feb **Omni Shoreham / Blue Room**

Presiding: Thomas R. Odhiambo

Agricultural Research for Sustainable Development in Africa: Building Institutional and Technological Capacity
Bede N. Okigbo *(Director, United Nations University Programme on Natural Resources in Africa, New York, NY)*

Conservation and Utilization of Crop Genetic Resources: An Ethiopian Perspective
Melaku Worede *(Director, Plant Genetic Resources Centre, Addis Ababa, Ethiopia)*

Nuclear Techniques and Solar Energy: A Quest for Sustainable Development in Africa
Malu wa Kalenga *(Professor, Faculty of Applied Sciences, Univ. of Zaire, Kinshasa, Zaire)*

Panel Discussion on Science and Technology in Africa: Policy Strategies for Continued Success

Panel Chair
C.J. Chetsanga

Panelists:
Lydia P. Makhubu *(Vice-Chancellor, Univ. of Swaziland, Kwaluseni, Swaziland)*, Thomas R. Odhiambo, Bede N. Okigbo, and Yeya Ttiemoko Touré

For the AAAS Sub-Saharan Africa Program, one of the most important realizations gleaned from years of collaboration with African colleagues has been the high quality of their research and its extensive contributions to African development. These impressive accomplishments are occasionally recognized but too often go unnoticed at home and abroad. Exceptional scientific talents exist in Africa and, with appropriate recognition and support, will have future growth and productivity. This symposium is intended to increase awareness of the success and importance of science in Africa. It will highlight several African scientists' achievements that have made a significant impact on science and technology within Africa and have affected the world scientific community. Opening remarks by Odhiambo place these achievements in historical and cultural context. Individual presentations follow, covering research in the biomedical sciences as well as research related to the sustainable use of natural resources. A concluding panel discusses the policy implications of this work, pointing to future needs for science and technology in Africa. With support from the Carnegie Corporation of New York, this symposium was organized by an advisory group of U.S. and African scientists chaired by Massey, former president of AAAS, and Odhiambo.

[**Sponsor:** AAAS Directorate for International Programs. **Cosponsor:** AAAS Consortium of Affiliates for International Programs.]

AAAS☆91 Exhibition
Sheraton Washington, Exhibit Hall C
Hours: *Friday, 6pm-8pm*
Saturday-Monday, 9am-3pm

16-4. Science, Technology, and Third World Economic Security

Organized by: **Cyril Ponnamperuma** *(Science and Technology Advisor to the President of Sri Lanka, Colombo, Sri Lanka)*

8:30 am / Sat / 16 Feb **Omni Shoreham / Palladian**

Presiding: Abdus Salam *(President, Third World Academy of Sciences, Trieste, Italy)*

The Role of the World Bank
David Hopper *(Former Vice President, World Bank, Washington, DC)*

The Role of International Research Network
Nyle Brady *(Former Science Advisor, U.S. AID, Washington, DC)*

The Role of Private Foundations
Ken Pruitt *(Vice President, Rockefeller Foundation, Washington, DC)*

2:30 pm / Sat / 16 Feb **Omni Shoreham / Palladian**

Presiding: George Bugliarello *(President, Polytechnic Institute, New York, NY)*

What the North Can Do for the South
Abdus Salam

The Third World Perspective
Cyril Ponnamperuma

The African Perspective
Thomas Odhiambo *(President, African Academy of Sciences, and Director, The International Centre of Insect Physiology and Ecology, Nairobi, Kenya)*

The Asian Perspective
G. K. Menon *(Minister of Science and Technology, Government of India, and President, International Council of Scientific Unions, New Delhi, India)*

The Latin American Perspective
Francisco Sagusti *(World Bank, Washington, DC)*

The Far Eastern Perspective
Hyung-Ki Kim *(EDI Institute, World Bank, Washington, DC)*

It is generally accepted that the difference between the First World and the Third World, between the North and the South, and between the haves and the have nots is science and technology. This symposium will explore possible means of alleviating a world crisis through a massive transfer of science and technology from the North to the South.

16-5. What Are the Effects of Human Activity on the Global Ecosystem?

Organized by: **Warren M. Hern** *(Assistant Professor Adjunct, Dept. of Anthropology, Univ. of Colorado, Boulder, CO)* and **Priscilla Reining** *(Adjunct Professor, Center for African Studies, Univ. of Florida, Gainesville, FL)*

2:30 pm / Fri / 15 Feb **Omni Shoreham / Palladian**

Presiding: Roger Revelle *(Professor of Science and Public Policy, Program in Science, Technology, and Public Policy, Univ. of California, San Diego, La Jolla, CA)*

Global Climate Change: Ecosystems Effects
Stephen H. Schneider *(Head, Interdisciplinary Climate Systems, National Center for Atmospheric Research, Boulder, CO)*

Nonlinear Dynamics and Chaos: Implications for a Brave New World
William M. Schaffer *(Professor, Dept. of Ecology and Evolutionary Biology, Univ. of Arizona, Tucson, AZ)*

Catastrophe or Maturity in Century 21?
Kenneth E. Boulding *(Distinguished Professor of Economics, Emer., Institute of Behavioral Science, Univ. of Colorado, Boulder, CO)*

Description and Diagnosis of a Planetary Ecopathological Process
Warren M. Hern

Discussants:
Tim Wirth *(U.S. Senate, Washington, DC)* and Priscilla Reining

A general theory for describing the effects of human activities on the natural planetary ecosystem has not yet emerged. Such a theory will need to incorporate the social as well as natural sciences. This symposium will examine four conceptual approaches that singly or together should help determine whether there is planetary ecosystem instability related to phenomena such as rapid growth of the human population, global warming, desertification, deforestation, atmospheric ozone depletion, and changes in biodiversity. The approaches are (1) general systems theory, (2) interrelationships among the "big systems" (biogeochemical cycles) and the possible impact of rapid climatic change, (3) application of nonlinear dynamics in theoretical ecology, and (4) a new formulation of the impact of human population growth on the planetary ecosystem. A member of Congress and a scientist will discuss the applicability of these approaches to their respective areas of responsibility.

[**Sponsor:** AAAS Section H. **Cosponsors:** AAAS Sections A, E, G, J, K, and W; AAAS Southwestern and Rocky Mountain Division; AAAS Consortium of Affiliates for International Programs.]

17. Environment

17-1. The Role and Responsibilities of Scientists and Engineers in Environmental Debates

Organized by: **Amy Crumpton** *(Program Assistant, Directorate for Science and Policy Programs, AAAS, Washington, DC)* and **Sheldon Krimsky** *(Professor of Urban and Environmental Policy, Tufts Univ., Medford, MA)*

2:30 pm / Mon / 18 Feb **Omni Shoreham / Executive**

Presiding: Sheldon Krimsky

Balancing Professional Integrity and Public Advocacy in Environmental Debates
Phil Regal *(Professor of Ecology, Evolution, and Behavior, Univ. of Minnesota, Minneapolis, MN)*

Ethics, Responsibility, and Environmental Scientists and Engineers
Mark Sagoff *(Director, Institute for Philosophy and Public Policy, Univ. of Maryland, College Park, MD)*

Speaking Truth to Power: Communicating Environmental Risks to the Public
Ellen K. Silbergeld *(Professor of Toxicology, Univ. of Maryland, Baltimore, MD)*

Government Scientists and Engineers in Environmental Disputes
Howard G. Wilshire *(Geologist, U.S. Geological Survey, Menlo Park, CA)*

From an Engineer's Perspective
Speaker to be announced

This symposium will discuss the ethical dilemmas faced by scientists and engineers when they participate as professionals and/or private citizens in environmental debates. These dilemmas include conflicts of preserving professional and advocacy interest, addressing ecological or health risks faced with uncertain knowledge, retaining professional integrity while in the public eye, and simplifying complex issues to the media. With growing national and global awareness and sensitivity to the environment, it is timely to discuss these issues as they relate to scientists and engineers who increasingly participate in intense public debates on environmental problems. The ethical issues that confront these scientists and engineers represent larger questions concerning principles of scientific freedom and responsibility faced by scientists and engineers in other fields as well.

[**Sponsor:** AAAS Committee on Scientific Freedom and Responsibility. **Cosponsors:** AAAS Sections L, M, and X; AAAS Committee on Science, Engineering, and Public Policy.]

17-2. Science: A Basis for Environmental Policy?

Organized by: **S. Fred Singer** *(Professor of Environmental Sciences, Univ. of Virginia, Charlottesville, VA)*

8:30 am / Mon / 18 Feb Omni Shoreham / Congressional

Presiding: S. Fred Singer

Science Base for Global Warming
Patrick J. Michaels *(Associate Professor of Environmental Sciences, Univ. of Virginia, Charlottesville, VA)*

Science Base for Acid Precipitation
James R. Mahoney *(Director, National Acid Precipitation Assessment Program, Washington, DC)*

Stratospheric Ozone: Time Trends and Mechanisms
S. Fred Singer

New Controls for Urban Ozone: The Role of Science in the Congressional Debates
Robert M. Friedman *(Senior Associate, Office of Technology Assessment, Washington, DC)*

Health Benefits of Air Toxics Legislation
John D. Graham *(Associate Professor of Policy and Decision Sciences, Harvard School of Public Health, Boston, MA)*

Economics and the Regulation of Environmental Risks
Paul R. Portney *(Vice President and Senior Fellow, Resources for the Future, Washington, DC)*

Scientific information should be a major component in setting environmental policy — in writing legislation and regulations, in setting both ambient and emissions standards, and in monitoring and enforcement. Without science, it is virtually impossible to determine the benefits of environmental actions or to make comparative risk assessments. In actual practice, however, science is often ignored or even misused. Political benefits from environmental decisions fall upon different groups. The scientific input is weakened by extravagant claims that are not based on data or by extrapolations that exceed the power of available theories.

Symposium speakers will examine, through specific examples, how well government uses science in making environmental decisions. These case studies are then followed by a discussion of various aspects of the policy process: (1) science advice to government agencies; (2) cost-benefit analysis; (3) comparative risk analysis; and (4) sociology and psychology involving the motivation of different interest groups — scientific, environmental, governmental, business, and the media — all of them driving the policy process.

[**Sponsor:** AAAS Section X. **Cosponsor:** AAAS Section W.]

17-3. Is Superfund Working?

Organized by: **William F. Isherwood** *(Project Leader, Livermore Site Restoration Group, Lawrence Livermore National Laboratory, Livermore, CA)*

8:30 am / Tue / 19 Feb Omni Shoreham / Hampton

Presiding: William F. Isherwood

Superfund: Environmental Progress?
Henry L. Longest II *(Director, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, DC)*

Using Improved Technologies for Superfund Cleanups Remains a Critical Need
Joel S. Hirschhorn *(President, EnviroSearch-East, Washington, DC)*

Improving Superfund Through the Remedy Selection Process
Thomas P. Grumbly *(President, Clean Sites, Alexandria, VA)*

Environmental Protection, Resource Allocation, and CERCLA: A Practitioner's Perspective
Richard B. Weiss *(Principal Hydrogeologist, Weiss Associates, Emeryville, CA)* and Marvin Feldman *(Resource Decisions, San Francisco, CA)*

Implementing CERCLA
William F. Isherwood

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as Superfund) was passed in 1980 and amended and reauthorized in 1986 (SARA). Since that time, over 1200 sites have been placed on EPA's National Priority List and spending on environmental cleanup projects has skyrocketed, but only a handful of sites have been remediated. Why have we not made more progress? Is it because of the severity of the environmental problems in this country? Have we underestimated the time required to see results? Do we not have appropriate technology to solve our environmental problems? Or is it because the law and subsequent regulations (and guidance) are inadequate or misguided for the task? There is a perception that "conventional"

technologies are not capable of providing timely and cost-effective environmental solutions. As a result, several large research efforts are under way to develop smarter, cheaper, and faster cleanup technologies. It is critical that these efforts be guided by real needs and ordered on a rational basis. Reduction of public health risk seems the appropriate standard, but can current programs and funds being appropriated be justified on this basis?

[Sponsor: AAAS Section E. Cosponsor: AAAS Section G.]

17-4. Assessing the Impacts of Nuclear Waste Facilities: The State of the Art Updated

Organized by: **Roger E. Kasperson** *(Professor, Center for Technology, Environment, and Development, Clark Univ., Worcester, MA)*

2:30 pm / Sat / 16 Feb **Omni Shoreham / Executive**

Presiding: Roger E. Kasperson

Overview: The Social Amplification Process
Roger E. Kasperson

The Importance of Imagery as a Causal Factor
Paul Slovic *(Research Scientist, Decision Research, Eugene, OR)*

Political Trust and the Siting of Nuclear Waste Facilities
K. David Pijawka *(Associate Professor, School of Public Affairs, Arizona State Univ., Tempe, AZ)*

Economic Impacts of a Nuclear Waste Facility
Howard Kunreuther *(Riklis Professor in the Practice of Management, Univ. of Pennsylvania, Philadelphia, PA)*

Anticipated Social Consequences of a Nuclear Waste Facility
Joanne Nigg *(Professor and Director, Disaster Research Center, Univ. of Delaware, Newark, DE)*

Discussants:
Kai Erickson *(Professor of Sociology and American Studies, Yale Univ., New Haven, CT)* and Richard Stoffle *(Associate Research Scientist, Institute for Social Research, Univ. of Michigan, Ann Arbor, MI)*

Nuclear waste facilities pose new challenges to environmental impact analysis and risk analysis. Existing assessment methodologies either neglect risk-driven impacts or separate technical risk from related social effects. The framework of the social amplification of risk provides a more integrated approach within which various studies or perspectives can be located. This session reports on a series of studies undertaken to assess, in integrated fashion, the potential risk-related social impacts at the proposed Yucca Mountain radioactive waste repository. Taken together, this research demarcates important new directions in the social impact assessment of risky and controversial facilities.

[Sponsors: AAAS Sections K and X. Cosponsor: AAAS Section G.]

Plan now to attend
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17-5. Cleaning Up the Mess at the DOE Nuclear Weapons Complex

Organized by: **Peter A. Johnson** *(Senior Associate, Oceans and Environment Program, Office of Technology Assessment, Washington, DC)* and **Robert P. Morgan** *(Professor, Dept. of Engineering and Policy, Washington Univ., St. Louis, MO)*

8:30 am / Sat / 16 Feb **Omni Shoreham / Executive**

Presiding: Robert P. Morgan

Cleaning Up the Weapons Mess: The OTA Findings
Emilia L. Govan *(Senior Analyst, Oceans and Environment Program, Office of Technology Assessment, Washington, DC)*

The DOE Weapons Complex Cleanup: Evaluation of Health Impacts
Tara O'Toole *(Senior Analyst, Oceans and Environment Program, Office of Technology Assessment, Washington, DC)*

Citizen Participation in DOE Weapons Cleanup
Daniel W. Reicher *(Attorney, Natural Resources Defense Council, Washington, DC)*

Public Health Assessments: Progress and Prospects
Mark M. Bashor *(Associate Administrator, Federal Programs, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, Atlanta, GA)*

This symposium will explore various aspects of a major undertaking facing the United States, namely, cleaning up the legacy of radiological and chemical contamination at the Department of Energy's nuclear weapons sites, and managing and minimizing defense waste so that future contamination and potential threats to public health will not occur. The session will examine the overall status of the cleanup effort and future prospects. The results of a 16-month study by the Congressional Office of Technology Assessment of the weapons sites and prospects for cleanup will be presented, focusing on policy issues and options. The session will also address assessing and regulating public health aspects of the weapons complex. Topics to be explored include (1) oversight for health and safety, (2) estimating past exposures, (3) participation in decisionmaking by affected publics, (4) access to information, and (5) the size, scope, and responsibility of health effects research and assessments at the DOE weapons complex.

[Sponsor: AAAS Section X. Cosponsors: AAAS Section M; AAAS Committee on Science, Engineering, and Public Policy.]

Technical Sessions

17T-1. Meta-analysis and Risk Assessment: A Tool for the '90s?

Organized by: **Resha M. Putzrath** *(Project Manager, Environ Corp., Arlington, VA)* and **Michael E. Ginevan** *(Principal Scientist, Risk Focus Division, Versar, Inc., Springfield, VA)*

2:30 pm / Fri / 15 Feb **Omni Shoreham / Calvert**

Presiding: Resha M. Putzrath

A Review of Current Issues in Meta-analysis
Ingram Olkin *(Professor, Statistics & Education, Stanford Univ., Stanford, CA)*

Some Statistical Approaches to Combining Cancer Risk Coefficients
Michael E. Ginevan

Meta-analysis of Cancer Bioassays
Resha M. Putzrath

Meta-analysis as a Tool in Passive Smoking Studies
A. Judson Wells *(Kennett Square, PA)*

Meta-analysis of Potential Health Effects of Electric Fields
Kay T. Kimball *(Research Assistant Professor, Baylor College of Medicine, Houston, TX)*

A Meta-analysis of Health Effects Associated with Exposure to Electromagnetic Fields
Edward P. Washburn *(Research Specialist, Technology Assessment Group, Harvard School of Public Health, Boston, MA)*

A Meta-analysis of Human Cancer Risks Associated with Polychlorinated Biphenyls
William J. Nicholson *(Professor of Community Medicine, Mount Sinai School of Medicine, New York, NY)*

Meta-analysis is the analysis of analyses (i.e., it provides a quantitative method for combining results across studies without combining the data from the studies). Use of meta-analysis assumes that more accurate estimates of the magnitude of an effect of a phenomenon can be gained by using the knowledge from several studies rather than examining each study alone. Without meta-analysis, evaluation of large and complex data bases for risk assessment has usually been divided into two components: qualitative evaluation of the entire data base (i.e., the weight of evidence) and quantitative analysis of one or a few studies (selected as being "best" or "most representative"). Meta-analysis allows information from some or all of the remaining studies in the qualitative evaluation to be incorporated into the quantitative analysis. This session will introduce the concepts of meta-analysis, demonstrate (by case studies) practical applications of the technique, and illustrate how the proper use of this tool could affect policy decisions.

[**Cosponsors:** AAAS Section U; American Statistical Association; Biometric Society.]

17T-2. Proof of Environmental and Natural Resource Damages in Litigation

Organized by: **Daniel A. Bronstein** *(Professor, Dept. of Resource Development, Michigan State Univ., East Lansing, MI)* and **Bert Black** *(Attorney, Smith, Gambrell & Russell, Atlanta, GA)*

2:30 pm / Sun / 17 Feb **Omni Shoreham / Calvert**

Presiding: Daniel A. Bronstein

Introduction to the Example Case
Bert Black

Assessment of Cleanup Methods and Costs
Linda S. Wennerberg *(Consultant, Safety and Environmental Health, Arthur D. Little, Inc., Cambridge, MA)*

Litigated Values: The Economics of Natural Resource Damage Assessment
V. Kerry Smith *(University Distinguished Professor, Dept. of Economics, North Carolina State Univ., Raleigh, NC)*

Economic Assessment of Resource Damages
Alan Randall *(Professor, Ohio State Univ., Columbus, OH)*

A Plaintiff's Lawyer's Perspective
Ron Simon *(Attorney, Connerton, Ray & Simon, Washington, DC)*

A Government Lawyer's Perspective
Steve C. Gold *(Attorney, Environmental Enforcement Section, U.S. Dept. of Justice, Washington, DC)*

A Defense Lawyer's Perspective
Sherry Bragg *(Attorney, Dickson, Carlson & Campillo, Santa Monica, CA)*

The issue of evaluating and proving "environmental" or "natural resource" damages in the courts is receiving increasing attention as "superfund" cases and incidents such as the *Exxon Valdez* spill multiply. In this session, techniques presently used for that purpose and others currently under development will be presented by researchers and practitioners in the field. These techniques will then be discussed by three lawyers — representing the government, corporate, and private plaintiff positions — regarding their perceived utility, legal admissibility, and legal credibility (i.e., whether the lawyer believes a judge and/or jury would be able to understand them and find them convincing).

[**Sponsor:** AAAS Section K. **Cosponsor:** AAAS-ABA National Conference of Lawyers and Scientists.]

18. Popular Science

18-1. Chemistry Is Fun!

Organized by: **Jean'ne M. Shreeve** *(Professor of Chemistry, Univ. of Idaho, Moscow, ID)*

8:30 am / Mon / 18 Feb **Sheraton / Sheraton So.**

Presiding: Bassam Z. Shakhashiri *(Professor of Chemistry, Univ. of Wisconsin, Madison, WI, and National Science Foundation, Washington, DC)*

Chemistry Is Fun!
Bassam Z. Shakhashiri, Ethel Schultz *(Program Officer, Division of Teacher Preparation and Enhancement, National Science Foundation, Washington, DC)*, and Lois Nicholson *(Program Officer, Division of Teacher Preparation and Enhancement, National Science Foundation, Washington, DC)*

Chemistry — the central science — must be communicated to audiences of all ages in effective ways. Throughout this session, experienced teachers will share their excitement and concerns about teaching chemistry at the elementary, secondary, and collegiate levels as well as in informal settings. Spectacular demonstrations will be presented and hands-on experiments will be displayed and discussed.

[**Sponsor:** AAAS Section C.]

18-2. Science for the Naked Eye; or, The Physics of Everyday Experience, XVIII

Organized by: **Rolf M. Sinclair** *(Program Director, Physics Division, National Science Foundation, Washington, DC)*

8:30 am / Sun / 17 Feb **Sheraton / Sheraton So.**

Presiding: Rolf M. Sinclair

A Collection of Simple Physics Demonstrations
Robert Ehrlich *(Professor of Physics, George Mason Univ., Fairfax, VA)*

The Bird's-eye View
Jerry A. Waldvogel *(Assistant Professor of Biology, Clemson Univ., Clemson, SC)*

Movement and New Forms in Photography: Documentation and Measurement
Phillip Leonian *(Photographer, New York, NY)*

2:30 pm / Sun / 17 Feb **Sheraton / Sheraton So.**

Presiding: Rolf M. Sinclair

Mozart's Starling
Meredith J. West *(Professor of Psychology, Indiana Univ., Bloomington, IN)*

Art and the Computer
Donna Cox *(Associate Director for Education, National Center for Supercomputer Applications, Urbana, IL)*

Lightning and How to Avoid It
Charles B. Moore *(Professor Emer. of Physics, New Mexico Institute of Mining and Technology, Socorro, NM)*

A number of phenomena in our daily lives can raise — and answer — quite profound questions, once our senses have been guided by the scientist or artist. This symposium will include presentations of the science behind everyday experience and will be replete with demonstrations and examples. It will include how simple demonstrations can yield surprising and counterintuitive results; the rich world that birds see, so different from ours; how photography can bring out both the details and beauty of motion; how birds can charm and mimic humans; how the computer gives the visual artist a whole new palette of expressions; and what lightning is, and how we now know ways to avoid it.

[**Sponsor:** AAAS Section B.]

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18-3. Science, Technology, Intelligence, and Espionage

Organized by: **Albert H. Teich** *(Director, Science and Policy Programs, AAAS, Washington, DC)*, **Donald N. Langenberg** *(Chancellor, Univ. of Maryland, Adelphi, MD, and President, AAAS, Washington, DC)*, and **Jill H. Pace** *(Executive Director, American College of Real Estate Lawyers, Washington, DC)*

8:30 am / Mon / 18 Feb **Sheraton / Cotillion So.**

Presiding: Albert H. Teich

Space Espionage: New Directions for the '90s and Beyond
William E. Burrows *(Professor of Journalism and Director, Graduate Program in Science and Environmental Reporting, New York Univ., New York, NY; and author of* Deep Black)

Intelligence and the Private Sector
Kerry Grawe *(Surveillance Technology Group, Washington, DC)*

Computer Espionage
Clifford Stoll *(Smithsonian Astrophysical Laboratory, Cambridge, MA, and author of* The Cuckoo's Egg)

Periscopes to Perestroika: An Eastern Bloc View of Intelligence
Name withheld *(Former Agent, KGB)*

Discussant:
Jill H. Pace

Intelligence gathering — the systematic collection of information about nations, firms, or individuals that those parties would, on the whole, prefer to keep secret — is an increasingly technological activity. Developments in electronics, microminiaturization, optics, and other fields have made possible a wide range of electronic surveillance, photographic observations, eavesdropping, and other forms of spying that until recently were largely the province of science fiction. The users of these technologies, or course, prefer to keep them secret. Many aspects are becoming known to the public, however, through popular fiction and nonfiction writing, through the appearance of some devices on the open market, and through the easing of government information restrictions under new political conditions.

This symposium will bring together a variety of knowledgeable individuals to discuss (within the limits of publicly available information) the ways in which science and technology have been and are being used to gather and analyze intelligence information and to counter intelligence collection. Topics include electronic eavesdropping, satellite observations, photographic surveillance, computer "hacking," and analysis of intelligence information. A representative of an East Bloc intelligence agency will give a view of these topics from the other side, and a speaker from a commercial organization in Washington, DC, will demonstrate some espionage devices that may be purchased over the counter.

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II

Life Sciences & Technology

20. General Life Sciences and Technology

20-1. Consciousness in Life

Organized by: **Roger Payne** *(President, Whale and Dolphin Conservation Society, Lincoln, MA)* and **Lynn Margulis** *(Distinguished University Professor, Dept. of Botany, Univ. of Massachusetts, Amherst, MA)*

2:30 pm / Mon / 18 Feb **Sheraton / Sheraton So.**

Presiding: Lynn Margulis

Are Whale Songs Evidence of Consciousness?
Roger Payne

Bacterial Consciousness
Lynn Margulis

Neuropeptides and Their Receptors in the Central Nervous, Endocrine, and Immune Systems: A Psychosomatic Network
Candace Pert *(Scientific Director, Integra Institute, and Guest Researcher, NIMH, Bethesda, MD)*

Inherited Memories and Learned Beliefs
Peter Frank Allport *(Winter Park, FL)*

Sensory Processing in Simple Nervous Systems
R.K. Murphey *(Director, Neuroscience and Behavior Program, Univ. of Massachusetts, Amherst, MA)*

This symposium will consider consciousness in the broadest terms, from bacteria to whale songs to humans, touching on both biochemical and neural aspects. If cognition is the reorganization of sensory input to produce meaningful actions, then even bacteria are cognizant. And if emotions are evidence of consciousness and are the results of a process (involving information and memory) that helps animals adjust to their environment, then consciousness is widespread. The 1980s saw the realization that classical hormones such as insulin are neuropeptides by all definitions except historical tradition and that the immune system is modulated by neuropeptides and their receptors, communicating between immune cells by secreting peptide informational molecules called lymphokines. If this intercellular communication network is the biochemical correlate of consciousness, then consciousness is a property of the entire body, not just of the brain (in keeping with many non-Western medical traditions suggesting that emotions play a profound role in health and disease). From all of this, the possibility of modifications to human consciousness will be considered by session speakers.

[**Sponsor:** AAAS Section G. **Cosponsor:** AAAS Section J.]

21. Molecular and Cellular Biology

21-1. The Revolution in Developmental Biology

Organized by: **Arthur S. Levine** *(Scientific Director, National Institute of Child Health and Human Development, Bethesda, MD)*, **Igor Dawid** *(Chief, Laboratory of Molecular Genetics, National Institute of Child Health and Human Development, Bethesda, MD)*, and **Heiner Westphal** *(Chief, Laboratory of Mammalian Genes and Development, National Institute of Child Health and Human Development, Bethesda, MD)*

2:30 pm / Fri / 15 Feb **Sheraton / Sheraton So.**

Presiding: Arthur S. Levine, Igor Dawid, and Heiner Westphal

Xenopus
Igor Dawid

Caenorhabditis
Andrew Fire *(Staff Member, Dept. of Embryology, Carnegie Institution, Baltimore, MD)*

Mouse Embryonic Development from Cell Fate to Targeted Mutations
Janet Rossant *(Senior Scientist, Division of Molecular and Developmental Biology, Mount Sinai Hospital Research Institute, Toronto, Canada)*

Transgenic Mouse
Heiner Westphal

8:30 am / Sat / 16 Feb **Sheraton / Sheraton So.**

Presiding: Arthur S. Levine, Igor Dawid, and Heiner Westphal

Dictyostelium
Alan Kimmel *(Senior Investigator, Laboratory of Cellular and Developmental Biology, NIDDK, Bethesda, MD)*

Arabidopsis
Gerald Fink *(Director, Whitehead Institute, Cambridge, MA)*

Drosophila
Michael Levine *(Professor, Dept. of Biological Sciences, Columbia Univ., New York, NY)*

Drosophila
James Kennison *(Senior Staff Fellow, Section on Developmental Biology, Laboratory of Molecular Genetics, NICHD, Bethesda, MD)*

The application of new techniques, including those of molecular biology, to studies of developing systems, both invertebrate and vertebrate, has been responsible for dramatically changing developmental biology from a largely descriptive to a rigorously experimental science. Results of the past decade have led to the conclusion that many of the most critical developmental control genes are highly conserved, so that even very simple biological models, such as weeds and fruit flies, have much to offer in illuminating developmental control pathways in higher animals, including humans.

This symposium will focus on six developmental models, each of which has unique properties. The frog (e.g., *Xenopus laevis*) is a felicitous model for the elucidation of cell interactions and other inductive phenomena that underlie vertebrate embryogenesis. While this animal has a long maturation time — and is therefore not particularly useful for genetic studies — frog oocytes and embryos are easily manipulated, and the embryos are characterized by very clearly demarked and rapidly occurring morphological stages, each with unique molecular markers. The fruit fly, *Drosophila melanogaster*, is, of course, remarkably useful for genetic studies due to its rapid generation time, small genome, and vast library of available mutants. Moreover, it is our best model for studying the molecular basis of segmentation and the establishment of polarity in the embryo. The transgenic mouse is a powerful model for studies of the spatial and temporal aspects of mammalian development. This model permits identification of those cell-specific transcription factors responsible for the developmental control of mammalian gene expression, including oncogenes. *Caenorhabditis elegans*, a small roundworm, is the best available model for studies of cell lineage, and a good model as well for studies on the genetic decisions that control cell differentiation. The worm is also a powerful model for the study of cell interactions that eventuate in defined organismal structures. *Arabidopsis thaliana*, a weed with a very short generation time, a small genome, and well-defined genetics, has proven to be of great value in elicidating the molecular genetics of developmental processes as well as identifying important elements of signal transduction. *Dictyostelium discoideum*, a slime mold, has offered great insight into the biochemical and molecular elements of signal transduction in a eukaryotic species. During its developmental cycle, the mold responds to a variety of environmental stimuli with dramatic morphologic changes that, in turn, can be traced to primary and secondary messengers such as ligands, receptors, G proteins, and cyclic AMP.

Each of these models has proven to have great power in illuminating specific pieces of the developmental puzzle. Taken together, the results so far achieved with these six models, using molecular biologic and sophisticated cell biologic techniques, provide a rapidly emerging picture of specific "master control" genes, highly conserved and acting in an orderly hierarchy to effect determinative decisions during development.

[**Sponsor:** AAAS Section G.]

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21-2. New Perspectives on Cellular Signaling

Organized by: **Maryanna Henkart** *(Program Director, Cell Biology Program, National Science Foundation, Washington, DC)*

2:30 pm / Sat / 16 Feb **Sheraton / Sheraton So.**

Presiding: Maryanna Henkart

Signaling Systems for Inducible Plant Defense Genes
Clarence A. Ryan *(Professor, Institute of Biological Chemistry, Washington State Univ., Pullman, WA)*

Chemical Signaling Through Cell-to-Cell Junctions: Lessons from a Primitive Organism
Kathleen Dunlap *(Associate Professor of Physiology, Tufts Medical School, Boston, MA)*

Chemosensory Receptors and Signal Transducers Controlling Settlement and Metamorphosis in Planktonic Abalone Larvae
Daniel E. Morse *(Professor of Molecular Genetics and Chairman, Marine Biotechnology Center, Univ. of California, Santa Barbara, CA)*

Calcium Signals and Cellular Clocks Control Cell Division
Robert B. Silver *(Associate Professor of Physiology, Cornell Univ., Ithaca, NY)*

The normal growth, development, and even survival of an organism depend upon specific communication between tissues and cells. In recent years, there has been an explosion of new information concerning the mechanisms by which cells respond to external signals such as physical stimuli, hormones, and growth factors, as well as how cells communicate with each other. In this symposium, some very exciting results will be presented that shed new light on these life processes. These insights come from studies of a variety of organisms — higher plants, luminescent coelenterates, abalone, and sea urchins — and represent contributions from a range of disciplines and techniques — biochemistry, molecular biology, electrophysiology, and high-resolution imaging with single-photon video microscopy. It is now within our grasp to understand at the molecular level the chain of events from the binding of a signal molecule to its receptor, through the subsequent cascade of biochemical second messengers, to changes in the expression of specific genes, and literally to see the progress of a signal passing between cells or between compartments within a single cell.

[**Sponsor:** AAAS Section G.]

Technical Sessions

21T-1. New Interactions Between Topology and Science

Organized by: **De Witt L. Sumners** *(Professor, Dept. of Mathematics, Florida State Univ., Tallahassee, FL)*

2:30 pm / Mon / 18 Feb **Sheraton / Idaho**

Presiding: Kenneth C. Millett *(Professor, Dept. of Mathematics, Univ. of California, Santa Barbara, CA)*

The Topology of Trypanosome DNA
Sylvia J. Spengler *(Staff Scientist, Human Genome Center, Lawrence Berkeley Laboratory, Univ. of California, Berkeley, CA)*

The Topology of DNA Recombination
De Witt L. Sumners

Topology and Chemical Synthesis
Jonathan L. Simon *(Professor, Dept. of Mathematics, Univ. of Iowa, Iowa City, IA)*

Random Knots in Ring Polymers
Stuart G. Whittington *(Professor, Dept. of Chemistry, Univ. of Toronto, Toronto, Canada)*

Knot Theory and Physics
Louis H. Kauffman *(Professor, Dept. of Mathematics, Univ. of Illinois, Chicago, IL)*

Topology is normally considered to be "pure" mathematics. Recently, however, scientists and mathematicians have begun to work together to use topological concepts and calculations in an effort to model and analyze physical systems. This session will highlight some of these new interactions between topology and experimental and theoretical science. Included will be the following topics: the topological structure of the kinetoplast DNA of trypanosome (a sheet of linked DNA circles); using knot theory to analyze the results of DNA recombination experiments on circular DNA; the chemical synthesis and proof-of-structure of molecules with exotic topology; topological entanglement (knotting) in random polymer configurations; and new concepts from statistical physics and quantum field theory in topology and DNA research.

[**Sponsor:** AAAS Section A.]

21T-2. National and International Efforts in Plant Genome Mapping

Organized by: **David R. MacKenzie** *(Director, National Biological Impact Assessment Program, U.S. Dept. of Agriculture, Washington, DC)* and **Bruno Quebedeaux** *(Professor of Horticulture, Univ. of Maryland, College Park, MD)*

8:30 am / Tue / 19 Feb **Sheraton / Idaho**

Presiding: David R. MacKenzie

Introduction
David R. MacKenzie

USDA Plant Genome Mapping Research Program
Jerome Miksche *(Director of the Office of Plant Genome Mapping, U.S. Dept. of Agriculture, Beltsville, MD)*

Analysis of Current U.S. Plant Genome Mapping Research Program Efforts
Bruno Quebedeaux

Arabidopsis as a Model for Plant Genome Studies
C.R. Somerville *(Professor, Plant Research Laboratory, Michigan State Univ., East Lansing, MI)*

New Advances in Plant Genomic Mapping Technology
Scott Tingey *(Director, Agricultural Products Dept., E.I. DuPont de Nemours Co., Inc., Wilmington, DE)*

Physical Mapping of the Wheat Genome
B.S. Gill *(Professor, Plant Pathology Dept., Kansas State Univ., Manhattan, KS)*

Integrated Physical, Molecular, and Genetic Mapping in Maize Breeding
Ed Coe, Jr. *(Univ. of Missouri, Columbia, MO)*

Barley Genome Mapping: National and International Networking
R. A. Nilan *(Professor, Dept. of Agronomy and Soils, Washington State Univ., Pullman, WA)*

Application of Plant Genome Mapping Technology to Problems in Agriculture
Tim Helentjaris *(Professor, Dept. of Plant Science, Univ. of Arizona, Tucson, AZ)*

Patterns of research organization for plant genome mapping and sequencing are emerging as national and international networks oriented by commodity. Some projects are more advanced than others, but communication within and especially between networks is poor. This technical session will provide a forum for the exchange of information and experience and permit the international research community a unique opportunity to assess programmatic orientations and directions, form stronger networks, and encourage international collaboration on this important research topic.

[**Sponsor:** AAAS Section O. **Cosponsor:** AAAS Section G.]

22. Medical Sciences

22-1. New Molecular Insights into "Old" Genetic Diseases

Organized by: **Victor A. McKusick** *(Johns Hopkins Univ. School of Medicine, Baltimore, MD)*

2:30 pm / Sun / 17 Feb **Sheraton / Cotillion So.**

Presiding: Victor A. McKusick

Neurofibromatosis
Francis S. Collins *(Associate Professor, Univ. of Michigan, Ann Arbor, MI)*

Cystic Fibrosis
Garry R. Cutting *(Assistant Professor of Pediatrics, Johns Hopkins Univ. School of Medicine, Baltimore, MD)*

Hemophilia
Haig H. Kazazian, Jr. *(Director, Center for Medical Genetics, Johns Hopkins Univ. School of Medicine, Baltimore, MD)*

Marfan Syndrome
Reed E. Pyeritz *(Professor of Medicine and Pediatrics, Johns Hopkins Univ. School of Medicine, Baltimore, MD)*

New approaches to the study of hereditary disease — particularly gene mapping and methods for cloning genes and identifying abnormalities therein — are shedding light on the fundamental nature of these diseases; providing methods for diagnosis of the basic genetic lesion in either the preclinical, prenatal, or carrier state; and opening the way for treatment through better understanding of the pathogenetic mechanisms. Mapping genes on chromosomes (actually a form of anatomy) is providing a neo-Vesalian basis for clinical medicine. The approach of "reverse genetics" involves first locating the gene producing a disease by identifying its proximity to the markers at specific chromosomal sites and then moving in on the gene, determining the nature of the normal ("wildtype") gene and its function, and finally, determining the nature of the abnor-

mality in the gene in patients with the particular genetic disorder. This was the approach used with brilliant success in neurofibromatosis and cystic fibrosis. Both were disorders in which the basic biochemical defect was previously unknown. In the case of hemophilia, types A and B, molecular genetics has provided the methods for delineating the great variety of defects in the gene that can give rise to deficiency of the clotting factors, including some novel forms of mutation. Understanding of the Marfan syndrome is at an earlier stage, but the mapping of the gene to chromosome 15 opens up the possibility of early elucidation of this disorder in a manner similar to the others.

[**Sponsor:** AAAS Section N.]

22-2. Gene Therapy: Scientific Prospects and Societal Implications

Organized by: **W. French Anderson** *(Chief, Molecular Hematology Branch, National Heart, Lung, and Blood Institute, National Institutes of Health, Bethesda, MD)*

2:30 pm / Mon / 18 Feb **Sheraton / Cotillion So.**

Presiding: W. French Anderson

The ADA Human Gene Therapy Clinical Protocol
R. Michael Blaese *(Chief, Cellular Immunology Section, National Cancer Institute, National Institutes of Health, Bethesda, MD)*

Gene Therapy for Cancer
Steven A. Rosenberg *(Chief, Surgery Branch, National Cancer Institute, National Institutes of Health, Bethesda, MD)*

Potential Applications of Human Gene Therapy
W. French Anderson

Ethical and Societal Implications of Human Gene Therapy
LeRoy Walters *(Director, Center for Bioethics, Kennedy Institute of Ethics, Georgetown Univ., Washington, DC)*

Implications of Human Genetic Manipulation
Andrew Kimbrell *(Foundation on Economic Trends, Washington, DC)*

Human gene therapy is a new treatment procedure that may, in time, be used to cure presently incurable diseases. There are a significant number of diseases that either result directly from a defect in a gene (i.e., genetic diseases) or are more severe due to genetic propensity. In this symposium, the physicians who are carrying out the present clinical trials will examine the scientific and clinical basis for their protocols. The first human gene transfer clinical protocol began May 22, 1989, and involved the insertion of a marker gene into cancer-fighting cells (called tumor-infiltrating lymphocytes, or TILs) that are used in the treatment of several types of cancer, including malignant melanoma. The first human gene therapy trial began September 14, 1990, with the infusion of gene-corrected cells into a four-year-old girl suffering from a genetic immune disease (ADA deficiency). About to begin is a gene therapy trial for cancer that will involve the infusion of TIL cells that contain a gene with anticancer activity (the tumor necrosis factor gene). In addition, there will be a discussion of the future outlook for gene therapy from a scientific as well as ethical viewpoint. An ethicist who chairs the subcommittee charged with reviewing and approving all federally funded human gene therapy protocols will evaluate the societal and ethical implications of human genetic engineering. Finally, a biotechnology activist will discuss the long-term implications and concerns that arise from our newly acquired ability to carry out human genetic manipulation.

[**Sponsor:** AAAS Section N. **Cosponsors:** AAAS Section S; AAAS Committee on Science, Engineering, and Public Policy.]

22-3. Molecular Determinants of Human Cancers

Organized by: **Albert H. Owens, Jr.** *(Director, Johns Hopkins Oncology Center, Baltimore, MD)*

2:30 pm / Fri / 15 Feb **Sheraton / Cotillion No.**

Presiding: Albert H. Owens, Jr.

The Cancer Cell Phenotype
Donald S. Coffey *(Professor, Urology, Oncology, Pharmacology, and Molecular Sciences, Johns Hopkins School of Medicine, Baltimore, MD)*

DNA Methylation and Malignant Transformation
Stephen B. Baylin *(Professor of Oncology, Johns Hopkins Oncology Center, Baltimore, MD)*

Altered Growth Factor Signaling Pathways in Human Cancer Cells
Stuart A. Aaronson *(Chief, Laboratory of Cellular and Molecular Biology, National Cancer Institute, Bethesda, MD)*

The Molecular Genetics of Bowel Cancers
Bert Vogelstein *(Professor of Oncology, Johns Hopkins Oncology Center, Baltimore, MD)*

Cancer is a group of diseases that has been responsible for much human suffering and morbidity throughout the ages. From another perspective, cancer is a cruel caricature of normal cell proliferation and maturation. During the past several years, research into the fundamental processes underlying tumor initiation and progression has yielded penetrating insights into the genetic and molecular mechanisms that determine cell behavior. This symposium will present especially exciting examples of this work. Coffey will relate instability in the structural elements of cells to tumor progression and metastasis. Baylin will discuss the significance of the abnormalities of DNA methylation that occur very early in the malignant transformation process. Aaronson will illuminate the role of oncogenes involved in the disturbed signaling events in cancer cells. Finally, Vogelstein will comment on the genetic alterations that underlie the progression of human colon tumors and the potential for new forms of diagnosis and treatment.

[**Sponsor:** AAAS Section N.]

22-4. The Aging and Cancer Interface: Multidimensional Research Perspectives

Organized by: **Rosemary Yancik** *(Assistant Director for Liaison and Applied Research on Aging, National Institute on Aging, National Institutes of Health, Bethesda, MD)*

8:30 am / Sun / 17 Feb **Sheraton / Cotillion So.**

Presiding: Rosemary Yancik

Cancer in the Aged: An Epidemiologic Overview
Rosemary Yancik

Senescence and Neoplasia: Two Sides of the Same Cellular Coin
Vincent Cristofalo *(Audrey Meyer Mars Professor and Director, Center for Gerontological Research, Medical College of Pennsylvania, Philadelphia, PA)*

Geriatric Oncology: Early Detection and Diagnosis
Harvey Jay Cohen *(Director, Geriatric Research, Education, and Clinical Center, Durham V.A. Medical Center and Center for the Study of Aging and Human Development, Duke Univ. Medical Center, Durham, NC)*

Cancer in the Elderly: To Treat or Not to Treat?
Paul Carbone *(Director, Univ. of Wisconsin Clinical Cancer Center, Madison, WI)*

Discussants:
T. Franklin Williams *(Director, National Institute on Aging, NIH, Bethesda, MD)* and Jerome Yates *(Associate Director for Clinical Affairs, Roswell Park Memorial Institute, Buffalo, NY)*

Data from the National Cancer Institute Surveillance, Epidemiology, and End Results Program — a national, population-based tumor registry — show that more than 50% of all cancers occur in the age segment 65 years or older. With the rapid expansion of the older segment of the population projected to occur over the next three-plus decades, it is important to draw attention to the interests and concerns associated with cancer in the elderly. A body of knowledge is evolving on the relationship of cancer to aging. This symposium provides multidisciplinary research perspectives from medical sociology, biology, geriatric medicine, and medical oncology. Speakers address the mechanisms involved in the development of cancer and the processes of aging and the influence of aging on early detection, diagnosis, and treatment of cancer.

[**Sponsor:** AAAS Section N.]

22-5. The Progesterone Antagonist RU-486: Science and Science Policy

Organized by: **Sheldon J. Segal** *(Director for Population Sciences, The Rockefeller Foundation, New York, NY)*

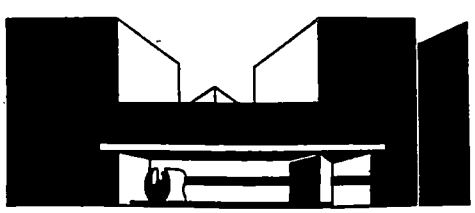
8:30 am / Sat / 16 Feb **Sheraton / Cotillion So.**

Presiding: Sheldon J. Segal

The Progesterone Receptor and Its Molecular Actions
Bert W. O'Malley *(Professor and Chairman, Dept. of Cell Biology, Baylor College of Medicine, Houston, TX)*

RU-486: The French Experience
Andre Ullmann *(Head of Clinical Research, Roussel-UCLAF, Romainville, France)*

Abortion in the United States
Jacqueline Darroch Forrest *(Vice President for Research, The Alan Guttmacher Institute, New York, NY)*



Antiprogesterone Drugs: Ethical and Legal Issues
Rebecca J. Cook *(Director, International Human Rights Program, Faculty of Law, Univ. of Toronto, Toronto, Canada)*

2:30 pm / Sat / 16 Feb **Sheraton / Cotillion So.**

Presiding: Sheldon J. Segal

Antiprogestins: Probability of Multiple Indications in Reproductive Medicine
Gary D. Hodgen *(President, The Jones Institute for Reproductive Medicine, Eastern Virginia Medical School, Norfolk, VA)*

RU-486: Antiglucocorticoid Research
M. Gaillard-Moguilewsky *(Clinical Research Assistant, Roussel-UCLAF, Romainville, France)*

RU-486: Anticancer Activity
H. H. Sedlacek *(Head of Research Laboratory, Beringwerke AG, Marburg, Germany)*

RU-486 and U.S. Science Policy
Cory Richards *(Vice President for Public Policy, The Alan Guttmacher Institute, New York, NY)*

The antiprogesterone compound mifepristone (RU-486) is a remarkable example of the rapid application to clinical medicine of a breakthrough in basic research. In the 1970s, cell biologists demonstrated the existence of receptors in some cells for the female sex hormone progesterone. This established the theoretical basis for synthesizing progesterone-like molecules that could occupy the receptor sites without eliciting changes that transform a cell from an inactive state to the progesterone-stimulated state needed, for example, for the establishment and maintenance of pregnancy. By 1980, RU-486 was synthesized and tested by Roussel-UCLAF, Paris. Most widely publicized has been the application of the French antiprogesterone for the termination of early pregnancy. Because of Roussel's policy, only French women have had access to this new, medical method of abortion. Other important applications in reproductive medicine include its use in prolonged labor to hasten widening of the cervix and thereby reduce the need for Caesarean sections and for the treatment of progesterone-dependent cancers of the breast. It may be useful in the treatment of other tumors that are rich in progesterone receptors. Roussel research disclosed, also, that RU-486 can competitively occupy receptor sites for cortisone-like hormones of the adrenal gland, thus opening an intriguing area of research in several conditions of clinical importance. Legislative threats and political pressure on federal agencies have effectively excluded American scientists, the world's largest medical research resource, from antiprogesterone research.

[**Sponsor:** AAAS Section N.]

22-6. Prospects for Immunocontraception

Organized by: **John C. Herr** *(Associate Professor of Anatomy and Cell Biology, Univ. of Virginia, Charlottesville, VA)*

2:30 pm / Fri / 15 Feb **Sheraton / Cotillion So.**

Presiding: John C. Herr

Molecular Genetics of the Mouse and Human Zona Pellucida Genes: Strategies for Immunocontraception
Jurrien Dean *(Laboratory of Cellular and Developmental Biology, National Institutes of Health, Bethesda, MD)*

Epitope Mapping of the Zona Pellucida (ZP) Protein Antigens for Human Contraceptive Vaccine Development
Bonnie S. Dunbar *(Associate Professor of Cell Biology, Baylor College of Medicine, Houston, TX)*

Sperm Surface Proteins as Antigens for a Birth Control Vaccine That Blocks Sperm Function
Paul Primakoff *(Associate Professor, Dept. of Physiology, Univ. of Connecticut Health Center, Farmington, CT)*

Contraceptive Vaccine Candidate SP-10 Associated with Human Sperm Acrosomal Membranes
John C. Herr

This symposium will highlight advances in the development of contraceptive vaccines based on protein antigens that are associated with the egg and sperm. Gamete-specific antigens offer the possibility of eliciting in males or females immune responses that prevent the interaction of egg and sperm. This type of vaccine thus acts before fertilization (prefertilization immunocontraception). The cell and molecular biology of component proteins of the zona pellucida, a glycoprotein investment surrounding the egg, will be discussed. Likewise, candidate contraceptive vaccine proteins that associate with the sperm membranes will be presented. Research on both animal and human models will be emphasized, with possible applications for veterinary and human populations. The biological effects of immunization with native proteins as well as recombinant DNA vaccines will be presented. This symposium is designed to familiarize attendees with the major conceptual paradigms and experimental hurdles in this rapidly evolving field.

[**Sponsor:** AAAS Section N.]

22-7. Development of Medications for the Treatment of Brain/Behavior Disorders

Organized by: **Frank J. Vocci** *(Chief, Developmental Therapeutics Branch, National Institute on Drug Abuse, Alcohol, Drug Abuse, and Mental Health Administration, Rockville, MD)* and **Betty C. Tai** *(Pharmacologist, Medication Development Division, National Institute on Drug Abuse, Alcohol, Drug Abuse, and Mental Health Administration, Rockville, MD)*

8:30 am / Tue / 19 Feb **Sheraton / Cotillion So.**

Presiding: Charles R. Schuster *(Director, National Institute on Drug Abuse, Alcohol, Drug Abuse, and Mental Health Administration, Rockville, MD)*

History of Medication Development and Brain/Behavior Disorders
Frederick K. Goodwin *(Director, Alcohol, Drug Abuse, and Mental Health Administration, Rockville, MD)*

FDA's Interactive Role in the Review of Drugs for Treating Addictive Disorders
Michael Klein *(Senior Scientist, Center for Drug Evaluation and Research, Food and Drug Administration, Rockville, MD)*

Medication Development for Drug Addiction
Charles O'Brien *(Chief of Psychiatry, Univ. of Pennsylvania/VA Medical Center, Philadelphia, PA)*

Current Approaches to Medication Development for Alcoholism
Markku Linnoila *(Chief, Laboratory of Clinical Studies, National Institute on Alcoholism and Alcohol Abuse, Alcohol, Drug Abuse, and Mental Health Administration, Bethesda, MD)*

Current Approaches to Medication Development for Mental Illness
Donald S. Robinson *(Vice President, CNS Clinical Research, Bristol-Myers Squibb Research Institute, Wallingford, CT)*

The "Decade of the Brain" recognizes the study of this organ as the final frontier of biological science. Disorders of brain and behavior exact an enormous toll in terms of affecting the quality and productivity of human life. Diseases such as alcoholism, drug addiction, schizophrenia, and Alzheimer's not only represent an enormous public health burden but also deprive people, to a substantial degree, of their essential being. Recent advances in understanding the neurobiology of brain and behavior raise the hope and expectation that new approaches, based on pharmacological and genetic intervention, will provide the opportunity to make significant advances, if not breakthroughs, in the treatment of these and related disorders.

The Alcohol, Drug Abuse, and Mental Health Administration has identified the development of medications for the treatment of brain and behavior disorders as one of its top priorities for this last decade of the 20th century. The development of new pharmacotherapies is a highly complex endeavor, requiring scientific expertise ranging from the discovery of new chemical entities, through the conduct of large-scale clinical trials, to the regulatory and commercial activities necessary to have a compound reach the patient population. This symposium will provide a state-of-the-science review of current activities in and approaches to developing new medications for the treatment of brain and behavior disorders, including alcoholism, drug addiction, and mental diseases such as schizophrenia and depression. The role of a regulatory agency in the approval process will also be addressed, along with a discussion of some of the unique methodological issues involved in clinical studies of brain/behavior dysfunction.

[**Sponsor:** AAAS Section N. **Cosponsors:** AAAS Sections G, J, and S.]

22-8. The Control of Infectious Diseases: New Aspects of Vaccines

Organized by: **Donald A. Henderson** *(Edgar Berman Professor, School of Hygiene and Public Health, Johns Hopkins Univ., Baltimore, MD)*

8:30 am / Fri / 15 Feb **Sheraton / Cotillion So.**

Presiding: Donald A. Henderson

Polio Eradication in the Western Hemisphere
Ciro DeQuadros *(Director, Expanded Program on Immunization, Pan American Health Organization, Washington, DC)*

Control of Vaccine-preventable Diseases in the United States
Walter Orenstein *(Director, Division of Immunization, Centers for Disease Control, Atlanta, GA)*

The National Vaccine Program
Kenneth Bart *(Director, National Vaccine Program, Rockville, MD)*

New Approaches in Vaccine Development
John La Montagne *(Director, Division of Microbiology and Infectious Diseases, National Institute of Allergy and Infectious Diseases, Bethesda, MD)*

Prospects for an AIDS Vaccine
Gordon Ada *(Professor, Immunology and Infectious Diseases, School of Hygiene and Public Health, Johns Hopkins Univ., Baltimore, MD)*

A global immunization program, coordinated by the World Health Organization, is now successfully vaccinating 70% of children throughout the world against six major diseases. More than two million deaths are being prevented annually. The eradication of poliomyelitis in the Americas is now at hand, and the goal of global eradication is foreseen by the year 2000. In the United States as well, remarkable progress has been made in the control of vaccine-preventable diseases, and a national vaccine program has been established to accelerate progress. Now, with the rapid advances being made in molecular biology and immunology, a large number of new and improved vaccines can be foreseen to be available for use by the end of the century. Conceivably, an AIDS vaccine may be one of them.

[**Sponsor:** AAAS Section N. **Cosponsor:** AAAS Section S.]

22-9. Scientific and Statistical Inferences in Modeling Animal Research

Organized by: **Ethel Tobach** *(Curator Emer., American Museum of Natural History, New York, NY)*

8:30 am / Fri / 15 Feb **Sheraton / Baltimore**

Presiding: Ethel Tobach

Animal Organisms as Individuals: Implications for Research
Strachan Donnelley *(Director of Education, The Hastings Center, Briarcliff Manor, NY)*

Interesting Errors Caused by the Use of Animal Models
Leo Vroman *(Senior Research Scientist, Dept. of Chemical Engineering, Columbia Univ., New York, NY)*

Statistical Aspects of Animal Modeling Research
William DuMouchel *(BBN Software Products, Cambridge, MA)*

The Concept of "Alternatives" to the Use of Animals in Research: Slogan or Useful Tool?
Jerrold Tannenbaum *(Assistant Professor, Tufts Univ. School of Veterinary Medicine, Boston, MA)*

Values and Conflicts in Living versus Nonliving Systems Research
Marcia Coleman-Adebayo *(U.S. Environmental Protection Agency, Washington, DC)*

Recent discussions about the various adjunct methods of studying biological phenomena using animals have centered primarily on the societal considerations of animal research. This symposium will evaluate the underlying assumptions in the use of these adjunct methods, focusing primarily on their scientific validity and reliability. The philosophical and cultural context of these considerations are also seen as vital to our understanding of the inferences that can be made about such methods. Speakers include a computer scientist/mathematician, a bioengineer, a social scientist, a philosopher, and an ethicist who specializes in issues in animal and veterinarian ethics, who will explore the issues of (1) analysis of the adjunct methods and (2) analysis of the theoretical assumptions underlying adjunct methods.

[**Sponsor:** AAAS Section L. **Cosponsors:** AAAS Sections G, J, S, and U; American Statistical Association; Biometric Society.]

23. Health Care and Policy

23-1. Consequences of HIV/AIDS in Eastern Africa

Organized by: **Priscilla Reining** *(Adjunct Professor, Center for African Studies, Univ. of Florida, Gainesville, FL)*

2:30 pm / Sat / 16 Feb **Sheraton / Baltimore**

Presiding: Kathryn Aultman *(Special Assistant to the Branch Chief, National Institute for Allergy and Infectious Diseases, Rockville, MD)*

HIV Transmission: The Solution Is Men
Christine Obbo *(Associate Professor, Dept. of Anthropology, Wayne State Univ., Detroit, MI)*

AIDS Control and History in Northwestern Tanzania
Frederick J. Kaijage *(Associate Professor of History, Center for African Studies, Univ. of Florida, Gainesville, FL)*

Mapping the Politics of AIDS: Illustrations from East Africa
Goran Hyden *(Professor, Dept. of Political Science, Univ. of Florida, Gainesville, FL)*

Designing Appropriate Intervention Strategies in Southern Africa
Peter H. Perine *(Professor of Preventive Medicine and Biometrics and of Medicine, Uniformed Services Univ. of the Health Sciences, Bethesda, MD)* and Subhash Hira *(Chairman, Consultant Dermato-Venerealogist, Univ. Teaching Hospital, Lusaka, Zambia)*

How Bad Will It Be? Modeling the Epidemic in Eastern Africa
Peter O. Way *(Chief, Africa and Latin America Branch, U.S. Bureau of the Census, Washington, DC)*

The Impact of HIV/AIDS on the Mortality of Mothers and on Orphaned Children
Linda A. Valleroy *(Biomedical Anthropologist, U.S. Agency for International Development, Washington, DC)*

Discussant:
Francis P. Conant *(Professor, Dept. of Anthropology, Hunter College, New York, NY)*

Much of the scientific effort on AIDS in Africa has gone to measure the location and severity of the epidemic or to implement immediate campaigns to reduce transmission rates. Now attention is turning to the current consequences of HIV/AIDS and the social and political perspectives. Some ethnic groups in eastern Africa face losses of up to a third of their able-bodied adult men and women. Under most epidemiological circumstances, the young and the old are subject to higher rates of morbidity and mortality.

HIV/AIDS is different. Core members critical to the functioning of families/households/communities are being affected. Because adult women, usually the care givers, are affected equally with their partners, those who are AIDS symptomatic require skills and services rather than having to render them to family members and neighbors. Similarly, adult males with AIDS are now unable to make their normal contribution to their households and society. While urban rates are usually higher than rural, some rural areas in Uganda, western Tanzania, Malawi, and Zambia have far higher rates than African cities outside of those areas. Research is now being targeted to these geographic areas to examine the political, social, medical, and demographic consequences of these high rates in order to understand coping and the best interventions.

[Sponsor: AAAS Section H. Cosponsors: AAAS Sections A, K, and N.]

23-2. AIDS: Scientific Research and Public Policy

Organized by: **Andrew A. Sorensen** *(School of Public Health, Johns Hopkins Univ., Baltimore, MD)*

8:30 am / Sat / 16 Feb **Sheraton / Baltimore**

Presiding: Andrew A. Sorensen

Discussants:
Anthony Fauci *(Director, National Institute of Allergy and Infectious Diseases, Bethesda, MD)*, June Osborne *(Dean, School of Public Health, Univ. of Michigan, Ann Arbor, MI)*, and Samuel Thier *(Institute of Medicine, Washington, DC)*

This session will address the effect of HIV/AIDS research on public policy. Scientific investigators often have abdicated efforts to influence the evolution of AIDS public policy because they are generally unfamiliar with the processes by which public policy is formulated and are frequently put off by what they regard as discussions of policy not informed by sophisticated understanding of the etiology and sequellae of HIV infection and AIDS. In an era of increasing constraints on resources for scientific research, the problems of scientifically informing AIDS public policy are complicated by increasing competition in the research community for available support.

Panelists will suggest ways in which scientific researchers and formulators of public policy may more effectively join forces to promote rationally developed AIDS policies. They will also describe barriers to such collaboration and propose methods by which these obstacles may be overcome.

[Sponsor: AAAS Section N.]

23-3. Modeling the Geographic Diffusion of the AIDS Epidemic

Organized by: **Peter R. Gould** *(Professor of Geography, Pennsylvania State Univ., University Park, PA)*

2:30 pm / Fri / 15 Feb **Sheraton / Baltimore**

Presiding: Peter R. Gould

Introduction: AIDS in Its Geographic Dimensions
Peter R. Gould

Geography's Role in the Decline of AIDS Cases Growth Rates
Wilpen L. Gorr *(Professor of Public Policy, Carnegie Mellon Univ., Pittsburgh, PA)*

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Expansion Modeling of the Spatial Spread of AIDS
Emilio Casetti *(Professor of Geography, Ohio State Univ., Columbus, OH)*

The Bronx Is Dying: Urban Burnout, Forced Migration, and AIDS
Rodrick Wallace *(Research Scientist, New York State Psychiatric Institute, New York, NY)*

Predicting the Next Maps: Spatial Adaptive Filtering in Pennsylvania
Joseph R. Kabel *(Researcher, Pennsylvania State Univ., University Park, PA)*

Efforts to model and predict the course of the AIDS epidemic have focused, almost without exception, upon the temporal domain, employing traditional differential equations or statistical extrapolations to elicit structure in time series. The geographic diffusion of the epidemic (HIV and AIDS) has been virtually ignored out of methodological ignorance and conceptual blindness, while the rich information in dynamic spatial series has never been employed for modeling the epidemic or for forecasting the next maps. In traditional approaches employed to date, the *where* of the epidemic, rather than the simplistic *when,* neither enters thinking nor informs understanding. This symposium brings to the forefront for the first time the geographic dimensions of the AIDS epidemic in selected areas of the country, at both inter- and intraurban scales. Presentations examine the spatial effects of rural-urban differences, the "drift" of predictive relations over geographic space, relations of AIDS to urban decay, and forecasts of geographic distributions for educational intervention and planning for enhanced health care services.

[Cosponsors: AAAS Sections K and U; American Statistical Association.]

23-4. The Father and the Fetus: Facts and Fallacies

Organized by: **Gladys Friedler** *(Associate Professor of Psychiatry and Pharmacology, Boston Univ. School of Medicine, Boston, MA)*

8:30 am / Sun / 17 Feb **Sheraton / Baltimore**

Presiding: Gladys Friedler

Paternal Influence in Mid-19th- and Early 20th-Century Hereditarian Theories
Joy Harvey *(Rockefeller Fellow, Dept. of History of Science, Univ. of Oklahoma, Norman, OK)*

Protecting Fetal Health Through Legal Constraints on the Behavior of Women
Renee M. Landers *(Assistant Professor of Law, Boston College of Law School, Newton, MA)*

Toxicants That Affect Sperm Cell Function May Have Fetal Consequences
Leonard Nelson *(Professor, Dept. of Physiology and Biophysics, Medical College of Ohio, Toledo, OH)*

The Effects of Paternal Exposure to Xenobiotics on Subsequent Progeny
Gladys Friedler

The implicit assumption that only the female parent can adversely affect the developmental course of the unborn lacks scientific foundation. The multidisciplinary symposium will address the role

of the male parent in the prenatal development of his progeny and will examine factors that have limited our understanding of putative paternal influences. The change in attitudes about male and female influences on heredity from the mid-19th to the 20th century will be traced. The response of the legal system to various fetal protection policies will be examined. These policies have excluded pregnant and fertile women from employment, with the rationale that the particular work environment is hazardous to the health of their potential offspring. Using a similar rationale, women are being prosecuted for the death of their offspring, exposed in utero to licit or illicit drugs. These legal actions have ignored the evidence that paternal exposure to a variety of xenobiotics can alter reproductive outcome. Both epidemiologic and experimental studies on the sequelae of paternal exposure to alcohol, drugs, and toxins in the workplace will be discussed. The major goal of the symposium is to offer a balanced perspective of the role of both parents in a successful reproductive outcome.

23-5. Challenges to Dentistry for the '90s

Organized by: **William H. Bowen** *(Professor and Chair, Dept. of Dental Research, Univ. of Rochester, Rochester, NY)*

8:30 am / Mon / 18 Feb **Sheraton / Baltimore**

Presiding: William H. Bowen

Manpower Needs for the '90s and Beyond
Richard R. Ranney *(Professor, Dept. of Periodontics, Univ. of Alabama, Birmingham, AL)*

Fluoride: A Reassessment
Preston A. Littleton, Jr. *(Executive Director, American Association of Dental Schools, Washington, DC)*

Dry Mouth: An Aging Problem
Lawrence A. Tabak *(Associate Professor, Dept. of Dental Research, Univ. of Rochester, Rochester, NY)*

Caries: Another Extinct Disease?
William H. Bowen

Mercury Amalgams: Where Are We?
Thomas W. Clarkson *(Professor and Director, Environmental Health Sciences Center, Univ. of Rochester, Rochester, NY)*

As we enter the final decade of the millennium, few professions face more challenges to their future than dentistry. During the past decade, several dental schools have closed and class size has been reduced; will there be enough dentists to provide treatment into the next century? The safety and efficacy of fluoride is now being questioned; its loss could have a devastating effect on oral health worldwide and particularly in developing countries. As life expectancy increases, people are retaining their teeth longer; at the same time, output from some salivary glands decreases and the use of prescription drugs may further reduce salivary output. Lack of saliva is a major contributor to the development of oral diseases and, in particular, dental caries. Unfortunately, the popular and political impression seems to be that dental caries is no longer a matter of public health concern. Although the prevalence of dental caries has declined in some groups, more than half the children aged 12 have lesions. Mercury amalgams are traditionally used to restore carious teeth. Questions are now being raised concerning the potential toxic effects of using mercury-containing amalgams. Clearly, these areas require examination and clarification, and they provide significant research challenges for the 1990s.

[**Sponsor:** AAAS Section R. **Cosponsor:** AAAS Section H.]

Technical Sessions

23T-1. Balance and "Dizziness": Assessment and Rehabilitation

Organized by: **Neil T. Shepard** *(Director of Vestibular Testing Center, Dept. of Otolaryngology, University of Michigan, Ann Arbor, MI)* and **Robert G. Turner** *(Associate Professor, Dept. of Otolaryngology, Univ. of California, San Francisco, CA)*

8:30 am / Tue / 19 Feb **Sheraton / Baltimore**

Presiding: Neil T. Shepard

Basic Science of Postural Control
Lewis M. Nashner *(President and Chairman of the Board, NeuroCom International, Inc., Clackamas, OR)*

Clinical Assessment of Postural Control and Rehabilitation of Balance
Neil T. Shepard

Oculomotor Control: Basic Science and Clinical Implications
Charles W. Stockwell *(Director, Vestibular Laboratory, Providence Hospital, Southfield, MI)*

Central Vestibular Physiology: Basic Science and New Clinical Horizons
Joseph M. R. Furman *(Associate Professor, Univ. of Pittsburgh, Pittsburgh, PA)*

Approximately 40% of all outpatient visits in the United States occur because of complaints of "dizziness" or balance dysfunction. These complaints are one of the leading reasons for doctor visits in patients over 65 years of age. Improved understanding of vestibular physiology, eye movement control, and postural control have led to new techniques for clinical assessment of the integrated balance system as well as of isolated portions of that system. Speakers will stress new advances in (1) the physiological basis of vestibular system control of eye movement and perceived body movement, (2) ocular movement control with and without head movement, and (3) postural control during perturbed stance. For each area, the use of basic science knowledge will be taken into practical clinical applications in both the assessment and rehabilitation of the balance disorder patient. The clinical applications of the basic science knowledge will be presented as it is currently being used in state-of-the-art laboratories, and advances being anticipated for the future will be discussed.

[**Sponsor:** American Speech-Language-Hearing Association.]

23T-2. Firearm Injury Prevention: Scientific and Public Policy Directions

Organized by: **James A. Mercy** *(Chief, Epidemiology Branch, Division of Injury Control, Center for Environmental Health and Injury Control, Centers for Disease Control, Atlanta, GA)*

2:30 pm / Tue / 19 Feb **Sheraton / Baltimore**

Presiding: Mark L. Rosenberg *(Director, Division of Injury Control, Center for Environmental Health and Injury Control, Centers for Disease Control, Atlanta, GA)*

Firearms and Health in the United States
Garen Wintemute *(Clinic Director, Dept. of Family Practice, Univ. of California, Berkeley, CA)*

Do Guns in the Home Increase or Decrease a Family's Risk of Violent Death? A Case-Control Study
Arthur Kellerman *(Chief, Emergency Medicine, Univ. of Tennessee, Memphis, TN)*

Firearm Regulation and Community Rates of Homicide and Suicide
Fred Rivara *(Director, Harborview Injury Prevention and Research Center, Univ. of Washington, Seattle, WA)*

Estimating the Effects of Firearm Regulations
Colin Lofton *(Professor, Institute of Criminal Justice and Criminology, Univ. of Maryland, College Park, MD)*

Policy and Legal Implications of Scientific Findings from Firearm Injury Research
Steve Teret *(Director, Injury Prevention Center, Johns Hopkins Univ., Baltimore, MD)*

This session will explore key scientific and public policy issues germane to the prevention of firearm injuries. Firearm injury is a serious public health problem in the United States. In 1987, 32,857 persons died as a result of firearm injuries. Firearm mortality rates for females, male teenagers, and young adults have been higher during the 1980s than at any time previously. In 1985, firearm injuries imposed a $14.4 billion economic burden on the United States. The time has come for us to address this problem in the same manner that we have addressed and successfully prevented other public health problems. Only through the application of sound scientific principles, however, were these advances wrought, and only by applying such principles will we be able to develop the information base necessary to identify effective strategies for prevention of firearm injuries. The session will sensitize the audience to (1) the magnitude of health injuries associated with firearms; (2) new scientific information on the association between firearms and injury; (3) directions for future prevention-oriented, policy-relevant research on firearm injuries; and (4) the public policy implications of scientific research for the prevention of firearm injuries.

[**Sponsor:** AAAS Section X.]

23T-3. Improving Drug Development and Regulation via Pharmacokinetic/ Pharmacodynamic Procedures

Organized by: **Meyer Katzper** *(Senior Staff Fellow, Center for Drug Evaluation and Research, Food and Drug Administration, Rockville, MD)*

2:30 pm / Mon / 18 Feb **Sheraton / Baltimore**

Presiding: Meyer Katzper

Optimal Integration of Pharmacokinetics and Pharmacodynamics in Drug Development and Regulation
Carl C. Peck *(Director, Center for Drug Education and Research, Food and Drug Administration, Rockville, MD)*

Pharmaceutical Industry View of the Value of Pharmacokinetics and Pharmacodynamics in Drug Development
Robert E. Desjardins *(Vice President, Clinical Research, Medical Research Division, Lederle Laboratories, American Cyanamid Co., Pearl River, NY)*

Overview of Data Analysis Methods for Modern Drug Evaluation
Lewis B. Sheiner *(Professor, Dept. of Laboratory Medicine, Univ. of California, San Francisco, CA)*

Using Meta-analysis in the Determination of Pharmacokinetic and Pharmacodynamic Parameters
John G. Harter *(Director, Pilot Drug Evaluation Staff, Food and Drug Administration, Rockville, MD)*

Planning the Future Computer-assisted Regulatory Research and Review Environment
Meyer Katzper

Pharmacokinetic and pharmacodynamic modeling is currently in a transition phase where these methodologies are finding increasing application in the drug development process. In part this is due to the conscious decision by the Food and Drug Administration's (FDA) Center for Drug Evaluation and Research to adapt the latest research findings to its program of drug evaluation and review. Such regulatory advances in turn owe much to the development of pharmacokinetic and pharmacodynamic concepts applied to drug development and to the availability of pharmacokinetic and pharmacodynamic computer analysis capabilities. The possibility exists that a plethora of beneficial results will come out of policy decisions and projects applying pharmacokinetic and pharmacodynamic modeling. Among envisaged benefits are shortened drug development time, shortened FDA review time, improved predictability of drug dosage and effects, and improved instructions to physicians on drug usage and for individualization of dosage regimens. This symposium will present an overview of the new approach, a description of some of the software used, and a listing of research questions that must be answered.

[**Cosponsor:** AAAS Section S.]

24. Agriculture

24-1. Economically Useful Plants for Developing Countries: From Research to Market

Organized by: **Barbara N. Timmermann** *(Associate Professor of Pharmaceutical Sciences, Univ. of Arizona, Tucson, AZ)* and **Robert H. Maybury** *(Executive Director, International Organization for Chemical Sciences in Development, Falls Church, VA)*

8:30 am / Fri / 15 Feb **Sheraton / Annapolis**

Presiding: Michael S. Tempesta *(Vice President, Shaman Pharmaceuticals, San Carlos, CA)*

New and Effective Compounds from Tropical Plants
James A. Duke *(Economic Botanist, National Germplasm Resources Laboratory, U.S. Dept. of Agriculture, Beltsville, MD)*

Bioassays as Guides to Fractionation of Natural Products Extracts
Jack R. Plimmer *(Research Leader, Environmental Chemistry Laboratory, U.S. Dept. of Agriculture, Beltsville, MD)*

"Bench-top" Bioassays for the Discovery of Bioactive Natural Products
Jerry L. McLaughlin *(Professor of Pharmacognosy, Purdue Univ., West Lafayette, IN)*

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Simple Bioassay-directed Fractionation Applied to African Medicinal Plants: Antimicrobial Agents
Lester A. Mitscher *(Professor of Medicinal Chemistry, Univ. of Kansas, Lawrence, KS)*

Industrial Utilization of Natural Products and Wastes Through Chemistry
James P. Kutney *(Professor of Chemistry, Univ. of British Columbia, Vancouver, Canada)*

Many plants produce organic substances in large quantities, making them economically useful as sources of medicinal and industrial products. A significant number of pharmacological natural compounds have uses in human and animal therapies as drug entities or as models for drug syntheses or semisyntheses. About 25% of the prescribed medicine in the industrialized nations contains active agents from plants. In much of the developing world, the population still relies on plants for the treatment of disease. In spite of considerable research over the past 30 years, the percentages of plant-derived drugs have not increased substantially, mainly due to narrow screening programs targeting for a single type (or, at best, a few types) of biological activity. By screening natural products useful for specific conditions (e.g., antitumor effects), other substances having pesticidal or allelopathic effects were overlooked. By expanding bioassays, many plants with useful biological properties could be discovered. The progress made in physical analytical methods, cell suspension cultures, scientific documentation, and ethnobotanical reports indicates that the abundant plant sources, especially in developing countries, are far from being exhausted with respect to potentially bioactive and industrial materials. This reality has always been attractive, since most of them have abundant biomass and much of the native flora is still unexplored. These and other important considerations make the issues addressed in this symposium a subject of great practical importance.

[**Sponsors:** AAAS Sections H and O. **Cosponsors:** AAAS Sections C and G; AAAS Southwestern and Rocky Mountain Division.]

24-2. Advancing Biotechnology: International Issues Regarding Biosafety Policy and Practice

Organized by: **Joel I. Cohen** *(Biotechnology and Genetic Resource Specialist, Bureau for Science and Technology, Office of Agriculture, U.S. Agency for International Development, Washington, DC)*, **Judith A. Chambers** *(AAAS Science and Diplomacy Fellow, Office of Agriculture, U.S. Agency for International Development, Washington, DC)*, **Marshall Phillips** *(Principal Scientist, Office of Agricultural Biotechnology, U.S. Dept. of Agriculture, Washington, DC)*, and **Robert F. Barnes** *(Executive Vice President, American Society of Agronomy, Madison, WI)*

8:30 am / Sat / 16 Feb **Sheraton / Annapolis**

Presiding: Judith A. Chambers

International Collaborative Research Programs in Biotechnology and Biosafety
Joel I. Cohen and Kerri Ann Jones *(Science and Technology Officer, Agency for International Development, Washington, DC)*

Domestic and International Regulatory Responsibilities of USDA: Global Harmonization
Terry L. Medley *(Director, Biotechnology, Biologics, and Environmental Protection, Animal and Plant Health Inspection Service, U.S. Dept. of Agriculture, Hyattsville, MD)*

African Perspective on International Issues Regarding Biosafety Policy and Practice
Thomas R. Odhiambo *(President, African Academy of Sciences, and Director, International Centre of Insect Physiology and Ecology, Nairobi, Kenya)*

A Commercial Perspective on Technology Advancement
Roger Salquist *(President, Calgene, Inc., Davis, CA)*

Collaborative Vaccine Development for Thailand: Transfer of Technology and Biosafety Issues
Chariya R. Brockelman *(Professor, Dept. of Microbiology, Mahidol Univ., Bangkok, Thailand)*

2:30 pm / Sat / 16 Feb **Sheraton / Annapolis**

Presiding: Marshall Phillips

Biotechnology and Biosafety at International Agricultural Research Centers
Richard L. Sawyer *(Director General, International Potato Center, Lima, Peru)*

USDA Guidelines: An Approach for Evaluating Risks of Field Tests and Commercial Releases
Alvin L. Young *(Science Advisor and Scientific Director, Office of Agricultural Biotechnology, U.S. Dept. of Agriculture, Washington, DC)*

EPA and Its Regulation of Biotechnology: Domestic Responsibilities and International Perspective
Elizabeth Milewski *(Special Assistant, Office for Pesticides and Toxic Substances for Biotechnology, U.S. Environmental Protection Agency, Washington, DC)*

An Environmental Perspective on the International Regulation of Genetically Engineered Organisms
Margaret G. Mellon *(Director, National Biotechnology Policy Center, National Wildlife Federation, Washington, DC)*

International Biosafety Arrangements
John Barton *(Professor of Law, Stanford Law School, Stanford Univ., Stanford, CA)*

Recent advances in the application of biotechnology for crop and animal improvement offer significant potential for positively affecting the future alleviation of hunger and poverty. Through donor support and increased public and private sector participation, this technology is gradually being transferred to the developing world. From a development perspective, the dilemma centers on the safe and responsible promotion and transfer of beneficial rDNA technologies and products to less developed countries eager to receive them but often lacking an appropriate regulatory environment necessary for adequate risk assessment. This session will

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examine (1) the regulatory infrastructure in the United States and in developing countries, (2) donor organization and agency responsibilities for technology transfer, and (3) the complex issues involved in the international dimensions of agricultural biotechnology.

[**Sponsor:** AAAS Section O. **Cosponsor:** AAAS Section G.]

24-3. Biological and Biotechnological Alternatives to Chemical Insecticides

Organized by: **Brian Federici** *(Professor of Entomology, Univ. of California, Riverside, CA)*, **Richard Weinzierl** *(Associate Professor of Entomology, Office of Agricultural Entomology, Univ. of Illinois, Champaign, IL)*, and **Ron Arp** *(Manager, Fleishman-Hillard, Inc., Kansas City, MO)*

8:30 am / Sun / 17 Feb **Sheraton / Annapolis**

Current and Future Technologies

Presiding: Brian Federici

Classical Biological Control: Successful Examples and Perspectives
James R. Nechols *(Associate Professor of Entomology, Kansas State Univ., Manhattan, KS)*

Emerging Technologies with Predators and Parasites in Biological Control
Marjorie Hoy *(Professor of Entomology, Univ. of California, Berkeley, CA)*

Uses and Limitations of Conventional Microbial Insecticides
Robert R. Granados *(Program Director, Plant Protection, Boyce Thompson Institute for Plant Research, Cornell Univ., Ithaca, NY)*

Recombinant Microbial Insecticides: Actual and Potential
Brian Federici

Transgenic Insecticidal Crops
David Fischhoff *(Director, Plant Molecular Biology, Monsanto Corp., St. Louis, MO)*

2:30 pm / Sun / 17 Feb **Sheraton / Annapolis**

Enhancing Implementation: Policies and Regulation

Presiding: Richard Weinzierl

Microbial Insecticides: Making Promises Match Reality
Ruedi B. Sandmeier *(Vice President, Research, Sandoz Crop Protection Corp., Palo Alto, CA)*

Commercial Criteria for Biopesticide Development
Wendy Gelernter *(Director, Biopesticide Development, Mycogen Corp., San Diego, CA)*

Impact of Regulatory Policy on Innovation in Biological Control
Charles Benbrook *(Executive Director, Board on Agriculture, National Research Council/National Academy of Sciences, Washington, DC)*

U.S. EPA Policy: Promoting or Impeding Change?
Anne Lindsay *(Director, Registration Division, U.S. Environmental Protection Agency, Washington, DC)*

University Extension: Changing Pest Management Education
Richard Weinzierl

In this symposium, the scientific, technical, and policy issues that are affecting the development of biological alternatives to chemical insecticides will be reviewed and discussed. Included will be presentations on the usefulness of naturally occurring organisms as biological control agents and microbial insecticides, as well as presentations describing potential advantages and problems that might develop from attempts to improve the pest control properties of these organisms using recombinant DNA technology. Specifically, the speakers will review the use of predatory and parasitic insects, and pathogens of insects, to control insect pest populations. These presentations will also describe the recent development of several genetically engineered organisms — including predaceous mites, bacteria and viruses, and transgenic plants — that have improved pest control properties. With respect to policy issues, the influence of government policies and regulations on the economic incentive, and therefore interest by industry, for developing alternatives will be explored. Finally, the role of science education in changing the attitudes of pest control operators, grower groups, and the public about pest control technologies will be discussed.

[**Cosponsors:** AAAS Sections G and O.]

24-4. Pest Resistance to Control Tactics: Impact on Sustainable Pest Management

Organized by: **Robert M. Hollingworth** *(Director and Professor, Pesticide Research Center, Michigan State Univ., East Lansing, MI)* and **Mark E. Whalon** *(Professor, Dept. of Entomology and Pesticide Research Center, Michigan State Univ., East Lansing, MI)*

2:30 pm / Fri / 15 Feb **Sheraton / Annapolis**

Presiding: Robert M. Hollingworth

Resistance and Its Management in IPM Systems
Mark E. Whalon

Impact of Pest Resistance to Pesticides on the Agricultural Chemical Industry
Homer M. LeBaron *(Senior Research Fellow, Agricultural Division, CIBA-GEIGY Corp., Greensboro, NC)*

Potential for Pest Resistance to Genetically Engineered Plants and Microbes
Fred L. Gould *(Professor, Dept. of Entomology, North Carolina State Univ., Raleigh, NC)*

Resistance Management Through Multisectoral Cooperation
Diana M. Horne *(Special Assistant for Integrated Pest Management, U.S. Environmental Protection Agency, Washington, DC)*

Resistance Management and Agricultural Policy
William A. Stiles, Jr. *(Staff Director, Subcommittee on Department Operations, Research, and Foreign Agriculture, Agriculture Committee, U.S. House of Representatives, Washington, DC)*

The negative impact of resistance to control tactics on pest management is considerable. Forces are at work that will tend to intensify this impact as more pesticides are lost to regulatory action and fewer are produced by the agrochemical industry. Further, resistance is a clear possibility with many alternative pest control methods. This is of particular concern with transgenic plants that have been engineered to contain genes conferring pest resistance. Despite these concerns, little funding is available for resistance research, and the impact of resistance has barely been considered in

either the drafting or administration of the laws that govern pesticide use and agriculture. This symposium will describe the status and trends of resistance and its destabilizing impact on pest management programs. Overall, it is intended to draw increased attention to this underappreciated problem and highlight solutions to the technical, economic, and regulatory barriers that obstruct the development and application of resistance management programs.

[**Sponsor:** AAAS Section O.]

Technical Sessions

24T-1. The Economic Potential for Aquaculture in the United States

Organized by: **Morton M. Miller** *(Senior Economist, National Marine Fisheries Service, Silver Spring, MD)* and **Douglas W. Lipton** *(Marine Economic Specialist, Dept. of Agricultural and Resource Economics, Univ. of Maryland, College Park, MD)*

8:30 am / Sat / 16 Feb **Sheraton / Vermont**

Presiding: Morton M. Miller

An Assessment of the Economic Feasibility of Hard Clam Aquaculture in the Southeastern United States
Charles M. Adams *(Associate Professor, Marine Economics, Univ. of Florida, Florida Sea Grant, Gainesville, FL)*

Production Potential for U.S. Shrimp Mariculture
Kenneth J. Roberts *(Marine Resources Economic Specialist, Louisiana State Univ., Baton Rouge, LA)*

Economic Constraints and Opportunities for Salmon Culture in the United States
James L. Anderson *(Associate Professor, Dept. of Resource Economics, Univ. of Rhode Island, Kingston, RI)*

The Potential for Hybrid Striped Bass Aquaculture in the United States
Douglas W. Lipton

Growth Prospects and Opportunities in Catfish Aquaculture
Henry W. Kinnucan *(Associate Professor, Auburn Univ., Auburn, AL)*

Demand for Seafood and Impacts for Successful Aquaculture
Ivar Strand *(Professor, Dept. of Agricultural and Resource Economics, Univ. of Maryland, College Park, MD)* and Amy Buss *(Research Assistant, Univ. of Maryland, College Park, MD)*

Defining the U.S. National Aquaculture Policy
Curtis L. Marshall *(Policy Analyst, National Marine Fisheries Service, Silver Spring, MD)*

Ocean fishing is fast approaching its physical limits, and global demand for seafood is increasing faster than supply. The Food and Agriculture Organization of the United Nations projects that under present conditions, there will be a supply shortfall of more than 20 million metric tons by the year 2000. Large-scale aquaculture has the potential to fill the void. Significant developments have occurred in several countries (e.g., Norway and Ecuador), but aquaculture in the United States is, on the whole, a fledgling industry. This technical session will (1) examine the economic potential for specific aquaculture activities in the United States, (2) analyze competitive market conditions and the impacts of aquaculture on domestic "capture" fisheries, (3) project time horizons for development potential, and (4) discuss public policy aspects of aquaculture development.

[**Cosponsors:** AAAS Sections G, K, and O.]

24T-2. Knowledge-based Systems in Agriculture: A Developmental Perspective

Organized by: **Stephen R. Ruth** *(Professor, Dept. of Decision Sciences, George Mason Univ., Fairfax, VA)* and **Adel El-Beltagy** *(Ain Shams Univ., Cairo, Egypt)*

2:30 pm / Fri / 15 Feb **Sheraton / Vermont**

Presiding: Stephen R. Ruth

Expert Systems in Protected Agricultural Environments
Adel El-Beltagy

Experience with Specific Expert Systems Applications in Agricultural Development in Egypt
Ahmed Rafea *(FAO Country Representative, Cairo, Egypt)*

Low-cost Tools for Agricultural Decisions: An Agroforestry Perspective
Merrill Warkentin *(Professor, George Mason Univ., Fairfax, VA)* and P. K. Nair *(Professor, Univ. of Florida, Gainesville, FL)*

Speakers at this technical session will describe powerful applications of the newest artificial intelligence (AI) techniques that make it possible to gain specific advantages in agriculture, fisheries management, and plant biology. The dominant focus is the use of these powerful tools in the context of developing nations. El-Beltagy and Rafea will examine a major $2 million project now under way in Egypt regarding the use of expert systems techniques to improve the productivity of farmers, especially in enclosed environments, in a variety of crops, including citrus. The project is a major cooperative effort between the government of Egypt and the United Nations Food and Agriculture Organization. If successful, it could be of benefit to technology transfer in international science. Ruth, who directs a university-based center for developing AI programs for many agricultural applications, will describe a recently developed expert system for use in alley-cropping decisions for agroforestry in developing nations. In aggregate, the panel offers an authentic perspective of the new opportunities available to scientists in harnessing artificial intelligence for specific applications in agriculture and biology in developing nations.

[**Sponsors:** AAAS Section O; AAAS Consortium of Affiliates for International Programs. **Cosponsor:** AAAS Section T.]

24T-3. Bovine Somatotropin: Biotechnology Product and Social Issues in the U.S. Dairy Industry

Organized by: **Joseph J. Molnar** *(Alumni Professor of Rural Sociology, Auburn Univ., Auburn, AL)* and **Robert G. Zimbelman** *(Executive Vice President, American Society of Animal Science, Bethesda, MD)*

2:30 pm / Tue / 19 Feb **Sheraton / Vermont**

Presiding: Robert G. Zimbelman

Biology of Bovine Somatotropin and the Lactational Response in Dairy Cows
Dale Bauman *(Liberty Hyde Bailey Professor and Professor of Nutritional Biochemistry, Dept. of Animal Science, Cornell Univ., Ithaca, NY)*

bST Safety and Human Consumption
C. Greg Guyer *(Regulatory Chemist, Center for Veterinary Medicine, Food and Drug Administration, Beltsville, MD)*

Bringing rbST to the Farmer: Product Development and Regulatory Approval
James W. Lauderdale *(Director, Growth Research, Upjohn Co., Kalamazoo, MI)*

Economics of bST: Impacts on the Farmer, the Consumer, and the Industry
Richard Fallert *(Agricultural Economist, U.S. Dept. of Agriculture, Economic Research Service, Washington, DC)*

Pros and Cons of bST: The Dairy Producer's Perspective
Frederic Halbert *(Co-owner, Halbert Dairy Farm, Delton, MI)*

Ethical Issues in Technical Change: The Case of bST
Jeffrey Burkhardt *(Associate Professor and Director, Ethics and Policy Studies Program, Institute of Food and Agricultural Sciences, Univ. of Florida, Gainesville, FL*

bST as a Social Issue: Symbolisms, Fears, and Misunderstandings
Joseph J. Molnar

Cows produce more milk when injected with bovine somatotropin (bST). Advances in biotechnology have lowered manufacturing costs for the substance to the point where firms are endeavoring to develop usable products, obtain regulatory approval, and market the technology to dairy farms. This technical session examines bST as a case study in the advent of a biotechnology-based innovation, one of the first to enter the market. bST has been controversial over its perceived safety, impact on farm structure, potential to shift the regional location of dairy production, and implications for government spending for milk price supports. The evolution of this technology will be reviewed in the context of the various claims, reactions, and projections of researchers, economic analysts, farm groups, and populist critics. Speakers will address the scientific basis for bST, the status of the research and development effort in the pharmaceutical industry, and the economic consequences for individual farmers and the industry, as well as the larger social and ethical implications of this specific technical development. An assessment of the foreseeable course and relative impacts of the rapid diffusion and widespread use of bST on farmers, rural communities, and the industry will be made. This session is designed to integrate basic information about scientific developments and societal concerns toward an interdisciplinary dialogue over a salient public issue. It first establishes the technical and regulatory foundation of the technology; then, later speakers will elaborate the broader implications for society from a variety of disciplinary frameworks.

[**Sponsors:** AAAS Sections K and O; American Society of Animal Science. **Cosponsors:** AAAS Sections G and X; Rural Sociological Society.]

24T-4. Value-added Products from Agriculture

Organized by: **William H. Tallent** *(Assistant Administrator, Agricultural Research Service, U.S. Dept. of Agriculture, Washington, DC)*

8:30 am / Sun / 17 Feb **Sheraton / Vermont**

Presiding: William H. Tallent

The ARS Regional Research Centers: 50 Years of Utilization Research
Arthur I. Morgan *(National Program Leader, National Program Staff, Agricultural Research Service, U.S. Dept. of Agriculture, Beltsville, MD)*

Value-added Processes: Comfort and Convenience from Cotton
Andrew G. Jordan *(Director, Technical Services, National Cotton Council of America, Memphis, TN)*

Starch-based Products for an Environmental Era
William M. Doane *(Research Leader, Northern Regional Research Center, Agricultural Research Service, U.S. Dept. of Agriculture, Peoria, IL)*

Edible Fats and Oils
Timothy L. Mounts *(Research Leader, Northern Regional Research Center, Agricultural Research Service, Dept. of Agriculture, Peoria, IL)*

Industrial Products from Fats and Oils
Gerhard Maerker *(Research Chemist, Eastern Regional Research Center, Agricultural Research Service, U.S. Dept. of Agriculture, Philadelphia, PA)*

Structure-baking Functionality Relationships Among the Seed Storage Proteins of Wheat
Frank C. Greene *(Supervisory Research Chemist, Western Regional Research Center, Agricultural Research Service, U.S. Dept. of Agriculture, Albany, CA)*

Innovations in Food Processing
James C. Craig, Jr. *(Research Leader, Eastern Regional Research Center, Agricultural Research Service, U.S. Dept. of Agriculture, Philadelphia, PA)*

Fermentation: The Original Biotechnology
Arthur E. Humphrey *(Director, Center for Molecular Bioscience and Biotechnology, Lehigh Univ., Bethlehem, PA)*

Value-added Products for the Competitive '90s
Ruxton H. Villet *(National Program Leader, National Program Staff, Agricultural Research Service, U.S. Dept. of Agriculture, Beltsville, MD)*

The first speaker will give a historical overview of the USDA/ARS Regional Research Centers in commemoration of their 50th anniversary. Jordan will describe research accomplishments that saved the cotton textile industry from annihilation by synthetics. This will be followed by summaries of research leading to products from starch with major advantages (e.g., water-trapping capacity, and biodegradability) turning fats and oils into high-quality food products and establishing their usefulness as raw materials for the manufacture of specialty chemicals. Greene will examine the relationship between protein structure and functionality. Focus will shift from product to process innovations in the succeeding presentations on food-processing innovations and fermentation from a biotechnical point of view. The final speaker will suggest ways that past experience can be built upon to address opportunities and challenges of the future. An added feature of the session will be the presentation of the Sterling Hendricks Award. Named for the leader of the team that elucidated the mechanism underlying photoperiodicity in plants, this annual ARS-sponsored award recognizes a scientist who has made outstanding contributions to the science and technology of food and agriculture.

[**Sponsor:** AAAS Section O.]

25. Ecology; Evolution

25-1. Inheritance of Acquired Characteristics: Evolutionary Origins of New Significant Traits

Organized by: **David G. Bermudes** *(Postdoctoral Research Associate, Center for Great Lakes Studies, Univ. of Wisconsin, Milwaukee, WI)* and **Ricardo Guerrero** *(Professor of Genetics and Microbiology, Univ. Autónoma de Barcelona, Bellaterra, Spain)*

2:30 pm / Sat / 16 Feb **Sheraton / Arlington**

Presiding: David G. Bermudes, Ricardo Guerrero, and Francisco Rodriguez-Valera *(Professor of Biology, Dept. of Molecular Genetics and Microbiology, Univ. of Alicante, Alicante, Spain)*

Bacterial Horizontal Gene Transfer
Ricardo Guerrero

Symbiosis and Sex: Acquisition of Partners
Lynn Margulis *(Professor of Biology, Dept. of Botany, Univ. of Massachusetts, Amherst, MA)*

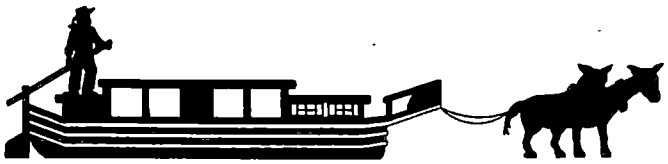
Frequency of Spontaneous Transfer of Plasmids from *E. coli* to Mammalian Cells Cultured Under Various Conditions
Juan López-Pila *(Professor of Virology, Institut für Wasser-Boden-und-Lufthygiene des Bundesgesundheitsamptes, Berlin, Germany)*

Kinetosomal Inheritance
Michael Adams *(Associate Professor of Biology, Eastern Connecticut State Univ., Willimantic, CT)*

Environmentally Induced Heritable Changes in Flax
Christopher A. Cullis *(Professor of Biology, Case Western Reserve Univ., Cleveland, OH)*

Although ridiculed as the core of Lamarckism, the inheritance of acquired characteristics is a concept of importance in evolutionary theory. Contrary to the "willful" changes conceived of by Lamarck, acquired genetic changes occur largely by lateral gene transfer. Viral transduction, plasmid transfer, and the establishment of obligate heritable symbiosis are all examples of such change. These genetic changes, as well as spontaneous mutations, may be inherited under conditions where they occur in reproductive cells. Study of these phenomena brings to light the growing need for revising the distinction between germ plasm and soma and its place in evolutionary theory. Contrary to what is implicit in the Neo-Darwinian "Modern Synthesis," most organisms do not differentiate germ plasm and soma to the extent exhibited by vertebrates (and some other animals) and are not limited to sexual reproduction. Asexual reproduction is widely distributed, making those organisms prone to the inheritance of acquired characteristics. The evolutionary origin within a lineage of groups of characteristics acting together can be linked to lateral transfer phenomena: metal resistance in some bacteria is plasmid borne, while photosynthesis arose in several algal lineages through endosymbiosis.

[**Cosponsor:** AAAS Section G.]



25-2. Defining Ecosystem Health: Science, Economics, or Ethics?

Organized by: **Bryan G. Norton** *(Professor of Philosophy, School of Public Policy, Georgia Institute of Technology, Atlanta, GA)*

8:30 am / Fri / 15 Feb **Sheraton / Richmond**

Presiding: Eugene Hargrove *(Professor of Philosophy, Univ. of North Texas, Denton, TX)*

Introductory Remarks
Laura Westra *(Secretary/Treasurer, International Society for Environmental Ethics)*

Aldo Leopold's Concept of Land Health
J. Baird Callicott *(Professor of Philosophy, Univ. of Wisconsin, Stevens Point, WI)*

Environmentalists and Economists and Philosophers and Biologists
Talbot Page *(Professor of Economics and Environmental Studies, Brown Univ., Providence, RI)*

Ecosystem Health/Integrity as Applied in the Great Lakes Basin
Henry A. Regier *(Director, Institute for Environmental Studies, and Professor of Zoology, Univ. of Toronto, Toronto, Canada)*

Environmental Integrity: A Positive or Privative Concept?
Mark A. Sagoff *(Director, Institute for Philosophy and Public Policy, Univ. of Maryland, College Park, MD)*

Ecological Health: Problems of Scale and Context
Bryan G. Norton

2:30 pm / Fri / 15 Feb **Sheraton / Richmond**

Presiding: Eugene Hargrove

Ecosystem Health and Ecological Theories
David Ehrenfeld *(Professor of Biology, Rutgers Univ., New Brunswick, NJ, and Editor,* Conservation Biology)

Trophic Flow Networks as Indicators of Ecosystem Health
Robert E. Ulanowicz *(Professor, Chesapeake Biological Laboratory, Univ. of Maryland, Solomons, MD)*

Fauna and Flora: Necessary Definitions of Ecosystem Health
Larry D. Harris *(Professor, Dept. of Wildlife, Univ. of Florida, Gainesville, FL)*

Alternative Models of Ecosystem Restoration
Susan P. Bratton *(Adjunct Research Professor, Institute of Ecology, Univ. of Georgia, Athens, GA)*

Toward an Operational Definition of Ecosystem Health
Robert Costanza *(Associate Professor, Coastal and Environmental Policy Program, Center for Environmental and Estuarine Studies, Univ. of Maryland, Solomons, MD)*

Conservation biologists and environmental managers employ science to manage and protect biological resources. Central to both disciplines must therefore be criteria by which to judge when a system is in need of restoration; there exists, however, no consensually accepted definition of "ecosystem health" that might anchor such judgments. This symposium will bring together ecologists, economists/managers, and environmental philosophers to discuss the contribution of their disciplines to these criteria. The first session will focus on historical, philosophical, and general questions regarding the theory of environmental management. In particular, philosophers and economists will discuss the role of values in

determining concepts of ecosystem health and the general applications of those concepts in determining criteria and standards for successful environmental management. In the second session, scientists will discuss the contributions of biological disciplines, especially ecology, in the formulation of these criteria and standards.

[**Cosponsors:** AAAS Section G; AAAS Committee on Scientific Freedom and Responsibility.]

25-3. Strategic Approaches to Conserving Genetic Resources in Natural Habitats

Organized by: **Joel I. Cohen** *(Biotechnology and Genetic Resource Specialist, Agency for International Development, Washington, DC)* and **Christopher S. Potter** *(Research Associate, Dept. of Biological Sciences, Stanford Univ., Stanford, CA)*

8:30 am / Mon / 18 Feb **Sheraton / Richmond**

Presiding: Christopher S. Potter

Strategies for Plant Conservation Worldwide
Peter H. Raven *(Director, Missouri Botanical Garden, St. Louis, MO)*

Managing Wild Biodiversity Resources for Economic Development in Costa Rica
Daniel Janzen *(Professor of Biology, Univ. of Pennsylvania, Philadelphia, PA)*

Diversity and Economic Enrichment in Managed Forests of Kalimantan and Amazonia
Christine Padoch *(Associate Scientist, The New York Botanical Garden-Institute of Economic Botany, Bronx, NY)*

Development Strategies for African Forest and Primate Conservation
William Weber *(Assistant Director for Conservation, Wildlife Conservation International, New York Zoological Society, Bronx, NY)*

Biological Diversity and Conservation of Ancient Forests of the Pacific Northwest
David Wilcove *(Forest Scientist, The Wilderness Society, Washington, DC)*

Biological diversity — the variety of genetic resources, organisms, and the ecological systems in which they occur — is threatened everywhere. Since donor resources for conservation are limited, it is imperative that effective management choices be made through strategic planning approaches. This symposium will explore strategies for on-site conservation of genetic resources in tropical developing countries. The objective will be to evaluate trade-offs between conservation strategies based on their potential contributions to economic development. Comparisons will be made among different operational approaches and their expected benefits. These include scientific research, education, restoration, economic botany, eco-tourism, and international cooperation. Conservation priorities for important biodiversity components (such as crop genetic resources, tropical tree species, arthropods, and primate populations) will be pursued. Social and institutional constraints to implementation of conservation strategies will be discussed.

[**Sponsor:** AAAS Section O. **Cosponsors:** AAAS Section G; AAAS Southwestern and Rocky Mountain Division.]

Computer Software/Equipment at the AAAS☆91 Exhibition

Come to Sheraton Exhibit Hall C and meet with representatives from these and other computer software and equipment companies: *IMSL, Language Systems Corp., Learning Services, PaperChase®, Prescience Corp., Texas Instruments,* and *Wolfram Research.*

Exhibit Hall C: Fri/6pm-8pm, Sat-Mon/9am-3pm

25-4. Nonrandom Evolution: Matter, Life, Mind

Organized by: **Sidney W. Fox** *(Distinguished Research Professor in Plant Biology and Electrical Engineering, Southern Illinois University, Carbondale, IL)* and **John H. Yopp** *(Dean, Graduate School, and Professor of Plant Biology, Southern Illinois Univ., Carbondale, IL)*

8:30 am / Tue / 19 Feb **Sheraton / Arlington**

Presiding: John H. Yopp

Cosmological Conditions Necessary for Biology
John D. Barrow *(Professor of Astrophysics, Univ. of Sussex, Sussex, UK)*

Nonrandom Protein in Prelife-to-Life Transition
Sidney W. Fox

Studies on the Origin of the Genetic Code
Cyril Ponnamperuma *(Professor of Chemistry and Biochemistry, Laboratory of Chemical Evolution, Univ. of Maryland, College Park, MD)*

Biological Form and Organization in Evolution
Mae-Wan Ho *(Reader in Biology, Developmental Dynamics Research Group, Open Univ., Milton Keynes, UK)*

Determination of Human Psychological Traits: Convergent or Divergent Processes?
Thomas J. Bouchard, Jr. *(Professor, Dept. of Psychology, Univ. of Minnesota, Minneapolis, MN)*

This symposium will feature contributions from scientists whose research provides support for nonrandom processes operating on the principle of inherent information in progressively complex units of matter. Analysis of Big Bang events in a forward direction has indicated that the early universe was highly ordered rather than chaotic. The elements of matter and the organic components of circumstellar compounds are now known to be highly nonrandom. Experiments indicate that amino acid precursors of thermal protein and protocells spontaneously organized therefrom were also highly nonrandom. Specificity of the linkage of amino acids in the reactions of aminoacyl nucleotide anhydrides has been found to reside in the amino acid, not the nucleotide. The endogenously limited arrays are seen to characterize a new evolutionary paradigm for the emergence of organisms, as well as a principle of natural selection of nonrandom variants instead of random variants. The nature of the organisms at the latest end of this sequence is found also to be highly deterministic, as in the studies of reunited monozygotic twins.

[**Cosponsors:** AAAS Sections G and J.]

25-5. Seeds Since Columbus: Crop Germplasm of the Americas

Organized by: **Douglas H. Boucher** *(Western Hemisphere Cooperation Program, AAAS, Washington, DC)*

2:30 pm / Sun / 17 Feb **Sheraton / Richmond**

Presiding: Douglas H. Boucher

Crop Migration Between the Old and New Worlds
Hugh L. Popenoe *(Director/Professor, Univ. of Florida, Gainesville, FL)*

American Crops That Didn't Make the Columbian Interchange
Calvin R. Sperling *(Plant Exploration Officer, National Germplasm Resources Laboratory, U.S. Dept. of Agriculture, Beltsville, MD)*

The Spice Trade Before and After Columbus
James A. Duke *(Economic Botanist, National Germplasm Resources Laboratory, U.S. Dept. of Agriculture, Beltsville, MD)*

The "Difficult" Seeds: Perspective on Their Conservation, with Special Reference to the Palm Family
Dennis V. Johnson *(Program Coordinator, Tropical Research and Development, Inc., Washington, DC)*

Conservation of Useful Crop Diversity: What Has to Be Done?
Trevor J. Williams *(Director, International Program for Tropical Tree Crops Conservation and Development, Washington, DC)*

1492 marked the beginning of an enormous flow of crops between the Old and New Worlds. Columbus's voyages were motivated by the profitable spice trade between Europe and the Far East, but his discovery led to migrations of all sorts of crops in both directions. Some native crops, such as the quinoa and tarwi of the Incas, were replaced by Old World grains and were nearly lost, while others, such as potatoes, became staples in European countries.

This symposium will examine the Columbian interchange of crops and its implications for germplasm conservation. It will cover both the major staples and the difficult-to-conserve minor crops, and will place modern problems of crop diversity in a historical perspective. The speakers will show how many of the threats to germplasm conservation go back to the events of five centuries ago.

The symposium will be accompanied by a display of some little-known crops of the Americas (some of them edible!). Publications dealing with conservation of crop germplasm, such as *Diversity* and *Economic Botany*, will also be displayed.

[**Sponsors:** AAAS Directorate for International Programs; Interciencia Association. **Cosponsors:** AAAS Sections G and O; AAAS Committee on Public Understanding of Science and Technology; AAAS Directorate for Education and Human Resources Programs.]



25-6. Stakes in the Tropical Forest

Organized by: **Robert L. Randall** *(Director, RainForest ReGeneration, Washington, DC)*

8:30 am / Sat / 16 Feb **Sheraton / Richmond**

Tropical Forests and the Biogeophysiological Equilibrium

Presiding: Thomas E. Lovejoy *(Assistant Secretary for External Affairs, Smithsonian Institution, Washington, DC)*

Tropical Forests and the Global Carbon Cycle
Richard A. Houghton *(Senior Scientist, The Woods Hole Research Center, Woods Hole, MA)*

Atmospheric Chemistry
Peter S. Bakwin *(Postdoctoral Fellow, Division of Applied Sciences, Harvard Univ., Cambridge, MA)*

Climatic Impacts of Amazon Deforestation
Jagadish Shukla *(Director, Center for Ocean-Land-Atmosphere Interactions, Univ. of Maryland, College Park, MD)*

Soil Types and Productivity
Pedro A. Sanchez *(Professor and Director, Tropical Soils Program, Soil Science Dept., North Carolina State Univ., Raleigh, NC)*

Bio-hydrological Coupling
Helmut Elsenbeer *(Research Scientist, Section Soil Science, Institute of Geography, Univ. of Berne, Berne, Switzerland)*

2:30 pm / Sat / 16 Feb **Sheraton / Richmond**

Tropical Forests: Conservation and Development

Presiding: Thomas E. Lovejoy

The Urgent Transition to Sustainability: Policy Options
Robert Goodland *(The World Bank, Washington, DC)*

Tropical Forest Economics
Jan K. Lewandrowski *(Economist, Economic Research Service, U.S. Dept. of Agriculture, Washington, DC)*

Nonwood Forest Products
Robert O. Mendelsohn *(Associate Professor, Yale School of Forestry and Environmental Studies, Yale Univ., New Haven, CT)*

Debt-for-Nature Swaps
Thomas E. Lovejoy

Making Development and Conservation Compatible
Brian M. Boom *(Associate Curator, New York Botanical Garden, Bronx, NY)*

Roundtable Discussion: How Can We Create a Conservation/Development-compatible Future?

This symposium explores both the role of tropical forests in the global geophysiological equilibrium and the human manipulation of those forests. The first session addresses tropical forests' influence on the geophysiological equilibrium, a term coined by James Lovelock for terrestrial-scale interaction between physical and biological systems. To get a measure of the significance of tropical forests on the equilibrium, the speakers were asked to estimate the effects on the natural equilibrium of a hypothetical 50% reduction in tropical forests and of the complete disappearance of tropical forests. Tropical forests are diminishing principally as a result of human activities. The afternoon session searches for ways of encouraging economic development to relieve the deforestation pres-

sures caused by poverty in the forested tropical countries while conserving natural bioresources. This session stresses political, economic, industrial, and cultural solutions, not simply analysis and interpretation of the present predicament.

[Cosponsors: AAAS Sections G, K, W, and X.]

25-7. Science and Management of Large Marine Ecosystems

Organized by: **Kenneth Sherman** *(Director, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Center, Narragansett Laboratory, Narragansett, RI)*, **Lewis M. Alexander** *(Director, Center for Ocean Management Studies, Univ. of Rhode Island, Kingston, RI)*, and **Barry D. Gold** *(Program Officer, National Academy of Sciences, Washington, DC)*

8:30 am / Mon / 18 Feb — **Sheraton / Annapolis**

Presiding: Kenneth Sherman

Biomass Yields and Management of LMEs
William W. Fox, Jr. *(Assistant Administrator for Fisheries, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Silver Spring, MD)*

The Science and Management of the Antarctic Ecosystem
R. Tucker Scully *(Director, Office of Oceans and Polar Affairs, U.S. Dept. of State, Washington, DC)*

Legal Mandates for the Management of LMEs
Martin H. Belsky *(Dean, Albany Law School, Albany, NY)*

A Regional Geographic Strategy for LMEs
Lewis M. Alexander

The Utility of the LME Concept to Ocean Management
Robert W. Knecht *(Professor, Center for the Study of Marine Policy, Univ. of Delaware, Newark, DE)*

2:30 pm / Mon / 18 Feb — **Sheraton / Annapolis**

Presiding: Lewis M. Alexander and Barry D. Gold

Global Ecosystem Dynamics and Large Marine Ecosystems
Brian J. Rothschild *(Professor, Chesapeake Biological Laboratory, Univ. of Maryland, Solomons, MD)*

The Ecological Basis for the Management of Living Marine Resources in Large Marine Ecosystems of Western European Seas
K. Vagn Hansen *(Director, Danish Institute for Fisheries and Marine Research, Hirtschals, Denmark)*

Research and Management in the Northern California Current Ecosystem
Daniel L. Bottom *(Senior Scientist, Research and Development Section, Oregon Dept. of Fish and Wildlife, Corvallis, OR)*

Management of Insular Pacific LMEs
Joseph R. Morgan *(Professor, Environment and Policy Institute, East-West Center, Honolulu, HI)*

The Ecological Basis for the Management of Living Marine Resources of the Northwest Atlantic Continental Shelf Ecosystem
Kenneth Sherman

During the last several years, ocean scientists and managers have gained important new insights into the processes that govern the ecology of coastal and ocean species. This has led to a new conceptual framework called the "large marine ecosystem (LME) approach," which provides the basis for developing new strategies for marine resource management and research. These new strategies have a broad application to the ways in which countries manage their exclusive economic zones (EEZs) and to many of the regionally focused conventions and action plans aimed at environmentally sound management of marine resources.

This symposium will assist scientists and ocean managers in gaining an understanding of the relevance and application of the LME approach to the conservation and management of living marine resources. Participants will be introduced to how they can apply the concept of LMEs within the context of ecological science and laws and regulations during a period when global environmental conditions are expected to change significantly. Scientific and management experts participating in the symposium will provide syntheses of available information on the scientific, economic, legal, and geographic bases for the management of entire marine ecosystems. The information presented will be reviewed, and suggestions on the next steps regarding the integration of the LME concept into a more holistic, ecologically sound management strategy for living resources within the EEZs of coastal states will be discussed.

Technical Sessions

25T-1. Policy Issues in Coastal Zone Management

Organized by: **John H. Cumberland** *(Professor Emer., Center for Environmental and Estuarine Studies, Univ. of Maryland, Solomons, MD)*

2:30 pm / Tue / 19 Feb — **Sheraton / Richmond**

Presiding: Joseph A. Mihursky *(Professor and Director, Chesapeake Research Consortium, Inc., Solomons, MD)*

Interactions of Science and Policy: Comparisons Between the Gulf of Mexico and the Chesapeake Bay
Donald F. Boesch *(Director, Center for Environmental and Estuarine Studies, Univ. of Maryland, Cambridge, MD)*

Economic Instruments for Coastal Zone Management
R. Scott Farrow *(Associate Professor of Economics, Council for Environmental Quality, Washington, DC)*

Estuarine Science and Public Health
Rita R. Colwell *(Director, Maryland Biological Institute, Univ. of Maryland, College Park, MD)*

Estuarine Policy Issues
Leonard A. Shabman *(Professor of Economics, Dept. of Agricultural Economics, Virginia Polytechnic Institute and State Univ., Blacksburg, VA)*

Economic Incentives in Coastal Zone Management
Wallace E. Oates *(Professor, Dept. of Economics, Univ. of Maryland, College Park, MD)*

Marine Debris
James R. Kahn *(Associate Professor, Dept. of Economics, State Univ. of New York, Binghamton, NY)*

Policies for Sustainable Development of Coastal Regions
Robert Costanza *(Associate Professor, Chesapeake Biological Laboratory, Center for Environmental and Estuarine Studies, Univ. of Maryland, Solomons, MD)*

The Effect of Coastal Land Use Restrictions on Housing Prices
George R. Parsons *(Professor, Dept. of Economics and College of Marine Studies, Univ. of Delaware, Newark, DE)*

Marine Environmental Policy in Louisiana
Leon E. Taylor *(Assistant Professor, Dept. of Economics, Tulane Univ., New Orleans, LA)*

This session will examine common problems that have affected all major U.S. estuaries and suggest improved policy instruments for addressing these problems. Although each estuary is unique, each is at risk from rising pollution levels, open access resources, intensive land development, and growing impacts from federal government programs. Although present policy instruments for dealing with these problems, based primarily upon a regulatory approach, have not been adequate for dealing with environmental pressures from rising levels of population and economic development, proposals for alternative policy instruments, based primarily upon economic incentives, have not been widely accepted. The design of more generally acceptable improvements in environmental management policies will be dependent not only upon the criteria of economic efficiency and scientific validity, but also upon broader public choice criteria, such as distributional justice and acceptability to major interest groups involved. In this session, senior scholars, younger colleagues, women, and minority specialists will examine these public choice issues as they affect many of the nation's major estuaries.

[**Sponsors:** AAAS Section K; American Economic Association.]

25T-2. Ecosystem Perspectives of Multiple-use Management

Organized by: **Wayne T. Swank** *(Project Leader, Coweeta Hydrologic Laboratory, Southeastern Forest Experiment Station, U.S. Forest Service, Otto, NC)* and **David H. Van Lear** *(Professor, Dept. of Forestry, Clemson Univ., Clemson, SC)*

8:30 am / Tue / 19 Feb **Sheraton / Richmond**

Presiding: David H. Van Lear and Wayne T. Swank

Philosophy, Aims, and Structure of New Perspectives for Managing the National Forest System
Hal Salwasser *(Director of New Perspectives, U.S. Forest Service, Washington, DC)*

New Forestry Principles from Ecosystem Analysis of Western Forests
Frederick J. Swanson *(Project Leader, Forestry Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station, U.S. Forest Service, Corvallis, OR)*

Gradient Analysis of Ecological Change in Time and Space: Implications for Multiple-use Management
James R. Gosz *(Professor, Biology Dept., Univ. of New Mexico, Albuquerque, NM)*

Watershed Ecosystem Analysis as a Basis for Multiple-use Management of Eastern Forests
James W. Hornbeck *(Research Forester, Forestry Sciences Laboratory, Northeastern Forest Experiment Station, U.S. Forest Service, Durham, NH)*

Principles of Landscape Ecology in Natural Resource Management of Southern Forests
Rebecca R. Sharitz *(Senior Ecologist, Savannah River Ecology Laboratory, Univ. of Georgia, Aiken, SC)*

Multiple-use management of natural resources is the foundation for Forest Service management of 191 million acres in 42 states and Puerto Rico. "New Perspectives" is an emerging program to revitalize the multiple-use ideal through operational management of resources using state-of-the-art ecosystem science. This technical session will examine the philosophy and direction of New Perspectives and illustrate with regional examples the coupling of ecosystem science with multiple-use management, including the challenges, complexities, and benefits of the approach. The speakers will focus on ecosystem analyses at stand and landscape scales and relate recent shifts in forest management to an improved balance between commodity production and ecological objectives. Problems of ecosystem restoration and riparian and nonriparian wetlands, and the importance of disturbance events such as fires, floods, and hurricanes, will be addressed. The use of small watersheds as a basis for ecosystem analysis will illustrate principles and procedures for assessing the impacts of individual and cumulative effects of current harvesting practices, atmospheric deposition, and past land use practices. Other discussions will focus on gradient analysis to demonstrate nonlinear, scale-dependent characteristics of forest ecosystems and the implications for multiple-use management.

[**Cosponsors:** AAAS Sections G, O, and W; AAAS Southwestern and Rocky Mountain Division.]

25T-3. Tropical Biology: Historical Perspectives and Contemporary Issues

Organized by: **Joel B. Hagen** *(Assistant Professor of Biology, Radford Univ., Radford, VA)*

8:30 am / Sun / 17 Feb **Sheraton / Richmond**

Presiding: Richard M. Burian *(Professor of Philosophy, Virginia Polytechnic Institute and State Univ., Blacksburg, VA)*

European Visions: Science, the Tropics, and the War on Nature
Michael A. Osborne *(Assistant Professor, Dept. of History, Univ. of California, Santa Barbara, CA)*

Biological Exploration of the New World Tropics in the 19th Century
George Angehr *(Liaison Officer, Smithsonian Tropical Research Institute, Washington, DC)*

Tropical Biology and Research Institutions in Southeast Asia, 1870 - 1930
David G. Frodin *(Philadelphia, PA)*

Castles in the Air: Laboratories, Research Stations, and the Emergence of Tropical Biology
Joel B. Hagen

OTS: A U.S. Initiative in the Late 20th Century to Develop Training and Research Programs in Tropical Biology
Donald E. Stone *(Dept. of Botany, Duke Univ., Durham, NC, and Executive Director, Organization for Tropical Studies)*

This session will place current concerns in tropical biology and conservation within an historical context. The speakers will address the following related questions: (1) How have European and North American attitudes toward tropical lands changed during the

past two centuries? (2) How have these attitudes been reflected in various types of scientific research done in the tropics? (3) How have social, economic, and political factors influenced the development of research institutions in the tropics? (4) To what extent can historical studies provide insights into the current status of tropical biology? Chronologically, the speakers will cover the period from the early 19th to the late 20th century. Geographically, they deal with both the Old and New World tropics.

[**Sponsor:** AAAS Section L. **Cosponsor:** AAAS Section G.]

25T-4. Advances in Zoo Biology and Conservation

Organized by: **Benjamin B. Beck** *(Associate Director for Biological Programs, National Zoological Park, Smithsonian Institution, Washington, DC)*

2:30 pm / Mon / 18 Feb **Sheraton / Richmond**

Presiding: Benjamin B. Beck

Species Survival Plans: Cooperative Efforts to Save Endangered Species
Michael Hutchins *(Director, Conservation and Science, American Association of Zoological Parks and Aquariums Conservation Center, Bethesda, MD)*

The Umwelt: Biologically Salient Features of Zoo Environments
Elizabeth F. Stevens *(Senior Research Associate, Dept. of Conservation and Research, Zoo Atlanta, Atlanta, GA)*

Causes of Death of Zoo-born Giant Pandas
Richard J. Montali *(Head, Dept. of Pathology, National Zoological Park, Smithsonian Institution, Washington, DC)*

Reproductive Endocrinology of Zoo and Wild Gorillas
Nancy Czekala *(Endocrinology Specialist, Center for Reproduction of Endangered Species, San Diego Zoo, San Diego, CA)*

Reintroducing Zoo-born Animals to the Wild
Benjamin B. Beck

Public Education and Professional Training in Conservation
Lou Ann Dietz *(Brazil Senior Program Officer, World Wildlife Fund, Washington, DC)*

Zoos continue to mature as educational, research, and conservation organizations. Ironically, as "the wild" shrinks, there is increased demand by wildlife ecologists for the knowledge and techniques that have been developed in zoos. This session will present a sampling of vital interdisciplinary research that is being conducted in zoos of the 1990s and remind nonzoo colleagues of the unique educational and scientific opportunities that zoos offer.

[**Cosponsors:** AAAS Sections G and X.]

U.S. Government Agencies at the AAAS☆91 Exhibition

Visit these and other federal agencies: *Animal Welfare Information Center, Armed Forces Institute of Pathology, Defense Technical Information Center, National Biological Control Institute, National Institutes of Health, National Library of Medicine, National Oceanic and Atmospheric Administration,* and *National Optical Astronomy Observatories.*

Exhibit Hall C: Fri/6pm-8pm, Sat-Mon/9am-3pm

26. Biomedical Ethics

26-1. Alternative Approaches to Clinical Trials in AIDS: Ethics and Methodology

Organized by: **Kenneth F. Schaffner** *(Professor of History and Philosophy of Science and Co-director, Center for Medical Ethics, Univ. of Pittsburgh, Pittsburgh, PA)*

8:30 am / Sun / 17 Feb **Sheraton / Arlington**

Presiding: Kenneth F. Schaffner

Controlled Trials and Expanded Access: Can We Do Both?
Ellen C. Cooper *(Director of Antiviral Drug Products, Food and Drug Administration, Rockville, MD)*

Developing New Approaches to Clinical Trials in AIDS
Susan S. Ellenberg *(Chief, Biostatistics Research Branch, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Rockville, MD)*

Design Options for AIDS Trials
David P. Byar *(Chief, Biometry Branch, National Cancer Institute, National Institutes of Health, Bethesda, MD)*

Large, Simple Trials: An Unexploited Opportunity
Paul Meier *(Ralph and Mary Otis Isham Distinguished Service Professor, Depts. of Statistics, Pharmacology, and Medicine, Univ. of Chicago, Chicago, IL)*

Community Consultation in Clinical Trials
Robert J. Levine *(Professor of Medicine, Yale Univ. School of Medicine, New Haven, CT)*

2:30 pm / Sun / 17 Feb **Sheraton / Arlington**

Presiding: Kenneth F. Schaffner

How AIDS Will Change the Way We Test Drugs
Jim Eigo *(ACT UP/NY, New York, NY)*

Mechanisms for Incorporating Community Input into Trial Design
Rebecca Smith *(Associate Program Manager of Community-based Clinical Trials Program, American Foundation for AIDS Research, New York, NY)*

An Ethical Assessment of Clinical Trials of AIDS Treatments
James F. Childress *(Kyle Professor of Religious Studies and Professor of Medical Education, Dept. of Religious Studies, Univ. of Virginia, Charlottesville, VA)*

Patient Demands, Therapeutic Obligations, and Clinical Trials
Loretta M. Kopelman *(Professor and Chair, Dept. of Medical Humanities, East Carolina School of Medicine, Greenville, NC)*

Discussant:
Samuel A. Bozzette *(Assistant Professor of Medicine and Clinical Director, Investigational HIV Treatment Center, Univ. of California, San Diego, CA)*

Clinical trials involving individuals who are HIV seropositive or who have AIDS have generated extensive recent discussion on both methodological and ethical fronts. HIV+/AIDS patients and others have raised ethical questions about the legitimacy of the use of placebo controls in this population. In addition, the problem of access to new agents only through admission to traditional clinical trials has produced ethical objections. The FDA has responded by developing "parallel track" designs to make new drugs more widely available and is contemplating other novel forms of clinical trials.

However, criticisms of the soundness of these new methodologies, as well as concerns about the safety of such new types of trials, have appeared. Symposium speakers — including nationally recognized experts on clinical trials, drug development and approval, and ethics, as well as community-based representatives of individuals with HIV disease/AIDS — will present various perspectives on these developments.

[**Sponsor:** AAAS Section L. **Cosponsors:** AAAS Section U; AAAS Committee on Scientific Freedom and Responsibility; Biometric Society.]

26-2. Ethical and Clinical Issues in Carrier Screening for Cystic Fibrosis

Organized by: **Jeffrey R. Botkin** *(Assistant Professor of Pediatrics and Biomedical Ethics, Case Western Reserve Univ. School of Medicine, Cleveland, OH)* and **Deborah Runkle** *(AAAS Committee on Scientific Freedom and Responsibility, Washington, DC)*

2:30 pm / Mon / 18 Feb **Sheraton / Arlington**

Presiding: Deborah Runkle

History and Lessons from Carrier Screening Programs
Robert F. Murray *(Professor of Pediatrics, Medicine, and Oncology, Howard Univ. School of Medicine, Washington, DC)*

Test Validity: Technical, Ethical, and Regulatory Issues
Neil A. Holtzman *(Professor of Pediatrics, Johns Hopkins Univ. School of Medicine, Baltimore, MD)*

Informed Consent and Decisions About Reproduction
Jeffrey R. Botkin

A Parent's Perspective on CF
Gayle Greenberg *(Executive Director, Metro DC Chapter, Cystic Fibrosis Foundation, Washington, DC)*

CF, Ethics, and the New Genetics
Thomas H. Murray *(Professor of Biomedical Ethics, Case Western Reserve Univ. School of Medicine, Cleveland, OH)*

The recent discovery of the cystic fibrosis (CF) gene offers the promise of a better understanding of CF and improved treatment for those afflicted with this disease. Identification of the gene will also provide the capability to perform carrier screening in the general population. Whether and how to perform carrier screening is highly controversial. This symposium will provide a forum for a discussion of the ethical and clinical issues inherent in developing a carrier screening program for CF. It will begin with a review of the clinical nature of CF and of the history and lessons learned from previous large-scale genetic screening programs. The technical limitations of the current screening technology will be addressed, and the ethical and regulatory issues in population screening will be discussed. Issues of informed consent and the nature of reproductive decisions for carriers will be presented. The perspective of those families and individuals affected by CF will be included as an essential component of policy development. Finally, the ethical issues in CF carrier screening will be discussed as a model for future genetic technology created by human genome research.

[**Sponsor:** AAAS Committee on Scientific Freedom and Responsibility. **Cosponsor:** AAAS Section X.]

26-3. DNA-based Identification Systems: Issues in Application

Organized by: **Paul R. Billings** *(Pacific Presbyterian Medical Center, San Francisco, CA)* and **Nachama Wilker** *(Council for Responsible Genetics, Boston, MA)*

8:30 am / Fri / 15 Feb **Sheraton / Arlington**

Presiding: Paul R. Billings

Statistical Problems in DNA-based Identification Systems
Donald A. Berry *(Professor of Statistics, Univ. of Minnesota, Minneapolis, MN)*

The FBI Program in DNA-based Identification
Bruce Budowle *(Research Chemist, Forensic Science Research and Training Center, Federal Bureau of Investigation, Quantico, VA)*

Legal Issues in the Use of DNA-based Identification Systems
Marjorie M. Shultz *(Professor, Boalt School of Law, Univ. of California, Berkeley, CA)*

The Public Policy Response to DNA-based Identification Systems
Jeroo S. Kotval *(Research Associate, New York State Legislative Commission on Science and Technology, Albany, NY)*

The Impact of DNA-based Identification Systems on Civil Liberties
Philip L. Bereano *(Professor of Engineering and Public Policy, Univ. of Washington, Seattle, WA)*

Over the last four years, results of DNA-based identification systems (DNA fingerprints) have been introduced into more than a hundred court cases in the United States. The development and use of these techniques has been credited with providing an important new tool for forensic experts. Methods comparing DNA fragment patterns from specimens such as blood, semen, or hair found at the scene of a crime with those in tissue samples from accused persons may allow the generation of significant identificatory evidence. Despite initial enthusiasm at the prospect of identifying and convicting criminals using DNA identification system results, serious questions have now been raised about applications and adverse consequences arising from widespread utilization of this method. Its accuracy, reproducibility, and statistical basis have been questioned. Concerns about invasions of personal liberties and privacy have been raised. For instance, it is unclear from whom DNA information may be taken and in what way it may be stored or used beyond a specific court case. With many important issues unresolved or unexplored, DNA-based identification systems are rapidly becoming commercialized and widely applied, and legislation mandating the storage of DNA information on individuals convicted of crimes is proposed.

This symposium will bring together experts from several disciplines to evaluate the scientific basis, application, and legal and public policy issues raised by the use of DNA-based identification systems. Speakers will define topics of current concern and suggest strategies for dealing with new problems.

[Sponsor: AAAS Section U. Cosponsors: American Statistical Association; Biometric Society; Institute of Mathematical Statistics.]

26-4. Scientists' Responsibilities When Research Is Socially Sensitive and Liable to Misinterpretation

Organized by: **Caroline Whitbeck** *(Senior Lecturer, Mechanical Engineering Dept., MIT, Cambridge, MA, and Member, AAAS Committee on Scientific Freedom and Responsibility)*

8:30 am / Mon / 18 Feb **Sheraton / Arlington**

Presiding: Caroline Whitbeck

Medical Journal Editors and the Public's Right to Know
Marcia Angell *(Executive Editor,* New England Journal of Medicine, *Boston, MA)*

Scientists' Responsibilities When Information of Potential Societal Significance Is Uncertain
Dale Hattis *(Research Associate Professor, Center for Environment, Technology, and Development, Clark Univ., Worcester, MA)*

Scientific Responsibility and Public Concern About Risk
Roger Kasperson *(Professor, Center for Environment, Technology, and Development, Clark Univ., Worcester, MA)*

Responsible Risk Assessment
Donald Millar *(Director, National Institute for Occupational Safety and Health, Centers for Disease Control, Atlanta, GA)*

This session addresses scientists' responsibilities when research, or a misinterpretation of it, has the potential to cause public fear or panic. A case in point is the hypothesis that there is a remote possibility that, because HIV is present in lymphocytes in the lung — and therefore, likely to be present in lung exudates in patients with pneumonia — variants of the HIV virus might arise that could be spread through the air. On the one hand, it will take research to determine the risk of such a mutation. Such research seems warranted to determine whether measures for early detection and containment of the disease are needed. On the other hand, casual discussion of this remote possibility would be likely to stimulate unfounded fear of people with AIDS. This session is intended to stimulate open discussion of the problem of socially useful but socially sensitive research. Such discussion will be a service to researchers who may find themselves involved in the conduct, funding, or publication of socially sensitive research. It will also help to prepare scientists, generally, for their role in the education of the public about socially sensitive research results.

[Sponsor: AAAS Committee on Scientific Freedom and Responsibility. Cosponsors: AAAS Sections H and X; AAAS Southwestern and Rocky Mountain Division; AAAS Committee on Science, Engineering, and Public Policy.]

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AAAS☆92: Chicago
6–11 February 1992

26-5. International Aspects of Ethical and Social Issues in Human Genome Research

Organized by: **Robert Mullan Cook-Deegan** *(Kennedy Institute of Ethics, Georgetown Univ., Washington, DC)* and **Daniel Wikler** *(Univ. of Wisconsin, Madison, WI)*

2:30 pm / Tue / 19 Feb **Sheraton / Arlington**

Presiding: Robert Mullan Cook-Deegan

The Role of HUGO
James Wyngaarden *(Director, Human Genome Organization, Bethesda, MD)*

International Aspects of Genome Research: Ethical and Social Issues
Thomas M. Murray *(Professor and Director, Center for Biomedical Ethics, Case Western Reserve Univ. Medical School, Cleveland, OH)*

Participation of Small Countries in the Human Genome Project
Vaclav Paces *(Professor, Institute of Molecular Genetics, Czechoslovak Academy of Sciences)*

State of the Debate in Japan
Rihito Kimura *(Professor, Waseda Univ., Tokyo, Japan)*

Discussants:
Victor A. McKusick *(University Professor of Medical Genetics, Johns Hopkins Univ., Baltimore, MD),* Eric Juengst *(National Center for Human Genome Research, NIH, Bethesda, MD),* and Diane Hinton *(Administrator, Americas Office, Human Genome Organization, Bethesda, MD)*

The Human Genome Project is an international enterprise. Dedicated genome research plans have been in place in Italy, the Soviet Union, Japan, and the United States for several years. France has announced intentions to commence a special program next year. The European communities approved a human genome analysis project in 1990. Genome research is distinctive in several respects. Its focus is necessarily collective, requiring the pooling of data from many different groups to assemble maps and to make research materials widely available. This is a particularly difficult problem at the international level, requiring collaboration among scientists under different organizational and funding arrangements ranging widely in size and wealth.

In addition, human genetics raises many social issues that do not bear on other biomedical research to the same degree. The historical abuse of genetics under eugenics and racial hygiene and the more recent experience with genetic screening indicate the potential social power of genetic knowledge. This raises the issue of what scientists should do to initiate and participate in public debate about the uses of their research results.

This symposium will introduce these issues, focusing on two among many possible topics. The Human Genome Organization was founded in 1988 to mediate international collaborations in genome research. Its history and role will be described by its director, James Wyngaarden, and the chairman of its ethical and social issues committee, Victor McKusick. Murray will survey the range of issues and describe the role of bioethics in dealing with them. Paces will comment from the perspective of a relatively small Eastern European country, and Kimura will note the differences in the debate between western and Asian countries. A panel will describe ongoing activities worldwide and outline mechanisms for dealing with the distinctive social and ethical implications of human genome research.

[Cosponsors: AAAS Committee on Scientific Freedom and Responsibility; AAAS-ABA National Conference of Lawyers and Scientists.]

27. Psychology; Neurobehavior

27-1. Reassessing Freud and Psychoanalysis

Organized by: **Frank J. Sulloway** *(Visiting Scholar, Program in Science, Technology, and Society, MIT, Cambridge, MA)*

8:30 am / Mon / 18 Feb **Sheraton / Alexandria**

Presiding: Frank J. Sulloway

The Dreaming Brain: Reassessing Freud's Model of the Mind
J. Allan Hobson *(Professor of Psychiatry, Massachusetts Mental Health Center, Harvard Medical School, Boston, MA)*

Reassessing Freud's Case Histories: The Social Construction of Psychoanalysis
Frank J. Sulloway

The Psychoanalytic Enterprise in Scientific Perspective
Adolf Grünbaum *(Professor of Philosophy, Univ. of Pittsburgh, Pittsburgh, PA)*

The Nature of Theory Change in Psychoanalysis
Morris Eagle *(Professor of Psychology, York Univ., North York, Canada)*

Unconscious Person Schemas and Control Processes
Mardi J. Horowitz *(Professor, Langley Porter Psychiatric Institute, Univ. of California, San Francisco, CA)*

Over the last decade, research on the life and thought of Sigmund Freud has greatly transformed the legendary image that was carefully cultivated by himself and his followers. This session will present the revisionist researches of historians, philosophers, neurophysiologists, psychiatrists, and psychologists. The session will argue, in part, that Freud's scientific assumptions, methodology, and current psychotherapeutic legacy are all seriously flawed in ways that have only recently been fully appreciated.

Among the specific topics to be dealt with are Freud's general model of the mind and his theory of dreaming; his major case histories and the issue of reliable "reconstructions" of early childhood events; problems inherent in psychoanalytic methods and training; the epistemological foundations of psychoanalytic theory; and developments in psychoanalysis since Freud. The session will also offer a review of recent experimental attempts to document unconscious mental processes in patients undergoing psychoanalytic therapy.

[**Sponsor:** AAAS Section L. **Cosponsor:** AAAS Section J.]

27-2. A Critical Examination of the Concept of Critical Periods

Organized by: **Thomas J. Tighe** *(Provost and Vice President for Academic Affairs, Univ. of Connecticut, Storrs, CT)*, **Barbara Lust** *(Professor of Human Development and Family Studies, Cornell Univ., Ithica, NY)*, and **Bert Moore** *(Dean, School of Human Development, Univ. of Texas at Dallas, Richardson, TX)*

2:30 pm / Sat / 16 Feb **Sheraton / Alexandria**

Presiding: Thomas J. Tighe

The Critical Period Concept: A Probabilistic Epigenetic Phenomenon
Gilbert Gottlieb *(Excellence Professor of Psychology, Univ. of North Carolina, Greensboro, NC)*

Visual and Auditory Sensitive Periods: A Search for Lessons
Richard D. Walk *(Professor of Psychology and Director of Graduate Program in Developmental Psychology, George Washington Univ., Washington, DC)*

Constraints and Development
Susan C. Oyama *(Professor of Psychology, John Jay College, City Univ. of New York, New York, NY)*

Sensitive for What?
Gerald Turkewitz *(Professor of Psychology, Hunter College, and Dept. of Pediatrics and Psychiatry, Albert Einstein College of Medicine, New York, NY)*

Discussant:
Michael Studdert-Kennedy *(Professor of Psychology, Univ. of Connecticut, Storrs, CT; Professor of Linguistics, Yale Univ., New Haven, CT; and President, Haskins Laboratories, New Haven, CT)*

The concept of critical periods has long been applied in language learning and is of great current interest in relation to second language acquisition. The present symposium does not focus on language development but rather pursues a critical examination of the concept of critical periods as that concept has been studied in other domains, notably from biological, ethological, and developmental perspectives. While such review and examination is timely in itself, the basic rationale of the symposium is that application of the concept of a critical period in language learning should proceed from an informed and critical view of the properties and utility of the concept as it has been studied in its basic biological manifestations (i.e., in embryological, neural, perceptual, and behavioral development). Speakers will assess the status of the concept of critical periods, define the function of critical periods in organismic development and adaptation, and explore the application of the concept to the study of language acquisition.

[**Sponsor:** AAAS Section J. **Cosponsors:** AAAS Section G; Linguistic Society of America.]

27-3. Critical Periods in Second Language Acquisition

Organized by: **Suzanne Flynn** *(Associate Professor of Second Language Acquisition, MIT, Cambridge, MA)* and **Barbara Lust** *(Professor of Human Development and Family Studies and Linguistics, Cornell Univ., Ithaca, NY)*

8:30 am / Sat / 16 Feb **Sheraton / Alexandria**

Presiding: Suzanne Flynn

Brain Bases for Possible Critical Periods
Lorraine K. Obler *(Director, Doctoral Program in Communication Disorders, Emerson College and City University of New York Graduate School, New York, NY)*

The Effects of Delayed Language Acquisition on the Acquisition of Grammar and Cerebral Organization
Susan Curtiss *(Professor of Linguistics, Univ. of California, Los Angeles, CA)*

Critical Periods in First and Second Language Learning: Evidence and Models of the Effect of Maturation on Language Acquisition
Elissa L. Newport *(Professor of Psychology, Univ. of Rochester, Rochester, NY)*

How Critical Is Age in Second Language Acquisition?
Suzanne Flynn and Gita Martohardjano *(Assistant Professor of Second Language Acquisition, MIT, Cambridge, MA)*

Discussant:
Lila Gleitman *(Professor of Psychology, Univ. of Pennsylvania, Philadelphia, PA)*

Much of second language acquisition research is concerned with answering three fundamental questions: (1) To what degree are adults capable of acquiring a second language? (2) Do adults share an equivalent capacity for acquisition of a second language? and (3) Is the process of adult second language learning comparable to that of children's first language learning? Answers to these questions depend on recent findings in two research areas — neuroscience and psycholinguistics. Ongoing neurological research has provided compelling disconfirmation of early hypotheses about brain lateralization, the mechanism long held to underlie a supposed "critical period" in language acquisition. Recent psycholinguistic findings have revealed deep and unexpected similarities between adult second language and child first language acquisition. Such findings provide important indicators that a new explanation of the basic properties of adult second language learning must be developed. This symposium will review and evaluate these recent discoveries and their implications for our understanding of the second language acquisition process. Such an integration provides great promise for transcending the specifics of a given language and for providing a model of language acquisition applicable in any linguistic community.

[**Sponsors:** AAAS Sections H and J. **Cosponsor:** AAAS Section G.]

27-4. Current Conceptions of Intelligence

Organized by: **Thomas J. Tighe** *(Provost and Vice President for Academic Affairs, Univ. of Connecticut, Storrs, CT)* and **Bert Moore** *(Dean, School of Human Development, Univ. of Texas at Dallas, Richardson, TX)*

2:30 pm / Sun / 17 Feb **Sheraton / Alexandria**

Presiding: Thomas J. Tighe

From Intelligence to Intelligences and Beyond
Howard Gardner *(Professor, Harvard Graduate School of Education, and Co-director of Project Zero, Harvard Univ., Cambridge, MA)*

Beyond IQ: A Triarchic Theory of Human Intelligence
Robert J. Sternberg *(IBM Professor of Psychology and Education, Yale Univ., New Haven, CT)*

Identical Twins Reared Apart: What They Reveal About Human Intelligence
Thomas J. Bouchard, Jr. *(Professor of Psychology, Univ. of Minnesota, Minneapolis, MN)*

General Mental Ability: From Psychometrics to Biology
Arthur R. Jensen *(Professor of Educational Psychology, Univ. of California, Berkeley, CA)*

Discussion: Current Theories from a System Perspective
Douglas K. Detterman *(Professor of Psychology, Case Western Reserve Univ., Cleveland, OH)*

The past decade has seen several challenges to the traditional psychometric model of intelligence and its appropriate measurement. The alternative conceptions stress the heterogeneous nature of intelligence and of intelligent behavior, positing relatively distinct components or categories of constituent processes and skills. The differing models suggest quite different approaches to the study and measurement of intelligence and have far-reaching implications for our understanding of individual differences and for educational practice. This symposium will bring together the leading theoreticians on intelligence in order to give exposition to the several models, to summarize the chief data bearing on their validity, and to explore the practical import of the differing conceptions.

[**Sponsors:** AAAS Section J; Society for Research in Child Development. **Cosponsor:** AAAS Section Q.]

27-5. Cognitive Aging Among Intellectually Able Individuals: Patterns, Precursors, and Implications

Organized by: **Douglas H. Powell** *(Coordinator, Behavior Therapy Program, Harvard Univ. Health Services, Cambridge, MA)*

8:30 am / Fri / 15 Feb **Sheraton / Alexandria**

Presiding: Douglas H. Powell

Cognitive Aging Among Intellectually Able Individuals: Overview
Douglas H. Powell

Quantitative Patterns of Normative and Superior Aging
Dean K. Whitla *(Director, Office of Instructional Research and Evaluation, Harvard Univ., Cambridge, MA)*

Patterns of Cognitive Change with Aging in Physicians: Results from Computerized Assessment of Mental State
Sandra Weintraub *(Assistant Professor of Neurology, Beth Israel Hospital, Boston, MA)*

Some Patterns of Cognitive Aging Among Superior Septuagenerians
Edwin R. Shneidman *(Professor, Dept. of Psychiatry, Univ. of California, Los Angeles, CA)*

Biopsychosocial Approaches to Physical and Cognitive Vigor in the Aging
Carl Eisdorfer *(Professor of Psychiatry, Univ. of Miami Medical School, Miami, FL)*

Discussant:
David R. Challoner *(Vice President, Health Affairs, Univ. of Florida, Gainesville, FL)*

The need to understand the patterns and implications of cognitive aging has never been greater. The reasons are three: demographic, legislative, and increasing variability in human mental functioning after age 45. These realities present challenges for educational institutions and professions. While a growing need exists for individuals to work longer, it is also true that the prob-

ability of cognitive impairment grows with every passing year after 65. This symposium will approach the problem in five ways: (1) providing statistical data on 1,101 physicians who took a new computerized test of cognitive functioning; (2) examining qualitative patterns of high- and lower level scores in these data; (3) comparing these findings with other longitudinal samples; (4) illuminating precusors of high-level cognition among octogenarians from subjects in Terman's studies of genius; and (5) discussing the implications of these findings from the perspective of the university and professional practice.

[Sponsor: AAAS Section J.]

27-6. Cults and the Courts: Use of "Brainwashing" Theory by Expert Witnesses

Organized by: **William H. Swatos, Jr.** *(Editor,* Sociological Analysis, *Silvis, IL)* and **David G. Bromley** *(Professor of Sociology, Virginia Commonwealth Univ., Richmond, VA)*

8:30 am / Sun / 17 Feb **Sheraton / Alexandria**

Presiding: Jeffrey K. Hadden *(Professor of Sociology, Univ. of Virgnia, Charlottesville, VA)*

Voluntary Motives versus Involuntary Causes: Conflicting Interpretations of Research on Cults and Communist Thought Reform
Dick Anthony *(Doctoral Candidate, Graduate Theological Union, Berkeley, CA)*

The Scientific and Popular Status of Brainwashing
Perry London *(Dean, Graduate School of Applied and Professional Psychology, Rutgers Univ., Piscataway, NJ)*

Social Scientists, the Law, and Expert Testimony
James T. Richardson *(Professor of Sociology and Judicial Studies, Univ. of Nevada, Reno, NV)*

Methodological Issues in the Scientific Investigation of the Brainwashing Conjecture
Benjamin Zablocki *(Professor of Sociology, Rutgers Univ., New Brunswick, NJ)*

Pathways to Krishna: Conversion, "Brainwashing," and the Ethical Uses of a Cult Researcher's Insider Information
Larry D. Shinn *(Vice President for Academic Affairs, Bucknell Univ., Lewisburg, PA)*

In the controversy over new religious groups, the single issue that has most energized the conflict has been the allegation that these groups employ "brainwashing" or "coercive persuasion" techniques that putatively have the effect of reducing the decisional capacity of individuals exposed to them to such an extent that the resulting "conversions" are regarded as unauthentic. There have been legal cases, some with major precedent-setting potential, in which "brainwashing" testimony has been introduced as evidence. Social scientists have served as expert witnesses in trial cases or amicus signatories in appellate cases, and social science associations have debated taking positions on specific cases and the academic standing of theories of extreme influence. This symposium provides an interdisciplinary exchange on two major issues: (1) the nature and effects of various types and degrees of social influence on individuals in religious groups, and (2) theoretical, methodological, and ethical issues confronting social scientists conducting field research or offering evidence in cases in which issues of group influence play a role. In what way can current social scientific knowledge about influence processes in the socialization practices of religious groups most accurately be represented to courts of law?

[**Sponsor:** AAAS Section K. **Cosponsors:** AAAS Sections H and J; AAAS-ABA National Conference of Lawyers and Scientists.]

27-7. Fragrance Research: Effects of Fragrances on Behavior, Mood, and Physiology

Organized by: **William N. Dember** *(Professor of Psychology, Univ. of Cincinnati, Cincinnati, OH)*

8:30 am / Tue / 19 Feb **Sheraton / Alexandria**

Presiding: Susan Schiffman *(Professor of Psychology, Duke Univ., Durham, NC)*

Development of Olfactory Perception in Infancy and Early Childhood
Hilary J. Schmidt *(Assistant Member, Monell Chemical Senses Center, and Assistant Professor, Dept. of Psychiatry, New Jersey Medical School, Newark, NJ)*

Effects of Fragrances on Performance and Mood in a Sustained-attention Task
William N. Dember

Effects of Fragrances on Sustained Attention and Visual-evoked Potentials
Raja Parasuraman *(Professor of Psychology, Catholic Univ. of America, Washington, DC)*

Fragrance as a Source of Environmentally Induced Positive Affect: Effects on Negotiation, Conflict, and Motivation
Robert A. Baron *(Professor of Psychology and Management, Rensselaer Polytechnic Institute, Troy, NY)*

Social Behavior and Fragrance Use
John B. Nezlek *(Associate Professor, Dept. of Psychology, College of William and Mary, Williamsburg, VA)*

In this symposium, recent efforts to investigate behavioral and physiological effects of fragrances will be reported by active researchers in this newly developing field. Following an overview by Schiffman, Schmidt will describe her research on the development of odor perception, including data indicating gender differences in infant sensitivity to fragrances. Dember will present the results of the first experiments to demonstrate enhancing effects of fragrances on performance in a sustained-attention (vigilance) task. That work has been replicated and extended by Parasuraman, who has also shown parallel fragrance effects on two components of the visual-evoked response that are known to reflect attentiveness, as well as effects on skin conductance suggestive of increased autonomic arousal. Effects of a pleasant fragrance on mood and consequent effects on self-efficacy and prosocial behavior in competitive situations will be discussed by Baron. Finally, Nezlek will present his research on the ways that wearing fragrances affect individuals' feelings about themselves and influence their social interactions.

[**Sponsor:** AAAS Section J.]

Join us in Chicago in 1992!
6–11 February, Hyatt Regency Chicago

27-8. Evolution of Cognitive Functions in Ecological-cultural Context

Organized by: **Anneliese A. Pontius** *(Associate Clinical Professor of Psychiatry, Harvard Medical School, Massachusetts General Hospital, Boston, MA)*

2:30 pm / Mon / 18 Feb **Sheraton / Alexandria**

Presiding: Anneliese A. Pontius

Can Natural Selection Yield Universal Principles of Mind?
Roger N. Shepard *(Professor, Dept. of Psychology, Stanford Univ., Stanford, CA)*

Evolutionary Psychology of Social Exchange
Leda Cosmides *(Visiting Assistant Professor, Dept. of Psychology, Univ. of California, Santa Barbara, CA)*

The Logic of Threat: Evidence for Another Cognitive Adaptation?
John Tooby *(Assistant Professor, Dept. of Anthropology, Univ. of California, Santa Barbara, CA)*

Natural Language and Natural Selection
Paul Bloom *(Assistant Professor, Dept. of Psychology, Univ. of Arizona, Tucson, AZ)*

Evolving Cognitive Potentials Fittingly Modified by Ecology
Anneliese A. Pontius

It is widely recognized that functions of the body such as digestion and circulation were shaped by evolution, but this insight has rarely been applied in the study of cognitive functions. Symposium speakers will present a series of models of how human cognitive functions were evolutionarily shaped by ecological, cultural, and social conditions. Included will be evidence for cognitive functions (1) that are adaptive reflections of very general properties of the world, such as that space is three-dimensional (Shepard); (2) that are specialized for reasoning about long-standing social problems such as cooperation and threat (Cosmides and Tooby); (3) that are evolved adaptations for language (Bloom); and (4) that vary in expression and neurological development in response to ecological and cultural conditions (Pontius).

[**Cosponsors:** AAAS Sections H and J.]

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Technical Session

27T-1. Cognitive Equilibrium

Organized by: **John N. Warfield** *(University Professor and Director, Institute for Advanced Study in the Integrative Sciences, George Mason Univ., Fairfax, VA)* and **Milan Zeleny** *(Professor, Fordham Univ., New York, NY)*

2:30 pm / Tue / 19 Feb **Sheraton / Alexandria**

Presiding: Milan Zeleny

Promoting Cognitive Equilibrium Through Group Process: The Development of a Center for Interactive Planning and Design
Benjamin J. Broome *(Associate Professor, Dept. of Communication, George Mason Univ., Fairfax, VA)*

Searching for Dynamic Cognitive Equilibrium in the Operation of Nuclear Power Plants
Alexander N. Christakis *(Research Director, Christakis and Associates, Ltd., Wayne, PA)*

Complexity and Cognitive Equilibrium: Experimental Results and Their Implications
John N. Warfield

Decisionmaking as Production and Organization of Knowledge
Milan Zeleny

This technical session will examine both theoretical and experimental concepts and results pertaining to cognitive equilibrium. Associated with the concept of cognitive equilibrium as a state of being related to knowledge, one finds such issues as how to engender such a state, what kinds of environments and practices promote the attainment of such a state, and how cognitive equilibrium itself forms a new core concept to replace older concepts of decisionmaking.

[**Cosponsor:** AAAS Section J.]

Cooperative Book Exhibits at the AAAS☆91 Exhibition

Stop by the exhibition, where *Academia Book Exhibits, The Association of American University Presses, Conference Book Service,* and *The Publishers Book Exhibit* will each display a wide range of current scientific books and/or journals from a variety of U.S. and international publishers.

Exhibit Hall C: Fri/6pm-8pm, Sat-Mon/9am-3pm

82ND ANNUAL MEETING OF THE AMERICAN ASSOCIATION FOR CANCER RESEARCH

May 15-18, 1991
Houston, Texas

PROGRAM COMMITTEE CHAIRPERSON

Curtis C. Harris, Bethesda, MD

TOPICS AND CHAIRPERSONS OF MAJOR SCIENTIFIC EVENTS

"Discoveries and Opportunities in Cancer Research" I. Bernard Weinstein, New York, NY and Carlo M. Croce, Philadelphia, PA
(A special symposium celebrating the 50th Anniversary of the AACR's journal, *Cancer Research*)
"Genomic Instability: Implications for Carcinogenesis and Therapy" Janet D. Rowley, Chicago, IL
"Molecular Mechanisms of Tumor Suppressor Genes and Oncogenes" Lewis T. Williams, San Francisco, CA
"Cancer and Development" George F. Vande Woude, Frederick, MD
"Molecular Pathogenesis of Lung Cancer" John D. Minna, Bethesda, MD
"Negative Growth Regulators" Harold L. Moses, Nashville, TN
"Multiple Primary Cancer: Epidemiology and Molecular Mechanisms" Louise C. Strong, Houston, TX
"Molecular Biology of DNA Damage and Repair" Larry H. Thompson, Livermore, CA
"Cell Cycle Control: Yeast to Humans" Fred Cross, New York, NY
"Hormones and Cancer" Marc E. Lippman, Washington, DC
"Ethnic Differences in Cancer Etiology" Pelayo Correa, New Orleans, LA
"Cancer Chemoprevention: Investigations in Animal Model Systems and Human Trials" Gary D. Stoner, Toledo, OH
"Recombinant DNA Approaches to Drug Development" Ira Pastan, Bethesda, MD
"Nuclear Matrix, Gene Regulation, and Cancer" Sheldon Penman, Cambridge, MA
"Molecular Epidemiology" Gerald N. Wogan, Cambridge, MA
"Current Status of the Human Genome Project" Mortimer L. Mendelsohn, Livermore, CA
"Clonal Evolution of Cancer" Peter C. Nowell, Philadelphia, PA
"Drug Delivery" Robert Langer, Cambridge, MA
"Tumor Vaccines and Active Immunotherapy" Ronald B. Herberman, Pittsburgh, PA

SPECIAL LECTURES

Presidential Address: I. Bernard Weinstein, New York, NY
Four Additional Award Lectures

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Minisymposia, poster discussion sessions, and regular poster sessions will be organized from submitted papers in all areas of cancer research

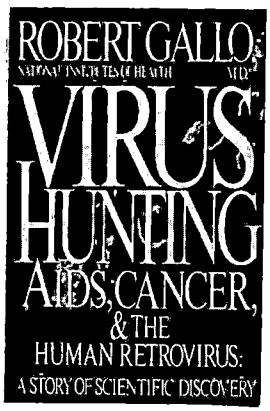
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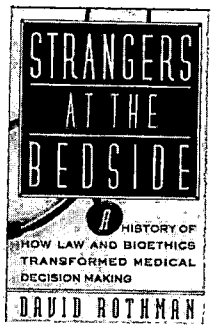
Cancer, Aids, and the Human Retrovirus: A Story of Scientific Discovery

ROBERT GALLO, M.D.

Here is a riveting portrait of the people, the politics, and the pace of modern scientific discovery, by the man at the cutting edge of AIDS research. The book is three books in one: the story of a life in science; the adventure of solving puzzles that could be the key to conquering human disease; and the drama of a political controversy gone haywire.

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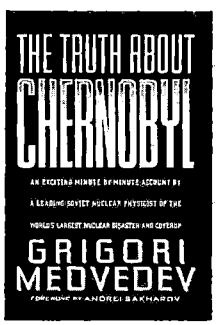
STRANGERS AT THE BEDSIDE

A History of How Law and Bioethics Transformed Medical Decision Making

DAVID J. ROTHMAN

What caused physicians, who once ruled uncontested over their domain, to have to confront committees, forms, general principles, and active patients? *Strangers at the Bedside* explores the critical ten years of change, beginning in 1966 with an expose by a Harvard Medical School professor of the scandals in human experimentation and culminating in the case of Karen Ann Quinlan in 1976.

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PREFACE BY ANDREI SAKHAROV

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III

Social Sciences & Science Policy

30. General Social Sciences and Policy

30-1. The Anthropology of Science and Scientists

Organized by: **Laura Nader** *(Professor of Anthropology, Univ. of California, Berkeley, CA)*

2:30 pm / Fri / 15 Feb **Sheraton / Sheraton No.**

Is Science Universal?

Presiding: Laura Nader

Conservation and Resource Management in Amazonia
Dominique Irvine *(Researcher, Cultural Survival, Inc., Cambridge, MA)*

Medical Ethnobotany in Southern Mexico: An Example of Mayan Ethnoscience
Brent Berlin *(Professor of Anthropology, Univ. of California, Berkeley, CA)*

Knowledge Construction Among James Bay Cree Hunters: Metaphors and Literal Understandings
Colin Scott *(Assistant Professor of Anthropology, McGill Univ., Montreal, Canada)*

A Native System of Ocean Navigation in the Western Pacific
Ward Goodenough *(Professor of Anthropology, Univ. of Pennsylvania, Philadelphia, PA)*

Science and/as Everyday Practice
Jean Lave *(Professor of Social and Cultural Studies in Education, Univ. of California, Berkeley, CA)*



8:30 am / Sat / 16 Feb **Sheraton / Sheraton No.**

The Study of Knowledge Formation and Its Use

Presiding: Laura Nader

The Prism of Heritability and the Sociology of Knowledge
Troy Duster *(Professor of Sociology, Univ. of California, Berkeley, CA)*

Gender and the Deconstruction of the Race Concept in the Sciences
Leonard Lieberman *(Professor of Anthropology, Central Michigan Univ., Mt. Pleasant, MI)*

Constructing Knowledge Across Social Worlds: The Case of DNA Sequence Data Bases in Molecular Biology
Joan H. Fujimura *(Assistant Professor of Sociology, Harvard Univ., Cambridge, MA)*

Socialization of Scientific Discourse
Elinor Ochs *(Professor of Linguistics, Univ. of California, Los Angeles, CA)*

Immunology and the Immune System
Emily Martin *(Professor of Anthropology, Johns Hopkins Univ., Baltimore, MD)*

2:30 pm / Sat / 16 Feb **Sheraton / Sheraton No.**

The Behavior of Scientists

Presiding: Laura Nader

The Anthropology of Geography
David R. Stoddart *(Professor of Geography, Univ. of California, Berkeley, CA)*

The Psychiatric Discourse on Post-traumatic Stress Disorder
Allan Young *(Professor of Humanities and Social Studies in Medicine, McGill Univ., Montreal, Canada)*

Political Structuring of the Institutions of Science
Charles Schwartz *(Professor of Physics, Univ. of California, Berkeley, CA)*

The Culture of Science and the Regulation of Biotechnology
Usher Fleising *(Professor and Chair of Anthropology, Univ. of Calgary, Calgary, Canada)*

Rituals of Empowerment Among Nuclear Weapons Scientists
Hugh Gusterson *(Doctoral Student, Stanford Univ., Stanford, CA)*

8:30 am / Sun / 17 Feb **Sheraton / Sheraton No.**

Science Traditions Across Cultures

Presiding: Laura Nader

The Role of Chaos in Creating Fishery Management Chaos
M. Estellie Smith *(Professor of Anthropology, State Univ. of New York, Oswego, NY)*

Conflicting Belief Systems of Scientists and Administrators in the Creation of a Covert Technological Surveillance System
David Jacobson *(Associate Professor of Anthropology, Brandeis Univ., Waltham, MA)* and Charles Ziegler *(Lecturer of Anthropology, Brandeis Univ., Waltham, MA)*

Tinkering with/in Japan: The Practice of International Collaboration in High-energy Physics at KEK, Tsukuba Science City, Japan
Sharon Traweek *(Associate Professor of Anthropology, Rice Univ., Houston, TX)*

Japanese and Western Approaches to Primatology: Limits Set to Questions
Pamela J. Asquith *(Assistant Professor of Anthropology, Univ. of Calgary, Calgary, Canada)*

Inuit Indigenous Knowledge and Science in the Arctic
Ellen Bielawski *(Killam Fellow, Arctic Institue of North America, Sidney, Canada)*

This multisession symposium will consider science and scientists in western and eastern science traditions, and knowledge produced by peoples without literate traditions, to examine assumptions not apparent without comparison. Studies of large-scale laboratories and other work on institutions of science illustrate that values act as driving forces and frame cognitive styles. Creativity in science, the militarization of science, and consequences of science products are subjects that interest anthropologists. Like the sociologists, philosophers, and historians of science, anthropologists attend to the contents of science — its concepts, theories, paradigms, methods, and institutions of socialization. Session 1, "Is Science Universal?" uses ethnographic data on agriculture, resource management, navigation, plants, and pharmacological domains to indicate how native knowledge is ordered and applied. Amazonian, Mexican, North American, and Western Pacific groups are represented. Session 2, "The Study of Knowledge Formation and Its Use," is interdisciplinary and delineates how science workers create knowledge. Session 3, "The Behavior of Scientists," treats western science organizations/laboratories to explore the institutional doing of science. Session 4, "Science Traditions Across Cultures," compares how science beliefs and traditions vary cross-culturally, asking whether science is a universal phenomenon characterized by rationality.

[**Sponsors:** AAAS Sections H, K, and L. **Cosponsors:** AAAS Sections B, E, and Y.]

AAAS☆91 Exhibition
Sheraton Washington, Exhibit Hall C
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Saturday-Monday, 9am-3pm

31. Anthropology; Archaeology

31-1. Indigenous Peoples and the Rain Forest: Science, Marketing, and Human Rights

Organized by: **Janet Gruschow** *(Senior Program Associate, Science and Human Rights Program, AAAS, Washington, DC)* and **Richard P. Claude** *(Professor of Government and Politics, Univ. of Maryland, College Park, MD)*

8:30 am / Fri / 15 Feb **Sheraton / Holmes**

Presiding: Thomas Eisner *(Schurman Professor of Biology, Section of Neurobiology and Behavior, Cornell Univ., Ithaca, NY)*

The Yanömami and Land Rights
Alcida R. Ramos *(Professor of Anthropology, Univ. de Brasília, Brasília, Brazil)*

Satellite Images and Scientific Research as Tools to Assist Brazilian Rubber Tappers in Forest Management
Foster Brown *(Associate Scientist, Woods Hole Research Center, Woods Hole, MA; and Univ. Federal Fluminense, Rio de Janeiro, Brazil)*

Can a "Green Consumer Democracy" Function in the Rain Forest?
Darrell A. Posey *(Investigador Titular, Núcleo de Etnobiologia, Museu Goeldi, Belém, Brazil, and Alexander Von Humboldt Stiftung, Munich, Germany)*

Diversity and Importance of Plants Useful to Indigenous Peoples in Amazonia
Brian M. Boom *(Associate Curator, Institute of Economic Botany, New York Botanical Garden, Bronx, NY)*

Chemical Prospecting: Can It Pay Off for Conservation?
Thomas Eisner

Kayapó Land Management
Speaker to be announced

2:30 pm / Fri / 15 Feb **Sheraton / Holmes**

Presiding: Thomas E. Lovejoy *(Assistant Secretary for External Affairs, Smithsonian Institution, Washington, DC)*

Biodiversity in the Rain Forest: What Can Science Do?
Thomas E. Lovejoy

Marketing Rain Forest Products
Jason Clay *(Research Director/Editor, Cultural Survival, Inc., Cambridge, MA)*

Sustainable Extraction in Brazil
José Lutzenberger *(Secretary of the Environment, Brasília, Brazil)*

Marketing Forest Products: The Indigenous Peoples' View
Evaristo Nugkuag Ikanan *(President, Coordinadora de las Organizaciones Indígenas de la Cuenca Amazónica, Lima, Peru)*

Challenges for the 1990s: Tropical Forest Peoples, Conservation, and Pharmaceutical Discovery
Steven R. King *(Director of Ethnobotany and Conservation, Shaman Pharmaceuticals, San Carlos, CA)*

The destruction of the rain forest through traditional timber extraction, agriculture, and cattle raising has resulted in the loss of species and the devastation of indigenous populations. Scientists are now working with indigenous groups, human rights organizations, and business to develop innovative ways to protect indigenous lands, discover new uses for rain forest species, and create markets for forest products, without harming the environment. Studies demonstrate that the extraction of nontimber rain forest plants is economically more valuable than the traditional extraction for timber and pasture. Indigenous peoples have adapted to the diversity of their environment and have found many uses for the wide variety of plant species in the rain forest. One means of preserving the rights of indigenous peoples and the biodiversity of the rain forest is to extract plants in a sustainable manner for food products, medicine, and other uses. While opening markets for rain forest products, conservation of the forest and the generation of income for forest peoples would be encouraged. The protection of indigenous lands is indispensible to ensuring that indigenous groups benefit from this economic production. Satellite images have been used to identify indigenous areas where there are land rights problems and environmental degradation.

[**Sponsors:** AAAS Section H; AAAS Committee on Scientific Freedom and Responsibility. **Cosponsors:** AAAS Section G; Interciencia Association.]

31-2. Evolutionary Interrelationships Between Technology, Language, and Social Behavior

Organized by: **Kathleen R. Gibson** *(Professor of Anatomical Sciences, Univ. of Texas Health Science Center, Houston, TX)* and **Tim Ingold** *(Professor of Social Anthropology, Univ. of Manchester, Manchester, UK)*

8:30 am / Sat / 16 Feb **Sheraton / Holmes**

Presiding: Kathleen R. Gibson and Tim Ingold

Tools, Language, Social Behavior, and Information-processing Capacities
Kathleen R. Gibson

From Pan to Man: The Language Link
Sue Savage-Rumbaugh *(Research Scientist, Yerkes Regional Primate Center, Atlanta, GA)*

The Development and Evolution of Hierarchically Organized Behavior
Patricia Marks Greenfield *(Professor of Psychology, Univ. of California, Los Angeles, CA)*

Early Stone Technologies and Linguistic Cognitive Inference
Nicholas Toth *(Associate Professor of Anthropology, Indiana Univ., Bloomington, IN)*

Tool Use, Sociality, and Intelligence in Human Cultures
Tim Ingold

Discussant:
William Calvin *(Seattle, WA)*

The meeting theme, "Science, Technology, and Society," touches upon two core issues of anthropology: (1) the nature of human, as compared to animal, tool use and social behavior; and (2) the nature of the relationships between technology and social structure. This symposium approaches these issues from integrated anthropological, neurological, and archaeological knowledge.* Research suggests that differences between ape and human tool use, social behavior, and language are primarily matters of degree rather than of kind and that syntax, like tool use, is an invention. Complex neurological, cognitive, motor, and social interrelationships characterize both tool use and language. Although they are mediated by partially separate neural "modules" in modern speaking adults, greater overlap in the neural circuitry of tool use and language occurs in small children and may have occurred in early hominids. Hence, technology, language, and complex social structures may have evolved together as a single adaptive complex. The archaeological record provides clues to the nature and time frame of this evolutionary event.

*Based on a conference, "Tools, Language, and Intelligence," sponsored by the Wenner Gren Foundation for Anthropological Research.

[**Sponsor:** AAAS Section H.]

31-3. The Evolution of Deception: A Biocultural Approach

Organized by: **Loyal D. Rue** *(Professor of Religion and Philosophy, Luther College, Decorah, IA)* and **Ursula W. Goodenough** *(Professor of Biology, Washington Univ., St. Louis, MO)*

2:30 pm / Sat / 16 Feb **Sheraton / Holmes**

Presiding: Loyal D. Rue

Molecular Deception
Ursula W. Goodenough

Deception in Evolutionary Perspective
Robert L. Trivers *(Professor of Biology, Univ. of California, Santa Cruz, CA)*

Deception in Primates
Robert W. Sussman *(Professor of Anthropology, Washington Univ., St. Louis, MO)*

The Negotiation of Self-realities: Psychic Shootout at the "I'm OK" Corral
C. Richard Snyder *(Professor of Psychology, Univ. of Kansas, Lawrence, KS)*

The Saving Grace of Noble Lives
Loyal D. Rue

The distinction between appearance and reality has always been fundamental to philosophy, but does this distinction also point to a fundamental dynamic in the processes of biological and cultural evolution? In this interdisciplinary symposium, speakers will explore the adaptive significance of morphological and behavioral strategies that might be characterized as "deceptive." There will also be an attempt to assess the value of deception as a clarifying principle across a wide range of disciplines, including molecular biology, entomology, ornithology, primatology, anthropology, psychology, and history. The central questions will be (1) whether and to what extent nature and culture both select for deceptive strategies, and (2) whether and to what extent a general theory of deception is possible (e.g., to include phenomena as disparate as molecular mimicry at one extreme and deliberate lying at the other).

[**Sponsor:** AAAS Section H. **Cosponsors:** AAAS Sections G and J.]

31-4. Ethnography of Drug Use in Traditional and Modern Societies

Organized by: Willett Kempton *(Research Anthropologist, Princeton Univ., Princeton, NJ)*

8:30 am / Mon / 18 Feb **Sheraton / Holmes**

Presiding: Willett Kempton

Use of Psychoactive Plants in Amerindian Civilization
Wade E. Davis *(Research Associate, New York Botanical Gardens, New York, NY)*

Marijuana, Pregnancy, and Child Health and Development in Jamaica
Melanie C. Dreher *(Dean and Professor, School of Nursing, Univ. of Massachusetts, Amherst, MA)*

Unintended Consequences of Crop Substitution Policy for Social Controls on Opium Use Among Highland Growers in Thailand
Jacquetta Hill *(Professor of Psychological Anthropology, Dept. of Educational Psychology, Univ. of Illinois, Champaign, IL)*

The Weakening of Alcohol Policy in a U.S. Industry: Company versus Union
Genevieve M. Ames *(Senior Research Scientist, Prevention Research Center/Pacific Institute for Research, Berkeley, CA)*

2:30 pm / Mon / 18 Feb **Sheraton / Holmes**

A Vehicle for Long-denied Masculinity in the Inner City
Tony L. Whitehead *(Chairman, Dept. of Anthropology, Univ. of Maryland, College Park, MD)*

Why Do Addicts Share Needles?
Stephen K. Koester *(Research Director and Ethnographer, Addiction Research and Treatment Services, Dept. of Psychiatry, Univ. of Colorado School of Medicine, Denver, CO)*

Managing Addictions in an Environment of Risk: Comparisons Among Male and Female Injection Drug Users
Theresa Mason *(Senior Research Scientist, Univ. of Illinois School of Public Health, Chicago, IL)*

Informal Economics of Drug Distribution in the Inner City: Ganja versus Crack
Ansley A. Hamid *(Assistant Professor, Anthropology Dept., John Jay College of Criminal Justice, New York, NY)*

This symposium reports ethnographic research findings on drug use in several traditional societies and compares it with drug use and drug distribution in the United States. American drug use has most frequently been seen from clinical, pharmacological, and criminal justice perspectives, which view drug use in terms of individual choice, personality, deviance, chemical dependence, and law enforcement. Ethnographic research uses the methods of participant observation and extensive open-ended interviewing to provide a more complete and holistic picture of how drugs fit into the lives of individuals and into the culture and political economy of communities. In societies that have a tradition of psychoactive drug use, ethnographers have found that drugs function to confirm religious or other important cultural systems. Although drugs have positive value in these cultures, at the same time, drug usage is limited by social control mechanisms. Ethnographic studies in the United States provide perspectives on the economy of drug distribution, the needs that drug use and distribution fill for participants, and the connection of use and distribution to the larger culture and economy.

[Sponsors: AAAS Section H; American Economic Association. Cosponsors: AAAS Sections K and S.]

31-5. The Deterioration of Human Health in Economic and Political Development: From Ancient Egypt to 20th-century United States

Organized by: Anna C. Roosevelt *(Director, Lower Amazon Project, Dept. of Anthropology, American Museum of Natural History, New York, NY)*

2:30 pm / Sun / 17 Feb **Sheraton / Sheraton No.**

Presiding: Anna C. Roosevelt

Introduction
Anna C. Roosevelt

The Impact of Political Change on Health and Nutrition of an Ancient Nubian Population
Dennis P. Van Gerven *(Professor, Dept. of Anthropology, Univ. of Colorado, Boulder, CO)*

Nutrition and Health Consequences of Prehistoric Economic and Political Centralization in North America
Alan H. Goodman *(Associate Professor of Biological Anthropology, Hampshire College, Amherst, MA)* and George J. Armelagos *(Professor and Chair, Dept. of Anthropology, Univ. of Florida, Gainesville, FL)*

Delocalization and Diets: Impacts in the Third World
Gretel H. Pelto *(Professor, Dept. of Nutritional Sciences, Univ. of Connecticut, Storrs, CT)* and Pertti J. Pelto *(Professor, Dept. of Anthropology, Univ. of Connecticut, Storrs, CT)*

The Health Crisis in Africa
Samuel Ofosu-Amaah *(Deputy Manager, Mamako Initiative Management Unit, UNICEF, New York, NY)*

Conclusions
Anna C. Roosevelt

This symposium will discuss the adverse impacts of economic and political development on human health, nutrition, and conditions of life from prehistory to the present. Economic intensification and political centralization are often seen as improving culture and human lifeways through the ages, and public planners and international policymakers often present development as progress for regional populations. The evidence of human history, however, does not support these views. The anthropological record reveals that human nutrition, disease rates, and longevity have measurably worsened for most people since the development of urban civilization. This deterioration is associated both with the rise of indigenous complex societies and with the European colonial expansion, and, now, in the world economic crisis, not only Third World countries but also some industrial nations, such as the United States, are experiencing a further decline in the quality of life for many people. This pattern is not usually recognized by policymakers, who assume that modern urban civilization generally improves human health. Although modern food production and medical science have done much to restore health in industrial nations to the favorable status that existed before the rise of urban civilization, the benefits have not reached the majority of people in the developing countries.

Recognition of the problems caused by past development can lead to better planning for the future of humanity.

[Sponsors: AAAS Sections H and K.]

Technical Session

31T-1. Uses of Light Stable Isotopes in the Natural and Social Sciences

Organized by: **Nikolaas J. van der Merwe** *(Clay Professor of Scientific Archaeology, Dept. of Anthrpology, Harvard Univ., Cambridge, MA)*

8:30 am / Tue / 19 Feb **Sheraton / Holmes**

Presiding: Nikolaas J. van der Merwe

Variation in the Carbon Isotopic Composition of Plants: Implications for Agriculture and Ecology
Larry L. Tieszen *(Professor of Biology, Augustana College, Sioux Falls, SD)*

Palaeoclimatic Reconstructions in Ice Cores
Michael L. Bender *(Professor of Oceanography, Univ. of Rhode Island, Kingston, RI)*

Light Stable Isotopic Tracers of Rapid Climate Change
Richard C. Fairbanks *(Rsearch Scientist, Lamont-Doherty Geological Observatory, Columbia Univ., Palisades, NY)*

Medical Epidemiological Studies of Helicobacter Pylori with the ^{13}C-Urea Breath Test
Peter D. Klein *(Director, Stable Isotope Laboratory, Children's Nutrition Research Center, Houston, TX)*

Carbon Isotope Ratios of Individual Compounds in Biogeochemical Processes
John M. Hayes *(Distinguished Professor of Biogeochemistry, Indiana Univ., Bloomington, IN)*

Greek and Roman Marble: Provenance Determination by Stable Isotopic Signatures
Norman Herz *(Professor of Geology and Director, Center for Archaeological Sciences, Univ. of Georgia, Athens, GA)*

Reconstructing Ancient Human Diets
Nikolaas J. van der Merwe

Global Climatic Changes over Long Time Scales
Thure Cerling *(Associate Professor of Geology and Geophysics, Univ. of Utah, Salt Lake City, UT)*

This technical session will bring together specialists from the life and earth sciences, as well as from palaeontology and archaeology, who utilize the techniques of light stable isotope tracing in their research. Long established in certain areas of the earth sciences, use of these techniques has recently mushroomed in the study of living organisms and the environment. Sharing of discoveries and procedures in the different fields represented by the speakers is likely to lead to improved techniques, new applications, and wider understanding of underlying natural processes.

[Sponsor: AAAS Section H. Cosponsors: AAAS Sections E and G.]

AAAS☆91 Exhibition
Sheraton Washington, Exhibit Hall C
Hours: *Fri/6pm-8pm, Sat-Mon/9am-3pm*

32. Demography; Political Science

32-1. Scientific and Technical Personnel: Issues for the 1990s

Organized by: **Alan Fechter** *(Executive Director, Office of Scientific and Engineering Personnel, National Research Council, Washington, DC)*

8:30 am / Fri / 15 Feb **Sheraton / Idaho**

Presiding: Alan Fechter

The Implications of Changing National Priorities
Eli Ginzberg *(Director, Conservation of Human Resources, Columbia Univ., New York, NY)*

Age and Performance in Academe
Pamela Ebert Flattau *(Director, Studies and Surveys, Office of Scientific and Engineering Personnel, National Research Council, Washington, DC)*

Managing Our Federal Science/Engineering Work Force
Allan (Scottie) Campbell *(Visiting Executive Professor, The Wharton School, Univ. of Pennsylvania, Philadelphia, PA)*

Discussants:
Harvey Brooks *(Harvard Univ., Boston, MA)*, Paula Stephan *(Professor of Economics, Policy Research Program, Georgia State Univ., Atlanta, GA)*, and Daryl Chubin *(Senior Analyst/Project Director, Office of Technology Assessment, Washington, DC)*

2:30 pm / Fri / 15 Feb **Sheraton / Idaho**

Presiding: Terrence Russell *(Manager, Dept. of Professional Services, American Chemical Society, Washington, DC)*

The Education and Human Resources Budget
Luther Williams *(Senior Science Advisor, Office of the Director, National Science Foundation, Washington, DC)*

Retention/Attrition in the Educational Pipeline
Sue Berryman *(Director, Institute for Education and Employment, Columbia Univ., New York, NY)*

Barriers to Careers: A Study of Female Science/Engineering Students
Henry Etzkowitz *(Professor of Sociology, State Univ. of New York, Purchase, NY)*

The Role of HBCUs in Producing Black Scientists and Engineers
William Trent *(Associate Professor of Educational Policy Studies and Sociology, Univ. of Illinois, Champaign, IL)*

Discussants:
Shirley M. Malcom *(Director, Directorate for Education and Human Resources Programs, AAAS, Washington, DC)*, Cheryl Leggon *(Staff Officer, Office of Scientific and Engineering Personnel, National Research Council, Washington, DC)*, Linda Dix *(Staff Officer, Office of Scientific and Engineering Personnel, National Research Council, Washington, DC)*, Willie Pearson *(Professor, Dept. of Sociology, Wake Forest Univ., Winston-Salem, NC)*, and Betty Vetter *(Executive Director, Commission on Professionals in Science and Technology, Washington, DC)*

This session will feature speakers addressing important issues that will dominate each of the major sectors of the economy —

industry, academia, and government. The implications of shifting national priorities — away from defense activities and into such nondefense areas as the environment — for industrial employment will be explored. Particular attention will be given to the adequacy of existing mechanisms for facilitating such a transition. The aging of our academic work force, its implications for faculty performance, and the consequences of these implications will be examined, as will the adequacy of personnel mechanisms in the federal government for recruiting and retaining the appropriate mix of scientific and engineering skills and for assuring proper utilization of these skills. The afternoon session on pipeline issues will address important issues related to recruitment and retention in the educational pipeline, with particular attention given to the experiences of underrepresented groups. Presentations will examine the federal education and human resource role, the nature of attrition from the educational system, barriers to science and engineering careers experienced by female students, and the role of HBCUs in recruiting blacks to science and engineering careers.

[**Sponsor:** AAAS Section M. **Cosponsors:** AAAS Sections K and Y; AAAS Committee on Science, Engineering, and Public Policy; AAAS Directorate for Education and Human Resources Programs.]

32-2. The Social, Economic, and Distributional Consequences of the Rapidly Increasing Physician Supply in the United States

Organized by: **Herbert Traxler** *(Chief, Modeling and Technical Assistance Branch, Bureau of Health Professions, U.S. Public Health Service, Rockville, MD)* and **Jerald Katzoff** *(Operations Research Analyst, Division of Medicine, Bureau of Health Professions, U.S. Public Health Service, Rockville, MD)*

8:30 am / Sat / 16 Feb **Sheraton / Idaho**

Presiding: Fitzhugh Mullan *(Director, Bureau of Health Professions, U.S. Public Health Service, Rockville, MD)*

Assessing the Adequacy of Physician Supply
Williams D. Marder *(Director of Health Labor Market Research, Abt Associates, Inc., Cambridge, MA)*

How Many Physicians Are Enough for Adequate Medical Care?
Alvin Tarlov *(Senior Scientist and Professor of Medicine at Tufts Univ., New England Medical Center Hospital, Boston, MA)*

Distributional Considerations Associated with Physician Supply
Itzhak Jacoby *(Professor and Director, Division of Health Services Administration, Uniformed Services Univ. of the Health Sciences, Bethesda, MD)*

Training Physicians for the 1990s and Beyond
Paul Jolly *(Associate for Vice President for Operational Studies, Association of American Medical Colleges, Washington, DC)*

Technology and Physician Manpower Projections: Past Practice and Future Directions
Louis P. Garrison, Jr. *(Director, Center for Health Affairs, Project HOPE, Chevy Chase, MD)*

A Skeptic Looks at the Physician Supply
Eli Ginzberg *(A. Barton Hepburn Professor Emer. of Economics, Columbia Univ., New York, NY)*

There is no consensus regarding the social, economic, and distributional consequences of the increasing supply of physicians, and available information and testimony on the subject are not definitive; both positive and negative effects have been identified repeatedly during the past decade. Desirable consequences often cited include increased availability of physician services; improved quality of care due to increasing time available per patient; and greater physician attention to health promotion and disease prevention activities, teaching, and community services. Among the undesirable consequences mentioned are poorer quality of care and increased patient risk due to the tendency to perform unnecessary or marginal procedures, and the rapid escalation of health care expenditures. Among the frequently debated issues are the appropriate or optimal numbers of physicians in the aggregate and by specialty, and the geographic maldistribution of physicians. The speakers in this symposium will elaborate on and debate these issues. They have been selected on the basis of their research and publications, which reflect a variety of viewpoints.

[**Sponsors:** AAAS Section K; American Economic Association.]

Technical Sessions

32T-1. Science Policy for Women in Science: Lessons from Historical and Contemporary Case Studies

Organized by: **Pnina Geraldine Abir-Am** *(Visiting Research Associate, Northeastern Univ., Boston, MA)*

8:30 am / Sun / 17 Feb **Sheraton / Idaho**

Presiding: Pnina Geraldine Abir-Am

National Science Foundation's Educational Programs for Women in Science
Judith S. Weis *(Professor, Dept. of Biological Sciences, Rutgers Univ., Newark, NJ)*

Concerns of Members of the Association for Women in Science (AWIS), a Multidisciplinary Science Organization
Barbara B. Mandula *(Environmental Protection Specialist, U.S. Environmental Protection Agency, Washington, DC)*

Gender and Research Productivity: Implications for Science Policy
Mary Frank Fox *(Associate Professor, Dept. of Sociology, Pennsylvania State Univ., University Park, PA)*

Women's Representation in Scientific Labor Markets in Developed and Developing Countries: Science or Society?
Beatriz Ruivo *(Assessor, National Board for Scientific and Technological Research, Lisbon, Portugal)*

Strategies for Improving the Representation of Women in the Medical Sciences
Merle Waxman *(Director, Office for Women in Medicine, Yale Univ. School of Medicine, New Haven, CT)*

Discussants:
Margrete S. Klein *(Program Director, National Science Foundation, Washington, DC)*, Daryl E. Chubin *(Senior Analyst/Project Director, Office of Technology Assessment, Washington, DC)*, Patricia L. Devaney *(Associate Dean of Research, Stanford Univ., Stanford, CA)*, and Henry Etzkowitz *(Associate Professor, Dept. of Sociology, State Univ. of New York, Purchase, NY)*

In the late 1980s, the problem of women's untapped potential for science and technology was redefined as an issue of national priority through its link to the anticipated shortage of scientifically

trained personnel in the 1990s. Moreover, this shortage occurs at a time when increased international competition intersects with demographic trends within the U.S. student population: an increase in the representation of social categories (women and minorities) with no tradition of strong recruitment and retention in science. This session contributes to an integration of science policy and gender research by bringing together the perspectives of scientists and policy analysts. The first speaker examines the experience of National Science Foundation's educational programs for women in science. The second speaker explores the concerns of members in a multidisciplinary science organization of women. The third speaker discusses the science policy implications of sociological research on gender and research productivity. The fourth speaker looks at economic, political, social, and cultural reasons for differences in the representation of women in the scientific labor markets in developed and developing countries. The final speaker discusses strategies for improving the representation of women in the medical sciences.

[**Sponsor:** AAAS Section L. **Cosponsors:** AAAS Sections H and Y; AAAS Committee on Science, Engineering, and Public Policy; AAAS Directorate for Education and Human Resources Programs.]

32T-2. Voting: Mathematical Foundations and Political Reality

Organized by: **Alan D. Taylor** *(Professor of Mathematics, Union College, Schenectady, NY)*

8:30 am / Mon / 18 Feb **Sheraton / Idaho**

Presiding: Alan D. Taylor

Social Choice: Some History and Background
Alan D. Taylor

Multicandidate Voting Systems
Samuel Merrill, III *(Professor of Mathematics, Wilkes College, Wilkes-Barre, PA)*

Homology, Dimension, and Graph Theory: Connections with Social Choice
William S. Zwicker *(Professor of Mathematics, Union College, Schenectady, NY)*

Shall Ever the Twain Meet? A Comparison of Social Choice and Comparative Electoral Studies Approaches to Voting Systems
Jack Nagel *(Professor of Political Science, Univ. of Pennsylvania, Philadelphia, PA)*

New Voting Systems
Steven J. Brams *(Professor of Political Science, New York Univ., New York, NY)*

The general area of social choice is concerned with the question of how one "reasonably" arrives at a "socially preferred alternative," given some knowledge of the preferences of the individuals. Social choice and voting schemes represent one of the few areas that bring together nontrivial mathematics and applications of immediate significance in a setting that can easily be appreciated by scientists in all fields. This session will illustrate this integration via a sequence of presentations by mathematicians and political scientists active in the field. Topics covered will include the voting paradox of Condorcet, Arrow's impossibility theorem, weighted voting, comparisons of voting systems, analogies with electric circuits via directed graphs, approval voting in the real world, and coalition voting and its potential in Israel and Eastern Europe.

[**Sponsor:** AAAS Section A. **Cosponsor:** AAAS Section K.]

32T-3. Supply and Demand for Scientists and Engineers in Emerging Markets

Organized by: **Eileen L. Collins** *(Senior Economist, National Science Foundation, Washington, DC)*

2:30 pm / Sat / 16 Feb **Sheraton / Idaho**

Presiding: Daniel Melnick *(Director, Division of Science Resources Studies, National Science Foundation, Washington, DC)*

BLS Projections of Demand for Scientist and Engineers in the Year 2000
Ronald E. Kutscher *(Associate Commissioner, Bureau of Labor Statistics, U.S. Dept. of Labor, Washington, DC)*

Sensitivity of Science and Engineering Baccalaureates to Starting Salary and Underlying Population
Eileen L. Collins

Supply and Demand for Doctoral Scientists and Engineers to the Year 2000
Lawrence R. Forest, Jr. *(Principal, DRI/McGraw-Hill, Washington, DC)*

Emerging Trends in Academic Labor Markets
Judith I. Gill *(Director, Research and Policy Analysis, Western Interstate Commission for Higher Education, Boulder, CO)*

A Critical Look at the Ph.D. Supply Crisis
Joe G. Baker *(Senior Staff Officer, National Research Council, National Academy of Sciences, Washington, DC)*

This session will evaluate (1) critical issues concerning the future supply of and demand for scientists and engineers and (2) the efficacy of available data and methods for projecting science and engineering labor markets. The session will consider (1) employment prospects for scientists and engineers to the year 2000, (2) the responsiveness of new baccalaureates to starting salaries and the underlying population, (3) doctoral markets by field and market sector to the year 2000, (4) the outlook for the academic sector, and (5) techniques that have been used to project science and engineering labor markets.

[**Sponsors:** AAAS Sections K and M; American Economic Association. **Cosponsors:** AAAS Sections A, U, and Y; AAAS Committee on Science, Engineering, and Public Policy; American Statistical Association.]

Workshop

32W-1. Women of Science: Secrets to Success

Organized by: **Margaret M. Lobnitz** *(Director of Environmental Compliance Programs, ICF Kaiser Engineers, Universal City, CA)* and **Harriet H. Kagiwada** *(Rockwell International Professor of Systems Engineering, California State Univ., Fullerton, CA)*

8:30 am / Tue / 19 Feb **Sheraton / Wisconsin**

Presiding: Margaret M. Lobnitz

Women of Science: A View from Academe and Industry
Harriet H. Kagiwada

Taste, Talent, and Tenacity
Ariel C. Hollinshead *(Distinguished Professor, Dept. of Medicine, George Washington Univ. Medical Center, Washington, DC)*

The Environmental Challenge
Suzanne L. Phinney *(Vice President, Environment, Aerojet, Folsom, CA)*

Success Despite Barriers
Elizabeth Rodriguez *(Special Assistant, Director of Defense, Research, and Engineering, U.S. Dept. of Defense, Washington, DC)*

Women in the Health and Environmental Sciences: Building Effective Organizations in the Federal Government and in the Public Sector
Elizabeth L. Anderson *(President, Clement International Corp., Fairfax, VA)*

The road to equality in the sciences has been long and arduous for women. In this workshop, prominent women in science will share their secrets to success in a "no-holds-barred" forum of questions, answers, and discussion. The panel will consist of members of academia, industry, and applied professions in which scientific backgrounds are a foundation for success. The session will be aimed at the practicing scientist as well as those entering scientific fields. It will deal with such issues as the definition of success, the concept of balance between career and outside priorities such as family, and techniques for developing and implementing success strategies. For career women, it will explore creative approaches to successful career paths. For those considering scientific careers, it will stress the diversity in careers available to women with scientific educational backgrounds.

[**Sponsors:** AAAS Section X; Sigma Delta Epsilon/Graduate Women in Science. **Cosponsors:** AAAS Sections H and Y; AAAS Southwestern and Rocky Mountain Division.]

33. Sociology

33-1. Drugs, Crime, and Violence: What Do We Know?

Organized by: **Paul J. Goldstein** *(Deputy Director, Narcotic and Drug Research, Inc., New York, NY)*

8:30 am / Sun / 17 Feb **Sheraton / Warren**

Presiding: Paul J. Goldstein

Experimental Studies of Drugs and Aggression
Stuart P. Taylor *(Professor of Psychology, Kent State Univ., Kent, OH)*

Human Laboratory Studies of Drugs and Aggressive Behavior
Don R. Cherek *(Associate Professor, Dept. of Psychiatry and Behavioral Sciences, Univ. of Texas Health Science Center, Houston, TX)*

Context and Contingency in Drug-related Violence
Jeffrey Fagen *(Associate Professor, School of Criminal Justice, Rutgers Univ., Newark, NJ)*

Drug Use: Its Role in Predatory and Violent Offending
Jacqueline Cohen *(Senior Research Scientist, School of Urban and Public Affairs, Carnegie Mellon Univ., Pittsburgh, PA)*

Drugs and Violence: Clinical and Epidemiological Studies
Kenneth Tardiff *(Professor of Psychiatry and Public Health, Cornell Univ. Medical College, New York, NY)*

Drugs and violence are related psychopharmacologically, economic compulsively, and/or systemically. Psychopharmacological violence occurs due to mood changes caused by ingestion of drugs or withdrawal from drugs. Economic compulsive violence results from economic crimes undertaken to obtain money to pay for drugs. Systemic violence is inherent in the distribution system for most illicit drugs; it includes boundary disputes between rival dealers, assaults to collect drug-related debts, punishment inflicted by drug business superiors on subordinates for normative transgressions, and punishment for selling bogus or tainted drugs. This symposium presents empirical findings pertaining to all three models of the drugs/violence nexus. Specific drugs vary with regard to psychopharmacological effects, costs, distribution systems, and characteristics of users. The speakers are all doing empirical research with different sorts of samples, in diverse locations, utilizing a variety of research methods, and investigating a broad range of drugs/violence issues. The symposium will clarify the conceptual confusion surrounding the relationships between drugs and violent behavior and increase levels of awareness about this complex and critically important social issue.

[**Sponsor:** AAAS Section X.]

33-2. Violence and Youth: Research and Prevention Programs

Organized by: **Felton J. Earls** *(Professor of Human Behavior and Development, Harvard School of Public Health, Boston, MA)*

8:30 am / Sat / 16 Feb **Sheraton / Warren**

Presiding: Felton J. Earls

Predicting Teens' Violence Risk: A Developmental Taxonomy
Terrie E. Moffitt *(Associate Professor, Dept. of Psychology, Univ. of Wisconsin, Madison, WI)*

The Development of Violent and Assaultive Youth
Robert B. Cairns *(Professor of Psychology, Univ. of North Carolina, Chapel Hill, NC)* and Beverly D. Cairns *(Professor of Psychology, Univ. of North Carolina, Chapel Hill, NC)*

Developmental Epidemiology, Vulnerability, and Prevention Research on Early Risk Behaviors
Sheppard G. Kellam *(Professor and Chair, Dept. of Mental Hygiene, Johns Hopkins School of Public Health, Baltimore, MD)*

Community-based Skills Development Program as a Preventive Strategy
Dan R. Offord *(Professor of Psychiatry, McMaster Univ., Hamilton, Canada)* and M. B. Jones *(Pennsylvania State Univ. College of Medicine, Hershey, PA)*

This symposium will examine what is known about the risk mechanisms governing the development of aggressive and violent behavior in children and adolescents and critically evaluate the types of prevention efforts currently under way to reduce the incidence of these problems. The range of biological and psychosocial

mechanisms explored operate throughout development. They include genetic contributions and biological risk factors affecting prenatal development, such as in utero drug exposures and alterations in the effect of gonadal steroids on brain differentiation. During early development, special consideration is given to the role of the parent-child relationship and other family influences. With the onset of puberty and the transition to early adolescence, concern again shifts to biological aspects of development as well as to peer influences, patterns of substance use, and school achievement. Several approaches to prevention will be discussed. Community and neighborhood programs to promote the development of physical and athletic skills will be presented. Preschool and elementary school programs to foster the development of academic and social skills provide a contrasting approach. The importance of teaching conflict resolution methods and other mediating techniques used to promote nonviolence in youth will also be considered.

[Sponsor: AAAS Section X. Cosponsor: AAAS Section J.]

33-3. Family Violence: Etiology, Impact, and Prevention of Child Abuse

Organized by: **Cathy Spatz Widom** *(Professor and Director, Hindelang Research Center, Univ. at Albany, Albany, NY)*

2:30 pm / Sat / 16 Feb **Sheraton / Warren**

Presiding: Cathy Spatz Widom

Risk Factors Associated with Child Abuse
Roy C. Herrenkohl *(Center for Social Research, Lehigh Univ., Bethlehem, PA)* and Ellen C. Herrenkohl *(Center for Social Research, Lehigh Univ., Bethlehem, PA)*

The Effects of Physical Abuse on the Development of Young Children
Byron E. Egeland *(Professor, Institute of Child Development, Univ. of Minnesota, Minneapolis, MN)*

Long-term Consequences of Early Child Abuse and Neglect
Cathy Spatz Widom

The Prevention of Child Maltreatment
David L. Olds *(Dept. of Pediatrics, Univ. of Rochester Medical Center, Rochester, NY)*

Over the last 20 years, an empirical knowledge base has accumulated on the causes and consequences of child abuse. This symposium is designed to examine what we currently know about child abuse and where the knowledge gaps remain. It is also designed to stimulate informed discussion on how society should respond. The speakers will begin with an ecological model of child abuse, illustrating the complexity and multidimensional nature of the problem. Then, factors are described that increase the risk of aggressive or abusive attacks on children. Findings from developmental psychology indicate that abuse and neglect are associated with increases in aggressive and problematic behavior in young children. In the long term, early child abuse and neglect have been found to be risk factors (at a minimum) for delinquency, adult criminality, and violent criminal behavior. This symposium concludes with a discussion of issues and strategies for the prevention of child maltreatment: What works with whom under what circumstances?

[Sponsor: AAAS Section X. Cosponsor: AAAS Section J.]

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Come to the AAAS booths (#514-522) and learn more about AAAS activities, publications, and services. Offices represented include Membership, Publications, Project 2061, *Science* magazine, Education and Human Resources Programs, and Science and Public Policy Programs.

Exhibit Hall C: Fri/6pm-8pm, Sat-Mon/9am-3pm

33-4. The Social Pathology of Large Cities

Organized by: **Keith D. Harries** *(Professor and Chair, Dept. of Geography, Univ. of Maryland-Baltimore County, Baltimore, MD)*

2:30 pm / Fri / 15 Feb **Sheraton / Warren**

Presiding: Keith D. Harries

Black Philadelphia Then and Now: The "Underclass" of the Late 20th Century Compared with the Poorer African-Americans of the Late 19th Century
Roger Lane *(Benjamin R. Collins Professor of Social Sciences, Haverford College, Haverford, PA)*

Emerging Settlement Patterns: Implications for the Inner City Poor
Mark Alan Hughes *(Assistant Professor, Woodrow Wilson School, Princeton Univ., Princeton, NJ)*

Does a Growing Underclass Threaten to Undermine Black Progress?
Sarah S. McLanahan *(Professor, Office of Population Research, Princeton Univ., Princeton, NJ)*

Why Homelessness Won't Go Away
Michael J. Dear *(Professor of Geography, Univ. of Southern California, Los Angeles, CA)*

Crimes in the Capital City: Case Study of Washington, DC
DeWitt Davis, Jr. *(Associate Professor, Dept. of Geography, Univ. of the District of Columbia, Washington, DC)*

Given that the AAAS meeting is located in Washington, DC, a city with extremely serious social problems, it is appropriate to focus on issues generically referred to as "social pathology." The first speaker will provide an historical perspective of urban pathology, a sense of how urban social problems have evolved and reached the stage that exists today in the typical U.S. city. The literature shows that a phenomenon that has come to be known as the underclass has attracted considerable attention in that many particular pathologies are found to reside overwhelmingly in underclass neighborhoods. Two of the speakers will touch on the underclass issue. One will provide an overview of the dimensions of the underclass; the other will focus more specifically on underclass demographics and address the question of whether the underclass is growing. The fourth speaker will address the critical issue of housing, and the final speaker wil assess another critical problem: street violence. The underclass, homelessness, and violence are all highly visible issues in Washington, DC, and other major metropolitan areas in the United States. Washington, however, has achieved singular notoriety as a result of its ranking as "the murder

capital of the United States." A scholarly review of several of the principal issues surrounding urban pathology will be timely.

[Sponsors: AAAS Sections E and X. Cosponsor: AAAS Section H.]

33-5. Mental Health and Violence

Organized by: Cathy Spatz Widom *(Professor and Director, Hindelang Research Center, Univ. at Albany, Albany, NY)*

2:30 pm / Sun / 17 Feb **Sheraton / Warren**

Presiding: Cathy Spatz Widom

Major Mental Disorder and Violence
Sheilagh Hodgins *(Phillipe Pinel Institute, Univ. of Montreal, Montreal, Canada)*

Crime and Mental Disorder Among Male Jail Detainees
Linda A. Teplin *(Coordinator, Psycholegal Studies Program, Northwestern Univ. Medical School, Chicago, IL)*

Situational Aspects of Violent Behavior
Edward T. Mulvey *(Law and Psychiatry Program, Western Psychiatric Institute and Clinic, Pittsburgh, PA)*

The Role of Serotonergic Activity in the Modulation of Violent Behavior
J. John Mann *(Professor, Laboratories of Neuropharmacology, Western Psychiatric Institute and Clinic, Pittsburgh, PA)*

Clinical Treatment Approaches to Violence
Kenneth Tardiff *(Professor of Psychiatry and Public Health, Cornell Univ. Medical College, New York, NY)*

Behavioral research on the origins of criminal behavior and violence has indicated that there may be a significant link between mental disorders and violent crime. Symposium speakers will review the state of knowledge about the relationship between violence and mental disorder, incorporating findings from American and Danish studies and drawing upon a variety of research perspectives. The session will also include a discussion of clinical treatment approaches to violence.

[Sponsor: AAAS Section X. Cosponsors: AAAS Sections J and K.]

Technical Session

33T-1. Rural Development Aspects of Recreation Enterprises

Organized by: Dale Colyer *(Professor of Agricultural Economics, West Virginia Univ., Morgantown, WV)*, Dennis K. Smith *(Professor of Agricultural Economics, West Virginia Univ., Morgantown, WV)*, and Anthony Ferrise *(Professor and Extension Specialist, West Virginia Univ., Morgantown, WV)*

8:30 am / Tue / 19 Feb **Sheraton / Warren**

Presiding: Dale Colyer

The Future of Access to Private Lands
Laurence R. Jahn *(President, Wildlife Management Institute, Washington, DC)*

A Typology of Outdoor Recreation Activities on Private Lands
James E. Miller *(National Program Leader, Fish and Wildlife, Extension Service, U.S. Dept. of Agriculture, Washington, DC)*

Economic Issues in Outdoor Recreation
E. Jane Luzar *(Assistant Professor, Dept. of Agricultural Economics, Louisiana State Univ., Baton Rouge, LA)*

The Demand for Outdoor Recreation
Linda L. Langner *(Economist, U.S. Forest Service, Washington, DC)*

The Efficacy of Enhancing Rural Economies Through Public Recreation on Private Lands
Brett A. Wright *(Director, Center for Recreation Resources Policy, George Mason Univ., Fairfax, VA)*

Legal Considerations in Making Private Land Available for Public Recreation
John C. Becker *(Associate Professor, Pennsylvania State Univ., University Park, PA)*

Research Issues and Needs for Recreational Development
Eric M. Thunberg *(Assistant Professor, Univ. of Florida, Gainesville, FL)*

Educational Issues and Needs for Outdoor Recreation
William N. Grafton *(Extension Specialist, West Virginia Univ., Morgantown, WV)*

The Public Policy Issues of Outdoor Recreational Development
Dennis K. Smith

There are many opportunities for rural landowners, businesses, and communities to increase their incomes by meeting the increasing demands of consumers for quality outdoor recreational experiences while simultaneously contributing to the conservation and management of the nation's natural resource base. Charging of fees by private landowners for recreational access can increase their incomes and promote rural development.

This session explores the topic by examining outdoor recreation's ramifications with respect to the status and needs for research, education, and public policy efforts for enhancing its contributions to rural development. The objectives include (1) evaluating the inherently multidisciplinary nature of these activities; (2) analyzing the economic feasibility of increasing the supply of recreational access in rural areas; (3) considering the increasing demand by consumers for quality outdoor recreation; (4) exploring the legal implications of charging a fee for recreational access; (5) examining the important rural development implications of recreational enterprises; and (6) discussing the variety of policy options used to provide incentives for outdoor recreational development.

[Cosponsor: AAAS Section K.]

34. Economics; Competitiveness

34-1. Systematic Economic Analysis: Policy on Monopoly and Competition

Organized by: Allen R. Ferguson *(President, Allen Ferguson Economics, Inc., Washington, DC)*

8:30 am / Fri / 15 Feb **Sheraton / Wisconsin**

Presiding: Elizabeth E. Bailey *(Dean, Graduate School of Industrial Administration, Carnegie-Mellon Univ., Pittsburgh, PA)*

Economic Analysis of Predatory Pricing Allegations
Allen R. Ferguson

Anticompetitive Effects of Exclusive Licensing
Sharon Oster *(Professor, School of Management, Yale Univ., New Haven, CT)*

The Causes and Costs of Thrift Institution Failures: A Structure-Behavior-Outcome Approach
Lawrence J. White *(Professor of Economics, Stern School of Business, New York Univ., New York, NY)*

Methodology for Economic Analysis of Mergers
Robert D. Willig *(Deputy Assistant, U.S. Attorney General, Antitrust Division, U.S. Dept. of Justice, Washington, DC)*

Economic policy on competition and monopoly presents an opportunity for applying rigorous economic analysis to important practical problems. In recent years, court decisions and policy pronouncements have placed new emphasis on economics in the antitrust area. Economic degregulation has simultaneously expanded the scope of antitrust enforcement by throwing back on the market mechanism the determination of prices, entry, and exit. Concurrently, there has been rapid expansion and refinement of quantitative methods suitable for the required analysis of problems of monopoly and competition in the new environment. Speakers in this symposium will cover the practices of the government and private parties in applying economic analysis to current antitrust cases and regulatory issues and to the impact of past policies of economic regulation and deregulation on the marketplace and the general welfare.

[**Sponsors:** AAAS Section K; American Economic Association.]

34-2. Frontiers of Research in Experimental Economics

Organized by: **Vernon L. Smith** *(Regents' Professor of Economics, Univ. of Arizona, Tucson, AZ)*

8:30 am / Sun / 17 Feb **Sheraton / Wisconsin**

Presiding: Vernon L. Smith

Introduction to Frontier Research in Experimental Economics
Vernon L. Smith

Market Engineering: Using the Laboratory as a Test-Bed for Designing Computer-assisted Markets
Stephen J. Rassenti *(Assistant Director, Economic Science Laboratory, Univ. or Arizona, Tucson, AZ)*

Designing Trading Institutions that Reduce Price Volatility
Kevin A. McCabe *(Associate Professor of Accounting, Univ. of Minnesota, Minneapolis, MN)*

Incentives and the Regulation of Public Utilities
Paula-Ann Cech *(Assistant Professor of Strategic Management, Dept. of Policy and Environment, Northwestern Univ., Evanston, IL)*

Horizontal Mergers: Concentration and Performance
Charissa P. Wellford *(Economist, Division of Economic Policy Analysis, Bureau of Economics, Federal Trade Commission, Washington, DC)*

This symposium will consist of presentations in two new areas of research using laboratory experimental methods in the study of market or regulatory performance. The first is research in "market engineering," wherein the experimental laboratory is used as a test-bed to examine the incentive, efficiency, and price performance of new computer-assisted market designs. Examples include auctions for airport runway rights, the simultaneous pricing of wellhead gas, delivered gas, and transportation in natural gas pipeline networks, and electric power networks. The resulting person-machine system combines the information advantages of decentralization with the coordination advantages of central dispatch. Other examples include the study of new experimental "call market" designs for financial market exchange that combine the advantages of uniform, nondiscriminatory pricing in sealed-bid auctions with the information feedback advantages of continuous auction trading.

Regulatory examples include the study of cost misrepresentation and rate base padding in cost markup price control, the competitive implications of allowing a regulated firm to enter a secondary unregulated market, and the evaluation of criteria used by the Department of Justice to challenge mergers — in particular, do mergers increase or decrease price competition, and how do the results relate to the criteria used by the Department of Justice?

[**Sponsor:** AAAS Section K. **Cosponsor:** American Economic Association.]

34-3. Sustainable Economic Development: Substance or Rhetoric?

Organized by: **Gardner M. Brown, Jr.** *(Professor, Dept. of Economics, Univ. of Washington, Seattle, WA)*

2:30 pm / Fri / 15 Feb **Sheraton / Wisconsin**

Presiding: Gardner M. Brown, Jr.

Sustainable Growth: An Impossibility Theorem
Herman Daly *(Senior Economist, The World Bank, Washington, DC)*

Sustainable Development: Some Implications for U.S. Policy
Robert Repetto *(Senior Economist and Program Director, World Resources Institute, Washington, DC)*

Energy and Sustainable Development
Adam Rose *(Professor, Dept. of Mineral Economics, Pennsylvania State Univ., University Park, PA)*

Economic-Environmental Interactions
Anil Markandya *(Lecturer, London Environmental Economic Centre and University College, London, UK)*

Ecosystems and Carrying Capacity
Gardner M. Brown, Jr.

Sustainable development is a shorthand expression for the consequence of successfully identifying and promulgating forms of economic progress that preserve environmental quality and do not inhibit opportunities for future generations. The World Commission on Environment and Development, the U.N. Development Programme, and other institutions with a global perspective have actively promoted the general concept of sustainable development. To what extent is it simply a new name for an old definition of conservation? What are the durable features of this new idea? How does the "new kid on the block" harmonize with the use of non-renewable resources such as fossil fuels? Is it rather a more envelop-

ing concept, more appropriate for appraising ecological system management?

This symposium will examine sustainable development from an economic perspective and focus on identifying its substantive elements. This is an important task, since ideas in their infancy, properly understood, can galvanize energy and resources in vitally important directions. Alternatively, ideas festooned only by moral overtones, without attention to their societal implications, easily can misdirect and waste critically scarce resources. The session should have broad appeal to social scientists due to its implied human and policy implications, as well as to natural and physical scientists specializing in natural resources affected by development.

[**Sponsors:** AAAS Section K; American Economic Association.]

34-4. Technology Transfer from the University or National Laboratory to the Marketplace

Organized by: **David Hsi** *(Professor, Agricultural Science Center, New Mexico State Univ., Los Lunas, NM),* **Edward H. Blum** *(President and Chief Executive Officer, Blum & Co., Reston, VA),* and **Gerold H. Yonas** *(Director, Laboratory Development, Sandia National Laboratories, Albuquerque, NM)*

8:30 am / Mon / 18 Feb **Sheraton / Wisconsin**

Presiding: Norman Friedland *(Attorney, Friedland & Associates, Glen Cove, NY)*

Transfer of Biomedical Technology: An Industry Perspective
Speaker to be announced

Transfer of Biomedical Technology: A Financial Perspective
Norman Friedland

Transfer of Biomedical Technology: An Academic Perspective
Edward L. McCordy *(Vice President for Research, Washington Univ. Medical School, St. Louis, MO)*

Transfer of Biomedical Technology: A Government Perspective
Robert P. Charrow *(Attorney, Crowell & Moring, Washington, DC)*

Panel Discussion: Transfer of Energy/Environment Technology
William S. Bradley *(Manager of Technology Licensing, ARCO Oil and Gas Co., Plano, TX),* Edward H. Blum, Robert Muir *(President and Chief Executive Officer, Research and Technology Institute of Western Michigan, Grand Rapids, MI),* and Patrick Von Bargen *(Administrative Assistant to Senator Jeff Bingaman, U.S. Congress, Washington, DC)*

2:30 pm / Mon / 18 Feb **Sheraton / Wisconsin**

Presiding: Harry L. Rook *(Deputy Director, Materials Science and Engineering Laboratory, National Institute of Standards and Technology, Gaithersburg, MD)*

Transfer of Manufacturing Technology: An Industry Perspective
Don Walukas *(Director, Technology Application Services, National Center of Manufacturing Sciences, Ann Arbor, MI)*

Transfer of Manufacturing Technology: A Financial Perspective
Gerald A. Marxman *(President, Commtech International Management Corp., Menlo Park, CA)*

Transfer of Manufacturing Technology: An Academic Perspective
Byron C. Winn *(Professor and Head, Dept. of Mechanical Engineering, Colorado State Univ., Fort Collins, CO)*

Transfer of Manufacturing Technology: A Government Perspective
Harry L. Rook

Panel Discussion: Transfer of Information Technology
George W. Arnold *(Director, AT&T Bell Laboratories, Holmdel, NJ),* A. R. Gale *(President, IBD Associates, Greenwich, CT),* Averett S. Tombes *(Vice President for Research and Economic Development, New Mexico State Univ., Las Cruces, NM),* and Charles W. Bernard *(President, Columbia Bay Co., Alexandria, VA)*

Essential to maintaining the U.S. competitive position in world markets is the effective transformation of research into commercial products. Much of the best U.S. research is still being conducted in universities, research institutes, and government-supported laboratories. This symposium presents the recent involvements of industry, financial institutions, universities, and government in transferring technology in several subject areas (biomedical, energy/environment, manufacturing, and information) to the marketplace. It presents a number of positive success stories and also current governmental policy and legal considerations of technology transfer from nonprofit public sectors to private sectors and commercialization.

[**Sponsor:** AAAS Section Y. **Cosponsors:** AAAS Sections M and P; AAAS Southwestern and Rocky Mountain Division; AAAS Committee on Science, Engineering, and Public Policy.]

34-5. Manufacturing's Future: Policy, Strategy, and the New Global Challenge

Organized by: **Christopher T. Hill** *(Executive Director, Manufacturing Forum, National Academy of Engineering and National Academy of Sciences, Washington, DC)*

8:30 am / Sat / 16 Feb **Sheraton / Wisconsin**

Presiding: Christopher T. Hill

Challenges to U.S. Manufacturing
William G. Howard, Jr. *(Senior Fellow, National Academy of Engineering, Washington, DC)*

An Assessment of U.S. Manufacturing: All Is Not Well
Julie Fox Gorte *(Senior Analyst, Industry, Technology, and Employment Program, Office of Technology Assessment, Washington, DC)*

U.S. Productivity Performance: (At Least So Far) It's Better Than You Think
William J. Baumol *(C.V. Starr Center for Applied Economics, New York Univ., New York, NY)*

Manufacturing's Health and the Standard of Living
Lawrence Mishel *(Economic Policy Institute, Washington, DC)*

The Manufacturing World of Tomorrow: New Technology, New Strategy, and New Structure
Joel D. Goldhar *(Professor of Technology Management, Illinois Institute of Technology, Chicago, IL)*

2:30 pm / Sat / 16 Feb **Sheraton / Wisconsin**

Presiding: Christopher T. Hill

Educating Leaders for Tomorrow's Manufacturing Enterprises
Kent H. Bowen *(Co-director, Leaders in Manufacturing Program, MIT, Cambridge, MA)*

Supporting a Competitive Manufacturing Industry
William Phillips *(Associate Director for Industrial Technology, Office of Science and Technology Policy, Washington, DC)*

International Cooperative Research in Manufacturing
Hiroyuki Yoshikawa *(Dean, Faculty of Engineering, Univ. of Tokyo, Tokyo, Japan)*

Cooperative Research for Manufacturing Survival
Edward A. Miller *(President, National Center for Manufacturing Sciences, Ann Arbor, MI)*

Federal Support for Manufacturing R&D
John A. Simpson *(Director, Center for Manufacturing Engineering, National Institute of Standards and Technology, Gaithersburg, MD)*

A strong manufacturing sector is critical to national economic performance and national security. Many believe that manufacturing in the United States is increasingly disadvantaged in international competition and that industry, finance, government, universities, and labor must act to forestall a continuing decline. Others believe equally strongly that American manufacturing is strong and becoming stronger — that whatever deficiencies appeared in the 1970s and early '80s are being addressed through advances in manufacturing technology, changes in corporate operations, and modifications of public policy. This symposium will bring together prominent students of, and participants in, manufacturing in an attempt to seek some consensus on (1) the state of manufacturing in the United States, (2) areas of analysis in which additional research or data collection would be desirable, and (3) actions that should be considered by actors in each sector.

[**Sponsors:** AAAS Sections M and P; AAAS Committee on Science, Engineering, and Public Policy. **Cosponsors:** AAAS Sections K and U; American Statistical Association.]

34-6. Mineral Resources and the Changing International Economy of the '90s

Organized by: **Carroll Ann Hodges** *(Geologist, Branch of Resource Analysis, U.S. Geological Survey, Menlo Park, CA)* and **John J. Schanz, Jr.** *(Adjunct Professor, Dept. of Mineral Economics, Colorado School of Mines, Golden, CO)*

2:30 pm / Sun / 17 Feb **Sheraton / Wisconsin**

Presiding: Carroll Ann Hodges and John J. Schanz, Jr.

The Global Shift from Strategic Priorities to Economic Competitiveness
Bruce C. Netschert *(Special Consultant, National Economic Research Associates, Inc., Washington, DC)*

Technological, Financial, and Political Pressures on World Mineral Endowment
Eugene A. Thiers *(Business Manager, Metals and Mining, SRI International, Menlo Park, CA)*

Perestroika and the End of the Cold War: Possible Mineral Trade Implications for the USSR and Eastern Europe
István Dobozi *(Visiting Professor, Dept. of Mineral Economics, Colorado School of Mines, Golden, CO)*

The Minerals Industry in an Interdependent World: Can Industry Deliver the Goods?
Simon D. Strauss *(Consultant on Metal Markets, New Rochelle, NY, and Director, Magma Copper Co.)*

Federal Minerals and Materials Policy in a Changing World
David S. Brown *(Associate Director, Information and Analysis, U.S. Bureau of Mines, Washington, DC)*

The vagaries of mineral resource distribution have contributed significantly to the causes of conflict and conquest throughout history. National concerns about resource dependency and industrial capacity were paramount between World Wars I and II, and the terms "strategic" and "critical" had entered the lexicon of government by 1945. With barriers between East and West rapidly disintegrating, it is timely to revisit the issue of mineral resource availability and examine its role in this emerging world of new political alliances.

During the 1980s, lack of both prolonged major military conflicts and acute resource shortages took critical materials, strategic stockpiles, and similar topics out of the headlines. The American mining industry seemed virtually moribund, the importance of South Africa as the source of key mineral commodities was seldom mentioned in the press, and little was heard about the pending perils of resource exhaustion and supply disruptions.

Recent political and economic upheavals have introduced to the 1990s new uncertainties in the equation of world trade. As centrally planned economies strive to become market driven, efficiency may dictate that raw materials be sought outside former politically aligned blocs, resulting in far more extensive international interdependence. Such dramatic changes on the political map evoke numerous questions: (1) What new tensions may result from increased competition for resources? (2) How much new mineral exploration will be stimulated, and where? (3) What geographic shifts will occur in the major sources of supply? (4) How much interchange of capital and technology will result? (5) What will happen to world commodity prices? (6) What will be the U.S. minerals policy response? (7) What role is there now for stockpiles? (8) What are likely environmental costs? (9) How will the domestic mining industry fare in a more interdependent and environmentally conscious world? and (10) Will the terms "strategic" and "critical" ultimately become anachronisms?

This symposium will examine the extraordinary changes that have occurred internationally with respect to the role of mineral resources in world affairs and will conclude with a discussion on the implications for developed as well as developing nations.

[**Sponsors:** AAAS Sections E and K; American Economic Association. **Cosponsor:** AAAS Section M.]

34-7. Systems Perspective for the Quality of Health Care

Organized by: **R. Clifton Bailey** *(Statistical Advisor, Health Standards and Quality Bureau, Health Care Financing Administration, Baltimore, MD)* and **W. Edwards Deming** *(Consultant in Statistical Studies, Washington, DC)*

8:30 am / Sat / 16 Feb **Sheraton / Arlington**

Presiding: R. Clifton Bailey

AAAS☆91 Exhibition
Sheraton Washington, Exhibit Hall C
Hours: *Fri/6pm-8pm, Sat-Mon/9am-3pm*

Optimizing a System: Profound Knowledge
W. Edwards Deming

Epidemiologic Oversight of the Effectiveness of Medical Care
Henry Krakauer *(Director, Office of Program Assessment and Information, Health Standards and Quality Bureau, Health Care Financing Administration, Baltimore, MD)*

Hospitalwide Quality Improvement: Beginning the Journey
Paul B. Batalden *(Vice President for Medical Care, Hospital Corp. of America, Nashville, TN)*

Quality Management for Health Care Delivery
Brent C. James *(Executive Director, Center for Health Care Delivery Research, Intermountain Health Care, Inc., Salt Lake City, UT)*

Learning from Others: The Application of Total Quality Management to Health Care Organizations
Donald M. Berwick *(Associate Professor of Pediatrics, Harvard Univ. Medical School, Boston, MA)*

Attempts to evaluate and enhance the health care system must consider the aim of the system as a whole. The health care system is complex and not well integrated. It consists of many individuals — physicians, nurses, hospital administrators, and support personnel — and their associated institutions. In responding to patients for a broad range of health needs — from minor irritations to life-threatening trauma — many subsystems of professionals, institutions, professional societies, payers, employers, and regulators collectively contribute to health care in the United States. The economic aspects of quality in industrial settings were clearly recognized in the earlier part of this century by W.A. Shewhart at the Bell Telephone Laboratories (*Economic Control of Quality of Manufactured Product*, New York, D. Van Nostrand Company, Inc., 1931). However, it is only recently that the relationship between the system and questions of quality have become clearly recognized in nonindustrial settings such as health care.

This symposium will examine the health care system from the perspectives of the government and its fiduciary responsibilities in managing the Medicare program and from several major institutional providers of health care. With the ever-expanding costs associated with health care delivery, there has been considerable rhetoric focused on the quality of this care. This session will highlight and examine the approaches to managing the delivery of quality health care. These include the regulatory or standards setting approach, various management systems, and the need to examine the consequences in terms of the whole system.

[**Sponsors:** AAAS Section U; Washington Academy of Sciences; American Statistical Association; Institute of Mathematical Statistics.]

Technical Sessions

34T-1. Economic Microsimulation for Public Policy Analysis

Organized by: **Daniel H. Weinberg** *(Chief, Housing and Household Economic Statistics, U.S. Bureau of the Census, Washington, DC)*

2:30 pm / Sat / 16 Feb **Sheraton / Vermont**

Presiding: Michael P. Cohen *(School of Public Affairs, Univ. of Maryland, College Park, MD)*

National Research Council Report on Microsimulation
Eric Hanushek *(Professor of Economics, Univ. of Rochester, Rochester, NY)* and Constance F. Citro *(Committee on National Statistics, National Academy of Sciences, Washington, DC)*

Labor Supply Response in Microsimulation Models
Gary T. Burtless *(Senior Fellow, Brookings Institution, Washington, DC)*

Future Computing Environments for Socioeconomic Microsimulation
Paul B. Cotton *(President, PBC & Associates, Nepean, Canada)* and George Sadowsky *(Director, Academic Computing Facility, New York Univ., New York, NY)*

Discussants:
Richard A. Kasten *(Principal Analyst, Congressional Budget Office, Washington, DC)* and Reuben Snipper *(Statistician, U.S. Dept. of Health and Human Services, Washington, DC)*

Microeconomic simulation models are important tools for analyzing the costs and distributional consequences of U.S. social welfare policies. They have played a significant role in the past and are expected to play an important role in the 1990s. The Departments of Agriculture and Health and Human Services commissioned the National Academy of Sciences to examine the usefulness and structure of such models for the decade ahead. This session presents the results of the panel's evaluation — as well as results from two working papers prepared for the panel — and discussion by two federal microsimulation users.

[**Sponsors:** AAAS Section K; American Economic Association.]

34T-2. Ecological Economics

Organized by: **Herman E. Daly** *(Senior Economist, Environment Dept., World Bank, Washington, DC)*

2:30 pm / Sun / 17 Feb **Sheraton / Vermont**

Presiding: Herman E. Daly

Ecological Economics: Creating a New Transdisciplinary Science
Robert Costanza *(Associate Professor, Coastal and Environmental Policy Program, Center for Environmental and Estuarine Studies, Univ. of Maryland, Solomons, MD)*

Environmental Management in Development: The Evolution of Paradigms
Michael E. Colby *(Consultant, The World Bank, Arlington, VA)*

Intergenerational Resource Rights: Implications for Neoclassical Economics
Richard B. Norgaard *(Professor of Energy and Resources, Energy and Resources Program, Univ. of California, Berkeley, CA)*

On the Economics of Sustainable Tropical Forestry
Robert Goodland *(Ecologist and Environmental Advisor, Environment Dept., World Bank, Washington, DC)*

A Historical Turning Point in Economic Development: From Empty-world to Full-world Economics
Herman E. Daly

Ecological economics is concerned with extending and integrating the study and management of "nature's household" (ecology) and "mankind's household" (economics). This integration is implied in the common Greek Root "oikos" shared by the two disciplines. Unfortunately, at present they share little else. Conceptual and professional isolation has led to economic and environmen-

tal policies that are mutually destructive rather than reinforcing over the long run. Because the two fields are too narrowly defined, there is a tendency for economists to ignore natural systems, while ecologists tend to ignore humans. No discipline studies what we might call the ecology of man or the economy of nature — the web of interconnections uniting the economic subsystem to the overall ecosystem of which it is a part.

Ecological economics aims to fill this gap. An incomplete and overlapping list of specific areas of work that would fit under the broad rubric of ecological economics includes the valuation of natural resources, sustainable agriculture and development, ecologically integrated technology, integrated ecologic-economic modeling at scales from regional to global, the implications of thermodynamics for economics and ecology, energy accounting and other methods aimed at allowing a unified treatment of economies and ecosystems, renewable resource management and conservation, critical assessments of the basic assumptions underlying current economic and ecological paradigms and the implications of alternative assumptions, economic and ecological consequences of genetically engineered organisms, gene pool inventory and management, alternative principles for valuing natural wealth, integrating natural resources and environmental services into national income and wealth accounts, methods of implementing efficient environmental policies, and case studies of economic-ecologic conflict or harmony.

[Sponsor: AAAS Section X. Cosponsors: AAAS Sections H and K.]

35. Science and International Security

35-1. Defense Technology and Policy After the Cold War

Organized by: **Amy Crumpton** *(Program Assistant, Directorate for Science Policy and Programs, AAAS, Washington, DC)*, **Ashton B. Carter** *(Director, Center for Science & International Affairs, Harvard Univ., Cambridge, MA)*, **Elizabeth Kirk** *(Senior Program Associate, Directorate for International Programs, AAAS, Washington, DC)*, **James L. Hecht** *(Director, Project for the Study of the American Future, Univ. of Delaware, Newark, DE)*, and **John R. Kort** *(Chief, Analysis Branch, Regional Economic Analysis Division, U.S. Dept. of Commerce, Washington, DC)*

8:30 am / Sat / 16 Feb **Sheraton / Dover**

Changing U.S. Defense Needs: Implications for Science and Technology

Presiding: Charles A. Zraket *(President and Chief Executive Officer, The Mitre Corp., Bedford, MA)*

New Thinking and Defense Technology
Ashton B. Carter

Administration Views on Defense Technology
Charles Herzfeld *(Director, Defense Research and Engineering, U.S. Dept. of Defense, Washington, DC)*

Export Controls on Technology: Do They Still Have a Role?
M. Granger Morgan *(Head, Dept. of Engineering and Public Policy, Carnegie-Mellon Univ., Pittsburgh, PA)*

American Defense Needs After the Cold War
Janne E. Nolan *(Visiting Fellow, Foreign Policy Studies Program, The Brookings Institution, Washington, DC)*

2:30 pm / Sat / 16 Feb **Sheraton / Dover**

National Security and Economic Competitiveness

Presiding: James K. Oliver *(Professor of Political Science, Univ. of Delaware, Newark, DE)*

Panel Discussion:
Daniel F. Burton, Jr. *(Executive Vice President, Council on Competitiveness, Washington, DC)*, James L. Hecht, Frederick Heldring *(Chairman Emer., Philadelphia National Bank, Philadelphia, PA)*, and Frank J. Gaffney *(Director, Center for Security Policy, Washington, DC)*

National Security and Economic Competitiveness
Joseph S. Nye, Jr. *(Director, Center for International Affairs, Harvard Univ., Cambridge, MA)*

8:30 am / Sun / 17 Feb **Sheraton / Dover**

Economic Effects of the Defense Build-down

Presiding: John R. Kort

The Shrinking Defense Budget: Economic Impact and Industry Response
Gordon M. Adams *(Director, Defense Budget Project, Washington, DC)*

Using DoD Data on Prime Contract Awards to Assess Cutbacks in the U.S. Defense Contractor Employment
Joseph V. Cartwright *(Senior Project Manager, U.S. Dept. of Defense, Washington, DC)*

The Impact of Defense Spending Reductions on the U.S. and Selected Regional Economies
G. Wayne Glass *(Principal Analyst, Congressional Budget Office, Washington, DC)*

2:30 pm / Sun / 17 Feb **Sheraton / Dover**

Nuclear Weapons Production After the Cold War

Presiding: Alan D. Beyerchen *(Professor of History, Ohio State Univ., Columbus, OH)*

Environmental and Health Effects of Nuclear Weapons Production
Robert Alvarez *(Professional Staff Member, U.S. Senate Committee on Governmental Affairs, Washington, DC)*

Where Values Collide: Public Interest and Nuclear Weapons Facilities
Beatrice Brailsford *(Eastern Idaho Coordinator, Snake River Alliance, Pocatello, ID)*

The Politics and Organizational Culture of Nuclear Weapons Production
Kosta Tsipis *(Director, Program in Science & Technology for International Security, MIT, Cambridge, MA)*

In from the Cold: Policy Implications for the U.S. Nuclear Weapons Industry
John C. Tuck *(Under Secretary of Energy, U.S. Dept. of Energy, Washington, DC)*

This two-day symposium will explore the political, economic, and social implications of the nation's changing national security

requirements in light of the rapidly changing political and economic global landscape and the seeming end of the Cold War. Session I, "Changing U.S. Defense Needs: Implications for Science and Technology," will assess the implications of world changes for U.S. defense technology and the effects that a changing defense base will have for overall U.S. science and technology policy. Session II, "National Security and Economic Competitiveness," will debate how the United States can best achieve both national security and economic growth. Session III, "Economic Effects of the Defense Build-down," will explore potential effects on the national economy of possible defense cutbacks, the regional distribution and federal budgetary effects of such cutbacks, and the possible adjustment processes of firms and individuals as they move from defense-related to nondefense-related activities. Session IV, "Nuclear Weapons Production After the Cold War," will examine the process for setting priorities used in formulating the policies that have guided research and production of nuclear weapons, how these priorities may be affected in light of new events, and the value conflicts between the nuclear weapons industry and the public that are influencing the industry's future direction.

[**Sponsors:** AAAS Section L; AAAS Committee on Science and International Security; AAAS Committee on Scientific Freedom and Responsibility. **Cosponsors:** AAAS Sections K and X; AAAS Committee on Science, Engineering, and Public Policy; American Economic Association.]

35-2. Still Needed: Arms Control in a Radically Changed Environment

Organized by: **Jonathan Dean** *(Arms Control Adviser, Union of Concerned Scientists, Washington, DC)* and **John B. Rhinelander** *(Attorney, Shaw, Pittman, Potts & Trowbridge, Washington, DC, and Member, AAAS Committee on Science, Arms Control, and National Security)*

8:30 am / Sat / 16 Feb **Sheraton / Rockville**

Presiding: Jonathan Dean

Is Arms Control Still Necessary?: The Issues
Jonathan Dean

Does the United States Need Naval Arms Control?
Senior U.S. naval officer

Does the Soviet Union Still Need Arms Control?
Senior Soviet expert

Does Europe Still Need Arms Control?
Senior German expert

Is Arms Control Still Needed?: Multilateral Aspects
John B. Rhinelander

The far-reaching changes in Soviet foreign and security policy under President Mikhail Gorbachev have moved a considerable distance toward dismantling the Cold War East-West military confrontation. The Treaty on Intermediate-Range Nuclear Forces is being successfully implemented. Negotiations are likely to be concluded during 1990 on a START treaty reducing strategic nuclear forces. A treaty on Conventional Forces in Europe calling for the destruction of two-thirds of major Soviet conventional arms west of the Urals and parity with NATO at reduced levels, and on a comprehensive new agreement on Confidence- and Security-Building Measures in Europe, were agreed to in November 1990. The meeting established an all-European security institution under the Conference on Security and Cooperation in Europe to coordinate arms control agreements affecting Europe. The United States has proposed to the Soviet Union mutual unilateral withdrawal of nuclear-capable artillery shells from Europe. Soviet political dominance over Eastern Europe has crumbled: Germany has been unified, and all Soviet forces will probably be withdrawn from Europe within the next five years. The security problem for the West posed by the Soviet Union has become far less pressing.

Given these changes, are the United States and other western countries better off to rely on their perception of national interest and forces to provide security, while avoiding the restrictions of further arms control limitations? Or is the slow movement of arms control negotiation blocking more rapid unilateral action by both sides to build down? Or is arms control still needed to bring down force levels further to provide for contractual limits and verification on remaining forces and to deal with proliferation dangers?

[**Sponsor:** AAAS Committee on Science and International Security.]

35-3. Soviet Politics and National Security Policy

Organized by: **Cynthia A. Roberts** *(Instructor, Dept. of Political Science, Hunter College, New York, NY)*

8:30 am / Fri / 15 Feb **Sheraton / Dover**

Presiding: Cynthia A. Roberts

Overview of Changing Shape of Soviet Politics and National Security Policy
Cynthia A. Roberts

The Impact of Domestic and International Changes on Soviet Arms Control
Raymond L. Garthoff *(Senior Fellow, Brookings Institution, Washington, DC)*

Military Reform in the Soviet Union
Phillip A. Petersen *(Assistant for Europe and the Soviet Union, Office of the Secretary of Defense, Washington, DC)*

Civil-Military Relations in the Soviet Union
Soviet participant to be announced

The Impact of Political Change on Soviet Security Policies
Soviet participant to be announced

This symposium will explore how changes in Soviet politics are affecting various facets of Soviet national security policy. While it is as yet unclear what kind of political system will emerge in the U.S.S.R., or even whether the Soviet Union will remain a unitary state, Mikhail Gorbachev's policies of glasnost and perestroika have already had a dramatic impact on virtually all aspects of Soviet life, including Soviet security policy. Moreover, present trends, including the decentralization and fragmentation of political authority, raise important questions about the future course of Soviet national security policies and arrangements. Speakers will address key aspects of this revolutionary situation, including (1) the changing shape of civil-military relations; (2) military reforms; (3) the impact of political fragmentation and ethnic and national movements on Soviet defense policies; and (4) the larger implications of political change in the U.S.S.R. for East-West security and arms control.

[**Sponsor:** AAAS Committee on Science and International Security.]

35-4. Implications of Proliferating Advanced Weaponry: Nuclear, Chemical, Missile, and Naval Forces

Organized by: **Janne E. Nolan** *(Senior Fellow, Brookings Institution, Washington, DC)*

8:30 am / Tue / 19 Feb **Sheraton / Annapolis**

Presiding: Janne E. Nolan

Economic and Sociopolitical Implications of the High-Tech Arms Race in the Middle East
Andrei V. Shoumikhin *(Head, Dept. of U.S. and Canada Studies Institute, Soviet Academy of Sciences, Moscow, USSR)*

Implications of Proliferating Advanced Weaponry: Nuclear, Chemical, Missile, and Naval Forces
Ravinder Pal Singh *(Institute of Defense Studies and Analyses, New Delhi, India)*

Preventing Regional Nuclear Weapon Proliferation: The Case for the Establishment of a Nuclear Weapon-free Zone in the Middle East
Mahmoud M. Karem *(Counsellor, Conference on Disarmament, Permanent Mission of Egypt to the United Nations, Geneva, Switzerland)*

The Implications of and Responses to Chemical Weapons Proliferation
Elisa D. Harris *(Senior Research Analyst, Brookings Institution, Washington, DC)*

Regional Security and Weapons Proliferation: The Middle East Crisis
Geoffrey Kemp *(Senior Associate, Carnegie Endowment for International Peace, Washington, DC)*

The proliferation of advanced weapon technology in the developing world poses new challenges to U.S. and global security, suggesting the potential for fundamental alterations in the international security environment in the coming decades. The United States and other industrial suppliers of missile technology are confronting a range of policy challenges in trying to curb missile proliferation. Symposium speakers will assess these challenges from several perspectives, including the incentives for developing countries to acquire missile technology, the implications posed for regional security by various missile programs, and the options available to the industrial countries to curb the supply of missile technology. Prospects for regional arms control will also be assessed. Given the inherent complexity of the issue and the political sensitivity of potential arms control initiatives, it is important to approach the discussion in a multidisciplinary and nonpartisan manner. The participants, including specialists who have expertise about specific regions as well as in arms control, have been selected to give as broad a view of the problem as is feasible.

[**Sponsor:** AAAS Committee on Science and International Security.]

Scientific Associations at the AAAS☆91 Exhibition

Come to the exhibition and meet representatives from: *American Geological Institute, American Institute of Physics, American Society of Mechanical Engineers, Assn. of American Geographers, History of Science Society, Mathematical Connections, National Science Teachers Assn., The Planetary Society, Scientists Center for Animal Welfare, Sigma Delta Epsilon, Union of Concerned Scientists.*

35-5. Chemical and Biological Weapons: Elimination or Proliferation?

Organized by: **Matthew Meselson** *(Thomas Dudley Cabot Professor of the Natural Sciences, Professor of Biochemistry and Molecular Biology, Harvard Univ., Cambridge MA)*

2:30 pm / Mon / 18 Feb **Sheraton / Dover**

Presiding: Matthew Meselson

Current Negotiations
Robert Mikulak *(Senior Scientist, U.S. Arms Control and Disarmament Agency, Washington, DC)*

Principal Issues and Possible Resolutions
Nikita Smidovich *(Deputy Head of the USSR Delegation to the Conference on Disarmament, Geneva, Switzerland)*

Chemical Proliferation and Disarmament: A Congressional Perspective
Martin Lancaster *(Congressman, U.S. House of Representatives, Washington, DC)*

Dealing with Proliferation With and Without a Treaty
Seth Carus *(Fellow, Washington Institute for Near East Policy, Washington, DC)*

Chemical Proliferation and Disarmament: An Industry Perspective
Will D. Carpenter *(Vice President, Technology, Monsanto Agricultural Co., St. Louis, MO)*

Negotiations at the 40-nation Conference on Disarmament in Geneva for a verified global ban on chemical weapons have led to a draft treaty that is nearly complete. Agreement is still lacking, however, on a number of key issues, including the precise scope of mandatory challenge inspection; the right, if any, to retain limited stocks of chemical weapons beyond an agreed cutoff date; the makeup, voting procedures, and authority of the executive body of the treaty organization; and possible incentives for accession and sanctions for noncompliance.

Outside of the multilateral negotiations for a global chemical weapons ban, the United States and the Soviet Union have agreed, pending legislative review and approval, to reduce their chemical weapons stockpiles to no more than 5,000 agent-tons each (about 20% of the presently declared amounts) by the end of the year 2002, with on-site inspections to verify destruction and a commitment not to produce such weapons.

The symposium will consider progress that has been made toward completion of a global chemical weapons ban, will discuss solutions that have been proposed for the major problems still outstanding, and will report the present status of the bilateral U.S.–USSR chemical weapons production cutoff and arms-reduction agreement.

[**Sponsor:** AAAS Committee on Science and International Security. **Cosponsor:** AAAS Section C.]

35-6. Verifying and Implementing Arms Control Agreements in the 1990s

Organized by: **Sidney N. Graybeal** *(Chief Scientist, Science Applications International Corp., McLean, VA)* and **Patricia Bliss McFate** *(Senior Scientist, Science Applications International Corp., McLean, VA)*

2:30 pm / Fri / 15 Feb **Sheraton / Dover**

Presiding: Patricia Bliss McFate

The Future Arms Control Agenda
S. Read Hanmer *(Deputy Director, Arms Control and Disarmament Agency, Washington, DC)*

Future Verification Regimes
Sidney N. Graybeal

On-site Inspection Agency's Future Role
Roland Lajoie *(Director, On-Site Inspection Agency, U.S. Dept. of Defense, Washington, DC)*

Verification and Ratification
John Keliher *(Professional Staff Member, House Permanent Select Committee on Intelligence, Washington, DC)*

Implementation Problems and Prospects
Frank W. Jenkins *(Vice President and Manager of the Strategy, Arms Control & Verification Operation, Science Applications International Corp., McLean, VA)*

Arms control is becoming an increasingly important aspect of U.S. and world security. It is the centerpiece of a large portion of the international dialogue. Assuring effective verification and implementation of arms control agreements is necessary for the continued viability of the agreements themselves, the arms control process, and international relations in general. This session will explore the arms control agenda for the 1990s; future verification regimes; the role of verification in the ratification process; the scope, nature, and problems of verifying and implementing agreements under active negotiation; and the impact of future verification regimes on international relations.

[**Sponsor:** AAAS Committee on Science and International Security.]

35-7. Scientific Approaches to the Study of International Conflict Resolution

Organized by: **Eric H. Arnett** *(Program Associate, Science, Arms Control, and National Security, AAAS, Washington, DC)* and **Richard W. Cottam** *(Professor, Dept. of Political Science, Univ. of Pittsburgh, Pittsburgh, PA)*

2:30 pm / Mon / 18 Feb **Sheraton / Vermont**

Presiding: Eric H. Arnett

Understanding Nationalism as a Source of International Conflict
Richard W. Cottam

Negotiating Resolutions to International Conflict
William I. Zartman *(Professor, Paul H. Nitze School of Advanced International Studies, Johns Hopkins Univ., Washington, DC)*

Crisis Management, Cooperation, and Deterrence: Lessons of the Superpower Relationship for International Conflict Resolution
Alexander L. George *(Professor, Dept. of Political Science, Stanford Univ., Palo Alto, CA)*

Sociological Aspects of International Conflict and Its Resolution
Martin Patchan *(Professor, Dept. of Sociology and Anthropology, Purdue Univ., West Lafayette, IN)*

Taking Stock of Research and Analysis on Conflict Resolution
Richard E. Rubinstein *(Director, Center for Conflict Analysis and Resolution, George Mason Univ., Fairfax, VA)*

The AAAS Program on Science, Arms Control, and National Security seeks, as its first objective, "to develop and focus the ... resources of the Association on effective approches toward conflict resolution." This symposium will approach that problem directly, realistically, and objectively from the perspective of well-developed areas of the social sciences. The goal of the symposium is not so much to present new research results as to take stock of the state of research on conflict resolution in a number of disciplines. The presentations will address approaches to international conflict resolution both at the roots of conflict — e.g., nationalism and domestic pressure for national aggrandizement — and at the stage where violent conflict has become unavoidable. In considering the state of the field, topics presented by the speakers will include research that has been completed, research that should be conducted, standards that might be applied to research to assure that it is "scientific," and the relevance of research on conflict resolution to the formulation of policy.

[**Sponsors:** AAAS Section K; AAAS Committee on Science and International Security.]

35-8. Technology and Military-Civilian Conversion in the Soviet Union

Organized by: **Ashton B. Carter** *(Director, Center for Science and International Affairs, Harvard Univ., Cambridge, MA)*

2:30 pm / Mon / 18 Feb **Sheraton / Warren**

Presiding: To be announced

Topics and speakers to be announced

Many industrialized nations are seeking to understand the relationship between military and commercial technologies and to use experience from military projects to increase economic performance. The problem of military-to-civilian conversion is particularly acute in the Soviet Union as it tries to create a market economy.

An unprecedented visit to the United States of captains of the Soviet military-industrial complex will be capped by a panel discussion by them of their efforts to convert Soviet enterprise from weapons work to serving civil markets. The panelists will include representatives of the Soviet aerospace, electronics, nuclear weapons, and heavy manufacturing industries.

[**Sponsor:** AAAS Committee on Science and International Security.]

Don't Miss the Exhibition!

Technical Sessions

35T-1. Naval Forces and Arms Control: Implications for U.S. Security

Organized by: **Eric H. Arnett** *(Program Associate, Program on Science, Arms Control, and National Security, AAAS, Washington, DC)*

2:30 pm / Sat / 16 Feb **Sheraton / Rockville**

Presiding: Patrick Cronin *(Director, Politico-Military Affairs Symposium, Center for Naval Analysis, Alexandria, VA)*

Structural Arms Control and Naval Forces
James McCoy *(Research Associate, International Institute for Strategic Studies, London, UK)*

Confidence- and Security-building Measures and Naval Forces
James E. Goodby *(Professor, Program on International Peace and Security, Carnegie Mellon Univ., Pittsburgh, PA)*

Naval Nuclear Weapons and Arms Control
Steve Fetter *(Professor, School of Public Affairs, Univ. of Maryland, College Park, MD)*

Sea-launched Cruise Missiles and Arms Control
Eric H. Arnett

Naval Forces and Arms Control in Perspective
Donald C.F. Daniel *(Director, Center for Naval Warfare Studies, U.S. Naval War College, Newport, RI)*

As the superpowers draw nearer to reaching an agreement reducing strategic nuclear weapons and conventional forces in Europe, unprecedented attention is being focused on arms control agreements that would limit naval forces. The Soviet Union is likely to call for the inclusion of sea-launched cruise missiles in a second strategic arms reduction agreement and insist that the United States should accept cuts in its superior naval forces in exchange for asymmetrical cuts in Warsaw Pact land forces. Domestically, the United States faces increasing pressure to cut military spending, and the high costs of naval forces are drawing renewed scrutiny in the light of an increasing consensus that the probability of a superpower war is virtually zero. Yet the United States is a maritime power linked to allies, resources, markets, and other interests by sea lines of communication. This session will examine the trade-offs of arms control agreements that would affect naval forces with the objective of detecting the sorts of agreements or unilateral actions that can solve nagging problems without reducing international security.

[**Sponsor:** AAAS Committee on Science and International Security.]

35T-2. Fissile Materials from Nuclear Arms Reductions: A Question of Disposition

Organized by: **William G. Sutcliffe** *(Staff Member, Center for Technical Studies of Security, Energy, and Arms Control, Lawrence Livermore National Laboratory, Livermore, CA)* and **Milo D. Nordyke** *(Director, Center for Technical Studies of Security, Energy, and Arms Control, Lawrence Livermore National Laboratory, Livermore, CA)*

8:30 am / Mon / 18 Feb **Sheraton / Vermont**

Presiding: William G. Sutcliffe

Limiting and Reducing Inventories of Fissionable Weapons Materials
L. Charles Hebel *(Manager, Technology Evaluation, Xerox Palo Alto Research Center, Palo Alto, CA)*

Options and Regulatory Issues Related to the Disposition of Fissile Materials from Arms Reductions
C. H. Bloomster *(Battelle, Pacific Northwest Laboratory, Richland, WA)*, M. H. Killinger *(Battelle, Pacific Northwest Laboratory, Richland, WA)* and P. L. Hendrickson *(Battelle, Pacific Northwest Laboratory, Richland, WA)*

Economics and Proliferation Issues with Converting Nuclear Weapons to Peaceful Use
John J. Taylor *(Vice President, Nuclear Power, Electric Power Research Institute, Palo Alto, CA)*

Coming to Terms with Excess Fissile Materials
David H. Albright *(Federation of American Scientists, Washington, DC)*

A Soviet Perspective on the Disposition of Fissile Material from Arms Reductions
Spartak T. Belyaev *(Deputy Director for Physics, I.F. Kurchatov Institute of Atomic Energy, Moscow, USSR)*

The Role of Congress in Nuclear Warhead Dismantling
Warren H. Donnelly *(Congressional Research Service, Washington, DC)*

[**Sponsor:** AAAS Committee on Science and International Security.]

36. Science and Technology Policy

36-1. Policy Issues in Science and Technology

Organized by: **Leon Lederman** *(Director Emer., Fermi National Accelerator Laboratory, Batavia, IL, and President-Elect, AAAS)* and **Albert H. Teich** *(Director, Directorate for Science and Policy Programs, AAAS, Washington, DC)*

8:30 am / Fri / 15 Feb **Sheraton / Colorado**

Presiding: To be announced

Speakers and topics to be announced

2:30 pm / Fri / 15 Feb **Sheraton / Colorado**

Presiding: To be announced

Speakers and topics to be announced

This symposium will explore the major science and technology policy issues of the day from the points of view of researchers; university, industry, and government administrators; and policymakers. The first session will be devoted to issues of resource allocation. Speakers will address topics such as the competition between federal funding for research and other elements of the budget; the allocation of resources within science, among fields, and between research facilities, centers, and individual grants; the problem of setting priorities for research; and systems of allocation — merit review and the so-called "research pork barrel."

Speakers at the second session will address issues associated with the environment for research: handling research fraud and miscon-

duct; managing conflict of interest in technology transfer; using animals in research; problems posed for research by environmental and occupational health regulation; and community concerns about location of research facilities (the "NIMBY" issue).

[Sponsors: AAAS Board of Directors; AAAS Directorate for Science and Policy Programs. Cosponsors: AAAS Sections L, M, and P; AAAS Committee on Science, Engineering, and Public Policy.]

36-2. Science Advice to National Leaders

Organized by: **Albert H. Teich** *(Director, Directorate for Science and Policy Programs, AAAS, Washington, DC)* and **William T. Golden** *(Treasurer, AAAS)*

8:30 am / Sat / 16 Feb **Sheraton / Colorado**

Presiding: William T. Golden

Advising the President of the United States
D. Allan Bromley *(Assistant to the President for Science and Technology, White House Office of Science and Technology Policy, Washington, DC)*

Science Advice in the Soviet Union
Yuri A. Ossipyan *(Vice President, Soviet Academy of Sciences, and Member of the Presidential Council of the USSR, Moscow, USSR)*

Scientific Advice to the Prime Minister of the United Kingdom
W. D. P. Stewart *(Chief Scientific Advisor, Cabinet Office, Whitehall, London, UK)*

Science and Technology Advice to the Top Levels of Government: The Japanese Experience
Wataru Mori *(Executive Board Member, Council for Science and Technology, Prime Minister's Office, Tokyo, Japan)*

Science and technology are increasingly involved in the affairs of state. Throughout the world, national leaders call on members of the scientific and engineering communities to provide advice on decisions ranging from military and space policy to the environment, public health, and economic competitiveness. Advising national leaders (i.e., presidents or prime ministers) on science and technology offers scientists unique opportunitites to help shape important decisions, but poses special political, ethical, and scientific problems. While scientists and policymakers in various nations, including the United States, have devoted considerable thought to the organization and operation of science advisory mechanisms in their own countries, less attention has been given to the comparative dimensions of scientific advice and what can be learned from examining responses to similar situations in different political systems.

This symposium will bring together several individuals who are serving as science advisors to the top levels of government in their respective countries to discuss similarities and differences in providing scientific advice to national leaders. Speakers will discuss their experiences — in terms of specific examples, to the extent possible — with different structures for providing scientific advice, the political context of science advising, relations between advisors and the scientific community, and other issues of mutual concern.

[Sponsors: AAAS Board of Directors; AAAS Directorate for Science and Policy Programs. Cosponsors: AAAS Section P; AAAS Southwestern and Rocky Mountain Division; AAAS Committee on Science, Engineering, and Public Policy.]

36-3. Organization for Science and Technology in the Executive, Legislature, and Judiciary

Organized by: **Jonathan Bender** *(Carnegie Commission on Science, Technology, and Government, New York, NY)* and **David Kirsch** *(Carnegie Commission on Science, Technology, and Government, New York, NY)*

8:30 am / Sun / 17 Feb **Sheraton / Colorado**

Presiding: William T. Golden *(Co-chairman, Carnegie Commission on Science, Technology, and Government, New York, NY)*

The Role of the President's Council of Science and Technology Advisors in Presidential Decisionmaking
David Z. Beckler *(Associate Director, Carnegie Commission on Science, Technology, and Government, New York, NY)*

Confronting a World Transformed: The Carnegie Commission on Science, Technology, and Government
David Z. Robinson *(Executive Director and Member, Carnegie Commission on Science, Technology, and Government, New York, NY)*

Better Use of Science in Science-based Regulation
Douglas Costle *(Dean, Vermont Law School, South Royalton, VT)*

Science in the Courthouse
Maurice Rosenberg *(Professor, Columbia Univ. School of Law, New York, NY)*

Science and Technology Analysis at the Congressional Support Agencies
John H. Gibbons *(Director, Office of Technology Assessment, Washington, DC)*

2:30 pm / Sun / 17 Feb **Sheraton / Colorado**

Presiding: David Z. Robinson

Responding to the Environment and the Economy Together
H. Guyford Stever *(Former Director, National Science Foundation, Washington, DC)*

The Role of Science and Technology in Economic Performance
Lewis M. Branscomb *(Director, Science, Technology, and Public Policy Program, Harvard Univ., Cambridge, MA)*

New Thinking and American Defense Technology
Ashton B. Carter *(Director, Center for Science and International Affairs, Harvard Univ., Cambridge, MA)*

Dual-Use Technologies in the Military and Commercial Domains
Charles A. Zraket *(President and Chief Executive Officer, The MITRE Corp., Bedford, MA)*

We live in a world transformed by the rapidly accelerating pace of scientific and technological (S&T) advances. Clearly, it is of critical importance that government be able to take careful account of S&T in policy formulation and implementation. The Carnegie Commission on Science, Technology, and Government was established in 1988 by Carnegie Corporation of New York to assess the mechanisms by which the federal government and the states incorporate S&T knowledge into policy and administrative decisionmaking. Commissioners include eminent scientists, former high-level government officials, and leaders from nongovernmental sectors. The commission has created ad hoc task forces with an institutional focus to examine the capacity of the three branches of American

government to obtain and utilize S&T information. In the morning session, commisioners, task force members, and staff will discuss some of their findings to date. The commission has also established task forces that are (or, in some cases, have completed) looking at S&T implications of several substantive problem areas, including national security, energy and the environment, and economic performance. The afternoon session will illustrate how several of these investigations coalesce around the theme of S&T in the economy.

[**Cosponsors:** AAAS Sections P and Y; AAAS Committee on Science, Engineering, and Public Policy; AAAS Committee on Science, Arms Control, and National Security.]

36-4. Conflict Between National and International Roles of Universities

Organized by: **Thomas H. Moss** *(Dean of Graduate Studies and Research, Case Western Reserve Univ., Cleveland, OH)*

8:30 am / Fri / 15 Feb **Sheraton / Kansas**

Presiding: Thomas H. Moss

The View from Universities
Harold K. Jacobson *(Jesse Reeves Professor of Political Science and Director, Center for Political Studies, Institute for Social Research, Univ. of Michigan, Ann Arbor, MI)*

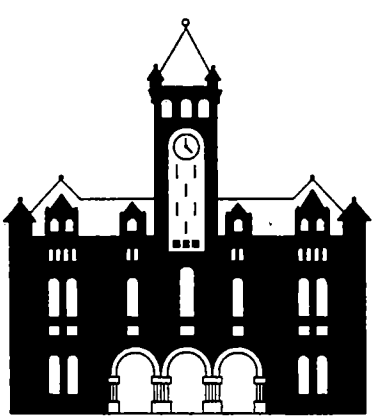
The View from the States
Richard F. Celeste *(Former Governor, State of Ohio, Columbus, OH, and Member of Advisory Committee, Carnegie Commission on Science, Technology, and Government, New York, NY)*

The View from Congress
Ted Weiss *(Member of Congress, U.S. House of Representatives, Washington, DC)*

The View from Industry
John A. Armstrong *(Vice President for Science and Technology, Internatioanl Business Machines Corp., Armonk, NY)*

Contradictions and Complexities: International Comparisons in the Training of Scientists and Engineers
Dorothy S. Zinberg *(Lecturer in Public Policy, Center for Science and International Affairs, Kennedy School of Government, Harvard Univ., Cambridge, MA)*

There is a growing concern that results of federal and industrial-supported research at American universities are being made available to foreign corporations and governments in ways that damage U.S. economic interests. The traditional openness of American universities to students, visitors, and industrial sponsors, without reference to nationality, is being challenged by the supporters of the research, who believe that, at a minimum, there should be no differential benefit to other nations and, preferably, that there should be special benefits to the sponsors. It is likely that American universities will increasingly encounter attempts to impose restrictions on access to research on the part of government or corporate sponsors. The issues deserve airing before the problems become worse.



[**Sponsor:** AAAS Committee on Science, Engineering, and Public Policy. **Cosponsor:** AAAS Section P.]

36-5. Making Witnesses out of Wizards: Bringing Oz into the Courtroom

Organized by: **Ruth C. Burg** *(Administrative Judge, Armed Services Board of Contract Appeals, Falls Church, VA)* and **Mark S. Frankel** *(Program Director, Scientific Freedom, Responsibility, and Law, AAAS, Washington, DC)*

8:30 am / Mon / 18 Feb **Sheraton / Colorado**

Presiding: Ruth C. Burg

The View from the Bench
Ruth C. Burg

Science Experts in Civil Lawsuits
Maurice Rosenberg *(Professor of Law, Columbia Univ. School of Law, New York, NY)*

Taming the Expert Witness
Rubin Bressler *(Professor and Head, Internal Medicine Dept., Univ. of Arizona Health Sciences Center, Tucson, AZ)*

The Engineer as Expert Witness
Neal Fitzsimons *(Fellow ASCE, Principal, Engineering Counsel, Kensington, MD)*

Tapping the Right Expert
Marshall J. Doke, Jr. *(Partner, Doke & Riley, Dallas, TX)*

Because of the growing volume of litigation involving scientific and technology-related matters, there is now need for a concerted effort to address the central difficulties that judges experience when called upon to adjudicate disputes involving complex scientific or technical issues. Many of the courts' difficulties in securing and using scientific and technical expertise are related in part to the practice of relying on experts recruited by the parties to a dispute. Scientists will not infrequently diverge in their views of theories and data interpretation, and it is important for the courts to be aware of the range of accepted views in the scientific community. But experts are typically selected to persuade the courts that the side employing them should prevail, not to clarify issues or educate judges and juries. Although the courts already have the authority to secure technical expertise unaligned with the litigants, they rarely use that power. Even more rarely do they use panels of court-appointed experts. This reluctance is due in part to the lack of ready access to impartial expertise and in part to a fear of tampering with the established norms of the adversary process.

This symposium focuses on how to broaden the range of expertise available to the courts, taking into consideration the reluctance of scientists to appear as expert witnesses. Speakers will include an engineer, a physician-scientist, a practicing attorney, a law professor, and an administrative judge.

[**Sponsor:** AAAS-ABA National Conference of Lawyers and Scientists.]

Technical Sessions

36T-1. Improving the Functioning of Government Agencies

Organized by: **Stephen D. Nelson** *(Program Director, Science, Technology, and Government, AAAS, Washington, DC)*

8:30 am / Tue / 19 Feb **Omni Shoreham/Caucus**

Presiding: Stephen D. Nelson

Policy Issues in Improving the Functioning of Government Agencies
Bruce L. R. Smith *(Senior Staff, Brookings Institution, Washington, DC)*

Total Quality Management in the Federal Government
Eric E. Anschutz *(President, Eric Anschutz Associates, Bethesda, MD)*

Organizational Facilitation and Troubleshooting Within the Federal Government
Marilyn Bott *(Organizational Development Specialist, U.S. Office of Personnel Management, Washington, DC)*

Contributions of Social Research to Governance
Roberta Balstad Miller *(Division Director, Social and Economic Science, National Science Foundation, Washington, DC)*

Overview of the Issues and Recent Government Initiatives
Marilyn K. Gowing *(Assistant Director for Personnel Research, U.S. Office of Personnel Management, Washington, DC)*

Government agencies are (to paraphrase from another setting) like *all* other organizations, like *some* other organizations, and — particularly the federal government — like *no* other organization. The task of managing agencies is extraordinarily complex and difficult under any circumstances, but particularly so under severe budget constraints. Although the quality of personnel is critically important, managing an effective government agency entails far more than attracting and retaining the best available people for the jobs. This session will examine both policy and management issues affecting the current state of agency functioning and development within the federal government. It will highlight various means of analyzing, diagnosing, and (when needed) intervening in organizations to improve performance. It will also give attention to the special problems of scientists and engineers in goverment.

[**Sponsor:** AAAS Committee on Science, Engineering, and Public Policy. **Cosponsors:** AAAS Sections K and Y.]

36T-2. Risk Perception and Public Policy

Organized by: **Michael A. Kamrin** *(Professor, Institute for Environmental Toxicology, Michigan State Univ., East Lansing, MI)* and **Daniel A. Bronstein** *(Professor, Dept. of Resource Development, Michigan State Univ., East Lansing, MI)*

2:30 pm / Sun / 17 Feb **Omni Shoreham/Cabinet**

Presiding: Michael A. Kamrin and Daniel A. Bronstein

Risk Perception, Trust, and Public Policy
Paul Slovic *(President, Decision Research, Eugene, OR)*

Consumer Perception of Risks from Pesticide Residues in Foods
Eileen van Ravenswaay *(Professor, Dept. of Agricultural Economics, Michigan State Univ., East Lansing, MI)*

Radon Denial: Deciphering the Causes
Sheldon Krimsky *(Professor, Dept. of Urban and Environmental Policy, Tufts Univ., Medford, MA)*

Impact of the Media on Risk Perception
Cristine Russell *(Special Health Correspondent,* Washington Post, *Washington, DC)*

The Impact of Seveso on Public Policy in Europe
Ortwin Renn *(Center for Environment, Technology, and Development, Clark Univ., Worcester, MA)*

Risk Perception and Global Climate Management
Steven Rayner *(Deputy Director, Global Environmental Studies Center, Oak Ridge National Laboratory, Oak Ridge, TN)*

This session will critically examine the interaction of public perception of health risks with public policy dealing with these same risks. Recent events, such as the earthquake in California and the controversy about Alar in apples, indicate that risk perception plays a major role in risk management decisionmaking. In addition, the recent EPA report on unfinished business concludes that agency priorities were based to a large extent on public perceptions of risk magnitudes rather than on scientific evaluations of these risks. Speakers at this session will examine the role of risk perception in the management of both natural hazards and human environmental interventions. From these presentations and associated discussions, one should gain a better understanding of the critical factors affecting perceptions and how they influence public policy.

[**Sponsor:** AAAS Section K. **Cosponsors:** AAAS Section X; AAAS Committee on Science, Engineering, and Public Policy; AAAS Directorate for Education and Human Resources Programs.]

36T-3. Allocating Public Funds for Science: Practice and Possibilities

Organized by: **Jack Sommer** *(President, Political Economy Research Institute, McLean, VA)*

8:30 am / Mon / 18 Feb **Omni Shoreham/Cabinet**

Presiding: Jack Sommer

And Now a Word from Our Sponsors
Elizabeth M. Robinson *(Analyst, Science, Education, and Transportation Program, Office of Technology Assessment, Washington, DC)*



NSF Examines Its Own Proposal Review System
James M. McCullough *(Director, Program Evaluation Staff, National Science Foundation, Washington, DC)*

Gender and Allocation Issues: Insights from Sigma Xi Surveys
Deborah L. Seltzer *(President, DLS Research Associates, Pittsburgh, PA)*

Peer Review as Self-Regulation: A Public Choice Perspective
Peter H. Aranson *(Professor and Chair, Dept. of Economics, Emory Univ., Atlanta, GA)*

Allocating Public Funds to Technology Development
Christopher T. Hill *(Executive Director, The Manufacturing Forum, National Academies of Engineering and Science, Washington, DC)*

Centers and the Individual Scientist: Conflict or Compromise?
Rita Colwell *(Director, Maryland Biotechnology Institute, Univ. of Maryland, College Park, MD)*

Peer Review to Plateau
David D. Moran *(Director, David Taylor Institute, Bethesda, MD)*

Self-Organization Through Prizes and Lots: A Radical Proposal
Jack Sommer

In the winter of 1991, a new Congress will consider, among other matters, the allocation of federal funds for science and technology (S&T). These deliberations will have been preceded by those in the executive branch; both will have been preceded by 35 years or more of concerted federal civilian science allocations. What has been learned during these years about priority setting, procedures for allocating public S&T funds, and peer review of grants? Are there allocation alternatives that might be fruitfully explored by the entire research community and by federal decisionmakers? Session speakers will comment on existing practices and voice opinions about these issues gathered from different surveys and research projects. Some theoretical perspectives will be advanced to aid the interpretation of current practice. The last part of the session will discuss alternative procedures aimed at improving upon existing practice.

[**Cosponsors:** AAAS Sections L, X, and Y; AAAS Committee on Science, Engineering, and Public Policy.]

36T-4. Knowledge Synthesis: An Ethical Imperative for Policy Development

Organized by: **Keith D. Wilde** *(Senior Policy Analyst, Canada Department of Agriculture, Ottawa, Canada)*

2:30 pm / Mon / 18 Feb **Omni Shoreham/Cabinet**

Presiding: Keith D. Wilde

Education for Creative Synthesis Against the Folly of Specialist Power
Richard R. Harwood *(C. S. Mott Professor of Sustainable Agriculture, Michigan State Univ., East Lansing, MI)*

Environmental Protection, Science, and Ideology
John M. Culbertson *(Emer. Professor of Economics, Univ. of Wisconsin, Madison, WI)*

The Greek Hell
Nicole Morgan *(Author and Ph.D. Candidate, Dept. of Philosophy, Univ. of Ottawa, Ottawa, Canada)*

Ecology, Religion, and Practical Reason
Langdon Gilkey *(Shailer Matthews Professor of Theology, Emer., The Divinity School, Univ. of Chicago, Chicago, IL)*

Common Sense in Uncommon Times
Timothy C. Weiskell *(Henry Luce Fellow, Harvard Divinity School, Cambridge, MA)*

The Conscious Employment of Emotions as an Adjunct to Creativity
Aristide H. Esser *(President, Association for the Study of Man-Environment Relations, Orangeburg, NY)*

Implications for Planetary Survival
Digby J. McLaren *(Past President, The Royal Society of Canada, Ottawa, Canada)*

The unwise or malevolent use of technology is a familiar ethical problem involving knowledge, as are fraud and deceit in research. A different kind of ethical problem is the failure to use knowledge intelligently in the formation of policy. Implications of default on the moral obligation to be intelligent in this sense are enormous. Ignorant policies foster behaviors that are breaking down civilization and threaten human and biospheric survival. Institutions, popular ideologies, and intellectual traditions of modern western culture are sources of this failure. To save ourselves, we must effect substantial changes to the social structures in which we generate, apply, and transmit knowledge. One example: tax-supported knowledge resources are converted to the service of special-interest groups on the faulty presumption that particular benefits to some add up to the general good of all. Disciplines with particularly obvious responsibility for dealing with the problem are philosophy, theology, economics, management, and political studies.

[**Sponsor:** AAAS Section L. **Cosponsors:** AAAS Sections H and K.]

Workshops

36W-1. Government Hearings and Expert Witnesses: Giving Effective Testimony

Organized by: **Stephen D. Nelson** *(Program Director, Science, Technology, and Government, AAAS, Washington, DC)*

2:30 pm / Sat / 16 Feb **Omni Shoreham/Cabinet**

Presiding: Stephen D. Nelson

Purposes of Hearings and Their Role in the Policy Process
Paul S. Rundquist *(Specialist in American National Government, Congressional Research Service, Library of Congress, Washington, DC)*

The Structure of Congressional Hearings: Strategic Implications
Grace L. Ostenso *(Staff Director, Subcommittee on Science, Research, and Technology, U.S. House of Representatives, Washington, DC)*

AAAS☆91 Exhibition
Sheraton Washington, Exhibit Hall C
Hours: *Fri/6pm-8pm, Sat-Mon/9am-3pm*

Hearings at the Local Community Level
Parris Glendening *(County Executive, Prince Georges County, Upper Marlboro, MD)*

Writing Effective Testimony
William G. Wells, Jr. *(Professor, School of Management Science, George Washington Univ., Washington, DC)*

Oral Presentation Skills for Witnesses
Dennis Barnes *(Associate Vice President for Government Relations, Univ. of Virginia, Charlottesville, VA)*

Legal Considerations for Witnesses
John C. Grabow *(Partner, Ginsberg, Feldman, and Bress, Chartered, Washington, DC)*

A growing proportion of public policy issues involves scientific-technical matters in significant ways. As a result, scientists and engineers are being called on increasingly to serve as witnesses or to provide expert testimony in structured hearings at federal, state, or local levels. In such settings, the scientist/engineer must address a primary audience that is (usually) not technically trained and so must communicate in ways that differ, both substantively and stylistically, from customary communications with one's professional peers. Even further, this usually takes place in public settings, often with media present, so that the general public is another (if not the primary) audience that must be reached.

This workshop will provide information to scientists and engineers on types of hearings, what they are designed to achieve (which is usually far more than just fact-finding), and how they are structured and developed. In addition, it will offer practical nuts-and-bolts information on how to prepare for the witness role, both in written and spoken testimony. Finally, legal considerations for witnesses will be addressed.

[**Sponsor:** AAAS Committee on Science, Engineering, and Public Policy. **Cosponsors:** AAAS Sections X and Y.]

36W-2. Communicating with Policymakers: Strategies for Scientists and Engineers

Organized by: **Aviva Brecher** *(Physical Scientist, Strategic Planning and Analyses Office, Transportation Systems Center, U.S. Dept. of Transportation, Cambridge, MA)* and **Stephen D. Nelson** *(Program Director, Science, Technology and Government, AAAS, Washington, DC)*

8:30 am / Sat / 16 Feb **Omni Shoreham/Cabinet**

Presiding: Aviva Brecher

Access Points for Scientific-Technical Input in the Policy Process
Anthony Fainberg *(Senior Analyst, Office of Technology Assessment, U.S. Congress, Washington, DC)*

The Federal Budget Process: Executive Branch Phase
Norine E. Noonan *(Chief, Science and Space Programs Branch, Office of Management and Budget, Washington, DC)*

The Federal Budget Process: Congressional Phase
Michael L. Telson *(Energy and Science Analyst, Committee on the Budget, U.S. House of Representatives, Washington, DC)*

The Political Ecology of Congressional Members' Offices
Dana Isherwood *(Senior Legislative Analyst, Lawrence Livermore National Laboratory, Livermore, CA)*

The Political Ecology of Congressional Committees
Herbert Lin *(Senior Staff Officer, Computer Science and Telecommunications Board, National Research Council, Washington, DC)*

The World View of Policymakers and Implications for Communicating with Them
Stephen D. Nelson

Scientists and engineers need to be able to communicate effectively on technical issues with policymakers: to inform, educate, alert, question, challenge, and help shape policy. While the scientific-technical community offers expertise in its own realm, its members typically find it difficult to communicate with policymakers because they are not familiar with the structure and operating principles of political processes. Learning to shape the message and bridge the culture/values gap between these two communities should help more scientists to promote awareness of increasingly important science and technology policy issues.

This workshop will highlight the budget and political processes, their timetables and goals, and their main protagonists in Congress and the executive branch. The speakers will be former Congressional Science and Engineering Fellows now in key positions in Congress, the executive branch, and other institutions. They will review the budget and legislative cycles; define the key access points for affecting legislative, regulatory, and funding decisions; and analyze the critical timing and effectiveness of various modes of interaction with policymakers.

[**Sponsor:** AAAS Committee on Science, Engineering, and Public Policy. **Cosponsors:** AAAS Sections X and Y.]

37. History and Philosophy of Science

37-1. The Beginning and the End of the World: Historical Perspectives

Organized by: **Stephen G. Brush** *(Professor, Dept. of History and Institute for Physical Science and Technology, Univ. of Maryland, College Park, MD)*

8:30 am / Sun / 17 Feb **Sheraton / Kansas**

Presiding: Stephen G. Brush

Impermanence Enters the Astronomical Universe: Comets, Novae, and Solar Radiation, 1400–1650
Peggy A. Kidwell *(Specialist, Section of Mathematics, National Museum of American History, Smithsonian Institution, Washington, DC)*

From Genesis to Apocalypse: Newton's God and Newton's Science
James E. Force *(Professor of Philosophy, Univ. of Kentucky, Lexington, KY)*

Nebular Birth and Heat Death, 1754–1905
Stephen G. Brush

Red Shifts, Galaxies, and General Relativity: Ideas on the Creation and End of the Universe in the Early 20th Century
Robert W. Smith *(Historian, Dept. of Space History, National Air & Space Museum, Smithsonian Institution, Washington, DC)*

The End of the Universe
Frank J. Tipler *(Professor of Mathematical Physics, Tulane Univ., New Orleans, LA)*

This symposium will present an overview of scientific theories and observations pertaining to the origin and ultimate fate of the earth and the universe, from the 16th to the 20th century, based on recent research in the history of science (and, in the case of the last speaker, current research in cosmology). Each speaker will describe some of the prevailing beliefs and new ideas in a particular period and show how they are related to general trends in the development of astronomy and physics.

Apart from the intrinsic interest of this topic — which has always fascinated the public as well as scientists, philosophers, and theologians — the symposium will offer insights into the ways in which scientists have tried to develop plausible explanations of phenomena that cannot easily be brought into the laboratory for controlled experimentation. The speakers will also address the important issues of how science interacts with religious beliefs and philosophical preconceptions and how scientific theories influence popular culture.

[Sponsor: AAAS Section L.]

37-2. Metaphors and Models in the Brain Sciences: Historical Perspectives

Organized by: **Edward Manier** *(Professor, Philosophy and Reilly Center for Science, Technology, and Values, Univ. of Notre Dame, Notre Dame, IN)*

2:30 pm / Sat / 16 Feb **Sheraton / Kansas**

Presiding: Edward Manier

Brain Wars in England: Richard Owen's Lost Cause
Christopher Smith *(Dept. of Vision Sciences and Dean, Faculty of Science, Aston Univ., UK)*

"Opening the Black Box": Figurative Uses of Molecules and Algorithms
Edward Manier

Evolutionary Assumptions in the Neurosciences
Terrence W. Deacon *(Associate Professor of Anthropology, Harvard Univ., Cambridge, MA)*

Brain Science and the Cultural Uses of Metaphors
Anne Harrington *(Assistant Professor, Dept. of the History of Science, Harvard Univ., Cambridge, MA)*

Metaphors and models are of exceptional importance in the brain sciences because their general scientific use includes the communication of information across barriers or gaps dividing groups that do not share a common language. Absence of a shared technical language characterizes the diverse research areas comprising the brain sciences: the comparative analysis of nervous systems within an evolutionary framework, the delineation of the functional architecture of the brain, and the analysis of its molecular messengers. The sciences of the brain also address central problems from the sciences of the mind (i.e., their reach extends beyond biology to the analysis and control of behavior, cognition, and emotion). Clinical-medical interests further complicate the use of figurative and graphic expression in the field. Finally, the brain-mind science (evolutionary psychology) offers to illuminate mechanisms by which culture is produced and reproduced. At this level, central insights are articulated in terms (analogous to those of the sociobiology controversy) engaging a much wider public. This symposium is designed to approach these problems from an appropriate variety of disciplinary perspectives.

[**Sponsor:** AAAS Section L. **Cosponsor:** AAAS Section J.]

37-3. Mathematics in Times of Social Upheaval

Organized by: **Sanford L. Segal** *(Professor of Mathematics, Univ. of Rochester, Rochester, NY)*

8:30 am / Mon / 18 Feb **Sheraton / Kansas**

Presiding: Sanford L. Segal

Mathematicians versus Humanists in the Göttingen Philosophical Faculty, 1900–1919
David E. Rowe *(Associate Professor, Mathematics, Pace Univ., Pleasantville, NY)*

The Antireligious Campaign and Moscow Mathematics
Charles Ford *(Associate Professor, Mathematics, Saint Louis Univ., St. Louis, MO)*

The Case of Nikolai Lusin
Aleksey Levin *(Professor, Physical Science and Technology, Univ. of Maryland, College Park, MD)*

Warren Weaver, Vannevar Bush, and the Applied Mathematics Panel in World War II
Larry Owens *(Professor of History, Univ. of Massachusetts, Amherst, MA)*

Mathematics and Nazi Politics: Three Examples
Sanford L. Segal

This symposium will discuss the interactions between mathematics and mathematicians and the ambient social, political, and ideological climate in times of great social stress. Five different areas will be covered: French revolutionary mathematics; mathematics in Stalin's Soviet Union; mathematics in Germany around World War I; mathematics in the United States during World War II; and mathematics under the Nazi regime in Germany.

Mathematics is often viewed as the exemplar of an autonomous scientific discipline. The "truths" of mathematics and nature of mathematical investigations are often thought of as less temporally contingent than those of the experimental sciences and, consequently, less subject to social pressures. Examination of mathematics in periods of great social stress puts this hypothesis of scientific autonomy to the test, and there have been a number of such recent investigations. Bringing these investigations into the same symposium will allow for a fruitful interchange on the commonality and differences in these seemingly widely varied situations. In fact, it is expected that common themes of the interaction between science and its practitioners and the social milieu will be revealed by considering such historically disparate "high-pressure"

AAAS☆91 Exhibition
Sheraton Washington, Exhibit Hall C
***Hours:** Friday, 6pm-8pm*
Saturday-Monday, 9am-3pm

periods when scientific autonomy is placed under a stress that makes such interaction particularly salient.

[**Sponsors:** AAAS Sections A and L.]

37-4. Creative Couples and Gender Complementarity: Cross-disciplinary Perspectives

Organized by: **Helena M. Pycior** *(Associate Professor of History, Univ. of Wisconsin, Milwaukee, WI)*, **Nancy G. Slack** *(Visiting Research Scholar, Section of the History of Medicine, Yale Univ. School of Medicine, New Haven, CT)*, and **Pnina G. Abir-Am** *(Visiting Research Associate, Northeastern Univ., Boston, MA)*

2:30 pm / Fri / 15 Feb **Sheraton / Kansas**

Presiding: Peggy A. Kidwell *(Specialist, Section of Mathematics, National Museum of American History, Smithsonian Institution, Washington, DC)*

Dividing the Research and the Credit: Marie and Pierre Curie
Helena M. Pycior

The Scientific Relationship of Albert and Mileva Einstein
John J. Stachel *(Professor of Physics, Boston Univ., Boston, MA)*

Mary Putnam Jacobi and Abraham Jacobi: Mixing Medicine with Politics
Joy Harvey *(Rockefeller Fellow, Dept. of the History of Science, Univ. of Oklahoma, Norman, OK)*

Contrasting Sex Roles in American Botanical/Ecological Couples
Nancy G. Slack

The Localization of Complementarity
Mary Catherine Bateson *(Professor of Anthropology, George Mason Univ., Fairfax, VA)*

Discussants:
Stephen G. Brush *(Professor, Dept. of History and Institute for Physical Science and Technology, Univ. of Maryland, College Park, MD)* and Audrey B. Davis *(Curator of Medical Sciences, National Museum of American History, Smithsonian Institution, Washington, DC)*

This symposium will analyze creative couples from cross-disciplinary perspectives. The specific couples to be considered range from Mileva and Albert Einstein, to whom the term "scientific couple" has only recently and tenatively been applied, to Marie and Pierre Curie, who are often taken as a paradigmatic scientific couple. Historical analysis of a particular couple will consider such factors as the education and credentials that each partner brought to the scientifc couple; the academic or other employment patterns of each partner; the division of scientific activities between the partners; and joint and independent publications of the partners.

Among topics to be addressed are the extent to which the historical record supports a reinterpretation of the Einsteins; conflict as well as contact in the partnership of Mary Putnam Jacobi and Abraham Jacobi; different modes of collaboration within American botanical/ecological couples; disruption of equality and complementarity by career moves; and the publication strategy followed by the Curies to assure that they shared scientific credit.

[**Sponsor:** AAAS Section L. **Cosponsor:** AAAS Section H.]

Information Services at the AAAS☆91 Exhibition

Visit the exhibition and learn about the latest in on-line information services from these and other organizations: *BRS Colleague, Johns Hopkins University/Welch Medical Library, NASA Scientific and Technical Information Program, National Library of Medicine, NIH Division of Research Grants (Research Documentation Section)*, and *U.S. Department of Energy (FEDIX)*.

37-5. AAAS in Public Affairs, 1848–1975

Organized by: **Albert H. Teich** *(Director, Science and Policy Programs, AAAS, Washington, DC)* and **Michele Aldrich** *(Director of Information Services, AAAS, Washington, DC)*

2:30 pm / Sun / 17 Feb **Sheraton / Kansas**

Presiding: Michele Aldrich

Power Through Persuasion: AAAS and National Science Initiatives in the 19th Century
Sally Gregory Kohlstedt *(Professor of History of Science and Associate Dean, Univ. of Minnesota, Minneapolis, MN)*

AAAS and the "Science and Society" Movement in 1930s America
Peter J. Kuznick *(Assistant Professor of History, American Univ., Washington, DC)*

AAAS and the Establishment of the National Science Foundation
Dael Wolfle *(Professor Emer. of Public Affairs, Univ. of Washington, Seattle, WA)*

AAAS and the Public Understanding of Science, 1945–1975
Bruce V. Lewenstein *(Assistant Professor, Dept. of Communications and Program on the History and Philosophy of Science and Technology, Cornell Univ., Ithaca, NY)*

Science Magazine and Public Policy, 1900–1945
Michael M. Sokal *(Professor of History, Dept. of Humanities, Worcester Polytechnic Institute, Worcester, MA)*

AAAS is a major player in public affairs related to science and technology in the United States during the 1990s. *Science* magazine, the Annual Meeting, Project 2061, Linkages, the R&D Budget and Policy Project, and the Science and Human Rights Program — all have high visibility and significant influence in their respective spheres. While many members and friends of the association are aware of these efforts, relatively few have an appreciation for the role AAAS has played in public affairs over its distinguished 140-year history. This symposium will put today's AAAS in historical perspective by examining the association's contributions to the organization of the U.S. scientific community, to science policy, to education, to public understanding of science, and to the progress of science itself from its founding to the present day. In the last decade, several historians and scientists have begun research on the history of AAAS as it relates to the broader context of American science. This symposium reports on their projects, some recently completed, others still under way. All are based on archival research as well as work on printed primary material. AAAS members, staff, and officers, past and present, who are in the audience will be encouraged to add their insights.

[**Sponsor:** AAAS Section L. **Cosponsors:** AAAS Section X; AAAS Committee on Science, Engineering, and Public Policy.]

Technical Sessions

37T-1. Beyond Historical Impressionism: Testing Theories of Scientific Change

Organized by: **Frank J. Sulloway** *(Visiting Scholar, Program in Science, Technology, and Society, MIT, Cambridge, MA)*

2:30 pm / Mon / 18 Feb **Sheraton / Kansas**

Presiding: Frank J. Sulloway

Testing Theories of Science
David L. Hull *(Professor, Dept. of Philosophy, Northwestern Univ., Evanston, IL)*

Scrutinizing Science: A Review of Empirical Studies of Scientific Change
Arthur L. Donovan *(Professor, Humanities Dept., U.S. Merchant Marine Academy, Kings Point, NY)*

Orthodoxy and Innovation in Science: A Multivariate Analysis
Frank J. Sulloway

The Limits of Scientific Reasoning: Implications for the Philosophy of Science
David Faust *(Professor, Dept. of Psychology, Univ. of Rhode Island, Kingston, RI)*

This session challenges the history of science discipline to go beyond impressionistic accounts of scientific change. The history of science has been largely characterized by myriads of localized and sometimes antiquarian studies. In order to form a more adequare conception of science as a process, it is necessary to go beyond such individual case studies and to generalize from specific historical instances. Various general hypotheses about the nature of science and scientific change have been proposed by historians, sociologists, and philosophers of science; however, most of these hypotheses, although testable, have never been subjected to actual testing. Researchers in these fields inronically employ methodological standards that they would instantly condemn as inadequate in the work of the scientists they study.

Not all historical claims are testable. But many interesting claims, which often involve probabilistic statements about the behavior of individuals within populations, are quite amenable to testing. Whenever it is possible to test such claims, researchers have a responsibility to do so. In short, historians and philosophers of science need to begin using the same methods of hypothesis testing that are regularly employed in science itself. This session will review several concrete cases of historical research projects that have sought to test various theories about the nature of science and scientific change.

[**Sponsor:** AAAS Section L. **Cosponsor:** AAAS Section K.]

37T-2. Neurobiology and Narrative: The Novels and Essays of Walker Percy, M.D.

Organized by: **Edward Manier** *(Professor, Philosophy and Reilly Center for Science, Technology, and Values, Univ. of Notre Dame, Notre Dame, IN)*

8:30 am / Tue / 19 Feb **Sheraton / Kansas**

Presiding: Edward Manier

Walker Percy, Neuroscience, and Common Sense
James H. Schwartz *(Professor/Investigator, Howard Hughes Medical Institute at Columbia Univ., New York, NY)*

Walker Percy's Symbol: Objects Claimed/Object Lost
Lewis A. Lawson *(Professor of English, Univ. of Maryland, College Park, MD)*

Walker Percy and "Existential" Narrative
Stephen H. Watson *(Associate Professor of Philosophy, Univ. of Notre Dame, Notre Dame, IN)*

Walker Percy's Challenge to Science
Patrick Samway *(Literary Editor of* America *Magazine, New York, NY)*

Near the end of his life, Walker Percy refined basic themes developed in his essays and novels over almost 40 years. Human beings are marked by two "singularities" or distinctive features, the ability to use language and a deeply rooted alienation, distinguishing them as inhabitants of a "world" rather than mere organisms in an environment. These themes set the background for parodies of the psychiatrist Dr. Tom More, naively susceptible to seductive claims that medical technology has the power to conquer every terror, from flatulence to the apocalypse. Percy's novels and parables also burlesque the scientific humanism, the liberal utilitarianism, of Dr. Tom's antagonists. His essays rejected the "qualitarian" bifurcation of man into an objective scientific consciousness and a consumer-self with a list of needs to be satisfied. This technical session probes the extent to which the disciplines of psychiatry, neuroscience, philosophy, and literature — united in Percy's medical training at Columbia College of Physicians and Surgeons — and his subsequent career as a philosophical essayist and novelist can address each other's fundamental concerns.

[**Sponsor:** AAAS Section L. **Cosponsors:** AAAS Section Y; AAAS Committee on Public Understanding of Science and Technology.]

37T-3. Measuring Similar Processes at Multiple Levels of Biological and Social Systems

Organized by: **Len Troncale** *(President, International Society for the Systems Sciences, and Professor of Biology and Director, Institute for Advanced Systems Studies, California State Polytechnic Univ., Pomona, CA)*

8:30 am / Sat / 16 Feb **Sheraton / Kansas**

Presiding: James G. Miller *(President, Univ. of the World, La Jolla, CA, and Adjunct Professor, Univ. of California, Los Angeles, CA, and San Diego, CA)*

Energy Transformation Across Natural and Social Levels
Howard T. Odum *(Professor of Environmental Engineering and Ecology, Univ. of Florida, Gainesville, FL)*

Progress in Cross-level Research on Living Systems
James G. Miller

Correlations Across Physical/Biological Systems Levels: Systems Allometry
Len Troncale

It is useful for systems theories to distinguish between abstract and concrete systems. Scientific work can be conducted in terms of either sort of system, but concrete systems theory has resulted in

more quantitative research. This symposium will survey the very recent appearance of empirically based tests of several systems-level processes that appear to be similar across clearly different disciplines, ranging from molecular/cellular levels of biology to its ecosystems levels and from biological to sociological and economic phenomena. These studies may help unite some aspects of the social sciences with the natural sciences.

Recognition of the similarity of subsytems at these diverse levels of systems facilitates the development of cross-level hypotheses and quantitative research to test the existence of formal identities across levels. Another objective of this symposium is evaluation of the validity of the methodology and results produced by attempts to test cross-level hypotheses. Such fundamental transdisciplinary research can potentially confirm, disprove, or refine very powerful systems principles. It remains to be seen whether or not these principles can then contribute back to the conventional disciplines from which they were generalized.

[**Cosponsors:** AAAS Sections J and L.]

37T-4. Technical Change and the State in the 20th Century: Case Studies

Organized by: **Eric Schatzberg** *(Postdoctoral Fellow, Center for the History of Electrical Engineering, Rutgers Univ., New Brunswick, NJ)*

8:30 am / Fri / 15 Feb **Sheraton / Vermont**

Presiding: Eric Schatzberg

The Origins of the French Nuclear Power Program
Gabrielle Hecht *(Ph.D. Candidate, Dept. of History and Sociology of Science, Univ. of Pennsylvania, Philadelphia, PA)*

The Indian Space Program: High Technology in a Developing Country
Raman Srinivasan *(Ph.D. Candidate, Dept. of History and Sociology of Science, Univ. of Pennsylvania, Philadelphia, PA)*

The U.S. Army, Strategic Materials, and the Development of All-metal Airplanes
Eric Schatzberg

Discussant:
David Shearer *(Assistant Professor, Dept. of History, Univ. of Delaware, Newark, DE)*

This session examines the role of the state in promoting specific "high" technologies in three different countries. Two speakers will discuss cases in the post-World War II era — the French civilian nuclear power program and the Indian space program — in which governments undertook large-scale projects to develop new technologies. The third speaker examines the role of the U.S. Army before WWII in the development of all-metal airplanes.

[**Sponsor:** AAAS Section L.]

Workshop

37W-1. Science in National Life: A Videohistory Workshop

Organized by: **David H. DeVorkin** *(Curator of Astronomy, National Air and Space Museum, Smithsonian Institution, Washington, DC)*

8:30 am / Tue / 19 Feb **Sheraton / Colorado**

Presiding: Nathan Reingold *(Senior Historian, History of Science Dept., National Museum of American History, Smithsonian Institution, Washington, DC)*

The Early Space Sciences: A Study of Laboratory Technique
David H. DeVorkin

Exploring the Manhattan Project: Using Video as a Technique in Artifact Preservation
Stanley Goldberg *(Unaffiliated Scholar, Washington, DC)*

Preserving the Scientist's Environment: Video Documentation of Laboratory Life
Pamela M. Henson *(Historian, Smithsonian Institution Archives, Washington, DC)*

Video Documentation of 20th-century Biomedical Instrumentation
Ramunas Kondratas *(Curator, Medical Sciences Division, National Museum of American History, Smithsonian Institution, Washington, DC)*

In participation with the Alfred P. Sloan Foundation of New York City, the Smithsonian Institution has been exploring programmatically the systematic application of video as a means of enhancing available historical documentation. Entitled "Science in National Life," the program was initiated to examine how historians of science and technology might effectively add videotaping techniques to more traditional means of information gathering. Eighteen historians have participated in the Smithsonian Videohistory Program. Each has employed videotaping in some form to augment his or her ongoing research agenda: group interviews, laboratory inspections, detailed examinations of shop practices and techniques, and focused interviews with inventors and designers and builders of instruments, as well as with instrument users and planners. Each historian has come away with impressions about how effective the application of video has been to his or her research. This workshop will provide a forum for four of those who have participated in the program.

[**Sponsor:** AAAS Section L. **Cosponsors:** AAAS Sections B, G, and Y.]

38. Science and Technology Education

38-1. Cross-national Perspectives on the Public Understanding of Science

Organized by: **Jon D. Miller** *(Director, Public Opinion Laboratory, Northern Illinois Univ., DeKalb, IL)*

8:30 am / Fri / 15 Feb **Sheraton / Rockville**

The Public Understanding of Science in Europe, Canada, and the United States

Presiding: Peter Briggs *(Executive Secretary, British Association for the Advancement of Science, London, UK)*

The Public Understanding of Science and Technology in the European Community
Jean Gabolde *(Director, Scientific and Technical Policy, Commission of the European Communities, Brussels, Belgium)* and

Wim Van Deelen *(Counselor for Science and Technology, Commission of the European Communities, Brussels, Belgium)*

Public Attitudes Toward Science in France
Daniel Boy *(Maison des Sciences de L'Homme, Paris, France)*

The Public Understanding of Science in Britain
John Durant *(Assistant Director for Research & Information Services, Science Museum of London, and Visiting Professor of the Public Understanding of Science, Imperial College, London, UK)* and Martin Bauer *(Research Associate, London School of Economics, London, UK)*

The Public Understanding of Science in Canada
Edna F. Einsiedel *(Professor of Communication Studies, Univ. of Calgary, Calgary, Canada)*

The Public Understanding of Science in the United States
Jon D. Miller

2:30 pm / Fri / 15 Feb **Sheraton / Rockville**

The Public Understanding of Science in Japan and the United States

Presiding: To be announced

The Public Understanding of Science in Japan
Tatsuzo Suzuki *(Professor, Institute of Mathematical Statistics, Tokyo, Japan)* and Hajime Nagahama *(Director, Second Policy-oriented Research Group, National Institute of Science and Technology Policy, Tokyo, Japan)*

Public Attitudes Toward Nuclear Power in Japan
Fujio Niwa *(Professor of Science Policy, Institute of Socioeconomic Planning, Tsukuba Univ., Ibaraki, Japan)* and Yasumasa Tanaka *(Professor, Dept. of Social Psychology and Communications, Gakushuin Univ., Tokyo, Japan)*

Empirical Comparisons of the Public Understanding of Science in Japan and the United States
Jon D. Miller

Communicating Science to the Japanese Public: A Journalist's View
Kenji Makino *(Science Editor/Writer, The Mainichi Newspapers, Tokyo, Japan)*

Some American Observations on the Public Understanding of Science and Technology in Japan
Charles W. Wallace *(Head, National Science Foundation, Tokyo Office, Tokyo, Japan)*

During the last two years, major national surveys of scientific literacy and public attitudes toward science have been conducted in 15 of the major industrialized nations of the world. This symposium brings together the primary authors of those studies and provides a unique opportunity for a comparative cross-national discussion of the levels and scores of scientific literacy in these 15 countries.

In the first session, Gabolde and Van Deelen will present the results of a 1989 survey of the 12 member countries of the European Community. Boy will review his 1989 French study, and Durant and Bauer will analyze the patterns of the public understanding of science in Britain from their 1988 study. Einsiedel will present the results of her 1989 study of scientific literacy in Canada. Miller's presentation will incorporate the data from his studies of public understanding of science in the United States from 1979 through his most recent 1990 study and will include some comparative models utilizing data from Canada and Western Europe.

The second session will focus exclusively on comparisons between the United States and Japan. Suzuki and Nagahama are currently developing plans for a major national study of scientific literacy in Japan in 1991 and will report on the results of a smaller study conducted in January 1990. Niwa and Tanaka will summarize their work on Japanese attitudes toward nuclear power. Miller will compare previous U.S. results with a 1990 Japanese study. To supplement these empirical analyses, Makino will discuss his assumptions as a Japanese science writer and editor who seeks to communicate scientific information to the Japanese public, and Wallace will discuss the social and cultural context of the public understanding of science in the United States and Japan.

[**Sponsors:** AAAS Section K; Project 2061. **Cosponsors:** AAAS Sections Q and Y; AAAS Committee on Public Understanding of Science and Technology; AAAS Directorate for Education and Human Resources Programs.]

38-2. Animals in the K–12 Classroom

Organized by: **Deborah C. Runkle** *(Senior Program Associate, AAAS, Washington, DC)*, **Jerod M. Loeb** *(Director, Division of Biomedial Science, American Medical Association, Chicago, IL)*, and **J. Fredrick Cornhill** *(Professor, Ohio State Univ., Columbus, OH)*

8:30 am / Mon / 18 Feb **Sheraton / Warren**

Presiding: Deborah C. Runkle

Animals or Alternatives: The Current Status
Juliana Texley *(Curriculum Director, Anchor Bay Schools, New Baltimore, MI)*

Perceptions of the Students
Linda J. LaScola *(President, LaScola Qualitative Research, Washington, DC)*

The Price of Ignorance
Jerod M. Loeb

Values in the Classroom
Joseph McInerney *(Director, Biological Sciences Curriculum Study, Colorado Springs, CO)*

Animals at the (Science) Fair
William R.M. Ritter *(Science Coordinator, Upper Dublin School District, Ft. Washington, PA)*

Teaching the Teachers
Margaret D. Snyder *(Training Specialist, Ohio State Univ., Columbus, OH)*

There is a broad national concern about the quality of science education in America and about our students' performance compared with that of students internationally. This highly publicized concern includes the examination of education in the life sciences, with the humane care and appropriate use of animals being prominent in this discussion. The responsibility for conveying information about science and society to our youth has fallen directly on teachers. However, teachers have little time or available resources to understand the social and legal issues involved in using animals in education and student research. There is increasing controversy regarding the use of animals in science education. Publications by "animals rights" groups denigrate the significance of animal use in educational pursuits and advocate student conscientious objection to a variety of animal uses by schools. Such objections are disquieting to students, teachers, and parents and shift the focus away from appropriate reasons for using animals in the educational process.

This symposium will address the following philosophical and didactic concerns raised by teachers and the public: (1) What are the current practices and problems in regard to using animals in education? (2) What do students think about animal use? (3) Are today's students uninformed or unappreciative regarding major biomedical advances that have relied on animals and of the efforts of biological scientists who could serve as potential role models for young people? (4) Are students taught a reverence for life and given guidance in formulating and articulating their values regarding the environment and animal and human well-being? and (5) What steps are necessary to assist educators in their review of this issue?

[**Sponsors:** AAAS Section Q; AAAS Committee on Scientific Freedom and Responsibility. **Cosponsor:** AAAS Section G.]

38-3. Science for the Nonscience Major

Organized by: **Cesare Emiliani** *(Professor of Marine Geology, Univ. of Miami, Coral Gables, FL)*

2:30 pm / Sun / 17 Feb **Sheraton / Holmes**

Presiding: Cesare Emiliani and David S. Saxon *(Honorary Chairman of the Corporation and President Emer., Univ. of California, Los Angeles, CA)*

Two Cheers for the Higher (and Lower) Vulgarization of Science
Derek A. Davenport *(Professor of Chemistry, Purdue Univ., West Lafayette, IN)*

Just About Life
William A. Loomis *(Professor of Biology, Univ. of California-San Diego, La Jolla, CA)*

Quantum Physics for Poets
Leon M. Lederman *(Professor of Physics, Univ. of Chicago, Chicago, IL, and President-Elect, AAAS)*

Cosmology: The Science of the Universe
Edward R. Harrison *(Professor of Astronomy, Univ. of Massachusetts, Amherst, MA)*

Planet at Risk
Cesare Emiliani

Science for College Students: It's Up to Us
David S. Saxon

Discussant:
David S. Saxon

Our college graduates in the liberal arts are abysmally ignorant of the basic principles of science. The usual procedure of requiring that the nonscience major take some standard science courses, often with labs, does not do the job. The nonscience major takes the "easiest" course(s), learns little, and retains less. David Saxon, in an article in *Science,* emphasizes that the students should be led to understand that "science is not a collection of isolated facts but a highly unified and consistent view of the world." Consequently, instruction should focus on the understanding of the basic principles of science rather than on the absorption of a plethora of facts. A structured approach in which physics leads into chemistry, which in turns leads into cosmology, geology, and biology, would seem preferable. The unifying thread is, of course, mathematics. Laboratories surveying the basic instruments of science and introducing the student to experimentation should complement the course work. Following the great discoveries of the past 50 years — in particle physics, in astrophysics, in geophysics, and in molecular biology — it is now possible, for the first time ever, to present science as a unitary body of knowledge that ranges in time from the Big Bang to the present, that has strong intellectual appeal, and that is highly relevant for the stabilization of a planet that is now at risk.

[**Cosponsors:** AAAS Sections H, Q, and Y; AAAS Southwestern and Rocky Mountain Division; AAAS Directorate for Education and Human Resources Programs.]

38-4. Science and the Media: Information Controls and Reporting of Science

Organized by: **Cristine Russell** *(Special Health Correspondent,* Washington Post, *Washington, DC),* **Carol L. Rogers** *(Graduate Fellow, Univ. of Maryland, College Park, MD),* and **Fred Jerome** *(Executive Vice President, Scientists' Institute for Public Information, New York, NY)*

8:30 am / Sun / 17 Feb **Sheraton / Rockville**

Presiding: Cristine Russell

Media Coverage of the Environmental Effects of Weapons Production
Keith Schneider *(National Correspondent,* New York Times, *Washington, DC)*

How Open Should Government Be?
John F. Ahearne *(Executive Director, Sigma Xi, Research Triangle Park, NC, and Chairman, U.S. Dept. of Energy Advisory Committee on Nuclear Facilities Safety)*

Dealing with the Press in Areas of Sensitive Science
Mary Joy Jameson *(Director of Public Affairs and Press Secretary, U.S. Dept. of Energy, Washington, DC)*

Public Access to Sensitive Information: A 20-year Perspective
Jane Kirtley *(Executive Director, The Reporters' Committee for Freedom of the Press, Washington, DC)*

Discussant:
Carol L. Rogers

Media coverage of science has raised new questions about the extent to which scientific information should be available to the public, especially in areas of public controversy. Over the past decade, there has been a series of incidents wherein government officials have attempted to prevent government scientists from communicating directly with the press in areas such as AIDS research, technologies associated with the Strategic Defense Initiative, and health or safety risks associated with radiation exposure. How widespread are these incidents? Do they reflect a broader public policy that is designed to limit public access to government information? How should reporters and scientists respond to information controls that inhibit public awareness of a new area of scientific controversy? This symposium will examine these issues in the context of a particular case, namely, the media coverage of environmental risks associated with nuclear weapons production facilities. The speakers include a journalist who "broke" the story, current and former government officials who will identify policy considerations that affect public access to government information, and the leader of an organization that works to broaden the rights of investigative journalists in promoting public access to information. The discussant will present an analysis of the issues.

[**Sponsors:** AAAS Section Y; AAAS Committee on Public Understanding of Science and Technology; National Association of Science Writers. **Cosponsors:** AAAS Sections T and X; AAAS

Committee on Scientific Freedom and Responsibility; AAAS Directorate for Education and Human Resources Programs.]

Technical Sessions

38T-1. Advocacy Journalism: Reporting on Sustainable Development

Organized by: **James Cornell** *(President, International Science Writers Association, and Smithsonian Institution Astrophysical Observatory, Cambridge, MA)* and **Tensie Whelan** *(Vice President for Conservation Information, National Audubon Society, New York, NY)*

2:30 pm / Mon / 18 Feb **Sheraton / Woodley**

Presiding: James Cornell

The Role of the Reporter in Environmental Issues
James Detjen *(Science Writer,* Philadelphia Inquirer, *Philadelphia, PA)*

Environmental Issues in the Caribbean Basin
Joy Rudder *(Reporter,* Caribbean Week, *Trinidad and Tobago)*

Hazardous Waste Dumping in Africa
Bunmi Makinwa *(Science Editor, Pan African News Agency, Dakar, Senegal)*

Conservation and Development in Costa Rica
Yanina Rovinski *(Writer, International Union for Conservation of Nature and Natural Resources, San José, Costa Rica)*

Temples or Tombs: Industry versus Environment
Darryl D'Monte *(Science Editor,* Times of India, *Bombay, India)*

Eastern European Perspectives on Sustainable Development
Helene Knorre *(Moscow Science Writers Association, Moscow, USSR)*

Population Pressure and the Press in East Africa
Josephine Mwasi *(Reporter, Kenya News Agency, Nairobi, Kenya)*

Environmental Journalism: Profession or Mission?
Manuel S. Satorre, Jr. *(President, Philippine Environmental Journalists, Inc., Manila, Philippines)*

Innocents Abroad: First World Reporters and Sustainable Development
Tensie Whelan

During the last decade, several major reports stressed the concept of "sustainable development" as a means of ameliorating the severe economic and environmental problems of developing nations. The resultant "sustainable development movement" coincided with the emergence of a new cadre of science and technology reporters in the Third World, typified by the 11-nation Asian Forum of Environmental Journalists. Generally young, well educated, professionally trained, and evangelistic, these journalists make no pretense to objectivity; rather, they proudly proclaim themselves public defenders of the environment. As one has written: "Environmental journalism is not a profession, it is a mission." Understandably, such advocacy is often in direct conflict with national policies, and reporters find themselves at odds with powerful political and economic forces and, ironically, even with old-line "development journalists," who urge direct and massive transfer of western technologies. This session will review international coverage of sustainable development and examine the role of journalists in the acceptance and adoption of this concept in several regions of the world. Advocacy in environmental reporting abroad will be compared with the American experience, where some journalists also have been accused of uncritical cheerleading for science and technology.

[**Sponsor:** AAAS Section Y. **Cosponsors:** AAAS Committee on Public Understanding of Science and Technology; AAAS Directorate for Education and Human Resources Programs.]

38T-2. Minority Mathematics and Science: Successful Programs at Community Colleges

Organized by: **Estrella M. Triana** *(Senior Program Associate, Directorate for Education and Human Resources Programs, AAAS, Washington, DC)* and **Eugenio Barrios** *(Acting Dean of Academic Affairs, Hostos Community College, Bronx, NY)*

2:30 pm / Sat / 16 Feb **Sheraton / Woodley**

Presiding: Eugenio Barrios

National Center for Academic Achievement and Transfer
Judith Eaton *(Vice President and Director, American Council of Education, National Center for Academic Achievement and Transfer, Washington, DC)*

The Minority Honors Training and Industrial Assistance Program
Isiah O. Sewell *(Minority Education Programs Coordinator, U.S. Dept. of Energy, Washington, DC)*

Minority Honors Program at Greenville Technical College
Judith H. Williams *(Minority Scholarship Program Recruiter, Greenville Technical College, Greenville, SC)* and Yvette Kinlaw *(Advisory Board Member for Greenville Minority Programs, Greenville Technical College, Greenville, SC)*

Hostos Community College Efforts to Increase Minorities in Science
Isaura Santiago Santiago *(President, Hostos Community College, Bronx, NY)*

Increasing Career Access Opportunities for Hispanics in Science and Technology
Henry Estrada *(Professor of Computer Science, Evergreen Valley College, San Jose, CA)*

Community colleges can be considered an important component for increasing mathematics and science education. Many two-year colleges have successfully provided white and minority students the opportunity to continue their studies in various areas, including science and mathematics, in preparation for entering the work force or for enrollment in four-year universities. This session will explore various programs and specifically address the elements that enhance the math and science opportunities of minority students.

[**Sponsor:** AAAS Directorate for Education and Human Resources Programs. **Cosponsors:** AAAS Sections A, H, and Q.]

Plan now to attend
AAAS☆92: Chicago
6–11 February 1992

38T-3. Satellite Delivery of Education: From Elementary School to the Working World

Organized by: **Patricia S. Curlin** *(Project Director, Public Understanding of Science and Technology, AAAS, Washington, DC)* and **Peter Lykos** *(Professor of Chemistry, Illinois Institute of Technology, Chicago, IL, and Science Consultant, National Technological Univ., Fort Collins, CO)*

2:30 pm / Mon / 18 Feb **Omni Shoreham/Embassy**

Presiding: Peter Lykos

Linking for Learning: OTA's Report on Distance Learning
Linda G. Roberts *(Senior Associate, Science, Education, and Transportation, Office of Technology Assessment, Washington, DC)*

Satellite-delivered Instructions at the High School Level
Linda K. DeGrand *(Chief Consultant, State of North Carolina Dept. of Public Instruction, Raleigh, NC)*

Potential Barriers to Satellite-delivered Distance Education
Smith L. Holt *(Dean, College of Arts and Science, Oklahoma State Univ., Stillwater, OK)*

Extraterrestrial Education: Not Science Fiction at All
Louis C. Nevins *(Professor, Instructional Media Center, California State Univ., Chico, CA)* and Charles F. Urbanowicz *(Professor, Instructional Media Center, California State Univ., Chico, CA)*

The National Technological University in the Service of the Engineering Community
Peter Lykos

Continuing Eduction Seminars by Satellite
Cyrelle Gerson *(Manager, Media Courses for Continuing Education, American Chemical Society, Washington, DC)*

The Jason Project: Using Satellites for Out-of-School Science Learning
Philip Parfitt *(Assistant Director of Public Programs, Museum of Science and Industry, Chicago, IL)*

Galaxy Classroom: A Vision for the Future
Norman Avrech *(Galaxy Classroom, Space Communications Group, Hughes Aircraft Co., Los Angeles, CA)*

Distance learning means transporting information, not people, to meet today's educational challenges. One-way video, two-way audio is being used — from the educational system to the working world — to share information across the United States in real time. Cost-effective technology is available to communicate with high-temperature superconductors or to bring forums on international environmental issues to a wider audience. But interactive video/satellite is a vastly underutilized technology. Why? What are the barriers to the use of this technology in the service of science? What impacts could it have on education in both formal and informal science settings? How can scientists and engineers take advantage of the new opportunities it offers? Who is involved in providing this educational delivery mechanism, and where might such efforts be increased?

This session will examine these questions and offer specific cases where this technology has been used successfully, including high school networks, professional enrichment, informal science education learning, and government/industry/educational conferences.

[**Sponsor:** AAAS Committee on Public Understanding of Science and Technology. **Cosponsors:** AAAS Section Y; AAAS Directorate for Education and Human Resources Programs.]



38T-4. Reform of Scope, Sequence, and Coordination (SS&C): A Progress Report

Organized by: **Marily DeWall** *(Assistant Executive Director, National Science Teachers Association, Washington, DC)*

2:30 pm / Fri / 15 Feb **Sheraton / Alexandria**

Presiding: Bonnie Brunkhorst *(Associate Director, Institute for Science Education, School of Education, California State Univ., San Bernadino, CA, and President, National Science Teachers Association)*

An Overview of NSTA's SS&C Project
Bill G. Aldridge *(Executive Director, National Science Teachers Association, Washington, DC)*

Implementation of SS&C in the Houston Independent School District
Linda W. Crow *(Assistant Professor, Baylor College of Medicine, Houston, TX)*

Implementation of SS&C in the State of California
Thomas Sachse *(Manager, Science Education, California Dept. of Education, Sacramento, CA)*

Implementation of SS&C in North Carolina
David Andrews *(Associate Professor, Univ. of North Carolina, Wilmington, NC)*

Implementation of SS&C in Iowa
John Pennick *(Professor of Science Education, Univ. of Iowa, Iowa City, IA)*

Implementation of SS&C in San Juan, Puerto Rico
Manuel Gómez *(Director, Resource Center for Science and Engineering, Univ. of Puerto Rico, Río Piedras, PR)*

Coordinating the Research and Development of SS&C
Russell Aiuto *(Director, Research and Development, National Science Teachers Association, Washington, DC)*

The National Science Teachers Association Scope, Sequence, and Coordination (SS&C) reform project, funded by the Department of Education and the National Science Foundation, addresses the restructuring of science courses in grades 7–12. The project was implemented on an experimental basis in selected schools in Texas and California in the fall of 1990. New field test sites are in North Carolina, Iowa, and San Juan, Puerto Rico. This session will address the various models, their challenges and successes, teacher retraining, and the results of the assessment effort that has taken place in the past year. Progress to date will be reported and examples of curriculum materials will be demonstrated.

[**Sponsor:** National Science Teachers Association. **Cosponsors:** AAAS Sections H and Q; AAAS Directorate for Education and Human Resources Programs.]

Workshops

38W-2. Progress in Public Understanding of Science

Organized by: **Sheila Grinell** *(Consultant for Science Exhibits and Museums, Teaneck, NJ)* and **Patricia Curlin** *(Project Director, Public Understanding of Science and Technology, AAAS, Washington, DC)*

8:30 am / Sun / 17 Feb **Sheraton / Woodley**

Presiding: Sheila Grinell

Creating the Culture of Science
Philip Morrison *(Professor of Physics, Emer., MIT, Cambridge, MA)*

Presiding: Michael Templeton *(Consultant in Science Learning, Portland, OR)*

The Audience for Science Communications: Getting Information at Home
John Riccobono *(Director, Center for Research in Education, Research Triangle Institute, Research Triangle Park, NC)*

The Audience for Science Communication: Knowledges in Context
Brian Wynne *(Director, Center for Science Studies and Science Policy, Univ. of Lancaster, Bailrigg, Lancaster, UK)*

The Audience for Science Communications: Setting a Gold Standard for Public Health Campaigns
Janine M. Jason *(Chief, Applied Communications Research and Evaluation, National AIDS Information and Education Program, Centers for Disease Control, Atlanta, GA)*

Discussant:
Jon D. Miller *(Director, Public Opinion Laboratory, Northern Illinois Univ., DeKalb, IL)*

Roundtable Discussion: The Art of Explanation, or Comparative Strategies for Making the Complex Clear

Presiding: Sharon Dunwoody *(Professor, Dept. of Journalism, Univ. of Wisconsin, Madison, WI)*

Panelists:
Tom Siegfried *(Science Editor,* Dallas Morning News, *Dallas, TX)*, Michael Spock *(Vice President, Field Museum of Natural History, Chicago, IL)*, Katherine E. Rowan *(Assistant Professor, Dept. of Communication, Purdue Univ., West Lafayette, IN)*, Libby Palmer *(Director, Operation Smart, Girls, Inc., New York, NY)*, and Jon Ward *(Producer, The Universe Group, Washington, DC)*

2:30 pm / Sun / 17 Feb **Sheraton / Woodley**

Presiding: Don E. Agostino *(Chair, Dept of Telecommunications, Indiana Univ., Bloomington, IN)*

Prospects for Assessment: Not Knowing, Needing to Know, and Wanting to Know
John M. Ziman *(Director, Science Policy Support Group, London, UK)*

Prospects for Assessment: Exploring a Variety of Approaches
Mark St. John *(President, Inverness Research Associates, Inverness, CA)*

Prospects for Assessment: Lessons from Applied Research
Valerie Crane *(President, Research Communications, Chestnut Hill, MA)*

Assessment Case Study: The Effects of SQUARE ONE TV upon Children's Problem-solving Behavior
Eve R. Hall *(Director of Research, Children's Television Workshop, New York, NY)*

Discussant:
Marcel LaFollette *(Center for International Science and Technology Policy, George Washington Univ., Washington, DC)*

Summary and discussion

Presiding: David Crippens *(Senior Vice President, Educational Enterprises, KCET, Los Angeles, CA)*

The public regularly receives messages about science from a variety of sources: news media and public television, magazines and movies, advertisers and employers, museums and zoos, scientific bodies, and others. How does this fragmented communication result in "public understanding of science?" What are we learning, through practice and research in various media endeavors, about science communications from the point of view of the end users — of society as a whole?

In this workshop, practitioners and researchers from a wide range of science communications media will address three themes: (1) ways to conceptualize the audience for nonschool science communications; (2) methods practitioners use for dealing with complexity; (3) and approaches to assessing the impact science media have on the public. The workshop will consist of a keynote talk, panel presentations, a roundtable discussion, and general discussion among all participant of workshop themes.

[**Sponsors:** AAAS Section Y; AAAS Committee on Public Understanding of Science and Technology; National Association of Science Writers. **Cosponsors:** AAAS Section T; AAAS Directorate for Education and Human Resources Programs.]

38W-3. Scientist-Teacher Partnerships in Middle School Science and Technology Education

Organized by: **Gerald Kulm** *(Professor, Dept. of Curriculum and Instruction, Texas A&M Univ., College Station, TX)*

8:30 am / Fri / 15 Feb **Sheraton / Woodley**

Speakers and topics to be announced

[**Sponsor:** AAAS Directorate for Education and Human Resources Programs.]

38W-4. Project 2061: What Can We Expect People to Learn About the Nature of Science?

Organized by: **Jo Ellen Roseman** *(Curriculum Director, AAAS, Washington, DC)*

8:30 am / Tue / 19 Feb **Sheraton / Rockville**

Presiding: Jo Ellen Roseman

See you at AAAS☆92: Chicago!

Panel Discussion
Jo Ellen Roseman, Andrew Ahlgren *(Project Associate Director, AAAS, Washington, DC)*, and Steven Kornguth *(Univ. of Wisconsin, Madison, WI)*

As an initial step in developing curriculum, Project 2061 teams are making "maps" of topics in *Science for All Americans (SFAA)*. Each map specifies the developmental sequence of ideas leading to a particular understanding recommended in *SFAA* for high school graduates. The mapping takes into account both the logical underpinnings of a topic and the psychological underpinnings — the ideas students bring to class and research about how kids learn. Educators at all levels have found the process to be difficult but revealing. Workshop participants will try this kind of mapping to get a sense of how it can inform curriculum development.

[**Sponsor:** AAAS Project 2061. **Cosponsors:** AAAS Section G; AAAS Directorate for Education and Human Resources Programs.]

39. Science and Technology Curricula

39-2. Assessment and Its Role in Curricular Reform

Organized by: **Thomas Sachse** *(Director, Science Education Unit, California State Department of Education, Sacramento, CA)*

2:30 pm / Sun / 17 Feb **Sheraton / Wilmington**

Presiding: Thomas Sachse

Assessment: A Policy Perspective
Richard P. Mills *(Commissioner of Education, Vermont State Department of Education, Montpelier, VT)*

Curriculum and Assessment: A View from California
Thomas Sachse

The Impact of Science Assessment on Classroom Practice
Nancy S. Cole *(Executive Vice President, Educational Testing Service, Princeton, NJ)*

State Initiatives in Assessing Science Instruction
Jane Armstrong *(Director of Policy Studies, Education Commission of the States, Denver, CO)*

Assessment in Mathematics
Mary Harley Kruter *(Project Director, Mathematical Sciences Education Board, Washington, DC)*

Assessment Implications of the New Science Curricula
Mary Budd Rowe *(Professor of Education, Stanford University, Stanford, CA)*

President Bush and the nation's governors agree that improving science, mathematics, and technology education is a central educational goal. What should the specific goals be for science and mathematics education? How can we work together to achieve them? How will we know when the goals have been achieved? Opinions on these questions may vary, but it is widely agreed that assessment plays a critical role in any reform. Presentations will look at classroom issues in assessment, the status of assessment of science and mathematics instruction in the states, and the implications within assessment for national curricular reform.

[**Sponsors:** AAAS Section Q; AAAS Directorate for Education and Human Resources Programs. **Cosponsor:** AAAS Section M.]

39-3. Learning Science and Mathematics: Constructivist Perspectives

Organized by: **Kenneth Tobin** *(Professor of Science Education, Florida State Univ., Tallahassee, FL)*

2:30 pm / Sat / 16 Feb **Sheraton / Wilmington**

Constructivist Perspectives
Ernest von Glasersfeld *(Professor Emer., Univ. of Massachusetts, Amherst, MA)*

Discussants:
Rodger Bybee *(Director, Biological Sciences Curriculum Study, Colorado Springs, CO)*, Jere Confrey *(Associate Professor of Mathematics Education, Cornell Univ., Ithaca, NY)*, Audrey B. Champagne *(Professor of Science Education, New York Univ., Albany, NY)*, Penny Gilmer *(Professor of Biochemistry, Florida State Univ., Tallahassee, FL)*, and Kenneth Tobin

For more than 100 years, the epistemology that has dominated thought and practice in science and science education has been positivism. However, in a dramatic paradigm shift, constructivism has become the dominant epistemology in educational research and curriculum development over the past 10 years. Within a constructivist framework, learning is defined as the construction of knowledge by individuals as sensory data are given meaning in terms of prior knowledge. This symposium reviews the roots of constructivism, compares it with other epistemologies, and looks at the implications of constructivism for the learning of science and mathematics. Discussants will cover curriculum and practice based on constructivist principles, critique constructivism, and examine constructivism as viewed by scientists and from science education research and teacher education.

[**Sponsors:** AAAS Section Q; AAAS Directorate for Education and Human Resources Programs. **Cosponsors:** AAAS Sections A and M; AAAS Committee on Science, Engineering, and Public Policy.]

39-4. Fulfilling the Promise: Biology Education in the Nation's Schools

Organized by: **Donna M. Gerardi** *(Commission on Life Sciences, National Research Council, Washington, DC)*

8:30 am / Sat / 16 Feb **Sheraton / Wilmington**

Presiding: Jane Butler Kahle *(Condit Professor of Science Education, Miami Univ., Oxford, OH)*

Fulfilling the Promise: Biology Education in the Nation's Schools
Timothy Goldsmith *(Chairman, Committee on High-School Biology Education, and Professor of Biology, Yale Univ., New Haven, CT)*

Discussants:
Jane Butler Kahle, Wilma Toney *(Manchester High School, Manchester, CT)*, Joseph McInerney *(1991 President, National Association of Biology Teachers, Colorado Springs, CO)*, Shirley M. Malcom *(Director, Directorate for Education and Human*

Resources Programs, AAAS, Washington, DC), and John A. Moore *(Dept. of Biology, Univ. of California, Riverside, CA)*

The National Research Council's Committee on High-School Biology Education recently completed a study on biology education at the K–12 level entitled "Fulfilling the Promise: Biology Education in the Nation's Schools." Supported by the Howard Hughes Medical Institute, the study was conducted by a committee of biologists, teachers, and science educators. Among issues considered by the committee were the continuum of science education from grades K–12; leadership in science education; textbooks; laboratories; tests and testing; teacher preparation and in-service; the role of the scientific community in K–12 science education; and the recruitment of students into science careers. Committee chairman Goldsmith and other members will describe the study's major conclusions and recommendations. Other panel members from the state and federal level will offer comments on how the scientific and education communities can best follow through on the recommendations of the report.

[**Sponsors:** AAAS Section Q; AAAS Directorate for Education and Human Resources Programs.]

39-5. Mathematics and Mathematics Education: Beyond Reports

Organized by: **Ronald G. Douglas** *(Vice Provost for Undergraduate Studies, State Univ. of New York, Stony Brook, NY),* **James A. Voytuk** *(Senior Staff Officer, National Research Council, Washington, DC),* and **Lawrence H. Cox** *(Director, Board on Mathematical Sciences, National Research Council, Washington, DC)*

8:30 am / Fri / 15 Feb **Sheraton / Wilmington**

High School Mathematics

Presiding: Alvin W. Trivelpiece *(Director, Oak Ridge National Laboratory, Oak Ridge, TN)*

Formulating and Implementing a National Plan
Alvin W. Trivelpiece

Leading Curriculum Reform in Mathematics: Changes in Practice and Content
Iris M. Carl *(Director of Mathematics, Houston Independent School District, Houston, TX, and President, National Council of Teachers of Mathematics, Reston, VA)*

What Does It Mean to Be Number One in Mathematics Education?
Lamar Alexander *(President, Univ. of Tennessee, Knoxville, TN)*

Minority Successes in Mathematics
Asa G. Hilliard III *(Fuller E. Callaway Professor of Urban Education, Georgia State Univ., Atlanta, GA)*

Mathematics Matters for All Students
Jackie B. Goldberg *(President, Los Angeles Board of Education, Los Angeles Unified School District, Los Angeles, CA)*

2:30 pm / Fri / 15 Feb **Sheraton / Wilmington**

College and University Mathematics

Presiding: Phillip A. Griffiths *(Provost and James B. Duke Professor of Mathematics, Duke Univ., Durham, NC)*

Revitalizing Undergraduate Mathematics
William E. Kirwan *(President, Univ. of Maryland, College Park, MD)*

Opening the Pipeline via Innovative Programs
Uri Treisman *(Director, Charles A. Dana Center for Mathematics and Science Education, Univ. of California, Berkeley, CA)*

The Changing Role of the Professor
John S. Toll *(President, Universities Research Association, Inc., Washington, DC, and Chancellor Emer. and Professor of Physics, Univ. of Maryland, College Park, MD)*

Moving Forward with the Recommendations of "Renewing U.S. Mathematics: A Plan for the 1990s"
Phillip A. Griffiths

A Reaction and Response from the Community
Michael Artin *(Norbert Weiner Professor of Mathematics, MIT, Cambridge, MA)*

The View from Washington
Erich Bloch *(Former Director, National Science Foundation, Washington, DC)*

During the 1980s, serious problems in mathematics and mathematics education were identified ranging from the schools to the colleges, up to and including the research enterprise. Reports describing the situation and pronouncing it grim include "A Nation at Risk," "Toward a Lean and Lively Calculus," "Renewing U.S. Mathematics: Critical Resource for the Future" (the David report), and several international comparison studies. The National Research Council established two boards, the Board on Mathematical Sciences and the Mathematical Sciences Education Board, partly in response to this. Since then, several studies have been conducted to understand what is wrong and to make recommendations on how to put it right. These include "Calculus for a New Century," "Everybody Counts," the final report of the Mathematical Sciences in the Year 2000 (MS 2000) project, the National Council of Teachers of Mathematics "Standards," and "Renewing U.S. Mathematics: A Plan for the 1990s," the five-year update of the first David report. Action in response to these studies has begun in many areas, but the real work lies ahead. What is happening and what will happen in the future could be of interest, both in terms of the depth and breadth of planning by the mathematics community and the impact the changes might have on other disciplines.

[**Sponsors:** AAAS Sections A and Q. **Cosponsors:** AAAS Section U; AAAS Directorate for Education and Human Resources Programs; Institute of Mathematical Statistics.]

39-6. NSF-supported Innovations in Undergraduate Education

Organized by: **Robert F. Watson** *(Director, Division of Undergraduate Science, Engineering, and Mathematics Education, National Science Foundation, Washington, DC)*

2:30 pm / Mon / 18 Feb **Sheraton / Rockville**

Presiding: Robert F. Watson

Comprehensive Regional Centers for Minorities
James M. Rosser *(President, California State Univ., Los Angeles, CA)*

Teaching a Mass-Market Dinosaur Course
Kevin Padian *(Professor of Paleontology, Univ. of California, Berkeley, CA)*

From Feasibility to a Focus on Laser Physics
John R. Brandenberger *(Professor of Physics, Lawrence Univ., Appleton, WI)*

An Integrated, First-Year Curriculum in Science, Engineering, and Mathematics: One Year's Experience
Jeffrey E. Froyd *(Professor of Electrical and Computer Engineering, Rose-Hulman Institute of Technology, Terre-Haute, IN)*

Calculus & Mathematica
J. Jerry Uhl, Jr. *(Professor of Mathematics, Univ. of Illinois, Urbana, IL)*

Undergraduate education is the essential bridge between the secondary schools and both professional careers and graduate education. Undergraduate education is a vital part of the U.S. scientific and technological enterprise because (1) it is the primary professional training for engineers and scientists and school science and math teachers and (2) it is the last formal exposure to science for the nonscience majors who may become future leaders and for all American citizens who will live in an increasingly technology-based society.

Many groups and leaders have identified pressing needs for improvement in the quality of undergraduate instruction. The NSF has responded by developing a coherent, Foundation-wide approach based on two major components: leadership and leveraged program support. The Division of Undergraduate Science, Education, and Mathematics Education within NSF's Directorate for Education and Human Resources is the focal point of this effort. NSF's plans and five exemplary projects aimed at strengthening undergraduate education in the areas of laboratories, curriculum, faculty enhancement, and career access will be presented.

[**Cosponsors:** AAAS Sections A, C, H, and Q; AAAS Southwestern and Rocky Mountain Division; AAAS Directorate for Education and Human Resources Programs.]

39-7. Science and Mathematics Curriculum Reform: How Do They Relate?

Organized by: **Robert L. Russell** *(Program Director, Informal Science Education Program, National Science Foundation, Washington, DC)*

8:30 am / Mon / 18 Feb **Sheraton / Rockville**

Presiding: Joan Leitzel *(Division Director, Materials Development, Research, and Informal Science Education, National Science Foundation, Washington, DC)*

Science Curriculum Reform as Related to Mathematics
F. James Rutherford *(Project Director, Project 2061, AAAS, Washington, DC)*

Mathematics Curriculum Reform as Related to Science
John A. Dossey *(Professor of Mathematics, Illinois State Univ., Normal, IL)*

Discussants:
Jaime Oaxaca *(Vice Chair, Coronado Communications, Rancho Palos Verdes, CA)*, Howard Goldberg *(Professor of Physics, Univ. of Chicago, Chicago, IL)*, and Iris M. Carl *(Director of Mathematics, Houston Independent School District, Houston, TX, and President, National Council of Teachers of Mathematics, Reston, VA)*

Major curriculum reforms in science and mathematics education (K–12) have been in progress throughout the 1980s and are continuing. These reforms have suggested major departures from past practices. However, the relationships of mathematics curricula to science curricula — and the converse — have not been explicitly addressed. The panel will (1) discuss and contrast the major philosophical foundations, approaches, and content of major reform efforts in science and mathematics curricula; and (2) discuss how mathematics and science instruction should be related and integrated at different levels.

[**Sponsor:** AAAS Section Q. **Cosponsors:** AAAS Sections A and H; AAAS Directorate for Education and Human Resources Programs.]

39-8. The Progress and Impact of Project 2061

Organized by: **F. James Rutherford** *(Chief Education Officer and Director, Project 2061, AAAS, Washington, DC)*

2:30 pm / Mon / 18 Feb **Sheraton / Wilmington**

Presiding: F. James Rutherford

The Response to *Science for All Americans*
F. James Rutherford

The Impact of Project 2061 in California
Tom Sachse *(Director, Science Education Unit, California Dept. of Education, Sacramento, CA)*

The Design of Phase II of Project 2061
F. James Rutherford

The Process of Creating the Curriculum of the Future
Clara Tolbert *(Pennsylvania School District, Bluebell, PA)*

Working with Teachers in Phase II
Steven Kornguth *(Univ. of Wisconsin, Madison, WI)*

In 1989, the first phase of Project 2061 — a comprehensive, long-term undertaking of the AAAS designed to help bring about the complete transformation of the American school system — was completed with the publication of *Science for All Americans* and the reports of five scientific panels. The second phase of the project is now well under way. With the help of scientists, mathematicians, engineers, cognitive scientists, and other specialists, teams of K–12 teachers are creating an array of curriculum models for schools to use in meeting the standards recommended in the Phase I report.

This symposium will describe the national response to the Phase I reports and focus on the reform of science education in California as a particular example. It will then provide an overview of the strategy and design of Phase II and describe the nature of the current work as seen by a team member and by a participating scientist.

[**Sponsor:** AAAS Project 2061. **Cosponsors:** AAAS Section Q; AAAS Southwestern and Rocky Mountain Division; AAAS Directorate for Education and Human Resources Programs.]



39-9. Science and Mathematics Education in the United States: A Report from the Longitudinal Study of American Youth

Organized by: **Jon D. Miller** *(Director, Longitudinal Study of American Youth, Northern Illinois Univ., DeKalb, IL)*

2:30 pm / Sat / 16 Feb **Sheraton / Colorado**

Presiding: Luther Williams *(Assistant Director, National Science Foundation, Washington, DC)*

Mathematics Achievement in Middle School and High School
Alan Osborne *(Professor of Mathematics Education, Ohio State Univ., Columbus, OH)* and Jon D. Miller

What Happened to the Gender Difference in Mathematics?
Elizabeth Fennema *(Professor, Dept. of Curriculum and Instruction, Univ. of Wisconsin, Madison, WI)* and Robert W. Suchner *(Associate Director for Testing and Measurement, Longitudinal Study of American Youth, Northern Illinois Univ., DeKalb, IL)*

Science Achievement in Middle School and High School
Thomas B. Hoffer *(Associate Director for Operations, Longitudinal Study of American Youth, Northern Illinois Univ., DeKalb, IL)* and Shelagh Gallagher *(Director of Research, Illinois Mathematics & Science Academy, Aurora, IL)*

Does Inquiry-based Science Instruction Make a Difference?
Arthur Reynolds *(Postdoctoral Fellow, Longitudinal Study of American Youth, Northern Illinois Univ., DeKalb, IL)*, Robert Suchner, and Thomas B. Hoffer

Tomorrow's Scientists, Mathematicians, and Engineers
Thomas Hilton *(Senior Research Scientist, Educational Testing Service, Princeton, NJ)*, Jon D. Miller, and Karen Brown *(Manager of Field Services, Longitudinal Study of American Youth, Northern Illinois Univ., DeKalb, IL)*

Discussants:
F. James Rutherford *(Chief Education Officer, AAAS, Washington, DC)* and Andrew Porter *(Director, Wisconsin Educational Research and Development Center, Univ. of Wisconsin, Madison, WI)*

For the last four years, the Longitudinal Study of American Youth (LSAY) has been tracking the science and mathematics achievement of 7,000 middle school and high school students in the United States. Osborne and Miller will report on the levels and relative gains in mathematics achievement during the middle school and high school years utilizing a series of developmental models. Fennema and Suchner will use the same LSAY data base to examine the factors that have contributed to the virtual elimination of gender differences in mathematics achievement. Hoffer and Gallagher will report on the levels and relative gains in science achievement during the middle school and high school years. Reynolds, Suchner, and Hoffer will present the results of a comparative study of the LSAY national probability sample and a purposive sample of schools with a history or inquiry-based science instruction in the elementary and middle school years. Hilton, Miller, and Brown will discuss a set of models to predict student preference for a career in science, mathematics, or engineering, relating curriculum, achievement, and family and peer influences to the decision to pursue a career in science, mathematics, or engineering.

[**Cosponsors:** AAAS Sections A, H, K, and Q; AAAS Committee on Public Understanding of Science and Technology; AAAS Directorate for Education and Human Resources Programs.]

Technical Session

39T-1. Calculus Reform: Some Examples

Organized by: **Thomas W. Tucker** *(Professor, Dept. of Mathematics, Colgate Univ., Hamilton, NY)*

8:30 am / Sat / 16 Feb **Sheraton / Woodley**

Presiding: Thomas W. Tucker

Calculus in Context: The Five Colleges Project
James J. Callahan *(Professor, Dept. of Mathematics, Smith College, Northampton, MA)*

The New Mexico State Project: A Student Research Problem Approach
Edward D. Gaughan *(Professor, Dept. of Mathematical Sciences, New Mexico State Univ., Las Cruces, NM)*

The Harvard Core Calculus Project
Deborah Hughes Hallet *(Senior Preceptor, Dept. of Mathematics, Harvard Univ., Cambridge, MA)*

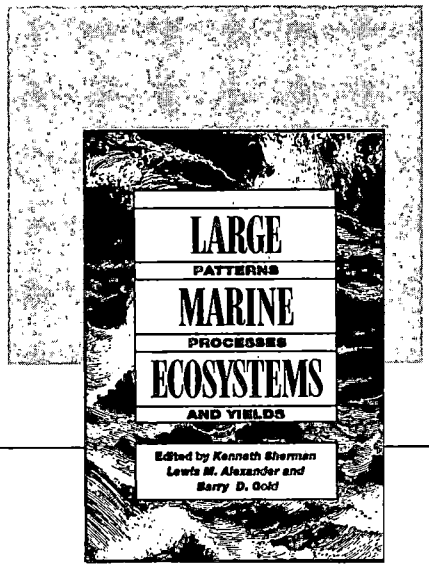
Project CALC
David A. Smith *(Associate Professor, Dept. of Mathematics, Duke Univ., Durham, NC)*

Calculus and Mathematica
J. Jerry Uhl, Jr. *(Professor, Dept. of Mathematics, Univ. of Illinois, Urbana, IL)*

Over the last five years, the mathematical community has been actively involved in rethinking what to teach in undergraduate calculus classes and how to teach it. This effort has been spurred by conferences such as "Calculus for a New Century," held in October 1987 at the National Academy of Sciences, and by a major curricular initiative in calculus begun by the National Science Foundation in 1988. The result has been a blossoming of calculus projects whose courses bear little resemblance to the standard calculus course: computer laboratories, "research" projects, group work, and essay questions — much more of a graphical and numerical viewpoint, with less algebraic manipulation.

The organizer of this session chairs a committee for the Mathematical Association of America (MAA) that has prepared a volume surveying calculus reform and will give an overview from the perspective of that book. The five speakers, four from featured projects in the MAA book, represent a range of institutions and pedagogical methods and illustrate the diversity in calculus reform.

[**Sponsor:** AAAS Section A.]



Large Marine Ecosystems

Patterns, Processes, and Yields

Kenneth Sherman, Lewis Alexander, and Barry Gold, editors

1990; 247 pp.; Softcover;
ISBN #0-87168-384-9
(indexed and illustrated)
#90-30S; $34.95 (AAAS members $27.95)

Large marine ecosystems (LMEs) — the relatively narrow ocean zones that produce nearly 95% of the world's useable marine biomass — are becoming increasingly stressed by both natural and anthropogenic changes, arousing major international concern about potentially negative ecologic and economic effects.

This volume, from a AAAS symposium, deals with the projected impacts of global changes on ocean productivity, and provides scientific, geographic, socioeconomic, and legal arguments for managing LMEs as multinational units, in order to sustain biomass yields of major coastal regions.

A useful book for conservationists and natural resource policymakers.

Contents:

I. Perturbations and Yields of Large Marine Ecosystems

The Weddell Sea: A High Polar Ecosystem — *G. Hempel*

Environmental Influence on Recruitment and Biomass Yields in the Norwegian Sea Ecosystem — *B. Ellertsen, P. Fossum, P. Solemdal, S. Sundby, and S. Tilseth*

Fluctuation in the Cod Biomass of the West Greenland Sea Ecosystem in Relation to Climate— *H. Hovgaard and E. Buch*

The Caribbean Sea: A Large Marine Ecosystem in Crisis — *W. J. Richards and J. A. Bohnsack*

Productivity and Fisheries Potential of the Banda Sea Ecosystem — *J. J. Zijlstra and M. A. Baars*

II. Biodynamics of Large Marine Ecosystems

Biodynamics of the Sea: Preliminary Observations on High Dimensionality and the Effect of Physics on Predator-Prey Interrelationships — *B. J. Rothschild and T. R. Osborn*

Physical-Optical-Biological Scales Relevant to Recruitment in Large Marine Ecosystems — *T. D. Dickey*

Direct Simulation of the Effect of Turbulence on Planktonic Contact Rates — *T. Osborn, H. Yamazaki, and K. Squires*

Application of Molecular Techniques to the Study of Marine Recruitment Problems — *D. A. Powers, F. W. Allendorf, and T. Chen*

Application of Image Analysis in Demographic Studies of Marine Zooplankton in Large Marine Ecosystems — *M. S. Berman*

Growth, Survival, and Recruitment in Large Marine Ecosystems — *G. C. Laurence*

Perspectives on Larval Fish Ecology and Recruitment Processes: Probing the Scales of Relationships — *C. T. Taggart and K. T. Frank*

III. Theory and Management of Large Marine Ecosystems

Scaling Pattern and Process in Marine Ecosystems — *R. E. Ricklefs*

Physical and Biological Scales and the Modelling of Predator-Prey Interactions in Large Marine Ecosystems — *S. A. Levin*

Biomass Potential of Large Marine Ecosystems: A Systems Approach — *N. J. Bax and T. Laevastu*

Productivity, Perturbations, and Options for Biomass Yields in Large Marine Ecosystems — *K. Sherman*

Geographic Perspectives in the Management of Large Marine Ecosystems — *L. M. Alexander*

Interrelationships of Law in the Management of Large Marine Ecosystems — *M. H. Belsky*

Other books in the series:

Variability and Management of Large Marine Ecosystems
Kenneth Sherman and Lewis M. Alexander, editors, 1986

Biomass Yields and Geography of Large Marine Ecosystems
Kenneth Sherman and Lewis M. Alexander, editors, 1989
Available from Westview Press, Boulder, Colorado.

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American Association for the Advancement of Science



Business Meetings

Board of Directors

Closed Business Meetings

Thursday, 14 February, 8:30 am–5:00 pm, Nathan Hale Room, Sheraton Washington. Open only to AAAS Board members, invited AAAS staff, and invited guests.

Committee on Council Affairs

Open Hearing on Resolutions

The Committee on Council Affairs, which serves as the steering committee of the AAAS Council, will hold an open hearing from **2:30 pm to 4:00 pm, Sunday, 17 February, Idaho Room, Sheraton Washington,** to give interested persons an opportunity to speak for or against resolutions or proposals that have been duly submitted (at least 60 days in advance) to the executive officer for possible presentation to the Council. Copies of such resolutions and proposals may be inspected in the AAAS Headquarters Office in the Sheraton and will be available at the open hearing.

Closed Business Meeting

At a closed meeting immediately following the hearing, the committee will consider, for possible inclusion in the Council agenda, any late resolutions or proposals delivered to the executive officer in advance of the hearing, provided they deal with urgent matters and are accompanied by a written explanation of why submission was not made on or before the 60th day prior to the meeting of the Council. The committee will also review and take appropriate action on requests from persons who wish to address the Council on particular agenda items. Such requests must be delivered to the executive officer, Richard S. Nicholson, or to the committee chairman, who is president-elect Leon M. Lederman, before the hearing.

Council

Open Business Meeting

The Council, which establishes the general policies governing all programs of the Association, will hold its annual meeting from **8:00 am to 12 noon, Monday, 18 February, Delaware Suite, Sheraton Washington.** The session will be open to observers. Principal items of business are the presentation of reports from other officers and committees, the election of new affiliates and AAAS Fellows, and consideration of proposals and resolutions. Summaries of the Council meeting agenda will be available at the AAAS Information Desk, Atrium, Sheraton. Copies of the full agenda may be inspected in the AAAS Headquarters Office.

Committees/Directorates

AAAS-ABA National Conference of Lawyers and Scientists: Sunday, 17 February, 8:30 am–5:00 pm, Shoreham, Caucus Room.

Opportunities in Science: Closed meeting, Wednesday, 13 February, 9:00 am–5:00 pm, AAAS Headquarters Bldg., 1333 H Street, NW, 9th floor Conference Room.

Education and Human Resources Programs—Association for Puerto Ricans in Science and Engineering: Saturday, 16 February, 12 noon–2:00 pm, Shoreham, Forum Room.

Minority Women in Science: Sunday, 17 February, 6:00–8:00 pm, Sheraton, Colorado Room.

Scientific Freedom and Responsibility: Saturday, 16 February, 8:30 am–5:00 pm, Shoreham, Council Room.

Affiliates

Foundation for Science and the Handicapped: Friday, 15 February, 6:00–8:00 pm, Sheraton, Kansas Room.

National Association of Academies of Science: Saturday, 16 February, 5:00–6:00 pm, Sheraton, Ethan Allen.

Sections

Section A—Mathematics
Saturday, 16 February, 6:00–8:00 pm, Shoreham, Presidential Room.
Chair: James W. Hamming *(Naval Postgraduate School)*; Chair-Elect: Hirsch Cohen *(Alfred P. Sloan Foundation)*; Secretary: Warren Page *(Dept. of Mathematics, New York City Technical College, CUNY, 300 Jay Street, Brooklyn, NY 11201 718/643-2470)*.

Section B—Physics
Friday, 15 February, 6:00–8:00 pm, Shoreham, Council Room.
Chair: To be appointed; Chair-Elect: James S. Langer *(Univ. of California)*; Secretary: Rolf M. Sinclair *(National Science Foundation, 1800 G Street, N.W., Washington, DC, 202/357-7997)*.

Section Business Meetings Locator Chart			
Location	Fri-15	Sat-16	Sun-17
OS/Cabinet		N	
OS/Caucus		E*, K	
OS/Chairman's	L	C	
OS/Conference 763	D	T*	
OS/Conference 863	W	R	
OS/Council	B	P	
OS/Forum			J*
OS/Presidential		A	S*
SW/Colorado		Y	
SW/Idaho		G	
SW/Kansas		O	
SW/Vermont	M	H	
SW/Wisconsin	Q	X	
SW/Woodley	U		

Business meetings marked with an asterisk (*) run from 12 noon to 2:00 pm; all others run from 6:00 to 8:00 pm.

Section C—Chemistry
Saturday, 16 February, 6:00–8:00 pm, Shoreham, Chairman's Room.
Chair: George S. Hammond *(North Garden, VA);* Chair-Elect: Ernest L. Eliel *(Univ. of North Carolina);* Secretary: Blaine C. McKusick *(1212 Bruce Road, Carrcroft, Wilmington, DE 19803, 302/762-1681).*

Section D—Astronomy
Friday, 15 February, 6:00–8:00 pm, Shoreham, Conference Room 763 (Truman).
Chair: Raymond E. White *(Univ. of Arizona);* Chair-Elect: Catherine A. Pilachowski *(Naval Optical Astronomy Observatory);* Secretary: Nancy Houk *(Dept. of Astronomy, 1041 Dennison Building, Univ. of Michigan, Ann Arbor, MI 48109-1090, 313/764-3436).*

Section E—Geology and Geography
Saturday, 16 February, 12 noon–2:00 pm, Shoreham, Caucus Room.
Chair: David R. Stoddart *(Univ. of California);* Chair-Elect: Gordon P. Eaton *(Iowa State Univ.);* Secretary: Dana Isherwood *(Lawrence Livermore National Lab., P.O. Box 808, L-1, Livermore, CA 94550, 415/422-6496).*

Section G—Biological Sciences
Saturday, 16 February, 6:00–8:00 pm, Sheraton, Idaho Room.
Chair: Eloise E. Clark *(Bowling Green State Univ.);* Chair-Elect: Jean Paul Revel *(California Inst. of Technology);* Secretary: Judith P. Grassle *(Marine Biological Lab., Woods Hole, MA 02543, 617/548-3705, ext. 263).*

Section H—Anthropology
Saturday, 16 February, 6:00–8:00 pm, Sheraton, Vermont Room.
Chair: Laura Nader *(Univ. of California);* Chair-Elect: Patty Jo Watson *(Washington Univ.);* Secretary: Anna C. Roosevelt *(c/o Weld, 28 Fayerweather St., Cambridge, MA, 617/868-5784).*

Section J—Psychology
Sunday, 17 February, 12 noon–2:00 pm, Shoreham, Forum Room.
Chair: George Sperling *(New York Univ.);* Chair-Elect: Mortimer Mishkin *(National Inst. of Mental Health);* Secretary: William N. Dember *(Dept. of Psychology, ML #376, Univ. of Cincinnati, OH 54221, 513/556-5537).*

Section K—Social, Economic, and Political Sciences
Saturday, 16 February, 6:00–8:00 pm, Shoreham, Caucus Room.
Chair: Harriet Zuckerman *(Columbia Univ.);* Chair-Elect: Marc Nerlove *(Univ. of Pennsylvania);* Secretary: William R. Freudenburg *(Dept. of Rural Sociology, Univ. of Wisconsin, 1450 Linden Dr., Room 350, Madison, WI 53706, 608/263-4893).*

Section L—History and Philosophy of Science
Friday, 15 February, 6:00–8:00 pm, Shoreham, Chairman's Room.
Chair: Edwin T. Layton, Jr. *(Univ. of Minnesota);* Chair-Elect: Kenneth F. Schaffner *(Univ. of Pittsburgh);* Secretary: Edward Manier *(Dept. of Philosophy, Univ. of Notre Dame, Notre Dame, IN 46556, 219/239-6520).*

Section M—Engineering
Friday, 15 February, 6:00–8:00 pm, Sheraton, Vermont Room.
Chair: Andrew P. Sage *(George Mason Univ.);* Chair-Elect: Hans Mark *(Austin, TX);* Secretary: W. Edward Lear *(5900 Southwest 35th Way, Gainesville, FL 32608, 904/376-8882).*

Section N—Medical Sciences
Saturday, 16 February, 6:00–8:00 pm, Shoreham, Cabinet Room.
Chair: Victor A. McKusick *(Johns Hopkins Hospital);* Chair-Elect: Henry Blackburn *(Univ. of Minnesota);* Secretary: Lewis H. Kuller *(Univ of Pittsburgh, GSPH, A526 Crabtree Hall, 130 DeSoto St., Pittsburgh, PA 15261, 412/624-3054).*

Section O—Agriculture
Saturday, 16 February, 6:00–8:00 pm, Sheraton, Kansas Room.
Chair: Robert G. Cast *(Michigan State Univ.);* Chair-Elect: Donald N. Duvick *(Pioneer Hi-Bred International, Inc.);* Secretary: Kenneth Frey *(Dept. of Agronomy, Iowa State Univ., Ames, IA 50010, 515/294-7607).*

Section P—Industrial Science
Saturday, 16 February, 6:00–8:00 pm, Shoreham, Council Room.
Chair: Charles S. Tuesday *(General Motors Research Lab.);* Chair-Elect: Frank X. Werber *(USDA-ARS-NPS);* Secretary: Robert L. Stern *(Industrial Research Inst., 1550 M Street, NW, Washington, DC 20005, 202/872-6355).*

Section Q—Education
Friday, 15 February, 6:00–8:00 pm, Sheraton, Wisconsin Room.
Chair: Jane Butler Kahle *(Miami Univ.);* Chair-Elect: Audrey B. Champagne *(Washington, DC);* Secretary: Ann C. Howe *(2311 Benjamin Building, Univ. of Maryland, College Park, MD 20742-1175, 301/454-7346).*

Section R—Dentistry
Saturday, 16 February, 6:00–8:00 pm, Shoreham, Conference Room 863 (Carter)
Chair: William H. Bowen *(Univ. of Rochester);* Chair-Elect: Ian C. Mackenzie *(Univ. of Texas Dental Branch);* Secretary: Marie U. Nylen *(7209 Honeywell La., Bethesda, MD 20814, 301/657-8933).*

Section S—Pharmaceutical Sciences
Sunday, 17 February, 12 noon–2:00 pm, Shoreham, Presidential Room.
Chair: Philip S. Portoghese *(Univ. of Minnesota);* Chair-Elect: William O. Foye *(Massachusetts College of Pharmacy and Allied Health);* Secretary: Betty-ann Hoener *(School of Pharmacy, Univ. of California, San Francisco, CA 94143-0446, 415/476-2543).*

Section T—Information, Computing, and Communication
Saturday, 16 February, 12 noon–2:00 pm, Shoreham, Conference Room 763 (Truman).
Chair: Linda C. Smith *(Univ. of Illinois);* Chair-Elect: Gerard Salton *(Cornell Univ.);* Secretary: Elliot R. Siegel *(National Library of Medicine, 8600 Rockville Pike, Bethesda, MD 20894, 301/496-8834).*

Section U—Statistics
Friday, 15 February, 6:00–8:00 pm, Sheraton, Woodley Room.
Chair: Theodore W. Anderson *(Stanford Univ.);* Chair-Elect: John Neter *(Univ. of Georgia);* Secretary: Joan R. Rosenblatt *(Center for Applied Mathematics, National Institute of Standards and Technology, Admin. A438, Gaithersburg, MD 20899, 301/975-2733).*

Section W—Atmospheric and Hydrospheric Sciences
Friday, 15 February, 6:00–8:00 pm, Shoreham, Conference Room 863 (Carter).
Chair: Gerald R. North *(Texas A&M Univ.);* Chair-Elect: Warren M. Washington *(National Center for Atmospheric Research);* Secretary: William H. Beasley *(Center for Analysis and Prediction of Storms, Univ. of Oklahoma, 401 E. Boyd, Norman, OK 73019-0515, 405/325-3041).*

Section X—Societal Impacts of Science and Engineering
Saturday, 16 February, 6:00–8:00 pm, Sheraton, Wisconsin Room.
Chair: Elena O. Nightingale *(Carnegie Corp. of New York);* Chair-Elect: Gretchen S. Kolsrud *(Office of Technology Assessment);* Secretary: Rosemary Chalk *(COSEPUP-NAS 182, National Academy of Sciences, 2101 Constitution Ave., N.W. Washington, DC 20418).*

Section Y—General Interest in Science and Engineering
Saturday, 16 February, 6:00–8:00 pm, Sheraton, Colorado Room.
Chair: George W. Tressel *(Potomac, MD);* Chair-Elect: Frederick Seitz *(Rockefekker Univ.);* Secretary: James M. McCullough *(National Science Foundation, 1800 G Street, N.W., Room 425, Washington, DC 20550, 202/357-9531).*

Open Forums

Directorate for Science and Policy Programs
Saturday, 16 February, 12 noon–1:00 pm, Sheraton, Colorado Room.
Everything you ever wanted to know about the AAAS Science and Engineering Fellowship Program: Panel discussion with former fellows. Refreshments available.

Committee on Science, Arms Control, and National Security
Monday, 18 February, 11:30 am–12:30 pm, Sheraton, Vermont Room.
Open discussion of issues on arms control and national security as they concern the scientific community.

Make an Impression at AAAS☆92: Chicago

If your organization provides publications, products, or services that would be of interest to AAAS members, or if you would like to publicize your latest advances in science and technology before an international audience, you should plan on exhibiting at **AAAS★92,** the next AAAS Annual Meeting, 6-11 February 1992, in Chicago.

The AAAS Annual Meeting serves as an important public forum at which registrants share ideas and information with each other and (through extensive press coverage) with their colleagues around the world.

By exhibiting, you can meet face to face with many of the 5,000+ attendees—scientists, educators, and researchers from virtually every field of scientific inquiry, including biological and medical sciences, physical sciences, social sciences, technology, and science policy.

You can develop new customers or members, give demonstrations, introduce new products or services, publicize your successes, recruit qualified personnel, increase name recognition, and demonstrate your organization's commitment to the cause of advancing science.

Organizations that should exhibit include publishers of books or journals, computer software and hardware companies, scientific associations, government agencies, scientific equipment manufacturers, on-line information services, and corporations with scientific interests.

Save $100 per booth when you reserve your space before 1 April 1991. To receive a special advance notice by mail, just leave your business card with the attendant at the Exhibit Registration desk. Or call Stacy Weinberg (after the Meeting) at 202-326-6462.

American Association for the Advancement of Science

Science Books & Films presents the ...

SB&F Science Film Festival

Atrium Meeting Room No. 1
Sheraton Washington Hotel
Washington, DC
Coordinated by Maria Sosa
Editor, *SB&F*

The *SB&F* Science Film Festival presents a great collection of natural and social science videos for all ages. Come and see programs on physics, biomedical sciences, AIDS, environmental science, anthropology, biology, and much more. Admission is free, and the Festival is open to both Meeting registrants and to the public. Classes accompanied by responsible supervisors are welcome. Young people age 12 and younger must be accompanied by an adult.

Due to time limitations, each program will be shown only once; please consult the listing on the following pages for dates and times of specific programs.

The starting and ending times for each day are as follows:

Friday, 15 February ..... 10:00 am–4:25 pm
Saturday, 16 February ..... 10:00 am–4:25 pm
Sunday, 17 February ..... 10:00 am–4:25 pm
Monday, 18 February .....10:00 am–4:30 pm

The suggested audience level(s) for each video is indicated by the letters in square brackets at the end of the program's citation, as follows:

E - Grades 1 through 6
I - Grades 7 through 9
H - Grades 10 through 12
C - First two years of college
P - Advanced undergraduate, graduate, and professional
T - Teaching professional
G - General adult audience

Information about the purchase, rental, or screening of all videos is available through the distributor listed after the title. Addresses are given at the end of this schedule. Please note that prices quoted are for the VHS format and are provided for viewer reference only. Many of the programs are available in other formats, such as 16 mm film or 3/4-inch video. Descriptions are excerpted from comments supplied by reviewers for *Science Books & Films,* the critical book and film review journal of the American Association for the Advancement of Science. The views and opinions stated or implied in the films and/or in the reviews do not necessarily reflect those of the AAAS.

Friday, 15 February

10:00 am Why Can't I Fly Like a Bird

Coronet/MTI Film & Video, 1989, color, 13 min., $220.00. [E]

Why do birds fly? Why do turtles have a shell? Why do skunks smell? Why do we breathe? This production provides simple answers to these and other questions commonly asked by young children. In answering these questions, the film looks at animals on the land and in the water and examines the difference between fish and mammals such as seals, whales, and porpoises. Though it packs a lot of information into a short time span, the use of a delightful cartoon character makes it all fun.

10:15 am Growing, Growing

Churchill Films, 1989, color, 11 min., $160.00. [E]

Topics covered in this delightful and superb film include plant parts, what plants need to grow, the role and diversity of seeds, and how plants change with the seasons. This special film teaches in an open-ended context that makes possible further explorations by students and teachers. The science concepts introduced are expressed in a clear, interesting, and accurate matter that can be integrated into art and language arts activities in a natural way.

10:30 am Push and Pull: Simple Machines at Work

Rainbow Educational Video, Inc., 1990, color, 20 min., $89.00. [E]

Using examples relevant to the lives of young students, this video successfully introduces the concepts of work and simple machines to students in the primary grades. The real-life examples include playground equipment and toys, which help to make the learning fun.

10:55 am Life on Ice

Benchmark Films, Inc., 1989, color, 30 min., $535.00. [E,I,H,C,G]

White and various shades of blue, the predominant colors of this excellent film, help set the appropriate mood for the environment portrayed—the icy Arctic Ocean. The theme is the Arctic food chain, developed by focusing on the lifestyles and interactions of a variety of organisms. The outstanding underwater photography combines with the straightforward narration and the sparse, ethereal music to create a dramatic but realistic texture.

11:30 am Volcano Scapes 3: Living on the Edge!

Tropical Visions Video, Inc., 1990, color, 56 min., $39.95. [E,I,H,C,G]

This timely and stunning video documents the recent activity of Kilauea, the world's most active volcano. The makers of this video have captured the devastation and splendor of Pele's most destructive eruption in this century as the beautiful coastal community of Kalapana is enveloped in the fiery flow.

12:30 pm The Immune System: Your Magic Doctor

Barr Films, 1988, color, 20 min., $335.00. [I,H]

This excellent and comprehensive project fully and successfully explains the actual workings of the cells—a complex and difficult task where the immune system is concerned. It accurately portrays the roles of macrophages, B-cells and supressor cells, killer and helper T-cells, and the communication between these cells in times of health and disease.

12:55 pm Women in Science: Door to the Future

Agency for Instructional Technology, 1989, color, 30 min., $180.00. [I,H,T]

One program from a seven-part series designed to encourage young women to pursue careers in science, this video provides a realistic examination of the prerequisites for a career in science, prerequisites that have historically been less available to girls than to boys during the crucial high school years.

1:30 pm Greenhouse Crisis: The American Response

Union of Concerned Scientists, 1989, color, 11 min., $20.00. [I,H,C,G]

This brief video provides a useful introduction to the greenhouse effect and suggests some methods of ameliorating its potential dangers. The well-produced presentation provides a positive message and urges viewers to stop procrastinating and do something about the problem.

1:45 pm Clouded Land

Intermedia Arts, 1989, color, 26 min., $80.00. [H,G]

In a very balanced presentation of the issues surrounding the attempt by the United States government to redress the loss of Indian reservation land, this video focuses on important cultural similarities and differences between those Chippewa affiliated with the White Earth Reservation in Minnesota and their non-Indian farming neighbors. The technique of allowing the individuals involved in the dispute to speak for themselves is employed very effectively.

2:15 pm The Frontier of Biomedicine

Films for the Humanities, Inc., 1990, color, 27 min., $149.00. [H,C,G]

This film explores several fascinating areas of marine biological research including the importance of the squid in nerve research and the eye of the horseshoe crab in understanding vision. The importance of screening new compounds in the search for cancer toxins is emphasized. The film should stimulate interest in scientific research among students.

2:45 pm Chico Mendes: Voice of the Amazon

The Cinema Guild, 1990, color, 60 min., $295.00. [H,C,G]

Serious conservationists should see and promote the showing of this illuminating film. The photography of the rain forest is outstanding, while the message conveyed will inform and stimulate environmental activists worldwide. The production is a memorable and well-deserved tribute to Chico Mendes, the Amazon's "voice of reason," who successfully organized worldwide opposition to ongoing activities that eventually led to the creation of Brazil's first extractive reserve in June 1988. Six months later he was murdered.

3:45 pm Finding Our Way: Men Talk About Their Sexuality

New Day Films, 1989, 38 min., color, $295.00. [C,P,G]

This documentary features a weekend-long discussion of men's sexuality by 12 participants ranging in age from 27 to 71. The language is adult and candid, but should not present a problem for high school aged viewers and above. The viewer learns not only that men can openly discuss their sexuality, but that widely held stereotypes may not be valid.

Saturday, 16 February

10:00 am Backyard Bugs

National Geographic Society Educational Services, 1990, color, 15 min., $69.95. [E,I]

This video emphasizes common names of several insects found around a house or garden using a musical format that is sure to be impressive from a child's point of view. There are several excellent close-up sequences of various insects, and the process of metamorphosis is clearly shown.

10:15 am Just Like Anyone Else: Living with Disabilities

Human Relations Media, 1989, color, 30 min., $185.00. [I,H,G]

This excellent video meets its objective of promoting an understanding of disabled teens. NBC News correspondent Bill Schechner introduces vignettes about five disabled teenagers who describe the ways they cope with deafness, cerebral palsy, neurofibromatosis, a brother's autism, and spinal cord injury. The issues of communication with parents, sibling relationships, friendships, and public attitudes are addressed with great insight and in a caring manner.

10:45 am Icewalk: How Fragile These Frozen Seas

PBS Video, 1990, color, 24 min., $39.95. [I,H,G]

This video, the first in the *Icewalk* series, invites students and teachers to accompany an international expedition on its environmental research trek to the North Pole. Viewers experience the frigid windchill temperatures, screaming winds, and frostbite firsthand as the explorers make their way across the frozen terrain collecting scientific data about our fragile environment.

11:10 am Introducing Crystals and Lasers

Films for the Humanities, Inc., 1989, color, 58 min., $149.00. [I,H,C,G].

The first in a series of Christmas lectures from Britain's Royal Institution, this video gives American audiences an excellent feeling for this classic lecture series, which makes use of all types of audiovisual media and at times is almost like a magic show. In addition to conventional physical and chemical demonstrations (such as wave motion and chemical reactions using light), the producers make use of spectroscopy, scanning electron microscopy, and computer simulations to produce a highly informative presentation that will appeal to all ages.

12:10 pm The Problem Solving Film

Alfred Higgins Productions, Inc., 1989, color, 18 min., $335.00. [E,I]

Intended to stimulate critical thinking skills, this short, perky film presents a group of youngsters who try to solve the problem of a missing pet. Their actions are used to illustrate eight major principles of problem-solving behavior, which they apply to the mystery at hand.

12:30 pm Reducing, Reusing, and Recycling: Environmental Concerns

Rainbow Educational Video, Inc., 1990, color, 20 min., $89.00. [E]

This excellent video introduces elementary school children to ways our society can control certain types of pollution by reducing, reusing, and recycling common solid waste materials. The narration is well illustrated by footage of children and parents applying these methods. By making a clear distinction between nonrenewable and renewable resources, the video shows that some items disposed of as garbage have value and should not be covered over and forgotten in public landfills.

12:55 pm Kopjes: Islands in a Sea of Grass

Benchmark Films, Inc., 1989, color, 30 min., $535.00. [I,H,G]

Above the grasslands of East Africa rise the kopjes, islands of granitic rock. Like oceanic islands, kopjes support unique forms of life that evolved in these specialized habitats of caves and crevices. This beautifully photographed film focuses on the life cycle and behavior of two key species, the herbivorous rock hydrax and its major predator, the black eagle.

1:30 pm Smoking: Everything You and Your Family Need to Know

Ambrose Video Publishing, Inc., 1989, color, 30 min., $99.95. [H,C,G]

This antismoking video attempts to balance opposing viewpoints about smoking by presenting short narrations by a wide variety of smokers and nonsmokers. It makes extensive and effective use of an interview with former Surgeon General C. Everett Koop to answer questions related to smoking and health. Dr. Koop, an impressive speaker, presents factual and accurate antismoking information in a frank and straightforward manner.

2:05 pm Drugs and Your Amazing Mind

Alfred Higgins Productions, Inc., 1988, color, 18 min., $355.00. [I,H]

This excellent film details the effects of various drugs on the brain and gives information on the nature of the drugs, where they come from, and what their effects are. The importance of a clear mind, unclouded by drugs, is stressed throughout. The influence of the mind on muscle coordination is also emphasized.

2:25 pm The Last Word on Dinosaurs

Films for the Humanities, Inc., 1989, color, 26 min., $149.00. [H,C,G]

A firsthand look into the nature of scientific research is the centerpiece of this video in which noted researchers present a lively debate on dinosaur biology, behavior, and evolution. Since a modern look at dinosaurs is likely to be absent from most school texts, this program is an excellent complement to the earth science or biology curriculum. For adults, the excitement many of us felt as youngsters can be rekindled by watching this excellent film.

2:55 pm A World Alive

Sea Studios, 1990, color, 25 min., contact producer for price information. [E,I,H,G]

Produced originally for the St. Louis Zoo, this exhilarating film profiles the myriad creatures of the planet, their activities, and interactions. Its dramatic musical score and powerful narration are blended with some of the most spectacular wildlife footage ever assembled. Narrated by James Earl Jones.

Join us in Chicago in 1992!
6–11 February, Hyatt Regency Chicago

3:20 pm Futures: Aircraft Design

PBS Video, 1990, color, 20 min., $60.00 (price includes two episodes from the series on one tape). [I,H]

An episode of the *Futures* series that features acclaimed mathematics teacher, Jaime Escalante. Using spectacular aerial photography, this video captures the thrill of flying while illustrating clearly how a knowledge of mathematics is the entry ticket into the field of aeronautics.

3:40 pm The Truth About Teachers

Pyramid Film & Video, 1989, color, 45 min., $49.95. [C,T,G]

At a time when our schools are the target of much criticism, we need to be reminded occasionally that there is still a cadre of talented, dedicated, highly competent teachers who are working diligently to make a difference in the lives of the children they serve. This video program, hosted by film star Whoopi Goldberg, provides a vivid and stimulating reminder of that fact by letting us observe 10 exemplary teachers as they interact with their students.

Sunday, 17 February

10:00 am Fetal Development: A Nine-Month Journey

AIMS Media, 1989, color, 14½ min., $250.00. [I,H,C,G]

Excellent photography highlights this visual depiction of normal fetal development from fertilization through birth. A fiber optic camera is used to obtain remarkable images of the stages of embryonic growth, including tissue differentiation.

10:15 am Stop Before You Drop

Durrin Productions, 1989, color, 12 min., $200.00. [I,H,G]

Using a music video format, this short presentation conveys a strong antismoking message to young people. An upbeat, hip sound track and excellent production values enliven the video and ensure a positive reaction from young viewers. Filmed as part of a community-wide effort to reduce cigarette smoking in the predominantly black community of Richmond, California, the video features over 200 Richmond-area youngsters in the cast.

10:30 am The Fabulous Five: Our Senses

Rainbow Educational Video, Inc., 1989, color, 20 min., $89.00. [E]

This colorful, lively video introduces the concepts of the different senses to young children. It begins by asking students to consider what it would be like to lack each sense and then goes on to present the five senses in a smooth, flowing sequence with excellent transitions. The program contains much interaction to involve the students and hold their attention.

10:55 am Garbage: The Movie—An Environmental Crisis

Churchill Films, 1990, color, 24 min., $350.00. [I,H,G]

This movie opens with a summary of the six-month voyage of a garbage barge that traveled the seas looking for a place that would accept its cargo only to return to its point of origin. The film then goes on to provide a straightforward, no-nonsense presentation of a universal, current problem and its possible amelioration.

11:20 am Gilbane Gold

National Society of Professional Engineers, 1989, color, 24 min., $95.00. [H,C,G]

Although this video is fictitious (as clearly indicated in the introduction), it is based on actual situations and clearly presents the reality of the conflict between economics, public health, and human nature. The story revolves around the environmental engineer of a newly established high-tech company that is discharging toxic waste into a city's sewage system. The engineer must decide whether to

report the dumping infractions or protect the company's interests by slanting his environmental reports.

11:45 am See Dick & Jane Lie, Cheat, & Steal: Teaching Morality to Kids

Pyramid Film & Video, 1989, color, 47 min., $95.00. [T,G]

Bertolt Brecht wrote in 1936, "They won't say: The times were dark. Rather: Why were their poets silent?" The 1990s look like dark times for America's children, but as this film shows, educators can be as imaginative and as passionate as poets. Statistics on crime, drugs, problems in schools, and teen pregnancy are used to buoy the focus here: educational efforts can help if they address the heart of the problem—the absence of morals in children.

12:35 pm The Search for Mind

PBS Video, 1988, color, 60 min., $69.95. [C,G]

This video takes on the formidable challenge of defining the human mind. The wide-ranging discussion is based largely on interviews with outstanding workers in the fields of biology, animal behavior, psychology, philosophy, and art.

1:40 pm Trigonometric Functions 1: Solving Triangles

TVOntario, 1989, color, 10 min., $199.00 (series price includes six episodes on one tape). [I]

This is the first part of a beautiful series of films that use animation to show how interesting and practical trigonometry is. The series features two space travelers heading for the center of the galaxy who encounter problems of celestial navigation whose solutions require finding the sides or angles of triangles. This introductory segment demonstrates the sine, cosine, and tangent functions for a right triangle.

1:55 pm Water Baby: Experiences of Water Birth

Point of View Productions, 1989, color, 57 min., $195.00. [G]

This beautiful film that enhances the premise that women instinctively know how to give birth presents an overview of the water birth process. An historic review of obstetrical practice from Dick-Read to Le Boyer to Odent is incorporated as a scientific, conceptual basis for underwater birth. Viewers are provided with a new perspective that will perhaps serve as an incentive to achieve a more gentle birth among healthy, well-screened women. The film contains footage depicting actual water births.

2:55 pm Hazardous Inheritance: Workplace Dangers to Reproductive Health

Cambridge Documentary Films, Inc., 1989, color, 24 min., $300.00. [G]

Reproductive disorders rank among the 10 leading work-related diseases and injuries in this nation, but they can be prevented when reproductive health hazards are controlled. This video provides experience-based guides for identifying risks and instituting controls. This presentation is enlightened, informative, and practical. It addresses the fallacy of exclusionary policies for female workers; hazards and preventive measures affect both males and females, as risks are associated with parental (maternal, paternal, or both) exposures to environmental agents.

3:20 pm AIDS: A Family Experience

Carle Medical Communications, 1989, color, 33 min., $395.00. [H,C,G]

It is wrenching to watch these interviews with an AIDS patient and his family, but it is for this very reason that they should be seen. This is not a clinical or factual presentation; such crucial information must be sought elsewhere. What viewers will find here is an utterly real human drama.

3:55 pm The Greenhouse Effect

Landmark Films, 1989, color, 30 min., $295.00. [H,C,G]

This film focuses on the history, causes, and problems of the greenhouse effect. The impact of time on the greenhouse effect is very well documented, research techniques are depicted, and the complexities of weather forecasting are explained. The film provides audiences with a clear scope of the problem and an insight into the decisions that taxpayers and scientists must make to minimize future problems.

Monday, 18 February

10:00 am Invent It!

Insights Visual Productions, Inc., 1988, color, 28 min., $99.00. [E,I]

Consisting almost entirely of interviews with children and adults who discuss and demonstrate their own inventions, this video effectively communicates to its audience that regardless of age, race, and gender, anyone can be a problem solver given enough self-confidence and the ability to follow a few simple guidelines.

10:30 am Dinosaurs

KIDSVIDS, 1989, color, 15 min., $50.00. [E]

In this video we hear and see a lively group of primary school-aged children romping through the dinosaur exhibits in the Tyrrell Museum in Drumheller, Alberta, Canada. The children make observations and ask the kinds of questions young viewers would likely ask in the same circumstances. A catchy song summarizes the many interesting facts about dinosaurs presented in the video.

10:45 am The Bones and Muscles Get Rhythm

Coronet/MTI Film & Video, 1989, color, 10 min., $250.00. [E]

Produced by Disney Educational Productions, this program blends superb animation with live action to present the basic anatomy and physiology of the musculoskeletal system to young viewers.

10:55 am Animal Habitats

BFA Educational Media, 1989, color, 12 min., $220.00. [E]

This short introduction to six of the earth's habitats is designed for children in the elementary grades, although older groups will also enjoy it. The script and technical quality are excellent, and the scientific material is presented in a fashion that will hold the interest of young audiences.

11:10 am The Keepers of Eden

WQED, 1990, color, 58 min., contact producer for screening and purchasing information. [H,C,G]

An episode in *The Infinite Voyage* series, this program examines zoos throughout the world to discover how these educational habitats have evolved to help preserve diverse and nearly extinct species. The reintroduction of tamarins born in captivity to natural habitats in Brazil and fertility tests on cheetahs in North American zoos are among the studies profiled in this fascinating and thought-provoking documentary.

12:10 pm Sex and the Scientist

Indiana University Audio-Visual Center, 1990, color, 86 min., $160.00. [C,G]

This film chronicles the transition of Alfred Kinsey from a long-time student of gall wasps to the pioneering researcher of human sexual behavior, giving clarity and engaging attention to both the human dimensions and underlying issues of science and academic freedom. This production makes excellent use of the medium, blending pictures, drawings, and old film footage with recent interviews with Kinsey's family, friends, co-workers, and former students. The

viewer is able to understand, respect, and like the man; this is biography of a scientist at its best.

1:40 pm Face Value

Filmakers Library, Inc., 1990, color, 38 min., $295.00. [H,C,G]

"We would not survive without faces," states a researcher in this excellent film that provides documentation of the importance of the face in providing a sense of identity and as the primary display system for emotions. Human faces depicted in art and in life illustrate this very interesting and aesthetic presentation.

2:25 pm Acid Rain

Landmark Films, Inc., 1989, color, 30 min., $250.00. [H,C,G]

This British film give the viewer a clear understanding of the causes of acid rain and possible steps to be taken on both a global and personal level to minimize the destructive effects of this phenomenon. The photography and audio portion of the presentation are outstanding, and the material presented is both accurate and current.

2:55 pm A Season in the Sun

Benchmark Films, Inc., 1989, color, 30 min., $535.00. [H,C,G]

This film follows the life cycles of many animal species throughout the wet or dry seasons of Africa. An excellent script complements the beautiful cinematography of renowned nature photographers Alan and Joan Root. It is highly recommended for its factual content as well as for its excellent visual and audio qualities.

3:30 pm The Power of Choice

Live Wire Publishers, 1989, color, 60 min., $79.95. [I,H]

This video is designed to help teenagers make choices based upon their best vision of themselves and not out of fear, guilt, or spite. Michael Pritchard, an experienced teen counselor and stand-up comedian, is featured. His warmth, caring, and concern are among the video's greatest assets. With delightful humor, Pritchard parodies himself as a teenager interacting with his harried parents and teachers.

Acknowledgments

AAAS wishes to thank Sharon FitzGerald for her assistance in coordinating the program for this year's festival.

We also wish to thank the following organizations and distributors for providing the videos shown in the *Science Books & Films* Science Film Festival. Inquiries concerning particular films should be sent directly to distributors at the addresses below:

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Carle Medical Communications, 611 W. Park, Urbana, IL 61801, 217-384-4838
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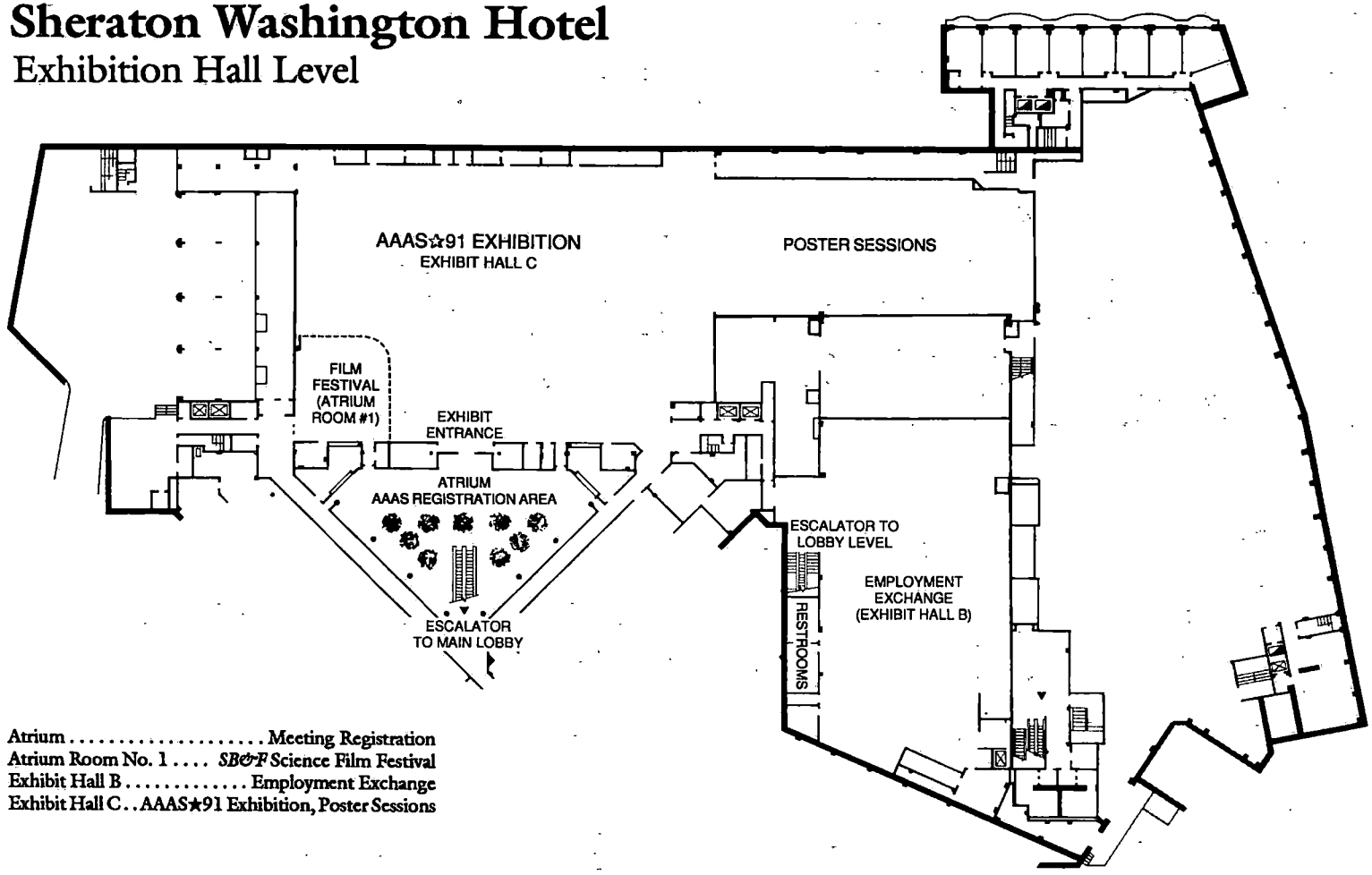
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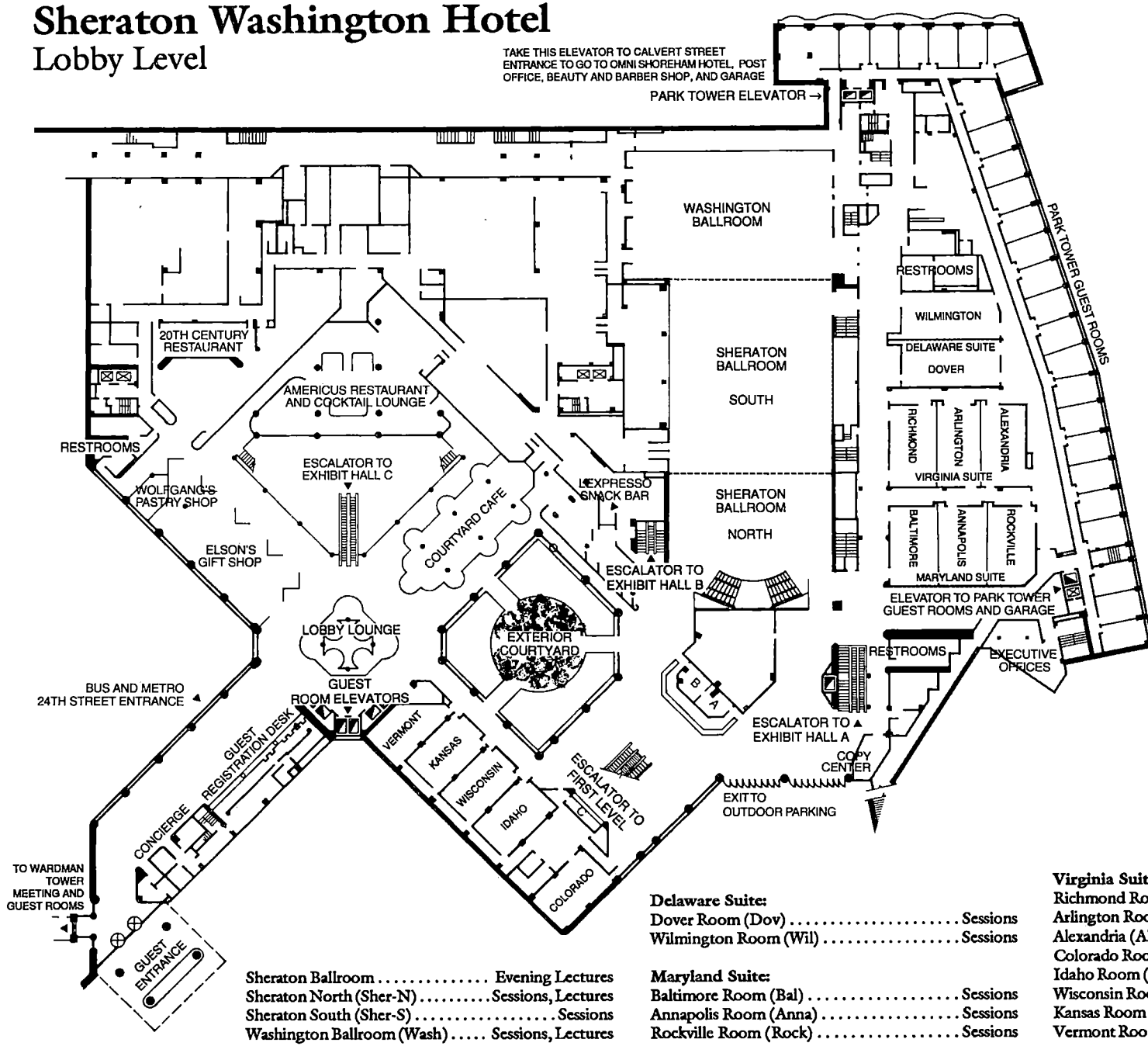
Exhibition Hall Level



Atrium ..... Meeting Registration
Atrium Room No. 1 .... *SB&F* Science Film Festival
Exhibit Hall B ..... Employment Exchange
Exhibit Hall C . . AAAS★91 Exhibition, Poster Sessions

Sheraton Washington Hotel

Lobby Level



Sheraton Ballroom ..... Evening Lectures
Sheraton North (Sher-N) ..... Sessions, Lectures
Sheraton South (Sher-S) ..... Sessions
Washington Ballroom (Wash) ..... Sessions, Lectures

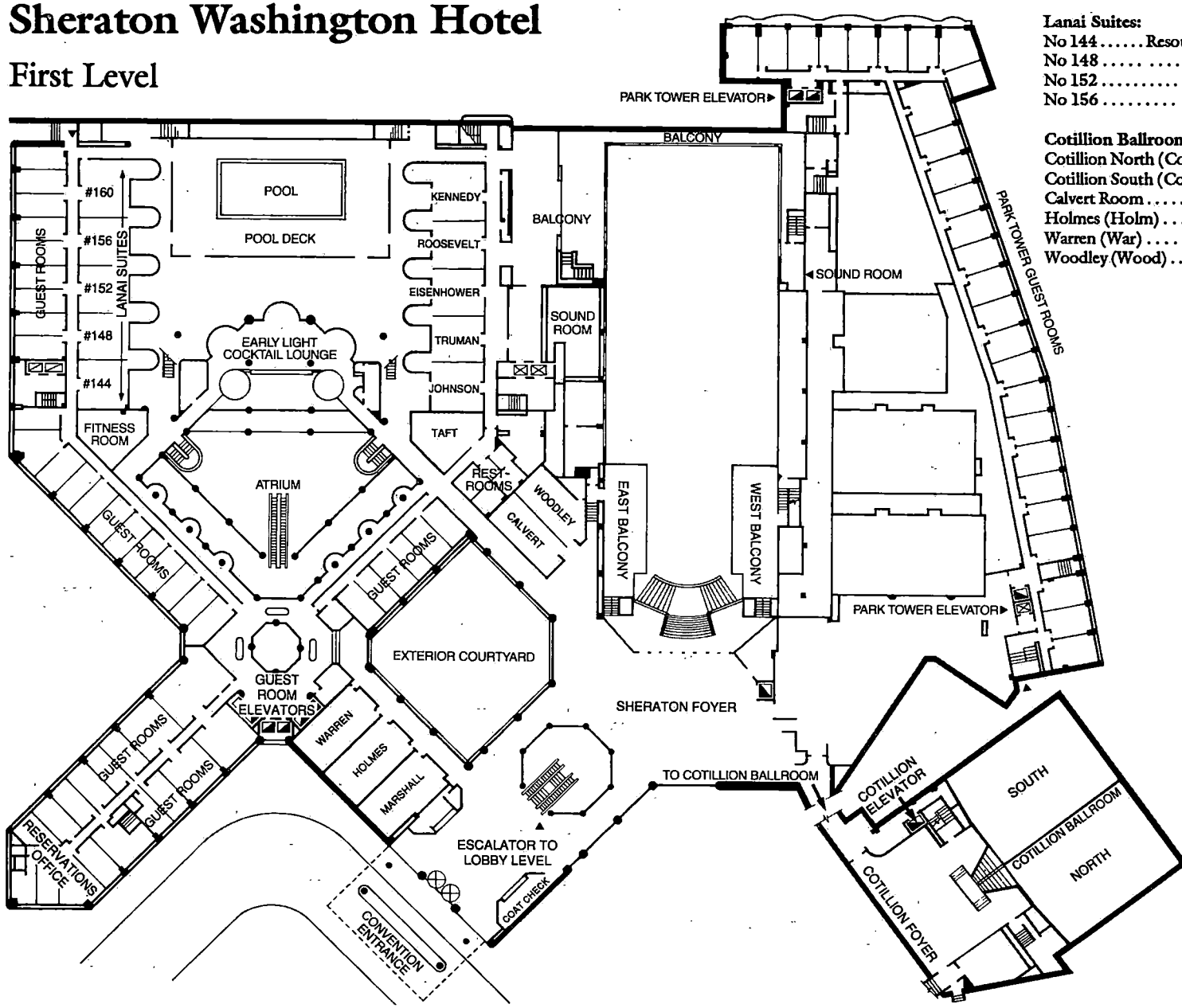
Delaware Suite:
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Wilmington Room (Wil) ..... Sessions

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Annapolis Room (Anna) ..... Sessions
Rockville Room (Rock) ..... Sessions

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Sheraton Washington Hotel

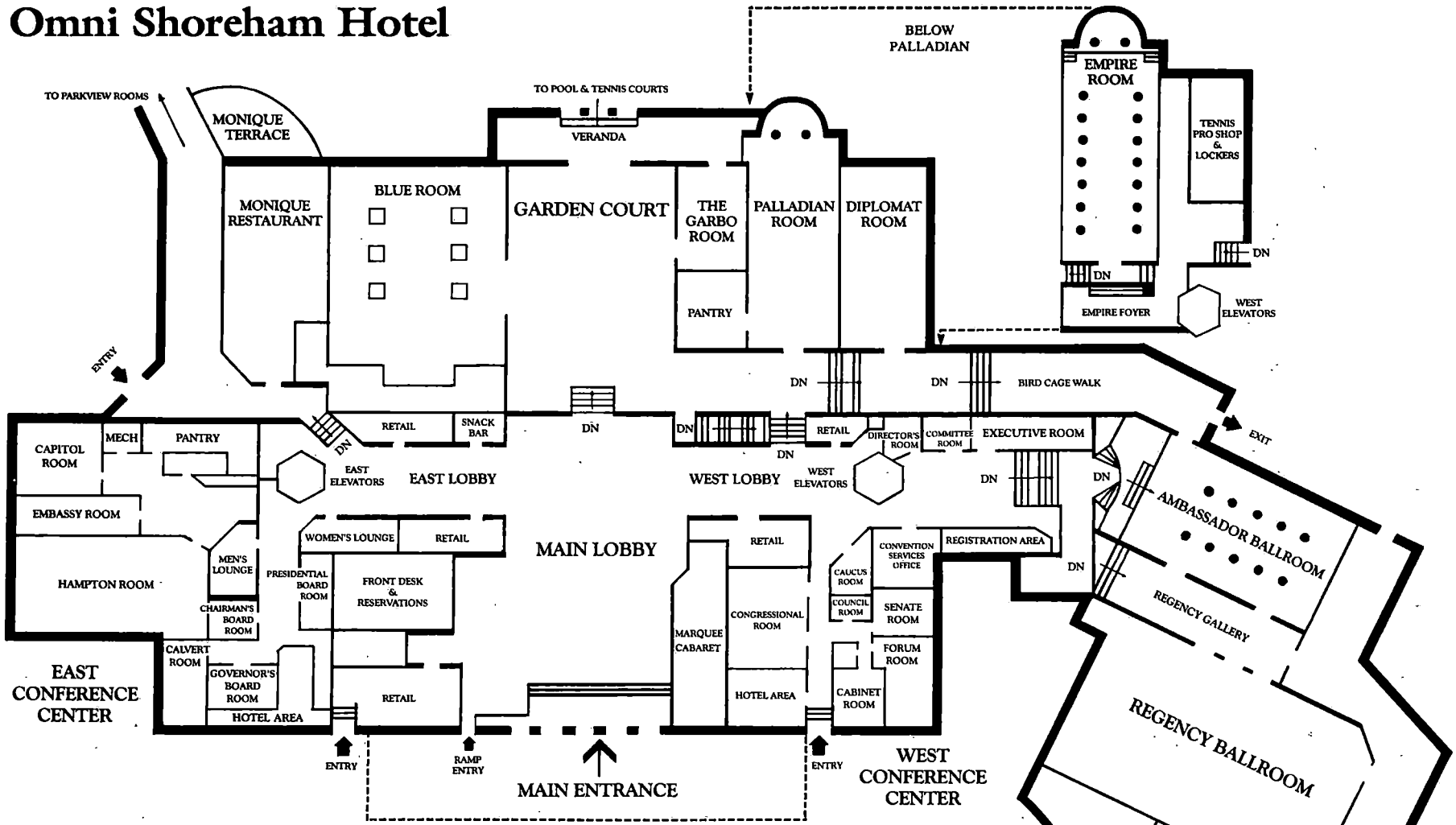
First Level



Lanai Suites:
No 144 ..... Resource Room for Disabled Registrants
No 148 ..... Speakers' Ready Room
No 152 ..... Meeting Headquarters Office
No 156 ..... Session Aides Office

Cotillion Ballroom:
Cotillion North (Cot-N) ..... Sessions
Cotillion South (Cot-S) ..... Sessions
Calvert Room ..... Newsroom Headquarters
Holmes (Holm) ..... Sessions
Warren (War) ..... Sessions
Woodley (Wood) ..... Sessions, Business Meetings

Omni Shoreham Hotel



Lobby Level - East

Calvert Room (Cal) ..... Sessions
Capitol Room (Cap) ..... Sessions
Chairman's Room ..... Business Meetings
Embassy Room (Emb) ..... Sessions
Hampton Room (Hamp) ..... Sessions
Presidential Room ..... Business Meetings

Executive Conference Rooms

(West Elevator to 7th and 8th Floors, respectively)
Suite No 763 (Truman Boardroom)..Business Meetings
Suite No 863 (Carter Boardroom)...Business Meetings

Lobby Level - West

Cabinet Room (Cab).....Sessions, Business Meetings
Caucus Room (Cau).....Sessions, Business Meetings
Congressional Room (Cong) ..... Sessions
Council Room ..... Business Meetings
Executive Room (Exec) ..... Sessions
Forum Room ..... Business Meetings
Senate Room ..... Business Meeting
Registration Counter .....AAAS Information

Regency Level

Ambassador Room (Amb) ..... Sessions
Empire Room (Emp) ..... Sessions

Garden Court Level

Blue Room (Blue) ..... Sessions
Diplomat Room (Dipl) ..... Sessions
Palladian Room (Pal) ..... Sessions

Meeting Information

Meeting Facilities

Sheraton Washington Hotel*
(Headquarters Hotel)
2660 Woodley Road, N.W., Washington, DC 20008
(202) 328-2000

Housing, meeting registration, plenary lectures, sessions, poster sessions, business meetings, social functions, exhibition, employment exchange, *SB&F* Science Film Festival.

Omni Shoreham Hotel*
2500 Calvert Street, N.W.
Washington, DC 20008
(202) 234-0700

Housing, sessions, business meetings, social functions.

Dupont Plaza Hotel
1500 New Hampshire Avenue, N.W.
Washington, DC 20036
(202) 483-6000

Housing only.

*For detailed meeting room floor plans, see pages 134–137.

Headquarters Offices

Meeting. The AAAS headquarters office is located in the Sheraton Washington Hotel (Lanai Suite 152, First Level). AAAS staff members will be available to provide assistance.

Mail and telegrams addressed in care of AAAS will be held only at the headquarters office for pick up by addressees. For telephone messages, the AAAS operates a message center in the registration area (see "Services" below). AAAS assumes no responsibility for the delivery of mail, telegrams, or messages, but will make every effort to see that they are delivered.

There will also be an information station in the Omni Shoreham (West Lobby), staffed by personnel from the Washington Convention Bureau, to provide general information and to contact the headquarters office for specific needs and questions.

Newsroom. The newsroom is headquartered in the Sheraton Washington (Calvert Room, First Level). News media representatives are registered and can be reached there.

Each year, several hundred reporters, editors, photographers, and radio and television correspondents attend the AAAS Annual Meeting. Their coverage produces news and feature stories that are published and broadcast around the world throughout the year. Because such coverage contributes to one of the Association's objectives — furthering the public understanding of science and technology — the cooperation of all Annual Meeting participants is essential.

The AAAS newsroom staff will be contacting speakers to arrange press conferences and individual interviews with the media. In addition, all speakers have been asked to provide copies of their remarks in advance. These texts are available only to registered members of the press.

Throughout the meeting, the AAAS communications staff will be available in the newsroom to facilitate the interaction between news media representatives and scientists, and to offer professional guidance in dealing with the media to speakers and authors of papers.

The presentation of the 1990 AAAS-Westinghouse Science Journalism Awards will take place on Saturday, 16 February, at the NASW Annual Banquet (7:30 pm, Delaware Suite, Sheraton Washington). Dinner tickets may be purchased in the AAAS Newsroom. The reception preceding the banquet will be held at 6:30 pm in the Cotillion Ballroom. The reception is open only to members of the working news media.

Registration

Location

Sheraton Washington Hotel
(Atrium)

Registration desks (advance and on-site)
Information desk
Message center (phone-in and message boards)

Hours

Thursday, 14 February .....10:00 am–8:00 pm
Friday–Monday,
15–18 February .....7:30 am–5:30 pm
Tuesday, 19 February .....8:00 am–12 noon

Fees

The on-site registration fees are shown below. Please note that AAAS members who registered in advance — before 11 January — paid only $110, a discount of 20%.

	Full Meeting	One Day
Regular member	$140	$50
Regular nonmember[1]	190	65
Student member[2]	10	5
Student nonmember[2]	15	5
Postdoctoral member	30	15
Postdoctoral nonmember	40	20
Emeritus	50	25
High school teacher	50	25
Spouse of registrant	40	20

[1]Regular nonmember 6-day registration fee includes an introductory membership with 25 issues of *Science* (16 issues if mailed outside of the U.S.).

[2]**Special rates:** To qualify for student rates, you must present your student ID card. (Student rates apply to full-time undergraduate and graduate students only.) To qualify for postdoctoral rates or high school teacher rates, you must present a letter from your chairman confirming your status.

Additional Fees

	Seminar (3 days)	Short Course (1 day)
Regular member or nonmember	$110	$50
Graduate student or postdoctoral	30	15

Registration Refunds

The AAAS will refund advance registration fees for all cancellations received by letter or telegram prior to 5 February 1991. No refunds will be made on cancellation notices received after that date. Refunds will be mailed from the AAAS offices in Washington after the Annual Meeting.

Tax Deduction for Educational Expenses

The 1986 Tax Reform Act modified the rules on income tax deductibility of educational expenses. These expenses continue to include registration fees and certain travel, meal, and lodging costs, and, as in the past, must be undertaken (i) to improve or maintain employment or business skills or (ii) to meet express requirements of an employer or law imposed as a condition to retention of employment, job status, or rate of compensation. Since 1987, however, educational expenses of an employee constitute a *miscellaneous itemized deduction.* To be deductible, the sum of all unreimbursed miscellaneous itemized deductions (which include, for example, financial planning fees, educational expenses, tax return preparation fees, and others) must exceed 2% of adjusted gross income. In addition, only 80% of the cost of meals incurred while away from home on business is deductible. Thus, travel meal costs are first subject to the 80% limitation, and the remaining amount is then added to other miscellaneous itemized deductions and is subject to the 2% adjusted-gross-income threshold. In light of these new laws, you may wish to consult your tax advisor about how to determine your deductions for educational expenses.

Resource Areas

Disabled Registrants. *Location*: Lanai Suite 144, Sheraton Washington (First Level). *Hours*: Thu. (14 Feb.), 10:00 am–6:00 pm; Fri.–Mon. (15–18 Feb.), 8:00 am–6:00 pm; Tue. (19 Feb.), 8:00 am–12 noon.

The AAAS staff and volunteers in this location offer special resources for disabled persons, including the following services:

- Assistance in movement within and outside the meeting facilities, as needed;
- Interpreters for the hearing impaired at all plenary lectures, and for other sessions on request;
- Audiotaped highlights of the meeting program for persons with visual impairments.

Employment Exchange. *Location*: Exhibit Hall B, Sheraton Washington. *Check-in hours: Fri.–Sat. (15–16 Feb.), 8:00 am–6:00 pm; Sun. (17 Feb.), 8:00 am–10:00 am. Interview Scheduling*: Fri.–Sun. (15–17 Feb.), 8:00 am–6:00 pm. *Interviews*: Sat.–Mon. (16–18 Feb.), 9:00 am–5:30 pm. *On-site Fees*: Candidates, $10; nonprofit employers, $125–$195; commercial employers, $175–$275 (depending on the number of positions posted). *Check-in Procedures*: Candidates must be registered for AAAS 91 before they can participate in the Employment Exchange. Those who have not already registered for the meeting can do so in the Sheraton (Atrium). Those who've registered in advance should first pick up their registration materials at the Advance Registrants Desk, Sheraton (Atrium), before proceeding to check in at the Employment Exchange in Exhibit Hall B. Once at the Employment Exchange, they will receive an identification number and procedures for using the service. While AAAS cannot guarantee that interviews and job placements will result from this effort, there is the potential for making important employment contacts.

Services

Child Care. Meeting attendees who are staying at the Sheraton Washington or the Omni Shoreham and who require babysitting or other child care services should contact the hotel concierge for a list of licensed agencies. Guests at the Dupont Plaza should call the bell captain. Please be aware that agencies may require 24-hour advance notice.

Directory of Advance Registrants. The names of all advance registrants are posted in the Sheraton (Atrium). Registrants will find the directory helpful in determining the convention locations of friends and colleagues who attend the meeting. Inquiries about on-site registrants may be made at the AAAS Information Desk.

Message Center. The AAAS Message Center is located in the meeting registration area (Sheraton Atrium) and will be staffed during registration hours. To leave telephone messages, call (202) 328-2000 and ask for the AAAS Message Center. Messages will be posted on message boards. Please check the message boards daily.

Speakers' Ready Room. Located in the Sheraton (Lanai Suite 148), this facility is open from 8:00 am to 6:00 pm each day of the meeting. The AAAS operates this service for the convenience of speakers who wish to review their visual materials or who would like to familiarize themselves with the operation of projection equipment.

Visitor Information. The AAAS Information Desk is staffed with personnel from the Washington area who can assist with local and area information and provide literature.

Ground Transportation

From Washington Dulles International Airport. "Washington Flyer" coaches run every 30 minutes and stops at both the Sheraton Washington and Omni Shoreham. Fare: $12 one way; $22 round trip. Taxi fare: $35–40. **From Washington National Airport.** Take Metrorail Blue Line to Metro Center, transfer to Red Line (to Grosvenor or Shady Grove), and get off at Dupont Circle station for Dupont Plaza Hotel, or at Woodley Park-Zoo station for Sheraton or Shoreham hotels. Fare (must purchase fare card): $1.40 during rush hour; $.85 at other times. Taxi fare: $10–15. **Metrorail.** Mon.–Fri., 5:30 am–midnight (every 10 minutes); Sat., 8:00 am–midnight (every 20 minutes). Sun., 10:00 am–midnight (every 20 minutes). Fares vary, depending on distance traveled. Maps of the Metrorail system are available at the AAAS Information Desk. **Metro Bus.** Mon.–Sun., 5:30 am–1:00 am. Buses run every 20 minutes on weekdays, every 30 minutes on weekends and holidays. Fare within D.C. city limits: $.85 (ready change only). **Taxis.** Washington taxis do not have meters, but operate within a system of "zones." This confounds visitors and residents alike. During afternoon rush hour, a surcharge to the regular fare is applied. Drivers are also permitted to pick up additional passengers on route if it does not take the initial passenger more than 5 blocks out of the way. **Parking** (all day rates): Sheraton, $12 for self-parking, $14 for valet parking (no in-and-out privileges); Shoreham, $9 for self-parking (no in-and-out privileges); Dupont Plaza, $12 for valet parking (with in-and-out privileges).

Audiotapes of Sessions

Cassette tapes of the seminar, plenary lectures, and other selected sessions will be available for purchase at the Mobiltape sales desk in the Sheraton (Convention Foyer, Lobby Level). A complete list of the taped sessions can be found (marked with *) in the *Sessions by Category* listing in this program. Tapes of morning sessions will be available after 3:00 pm on the day the session has been held; tapes of afternoon sessions are available the following morning. In most cases, a half-day (3-hour) session is reproduced on two cassettes. On-site sales price for each cassette: for members, $8.00 plus tax; for nonmembers, $10.00 plus tax; for students, $6.00 plus tax (student identification required). Orders that require shipping will have a shipping and handling charge added. Purchases may be paid with cash or personal check or charged to VISA or MasterCard; institutional billing is accepted.

Mark Your Calendar

For the next AAAS Annual Meeting



AAAS☆92 Chicago

6–11 February 1992
Hyatt Regency Chicago

American Association for the Advancement of Science

AAAS

Founded in 1848, AAAS is the world's leading general scientific society, with 132,000 individual members and 290 affiliated societies and academies covering the spectrum of the natural and social sciences, engineering, and medicine. AAAS offers its individual members a voice in the larger scientific community through its publications, programs, and meetings. Membership in AAAS includes the weekly journal ***Science*** and the opportunity to participate in one of 22 sections that embrace the basic fields of science and engineering. Members can also take part in programs to increase the public's understanding of science, improve science and mathematics education, safeguard human rights, and affect public policy.

AAAS Publications include ***Science,*** the official weekly journal of AAAS, and numerous books, reports, directories, and newsletters.

AAAS Programs include activities that help school systems improve the quality of science and mathematics education; work to enhance the public's understanding of science; focus attention on scientists and engineers who suffer human rights violations; expand science education and career opportunities for minorities, women, and the disabled; and improve international cooperation among scientists.

The AAAS Annual Meeting and Exhibition provides a forum for the discussion of recent developments in science and related policy issues, as well as an opportunity to see the latest high-technology products and services essential to science professionals. Annual colloquia on science education, international security, and science and technology funding and policy are also held.

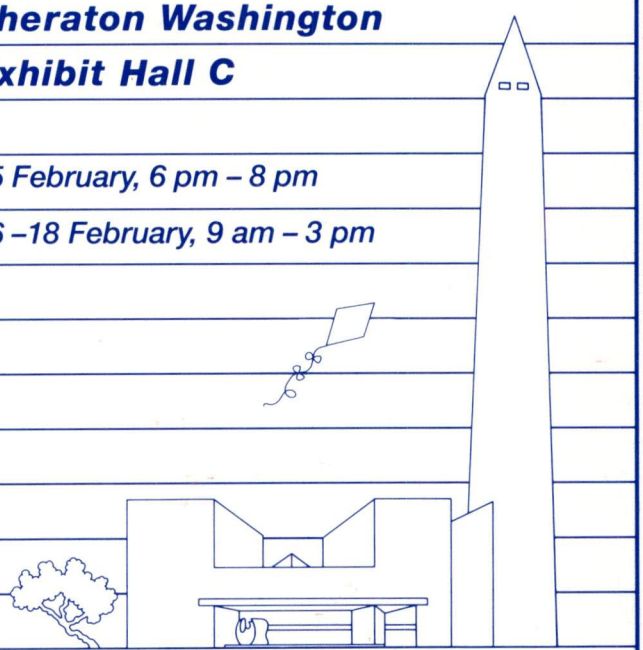
American Association for the Advancement of Science 1333 H Street, NW, Washington, DC 20005

Don't miss the AAAS☆91 Exhibition!

Sheraton Washington
Exhibit Hall C

15 February, 6 pm – 8 pm

16 –18 February, 9 am – 3 pm



American Association for the Advancement of Science
1333 H Street, NW, Washington, DC 20005

AAAS ☆ 91

The AAAS Annual Meeting

ABSTRACTS

WASHINGTON, DC

14–19 February 1991



AAAS Annual Meeting

ABSTRACTS OF PAPERS

157th National Meeting ★ Washington, DC ★ 14–19 February 1991

Compiled by Michelle D. Games

American Association for the Advancement of Science
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All poster sessions will be held in the Sheraton Exhibit Hall.

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I. Physical Sciences & Technology

10. General Physical Science and Technology

10-1. Frontiers of the Physical Sciences: 1991

Organized by: **Rolf M. Sinclair** *(Program Director, Physics Division, National Science Foundation, Washington, DC)*

8:30 am & 2:30 pm / Fri / 15 Feb **Omni/Hampton**

Enzyme Models and Mimics.
RONALD BRESLOW (Columbia University)

Enzyme models can furnish insights into the chemical pathways used in enzymic catalysis, but they can also extend the scope of chemistry by using biochemical principles. Examples will be described of systems that elucidate specific enzyme mechanisms and general principles, and others that achieve high specificity and catalytic effectiveness by mimicking enzymatic pathways.

LIGO: A Laser Interferometer Gravitational Wave Observatory.
ROCHUS E. VOGT (California Institute of Technology).

The LIGO project is a collaborative effort between scientists at the California Institute of Technology and the Massachusetts Institute of Technology to construct a laser interferometer gravitational wave observatory.

The existence of gravitational waves has been predicted by Einstein's Theory of General Relativity. LIGO is designed to detect gravitational waves and to use them as an observational tool in opening a new window on the astrophysical universe.

The scientific basis, the technology, and the implementation plans for LIGO will be discussed.

How to Arrange Points on a Sphere.
N.J.A. Sloane (AT&T Bell Laboratories, Murray Hill,NJ 07974)

What is the best way to place 1500 points on a 3-dimensional sphere? Here "best" depends on the application. It could mean that the points are not too close together, or that they efficiently cover the sphere in some appropriate sense. More generally, what is the best spherical code consisting of M points on the n-dimensional sphere? There are applications to numerical analysis, the placing of detectors on a sphere to measure radiation, and the design of signal constellations for data transmission. R.H. Hardin, W.D. Smith and the author (the "CODEMART" group) have constructed a great many spherical codes using a variety of methods.

Toward a Science of Storm-Scale Weather Prediction
KELVIN K. DROEGEMEIER (University of Oklahoma)

In contrast to global and regional weather forecasts, which have improved considerably during the past few years due to advances in prediction models and the computers they run on, the practical prediction of thunderstorms and related phenomena has been slow to evolve due to the lack of observational data on the scales of individual storms, the absence of adequate computing resources and communication networks, and an insufficient understanding of issues related to small-scale predictability. However, the deployment of some 150 operational scanning Doppler radars nationwide by the mid to late 1990's, coupled with the use of newly developed techniques by which unobserved physical quantities can be derived from the single Doppler wind component and used to initialize storm-scale models, suggest that thunderstorm prediction may be practicable within the next ten years. In this presentation I will review the theoretical impediments to and bases for thunderstorm prediction, and describe various scientific components of a national project directed toward addressing the storm-scale predictability problem. In particular, I will describe a new thunderstorm prediction model which is being developed on massively parallel computers using techniques adopted from astrophysics; methods by which observed data can be assimilated into a forward prediction model; relationships between storm-scale predictability and chaotic dynamical systems; and realtime visualization strategies using gigabit networks. Throughout the presentation I will show animations of numerical simulations to illustrate the time-dependent and three-dimensional nature of thunderstorms, including low-level windshear events and their impact on aircraft safety.

11. Computing; Communications

11-1. Global Initiatives in High-Performance Computing and Networking

Organized by: **Gligor A. Tashkovich** *(MBA Degree Candidate, Cornell Univ., Ithaca, NY)*, **Bonnie C. Carroll** *(Secretariat Director, Commerce, Energy, NASA, NLM, Defense Information Managers [CENDI], Oak Ridge, TN)*, and **Lawrence A. Lee** *(Executive Director, North Carolina Supercomputing Center, Research Triangle Park, NC)*

2:30 pm / Fri / 15 Feb **Omni/Empire**

8:30 am & 2:30 pm / Sat / 16 Feb **Omni/Empire**

The Grand Challenges In Supercomputing
JOHN W.D. CONNOLLY (University of Kentucky)

As an example of the old adage that "It is easier to measure input than output," the supercomputing debate is usually confined to the question of "How fast is a supercomputer?" rather than "What is a supercomputer good for?"

The answer to the latter question is the list of grand challenge problems of science and engineering, which are defined as important problems solvable only on a supercomputer. These involve the most critical issues facing the United States today: Environment, Energy, Materials, and Biotechnology, for example.

Any one of the grand challenges could easily justify an investment of ten times the meager budget assigned to the NSF supercomputer program.

With the imminent demise of the NSF program, it is important for all scientists to support the new U.S. High Performance Computing Initiative, which will broaden support to other agencies, and ensure that the United States remains preeminent in supercomputing hardware, software, netware, and liveware.

Building Upon the 1985 NSF Advanced Scientific Computing Initiative.
ELIZABETH C. SCHERMERHORN (Syracuse University).

Supercomputer centers were established by the NSF in response to pressure from academic research scientists and expressions of congressional concern for US competence and precedence in science and engineering. The success of these centers has resulted in a higher demand for supercomputing cycles than they can now deliver. Changing funding scenarios have hastened the opening of state, regional and commercial centers delivering high performance computing services and support programs. This talk will describe how several established and new centers have responded to the mixed challenge of providing state of the art computing hardware with diminishing state and federal dollars to an ever-growing user community. Some of the cultural and conceptual changes that have occurred to enable this evolution will also be discussed.

The NSF Supercomputer Centers as a Catalyst for Change
LAWRENCE L: SMARR (National Center for Supercomputing Applications)

In the five years since the NSF Supercomputer Centers were established, the number of academic researchers who have regular access to supercomputers has increased by two orders of magnitude to roughly 10,000. In addition, about 20 state and regional supercomputer centers have arisen which multiply these numbers. This has created a new force for change within the science and engineering disciplines as well as creating a new marketplace for high performance computing products. Thousands of individuals are trained at the centers each year in all aspects of computational science and engineering (CS&E). Several hundred universities are affiliated with the national centers and have people on campus who have been trained at the centers and who are in turn locally training new practitioners of CS&E. Many courses at universities are allowing students to solve course problems on remote supercomputers. The workstation software tools which have been developed at the centers are being used by a very broad pool of CS&E users, probably ten times as large as the pool of actual supercomputer users. During the next few years, the NSF centers should become focal points for developments in parallel processing, high speed networking, distributed software tools, and new algorithms for applications in a wide range of science and engineering disciplines.

Supercomputing for Science-Based Economic Development
LAWRENCE A. LEE (North Carolina Supercomputing Center)

Supercomputing Centers face many stiff challenges: keeping a position at the leading-edge of technology, developing and revising training & education programs, testing emerging technologies, feeding the technical requirements of the scientific community to the computer industry, and integrating heterogeneous systems into seamless environments. To meet these challenges, it is critical that supercomputing centers develop partnerships with the computer industry. In this talk, the nature of two such partnerships will be discussed. At Cornell University, IBM and the Cornell National Supercomputer Facility are conducting several joint efforts: parallelism across IBM 3090-600s, workstation-based scientific workbenches, and a high school supercomputing competition named SuperQuest. At the North Carolina Supercomputing Center, IBM is participating in (i) a joint study to seek an effective solution to scientific mass storage needs, (ii) a computational science education initiative, and (iii) a widely-distributed workstation-based visualization effort.

Both centers have served as stimuli and magnets for the coalescence of all aspects of computational science. In this presentation, the accomplishments and directions of the two centers will be highlighted and the partnerships with IBM will be emphasized.

IBM European Initiatives in Supercomputing
FRANCO PAVONCELLI (IBM ECSEC)

This lecture will discuss the initiatives which IBM has in place to support supercomputing capabilities in Europe. These initiatives include the IBM European Center for Scientific and Engineering Computing (ECSEC) in Rome, Italy. The mission and activities of ECSEC will be reviewed, as well as those of other IBM centers in Europe which support technical computing. The scope and nature of various IBM-customer partnerships in European supercomputing will also be presented.

NREN Initiatives at the NSF
STEPHEN WOLFF (National Science Foundation)

Wide-area computer networks are fast becoming an indispensable tool of contemporary research. The proliferation of networks over the past several years and the rapidly growing reliance upon them by the worlwide scientific community are both due in large part to the catalyzing funding of NSFNET by the National Science Foundation. From humble - even stumbling - beginnings in mid-1986, the NSFNET cross-country Backbone network and its connected and (partially) subsidized family of mid-level networks now connect all major research universities, over a hundred primarily undergraduate institutions, and many industrial and government laboratories, with one another and with a variety of unique scientific resources. Over the same period, there has developed broad consensus to parlay this success, together with that of other Federal and private networking initiatives, to a unified and ubiquitous National Research and Education Network (NREN). NSF has several initiatives contributing to the development of the NREN, including deployment of 45 megabit service on the NSFNET Backbone and the funding, jointly with DARPA, of a substantial research program in gigabit networking. Significant challenges remain, however, including the development of class-of-service guarantees and policy-based routing, deployment of universal user and directory services, and provision of a wider spectrum of useful application-level protocols, to name just a few.

Social and Behavioral Issues in Network Development.
CHARLES R. MCCLURE, PHILIP DOTY, and ANN BISHOP (School of Information Studies, Syracuse University).

If the National Research and Education Network is to be successful, it must be integrated into the working lives of researchers. Such integration depends upon identifying and addressing a number of social and behavioral issues related to the use of communication and analytic tools by researchers. These issues include the culture of the communities and subcommunities involved; the relationship between the normative structure of the scientific enterprise and the use of electronic networks; effects of networks on collaboration and scholarly communication; defintions of eligible users and acceptable uses; relationships among users in academia, government, and the private sector; and the training and support of onsite and remote users of networked facilities. The authors will present findings and conclusions from an empirical study funded by the Congressional Office of Technology Assessment and from additional research into scientific norms and the behavioral aspects of electronic communication. They will also discuss implications of this research for policy makers at various levels, network designers, network managers, and R&D managers.

Legal, Regulatory, and Pricing Issues in Network Development
BRIAN KAHIN, Esq. (Kennedy School of Government, Harvard)

Research networks are seen both as technology-specific R&D and as an expression of traditional science policy -- in particular, facilitating the sharing of unique facilities such as supercomputers. However, below the national level, such networks are often seen as a component of the higher education system or even the local economic infrastructure. Recently, private firms have begun to compete with the cooperative "quasi-public" research networks. The result is overlapping autonomous networks of varying character offering different degrees of service -- a microcosmic caricature of the deregulated telephone system with funding policy assuming the role of regulatory policy. Structures, legislated or de facto, are required to reconcile "network pluralism" with the need to ensure the accountability and coherence of the whole.

High Performance Computing: The Real Customers. ALVIN W. TRIVELPIECE (Oak Ridge National Laboratory, Oak Ridge, TN)

During the past decade, the Department of Energy and its laboratories have expanded their educational role. A historical perspective will be addressed, including the origin of the Department of Energy's "Superkids" program. Under the leadership of Secretary Watkins, the national laboratories are assuming even more responsibility for education. Selected Mathematical Sciences Education Board studies will be summarized and updated. A description of specific education programs including the Saturday Academy for Computing and Mathematics initiated by Oak Ridge National Laboratory will be given.

Biomedical Applications of a National Electronic Superhighway
DONALD A.B. LINDBERG, MD (National Library of Medicine)

High performance computers and high-speed computer networks are key technologies for modern science. Grand biomedical challenges

such as the analysis of the human genome, prediction of biological structure and function from genetic code, and rational drug design will require new and faster computer designs, advanced software development, a national research and education computer network, and expanded training of biomedical scientists in the use of computer-based research tools.

The President's Office of Science and Technology Policy has proposed a multi-agency High Performance Computing Initiative to strengthen our national research computing enterprise. Within the Department of Health and Human Services, the National Institutes of Health proposes a High Performance Computing program whose elements include molecular biology computing, creation and transmission of digital electronic images, the linking of academic health centers via computer networks, the creation of advanced methods to retrieve information from life sciences databases, and expanded training in medical computer science. This presentation will touch on each of the elements of the HPC program at NIH, whose organizational focal point is the National Library of Medicine and its research and development efforts in medical informatics.

Status of Efforts to Connect Higher Education and K-12 to the National Networking Matrix
KENNETH M. KING (EDUCOM)

Approval has been given by both the CREN Board (which manages BITNET and CSNET) and the NSF to connect K-12 systems to CREN networks and NSFNET. EDUCOM has been surveying the educational uses of existing K-12 networks and developing a plan to encourage connection of these networks to the national networking matrix. Many other groups have also been working to create a national K-12 network which would support a wide range of applications. This paper will discuss projects involving Higher Education & K-12 cooperation enabled by networking and the current status of the efforts to create a national K-12 network.

11-2. Computer Virus Legislation: Problems and Pitfalls

Organized by: **Anne Wells Branscomb** *(Attorney, Harvard Univ., Cambridge, MA)* and **Mark S. Frankel** *(Program Director, AAAS, Washington, DC)*

8:30 am / Fri / 15 Feb **Omni/Executive**

Maintaining Perspective --
Worms and Viruses, Babies and Bathwater.
JOHN F. SHOCH (Asset Management Company).

Several recent highly-publicized events have focused attention in the legal and computer community upon the impact of software "worms" and "virus" programs. It should be obvious that we cannot tolerate people who deliberately or negligently interfere with the operation of other people's computer systems. At the same time, we need to maintain some perspective on the issues:
--The vast majority of computer system "damage" does not come from worms or viruses, but from errors and improper operation.
--Most deliberate attacks on computer systems come from "insiders" -- current or former employees.
--Many computer attacks have been successfully resisted with well known security measures.
--There are many imaginative and useful applications for worms and other forms of distributed computation.*
--Some proposed legislation might have made it a crime for a user of a computer program to make a typing error during input!
Thus, we need to maintain some balance and perspective while exploring legislative and judicial approaches to managing worms and viruses.

*John F. Shoch and Jon A. Hupp, The Worm Programs -- Early Experience with a Distributed Computation, *Communications of the ACM*, March 1982.

Bugs and Bugaboos: Concerns of the Software Industry.
Ronald J. Palenski (ADAPSO, The Computer Software and Services Industry Association)

In 1988, the Aldus Corporation had to recall 5,000 copies of its "Freehand" program because of a "virus," introduced inadvertantly into the computer system used to make distribution copies. Later that same year, computers around the nation linked by Internet were shut down by a "worm" introduced by a graduate student. Although neither the Aldus virus nor the Internet worm caused serious loss, both incidents have raised anxieties on the part of commercial software and systems vendors regarding their liability for damge inflicted by worms, viruses, and other technological security threats. This article will explore vendor's potential liabilty and ways to limit it.

Hardening the Hardware: The Limits of Technological Fixes.
OLIVER R. SMOOT (Computer and Business Equipment Manufacturers Association)

Prosecutorial and legislative concern over the introduction of computer viruses into computer networks has resulted in calls for technological fixes to prevent such occurrences. The systems manufacturers have reacted by pushing for changes in current Federal legislation to clarify the personal nature of computer crimes and have opposed proposals to make networks physically invulnerable or to outlaw the creation of any virus or other similar program. This presentation will address the industry consensus that while much can be done to improve computer security in general, technological fixes will have among the lowest payoffs from the choices available.

Practical Problems in Applying Federal Computer Crime Laws.
MARK D. RASCH (Fraud Section, Criminal Division, United States Department of Justice)

This presentation will discuss the evolution of the present computer crime law (Title 18, U.S.C. Section 1030) and some of the practical problems presented to prosecutors who wish to use this statute for criminal cases. There will be a special emphasis on the issues presented in the so-called Internet "worm" case, United States v. Robert Tappen Morris, and will include issues from the public record raised by that prosecution. The application of other, non-computer related federal statutes to computer crime will be discussed, as will the prevelance of computer crime in society.

11-3. Information Technology in Support of Research: What Your National Libraries Are Doing

Organized by: **Linda C. Smith** *(Associate Professor of Library and Information Science, Univ. of Illinois, Urbana, IL)* and **Elliot R. Siegel** *(Assistant Director for Planning and Evaluation, National Library of Medicine, NIH, Bethesda, MD)*

8:30 am / Mon / 18 Feb **Omni/Embassy**

Outreach Through Technology. ELLIOT R. SIEGEL, PH.D.
National Library of Medicine (NLM).

Information technology--the set of computer and telecommunications technologies that makes possible computation, communication, and the storage and retrieval of information--has changed the conduct of scientific, engineering, and clinical research. Donald Langenberg, in his 1989 National Academy of Sciences panel report, "Information Technology and the Conduct of Research: The User's View," challenges the institutions supporting the nation's researchers to develop support policies, services, and standards that help researchers use information technology more widely and productively. This paper examines the latest outreach activities of the National Library of Medicine that address the information access needs of the biomedical research community.

Visiting the Virtual Library. DANIEL R. MASYS, M.D. (Lister Hill National Center for Biomedical Communications, National Library of Medicine (NLM)).

The transformation of major national libraries from physical archives to instantly-accessible information centers is not yet complete. In order to

provide the entire spectrum of traditional library services in a distance-independent fashion, several key technologies currently under development will need to be applied. System architectures which can accommodate different "information objects" such as bibliographic citations, full text, bit-mapped images, sound, and other data types will need to exist. High-bandwidth digital networks will need to be available ubiquitously to service the transmission of large data sets such as those representing images.

Work currently underway at the Lister Hill Center, the research and development division of the NLM, includes new methods for managing digitized page images, automated facsimile transmission, and the building of image data sets representing the x-y-z volumetric coordinates of human biological structure. Expert systems for assisting users to perform bibliographic searches are under development, as is a Unified Medical Language System *Metathesaurus*, an electronic Rosetta stone for mapping among the various vocabularies of biology and medicine. Implications of these technologies for the practicing biomedical researcher will be discussed.

Access to Biotechnology Information. DENNIS A. BENSON (National Center for Biotechnology Information, National Library of Medicine).

The National Center for Biotechnology Information (NCBI) was established by Congress in October, 1988 in recognition of the importance of information technology in support of research in the area of biotechnology. This fast-moving area of the life sciences, dealing with the understanding of genetic processes, has been marked by an explosive growth in the amount of research data and a proliferation of highly specialized databases. Unlike traditional scientific databases which primarily serve a repository function, databases of biosequence and biostructural data are essentially tools for computer analyses. The volume of data and the complexity of relationships are challenges for biologists and information scientists to develop advanced techniques for representing and searching the data.

Work is in progress at the NCBI to develop new approaches to database design, data exchange standards, and software tools in order to provide scientists and health professional ready access to this body of information. The NCBI is in a unique position to provide this support by virtue of its organizational structure which combines a basic research group focused on fundamental problems in molecular biology analysis with a software development group, most of whom have biology backgrounds. NCBI databases, retrieval tools, and modes of access will be discussed.

The Role of Laserdisc Technology in Agriculture
ALAN FUSONIE (National Agricultural Library), RON YOUNG (National Agricultural Library), RICHARD MYERS (National Archives and Records Administration).

A creative revolution in image preservation and end-user access to valuable historical images is underway. Laser discs are changing the way images--photographs, slides, artworks, and other unique and rare historical records--are stored, preserved, retrieved, distributed, utilized, and displayed. Providing access to and preservation of the non-textual materials entrusted to their care are the dual reasons for the existence of a research institution. Curators, librarians, and archivists within the Federal Government are finding that laser disc systems enhance significantly their preservation efforts through reduced physical handling of original materials by their staffs and patrons and improve overall administration of their holdings. This presentation will highlight the preservation and access components of the NAL program in conjunction with an actual demonstration of the disc system as well as the effectiveness of related end-user network sites within the Federal Government. The success of this program and its future enhancements will have a far-reaching impact on the preservation and dissemination of non-textual research material within the Federal Government, and by extension it serves as a model for other research institutions worldwide.

Bringing the Library of Congress to Its Offsite Users. SUZANNE THORIN (Library of Congress).

As Dr. James H. Billington met with groups of librarians across the country soon after his appointment as Librarian of Congress, he heard repeated requests for general access to the Library of Congress' online computer system. Accordingly, the Library implemented the six-month LC Remote Access Pilot, designed to put the Library of Congress online to the Nation by offering access to current bibliographic, legislative, copyright, and referral information. The experiment successfully tested the need for the Library of Congress Information System (LOCIS) in a variety of reference environments. Fourteen libraries--academic, federal, state, and public--provided test sites around the Nation, beginning October 1989. The study fulfilled its purpose to determine the potential feasibility, desirability, and need for reference and research access to LOCIS from remote sites. As a result, the Library is currently evaluating a plan to offer access to its systems to the 50 state library agencies, serving as efficient conduits to large numbers of Americans.

11-4. Can Electronic Publishing Solve the Science Library Crisis?

Organized by: **H. H. Barschall** *(Professor of Physics. Univ. of Wisconsin, Madison, WI)*

8:30 am / Mon / 18 Feb **Omni/Executive**

Electronic Publishing from a Publisher's Point of View
STUART ROTHENSTEIN (The Institute of Electrical and Electronics Engineers, Inc.)

Profitable solutions to complex business problems by establishing corporate goals and implementing them in a direct fashion. Selecting appropriate methodologies, researching potential vendors, selecting sources, negotiating contracts and assuring compliance. Researching, installing and implementing technologies encompassing telecommunications, computers, media converters, optical character readers, graphic scanners, design/layout/page make-up workstations, editorial/composition systems, manufacturing systems and distribution systems including CD-ROM and ON-LINE.

Research and Development in Electronic Publishing.
MARTIN DILLON (OCLC)

This talk will address the functional requirements of electronic journals as requested by researchers in two recent surveys and in informal discussions. The obstacles to the electronic journal presented by today's technology will then be discussed, focussing on telecommunications and workstations. Key issues are the need for graphics, a critical mass of material available online, and low cost. Finally, OCLC's activities in developing an electronic journal will be discussed.

Electronic Publishing: An Economic View
MALCOLM GETZ (Vanderbilt University)

Economic forces are moving strongly toward the development of electronic means of communication among scholars. Electronic storage may already cost less than print for most character-based documents. High speed networks allow scholars to communicate quickly. The power of affordable graphic workstations is increasing rapidly. Electronic documents will not necessarily evolve simply as clones of familiar print documents. Electronics add dimension in ways that make it worthwhile for authors, libraries, and readers to prefer and pay a premium price for the electronic documents. Early electronic documents, then, may cost more than print. Whether the markets for electronic documents will be more competitive and therefore more efficient than the corresponding print markets is unknown. There is now active entrepreneurship from both the for-profit and not-for-profit sectors. There will be a period of experimenta-

tion with products and price strategies with many participants. Then, we might expect a shake-out and consolidation. There is every possibility that the flaws in the current regime will emerge in the new one.

When Will Electronic Information Systems Replace Printed Journals?
STEWART C. LOKEN (Lawrence Berkeley Laboratory).

Recent changes in computing, data storage and networking are likely to have a dramatic effect on the dissemination of scientific information. To assess the impact of these changes on the physics community the American Physical Society has formed a Task Force on Electronic Information Systems. This paper reviews the conclusions of the Task Force. The report will assess the prospects for replacing paper journals in the short term. It will also describe a vision for scientific information management in the next century.

11-5. Scientific Communications in a Changing World

Organized by: **Bonnie C. Carroll** *(Secretariat Director, Commerce, Energy, NASA, NLM, Defense Information Managers (CENDI), Oak Ridge, TN)*

8:30 am & 2:30 pm / Sun / 17 Feb **Omni/Empire**

The Scientific and Technical Information Infrastructure: Perspective of the National Science Foundation
DR. F. KARL WILLENBROCK (National Science Foundation).

Openness in scientific communication is fundamental to the effective conduct of basic research and has been a time-honored tradition in this country. New factors are making the traditional exchange more complex, including access to and use of electronic networks, timeliness and completeness in reporting research results and proprietary issues associated with near-term commercialization. The National Science Foundation, in its mission to support basic scientific and engineering research, has responsibility to promote openness in scientific communication. NSFNet, a high-speed electronic network, is a visible example of NSF's commitment to this concept. Today's complex research environment introduces new challenges and pressures. It also provides new opportunities for communication, sharing and cooperation. A continuing concern in the future will be effective management of research, balancing the need for sharing information with proprietary and security interests to maintain an open and dynamic system. If research results are appropriately managed, the sharing of scientific and technical information can be successfully balanced with proprietary and security interests and an open system can still be maintained.

STI as an Integral Part of the R&D Process: An STI Manager's Perspective. JOSEPH G. COYNE (U.S. Department of Energy, Office of Scientific and Technical Information)

The advent of the electronic age brings unique challenges to Federal science agencies in the quest to provide public access to their scientific and technical information (STI) resources. Rapid development in information technology presents an array of options for providing faster access to researchers, industry, and the general public; and increased use of electronic formats such as online systems, compact disk technology, and high density magnetic storage are dramatically improving the timeliness, quality, and completeness of information. However, efficient public access to STI can only occur through appropriate planning and integration of information/user needs within the context of the available technologies. Design of a Federal infrastructure, with respect to both internal agency organization and interagency coordination, is implicit. The role of the STI manager is to balance all the relevant issues: efficient access to a broad base of users, budget considerations, disparate capabilities of various user groups, standardization of systems, commercialization of R&D results, and maintaining compatibility with existing systems.

Information Resource Management: A Competitive Edge
DR. BARBARA W. MIHALAS (National Center for Supercomputing Applications; University of Illinois)

One of the greatest challenges in dealing with massive quantities of data in the coming decades will be to respond adequately to the manner in which research scientists work with and think about data. Initially, this requires providing all the descriptive material necessary to make data, which alone is nothing but numbers, meaningful and self-contained. Second, it requires developing methods for responding to very complex and totally unpredictable queries about the data.
Enormous quantities of data, gathered in order to better understand many complex processes that cross traditional disciplinary lines, are anticipated in the fields of geoscience (e.g. global change) and biological science (e.g. medical research). At present, we have little collective knowledge of how researchers would use a responsive "data library" if they had it. And we are just learning how to create such an entity. I will discuss the strong needs and motivations for incorporating new technology into the management of large data archives, with emphasis on the potential for increasing capabilities in data access and use and increasing research productivity. I will describe some current prototyping efforts including our own, and look at where we might hope to go in the near future. My approach will be that of a research scientist who has queried scientists working with data in dozens of fields and has recently been working closely with computer scientists active in many aspects of Data Base, AI, and data management.

Intellectual Property Law and Scientific Communication. GERRY J. ELMAN J. D. (Elman & Wilf, 20 West Third Street, Media, PA)

Promotion of scientific and technological progress is written into the federal Constitution, where Congress is empowered to pass copyright and patent laws. The right of exclusivity for a limited time provides an incentive to allocate the resources to develop the work of authorship or invention. Because publication of an invention before filing a patent application destroys foreign patent rights, a myth circulates that patents are antithetical to publication. Yet patents are the core of a worldwide system of useful published technological information. International harmonization of patent laws and use of the Patent Cooperation Treaty (PCT) are proceeding apace, with Asian and Eastern European nations joining South American countries in improving the scope of patent protection, especially for the fruits of biotechnology. Software is an anomaly, with most protection based on copyright and trade secret law, rather than patents. Courts have difficulty squaring the traditional role of copyright in protecting "expression" but not "ideas" with the desire to prevent commercial coattail-riding. The antitrust laws may sometimes provide a counterbalance where excessive power is concentrated in a single holder of intellectual property.

The Pitfalls of Intellectual Property
ART KLEINER (Belmont, MA 02178)

"Information wants to be free," a phrase coined by writer Steward Brand, suggests that as communication technologies (such as hypermedia) proliferate, intellectual property will not be able to stay intact. Words and images will flow and merge from one creator to another, and should: because quotation, adaptation, and even plagiarism under some circumstances are in the best interests of readers and consumers of information. Quoting, paraphrasing, copying and reframing are how people educate themselves. However, giving support, credit, and reward for creativity is also in the best interests of readers and consumers. New technologies have not changed that dilemma, but have made it more pressing on everyday life. So far, Western culture has only developed haphazard ways of coping with the dilemma. These include fair use copyright provisions, "look-and-feel" lawsuits, informal etiquette for "porting" on computer networks, a noblesse oblige attitude in which people feel that creativity should not be financially rewarded, and wild fluctuations in the value of some intellectual property (such as videotapes). "Information

wants to be freely copyable," and will be, but not "free" -- and the dilemma we face is not controlling the flow of information, but in deciding how best to deal with the complexity of this freedom.

Electronic Watermarks: Toward a Technological Solution to the Problem of Intellectual Property. PAUL LEVINSON (Connected Education, Inc., NYC)

The problem of professional recognition and remuneration for creators of intellectual property has been exacerbated by the easy reproduction and instant global dissemination of text and images made possible by computer networks, fax, and new telecommunications. One response to this problem has been to argue that patent and copyright structures for support of intellectual property, developed in a pre-electronic era of print and paper and inadequate even in their own time, are inoperable in an electronic age and ought to be scrapped in favor of a more free, less regulated flow of information. This paper argues the opposite, detailing (a) how the weakening of intellectual property rights may result in a dampening of the creative process and a reduction in the flow of information, and (b) how the same technological sophistication that has heretofore jeopardized the enforcement of intellectual property rights may be used to strengthen these rights and their application. Such technological remediation is explored in terms of specific strategies for embedding inextricable authorial attribution in text, images, and hard technologies, and the consequences of such embedding for the scientific community and society at large.

11-6. Mathematics in the Public Policy Arena

Organized by: **Mary Beth Ruskai** *(Professor, Dept. of Mathematics, Univ. of Lowell, Lowell, MA)*, **Mary W. Gray** *(Professor of Mathematics, and Statistics, American Univ., Washington, DC)*, and **Jill P. Mesirov** *(Director, Mathematical Sciences Research, Thinking Machines Corp., Cambridge, MA)*

2:30 pm / Mon / 18 Feb **Sheraton/Colorado**

Public Policy Aspects of Statistics: An Application to the Study of Complex Salary Structures. MARY W. GRAY (American University).

Judicial reception of statistical evidence has varied from complete disbelief to healthy skepticism to uncritical acceptance. Courts' perception of statistics shapes public policy in such areas as discrimination, the identification of criminals, and anti-trust. Statistics can influence the political process itself through the allocation of Congressional and state legislative seats. In spite of the impact of their evidence, little attention has been paid to the ethical responsibility of expert statistical witnesses. An area in which the public policy and ethical responsibility issues are highlighted is the application of multiple regression to the examination of complex salary structures, particularly those of college and university faculty. Beginning with data issues and progressing through the selection of models to the interpretation of results, each statistical decision presents opportunities for the introduction of bias. The appropriateness and limitations of a number of statistical techniques are examined, and their potential impact on liability and remedy issues is evaluated.

The Wavelet Revolution in Mathematics and Signal Processing. INGRID DAUBECHIES (AT&T Bell Laboratories)

Wavelets are generated from one basic function by dilations and translations, either continuous or discrete. General functions can be represented by and reconstructed from their inner products with wavelets, the "wavelet coefficients". The wavelet coefficients of a function give a time-frequency decomposition of the function, with higher time-resolution for high frequency than for low frequency components. The analysis can easily be extended to higher dimensions.

An especially important case are orthonormal bases of wavelets. These turn out to be related to a special form of subband coding, a technique used in electrical engineering. The subband coding filters suggested by the wavelet approach are different from the usual designs in electrical engineering, yet give very good results in many applications.

Wavelets are of interest to pure as well as applied mathematics. Applications include numerical analysis and signal analysis. Wavelets have also generated a wide interest in the physics and engineering communities.

Human-Computer Collaboration. BARBARA J. GROSZ (Harvard Univ.)

Dialogues are fundamentally instances of collaborative behavior among multiple agents. This collaborative property affects communication in all modalities and thus is a factor that must be reckoned with in developing more advanced systems for human-machine communication. The participants in a dialogue work together to satisfy various of their individual and joint needs. Their utterances are actions that contribute to the satisfaction of these needs. From this perspective communication is a means for working collaboratively to achieve shared objectives. I will describe recent work in Artificial Intelligence on defining a model of collaborative planning to support the development of systems that can communicate using an appropriate combination of natural language and graphics, and will discuss questions it raises about modelling reasoning about actions and beliefs, negotiation, and communication.

Calculating Fractal Dimensions and Invariant Measures FERN Y. HUNT (Howard University)

Fractal dimensions have become an important tool for characterizing the sets - called strange attractors that arise in the study of dynamical systems. The structure of these sets can also be characterized in a quantitative way by its invariant measure. Recent results on these topics will be described and some public policy implications of the research in this general area will be discussed.

Convergence Analysis for Simulating Flow in Root-Soil Systems. MARY F. WHEELER (Rice University), TODD ARBOGAST (Rice University), and MANDRI OBEYESEKERE (University of Houston).

Optimal order error estimates are derived for finite difference and finite element approximations to the solution of a nonlinear parabolic partial differential equation coupled to a linear ordinary differential equation. These equations model the potential and intake of water in a root-soil system. The finite difference scheme is shown to be equivalent to a finite element scheme combined with certain quadrature rules; consequently, all of the error estimates are derived from finite element and quadrature analysis. Computational results which verify the theoretical convergence rates are given for the finite difference scheme.

Technical Sessions

11T-1. Robotics and Mathematics

Organized by: **Bhubaneswar Mishra** *(Assistant Professor, Courant Institute of Mathematical Sciences, New York Univ., New York, NY)*

2:30 pm / Tue / 19 Feb **Omni/Executive**

Robotics as an Influence on Computer Science
J.T. SCHWARTZ (Courant Institute of Mathematical Sciences, New York University)

Computer science has of late had a combinatorial focus; robotics renews its contact with more traditional continuum mathematics. This influence has proved to be productive of many intriguing problems in the geometry of real space and 'force' space, geometric modeling, optimization, and control theory. This talk will trace the recent history of work on some of these problems, and offer some reflections on the role of 'raw' practical problems in the development of theoretical areas.

Toward a Science of Robot Planning and Control.
D. E. KODITSCHEK (Center for Systems Science, Electrical Engineering, Yale University).

Programming machines to operate flexibly and autonomously in the physical world seems to require a sophisticated representation that encodes simultaneously the nature of a task, the nature of the environment within which the task is to be performed, and the nature of the robot's capabilities with respect to both. Of these fundamental representation issues, only the last may be said to be scientifically well founded at present: the robot may be effectively modelled as a nonlinear control system using techniques of 19th century physics. We seek a scientific methodology of robot task encoding that encompasses the desired behavioral goals and and environmental conditions as well. Accepting the standard physical model of the robot as a controlled dynamical system, any language for prescribing its behavior must ultimately be resolved into force commands at the actuator level. The resulting behavior is then governed by certain nonlinear differential equations and it makes sense to model task and environment in terms amenable to analysis by dynamical systems theory. This talk will focus on the problem of motion planning as an example of how we propose to say what we mean to the robot and to know what we have said. The allowable configurations of a robot moving in a cluttered space may be formally modeled as a manifold with boundary — the "free configuration space." Proper attention to the formal properties of a cost function that "goes high" on the obstacles and "goes low" on the destination results in provably correct motion planning algorithms that are simultaneously control laws for the physical machine as well. Suitable coordinate changes generalize these solutions over the larger task domain (i.e., the topological equivalence class of the original manifold).

The Mathematics of Grasping
BHUBANESWAR MISHRA (New York University)

In this talk, the speaker will present in a self-contained manner some of the basic ideas in the theory of dexterous manipulation. In particular, the discussion will focus on the models of robot hands and analysis and synthesis of multifingered grasps for objects of arbitrary geometry. This will allow us to answer questions of the following kind: How many fingers do you need to grasp an object? How does the grasp depend on the geometry of the object? How strong can a grasp be, if one is allowed to use only a fixed number of fingers?

The techniques exploit an interesting connection between the problems of grasping and some classical results in combinatorial geometry.

Geometric Phases, Optimal Control and Space Robotics
P.S. KRISHNAPRASAD (University of Maryland, College Park)

Precise nonlinear dynamic models have had a significant role in the analysis, simulation and control of a variety of space-based systems. The use of global geometric methods, including concepts based on symplectic geometry, symmetry groups and reduction, leads to valuable insight into the qualitative properties of such models. In the formulation of (constrained) motion planning problems for space-based robots, a very powerful tool is derived from the theory of geometric phases. It is noteworthy that geometric phases have recently been the subject of intense study in a variety of areas of classical and quantum physics. In this talk, we will indicate the common mathematical framework underlying such applications in physics and our work in robotics. We will also expose some of the beautiful mathematical structures arising in the related problem of efficient or optimal manipulation.

11T-2. Stereo Computer Imaging and Analysis in Science

Organized by: **Robert S. Ledley** *(Professor, Physiology and Biophysics, Georgetown Univ. Medical Center, Washington, DC)*

8:30 am / Tue / 19 Feb **Omni/Executive**

Basic Concepts of Stereo Imaging
ROBERT S. LEDLEY (Georgetown University Medical Center)

Visual recognition and interpretation by humans is primarily done in stereo three-dimensions. Not only does the brain perceive stereo images with less noise, but also with greater acuity in recognizing shape and form. Thus the computer generation of stereo three-dimensional images can significantly enhance the value of medical imaging.

There are three basic concepts of stereo imaging. The first involves the fact that a person senses three dimensions primarily due to the convergence of the two eyes at an object in space. The brain not only senses the amount of convergence but also notices the parallax that appears between the object in focus and the background. The result is visual depth perception. The second basic concept concerns the manner of displaying on a television screen the two images of a stereo pair such that one image is seen only by the observer's right eye and the other image is seen only by the left eye. The displayed images are fused by the observer's brain resulting in virtual depth perception. The third basic concept involves the method for utilizing a cursor in virtual three-dimensional space for pointing to objects in depth. Such a cursor (which we call a 'bat', i.e. a flying mouse) can then be used for quantitative analysis of the image. Each of these basic concepts will be described in detail and their interaction in 3-D image display and analysis will be discussed.

Stereo Volumetric Echocardiograms. J. F. GREENLEAF (Mayo Clinic, Rochester, MN), J. B. SEWARD (Mayo Clinic), T. KURODA (Jichi Medical School, Tochigi-Ken, Japan).

Full volumetric sets of echocardiographic data are obtained by rotating a transesophageal probe within the esophagus of patients. The probe is incrementally rotated with a stepper motor acquiring two-dimensional echocardiograms at a fixed angle through several heartbeats of one respiration for each of about 50 angles of view. From these recorded images complete three-dimensional data sets are obtained at each of up to 11 points in the cardiac cycle. The resulting data sets, gated at appropriate points in the cardiac cycle, are filtered and rendered in three dimensions. Two-dimensional images at angles through the data can be obtained that are not possible from normally available probe orientations. Stereo views are produced through the cardiac cycle depicting wall motion and valve dynamics. Dynamic volumes of chambers are also calculated. Video recordings of these images can be used for teaching and perhaps clinical evaluation.

This work was supported in part by grant HL-41046 from the National Institutes of Health.

Brain Cortical Surface - Quantitative Heritability Analysis
MICHAEL W. VANNIER (Mallinckrodt Institute of Radiology, Washington University, St. Louis), CHARLES F. HILDEBOLT (Washington University), DEAN FALK (State University of New York, Albany), GARY FIGIEL (Washington University), JAMES CHEVERUD (Washington University).

The brain may be visualized from magnetic resonance gradient echo imaging techniques with rapid 3D acquisition. Using these data, obtained in less than 15 minutes, it is possible to map the cortical surface of the human brain, including the surface sulcal markings. Quantitation of the size, orientation,

and distribution of cortical markings is facilitated by computer graphics workstation hardware and software.

We have undertaken the assessment of brain surface cortical features and their heritabilities via measurements extracted from 3D in vivo MR image data sets. The methods for obtaining these data, extracting the cortical surfaces and converting the image data into accurate and repeatable measurements of the surface sulcal patterns will be described. The quantitative analysis allows us to begin the investigation of heritabilities of brain cortical surface features in intact humans.

Stereo Computer Imaging and Analysis in Science.
BOYD MACNAUGHTON (Tektronix, Inc.)

Stereoscopic computer imaging systems have been available for several years. While their use is not widespread, they have proved of particular utility in many fields. Most notable of these are computer aided chemistry, photogrammetry, computer aided design, meteorology, cartography, telerobotics and medical imaging. This paper examines the use of stereo imaging in the fields other than medicine. Examples of the successful application of the technology are given and reasons for their success and utility are explored.

Real-Time, 4-Dimensional Imaging of Living Organ Systems.
JAMES V. JESTER, W. MATTHEW PETROLL, PETER ANDREWS, and H. DWIGHT CAVANAGH (Center For Sight, Georgetown University).

Confocal microscopy is known to provide dramatic improvements in both lateral and axial resolution compared to conventional light microscope designs. The addition of real-time, confocal microscopic imaging available with Nipkow disk based systems further provide for imaging of living tissue at a cellular level in the intact organ system. High resolution images can be obtained non-invasively by optical sectioning of living opaque tissue. Images are detected using a low light level DAGE MTI x66 SIT camera and captured using a Gould IP9527 image processor with a Real-Time Digital Disk (RTDD). This system is capable of digitizing and storing single video frames at video frame rates (1/30 sec). Selected frames from the RTDD are then processed and analyzed to quantitate both the spatial and temporal cellular changes through 3-D reconstruction and graphic display. Using this system, reflected light from living cells and other tissue structures reveal dynamic cellular details comparable to the static conventional light microscopic images of dead, fixed, and sectioned tissue. (Supported in part by EY07348, RPB Inc, and the Eleanor Naylor Dana Charitable Trust)

Stereo Electron Imaging and Reconstruction of Thick Biological Preparations.
LEE D. PEACHEY (University of Pennsylvania).

Transmission electron microscopes operating at accelerating voltages greater than the usual 100 kV can be used to produce high quality images of biological specimens thicker than the usual 0.1 micrometer, including both sections of embedded tissues and whole cell mounts. For example, sections of epoxy embedded tissues up to 2-3 micrometers in thickness can be examined at 400 kV. Using appropriate specimen stages and holders, specimens can be tilted between exposures, and pairs of stereo micrographs made. These can be viewed in stereo, and the full depth of the specimen, including its internal structures can be appreciated in a direct way. Additionally, computer graphic procedures can be used to reconstruct and measure selected structures. In their simplest form, these procedures are wholly interactive, with the user tracing structures in 3D while viewing stereo pairs. Procedures under development in this laboratory are designed to perform some of the 3D reconstruction automatically, using digitized images and algorithms that can segment and recognize corresponding views of the same structures in two or more tilted views. (supported by NIH Grant RR-2483).

12. Energy; Technology

12-1. Energy R&D Policy in the United States

Organized by: **H.M. Hubbard** *(Executive Vice President, Midwest Research Institute, Golden, CO),* **Robert W. Fri** *(President and Senior Fellow, Resources for the Future, Washington, DC),* and **Barbara Farhar** *(Senior Social Scientist, Solar Energy Research Institute, Washington, DC)*

8:30 am / Fri / 15 Feb **Omni/Congressional**

The U.S. National Energy Strategy. HONORABLE LINDA STUNTZ (Deputy Under Secretary, Office of Policy, Planning and Analysis, DOE)

In response to the President's request, the Department of Energy has carried out an exhaustive review of the U.S. energy situation and has identified a variety of energy strategy options for consideration by the Administration. This paper will review the process by which this National Energy Strategy (NES) review was carried out and summarizes its current status.

U.S. Science and Technology Policy: What Priority for Energy R&D? RODNEY W. NICHOLS (The Carnegie Corporation of New York)

In assessing the policies for needed R&D to serve any one of the nation's major purposes, the overall trends must be reviewed. To be sure, science and engineering are flourishing and have splendid opportunities for progress. Yet the research community faces: rising unit costs; high productivity leading to better questions and further financial demands; increasing regulatory burdens and conflicting social pressures; keener competition for support of young and senior investigators, which stresses the evaluation system's capacity to judge fairly; and a probable squeeze on the supply of women and men entering science and engineering. Many other national and international cross-currents influence the R&D strategies of government, industry, and universities. These trends will be summarized briefly from the standpoint of the Federal government's priorities. Past and current Energy R&D investments will be surveyed against the ongoing claims of other national programs such as defense, health, agriculture, commerce, and space. Illustrations of the difficult choices will be outlined. The enormous importance of a robust, balanced R&D program--in each mission agency, especially the Department of Energy--will be documented. The renewed imperatives for programs designed to foster diffusion of knowledge toward applications will be emphasized.

Industry Perspective on Energy R&D Policy.
DANIEL A. DREYFUS (Gas Research Institute)

The primary responsibility to introduce new energy technologies into the marketplace rests with the energy industries and their equipment manufacturers. It is generally conceded, however, that market barriers often deter entrepreneurial businesses from carrying out research, development, and commercialization of energy technologies that, once commercialized, would provide important social and economic benefits. The barriers operate differently at each stage of R&D--proof of concept, development and field test, and commercialization. In general, however, they include excessive delay between the initial investment and any prospect of a financial return, the inability of the technology developer to capture a sufficient portion of the ultimate economic rewards that will be derived from the technology, and the inability of the technology developer to profit at all from the social benefits provided by the technology. These market barriers often

can be addressed by government acting on behalf of the society at large or by collaborative or cooperative research entities working on behalf of an entire industry. The role of government R&D and cooperative industrial R&D should be to better distribute the burden of the R&D investment across the potential beneficiaries of the technologies.

Economics, Environment and Energy R&D Priorities
ROBERT W. FRI (Resources for the Future)

Economic competitiveness, environmental protection, and energy services are important national goals. They can also compete with one another. Technology plays an essential role in resolving possible conflicts among these goals. In this session, the major R&D and institutional priorities for developing such technologies will be discussed.

12-3. Scientific Advances in Emerging Solar Energy Technologies

Organized by: **H.M. Hubbard** *(Executive Vice President, Midwest Research Institute, Golden, CO)*, **Robert L. San Martin** *(Deputy Assistant Secretary, Office of Conservation and Renewable Energy, U.S. Dept. of Energy, Washington, DC)*, and **Barbara Farhar** *(Senior Social Scientist, Solar Energy Research Institute, Washington, DC)*

2:30 pm / Fri / 15 Feb **Omni/Congressional**

Photon Conversion Processes
A.J. NOZIK (Solar Energy Research Institute, Golden, CO 80401)

Solar photons can be converted directly into electrical and chemical free energy with high efficiency. Many types of photon conversion systems are possible and are under investigation. The most developed approach involves photovoltaic devices that are based on solid-state semiconductor junctions; they convert solar photons into electricity. Another approach, commonly termed photoconversion, emphasizes the direct conversion of solar photons into chemical free energy in the form of liquid and gaseous fuels, such as hydrogen, methane, or alcohol. One major attraction of this approach is that the incident solar energy is conveniently stored in the product fuel. Photoconversion can be considered as a type of artificial photosynthesis and is divided into three areas that are distinguished by the nature of the photoactive material in the system: photobiology, photochemistry, and photoelectrochemistry. The respective photoactive species in these three areas involve photosynthetic pigments (e.g., chlorophylls), molecules, and semiconductors. The current status and prognosis for photoconversion will be reviewed with respect to both scientific and technological issues. Scientific and technological spin-offs from photoconversion research, such as photocatalysis, will also be discussed.

Advances in Photovoltaic Solar Technology.
DON L. MOREL(University of South Florida)

Photovoltaic solar energy now powers many consumer electronic products throughout the world and serves as the primary source of power in a small number of remote installations. Manufacturers are running factories at capacity to keep up with growing demand. However, with few exceptions photovoltaic companies are not basing their measure of success on these limited applications, but rather on accessing the massive bulk power market. In addition to the significant financial aspects of this market, its attractiveness is as well an opportunity to provide the world with a clean renewable energy source. Although the requirements for bulk power are much more difficult, significant progress is being made toward its realization. Si based technologies in various forms are dominating current applications. In the drive toward bulk power Si based approaches ranging from thin-film amorphous Si:H and polycrystalline thin-films through advanced sheet growth techniques are being pursued. Also, new thin-film materials, such as CdTe and $CuInSe_2$, are being advanced toward commercialization. $CuInSe_2$ in particular has shown rapid progress with cell efficiencies(13%) and module efficiencies(10%) approaching those of Si. The reach for bulk power encompasses problems ranging from fundamental science through manufacturing. It provides significant opportunities and challenges for physical scientists and engineers to participate in the evolution of a favorable new energy source.

Research Perpectives on the Status of Photovoltaic Cell and Moldule Technologies. LAWRENCE L. KAZMERSKI (Solar Energy Research Institute, Golden, Colorado 80401)

The status and assessment of current photovoltaic *cell and module* technologies are presented. Comprehensive evaluations of single-crystal, polycrystalline and amorphous solar cell technologies are provided, considering both flat-plate and concentrator approaches. The economics and cost goals for the photovoltaic energy generation alternative are discussed, and future trends are examined. Problems and limitations with the various PV technologies are indicated, and research directions for both technology improvement and cost reduction are reviewed. Single-junction solar cells and multiple junction approaches are presented and compared. Data are provided on single crystal technologies, in which Si, GaAs and InP cells have exceeded 22% AM1.5 efficiencies; for thin film, polycrystalline cell, represented by CdTe and $CuInSe_2$ devices with better than 11% conversion efficiency; and for amorphous Si:H with almost 12% efficiency for single-junction structures. Concentrator cells with conversion efficiencies exceeding 25% for single-junction devices and more than 30% for multiple-junction designs are described. Recent advances in component designs, recent efficiency records and stability improvements are reported for research devices and modules. Thin-film modules (greater than 1000 cm^2 in area) with efficiencies in excess of 10% are represented, and structures and operating lifetime data are compared. Research directions required for the continued improvement of the photovoltaic technologies are discussed. Issues relating to component reliability and future research trends are discussed.

Development of Biomass Energy Crops*
WRIGHT, LYNN L. (Oak Ridge National Laboratory)

Biomass energy crops are solar energy collection and storage systems serving as cost-effective feedstocks for a wide variety of fuels and chemicals. Specialized energy crop systems capture 1 to 2% of the total sunlight energy resulting in production of 10 to 30 dry Mg/ha/year of harvestable biomass. This is equivalent to 190 to 570 Gj/ha/year of raw chemical energy produced at a cost range of $3.10 to $1.90 per Gj. Energy crop systems now involve establishment of selected superior trees and grasses as monocultures on agricultural land using specialized planting and maintenance techniques. Genetic engineering is now developing a greater variety of disease-, pest-, and stress-resistant tree and grass cultivars. Systems optimization studies are directed toward developing environmentally sound, sustainable cropping techniques such as mixed species stands. Such efforts will allow more effective utilization of the 15 to 50 million hectares of cropland potentially available for energy crop production in the United States.

*Research sponsored by the Biofuels Systems Division, U.S. Department of Energy, under contract DE-AC05-840R21400 with Martin Marietta Energy Systems, Inc.

Conversion of Lignocellulose to Fuels and Chemicals. B. GOODMAN (Solar Energy Research Institute), J. SCAHILL (Solar Energy Research Institute).

Lignocellulose includes plant materials and certain wastes that can be converted into fuels and chemicals using biological and thermal technologies. Energy crops, which are fast-growing grasses, shrubs, and trees genetically improved and grown specifically for energy use, are the largest potential source of lignocellulose. These materials are composed primarily of cellulose, hemicellulose, and lignin, plus smaller amounts of extractives, ash, protein, and other carbohydrates. Each fraction has the potential to be utilized as a resource for production of renewable transportation fuels or chemicals.

Biological conversion processes can be employed to produce ethanol and methane, while thermochemical conversion processes produce methanol, biocrude-derived gasoline, and chemicals. Research efforts funded by the United States Department of Energy including simultaneous saccharification and fermentation, anaerobic digestion, gasification, and pyrolysis are described. The current state of each technology, current production cost, and research goals are presented.

12-4. Engineering in Japan

Organized by: **Robert S. Cutler** *(Consultant Advisor, Potomac, MD)*, **Ryo Hirasawa** *(Professor, Dept. of General Systems Studies, Univ. of Tokyo, Tokyo, Japan)*, and **Kazuhiko Kawamura** *(Professor, Management of Technology Program, Vanderbilt Univ., Nashville, TN)*

2:30 pm / Sun / 17 Feb **Omni/Congressional**

Research and Engineering at Fuji Xerox and Xerox Corporation
Y. OGAWA (Senior Managing Director, Fuji Xerox Co., Ltd., Tokyo, Japan), W.J. SPENCER (Senior Technical Officer and Director of Research, Xerox Corporation, Stamford, CT).

Xerox Corporation and Fuji Photo Film entered into a joint venture nearly 30 years ago to market plain-paper copiers in Japan. The relationship has grown to over a multi-billion dollar, fully vertically integrated corporation which today collaborates with the Xerox Corporation as a full partner in global markets in photocopiers, laser printers, workstations and other office equipment.

The research and engineering work of the two organizations, which takes place both in Japan and in the United States, is coordinated through a series of senior management councils. These councils have responsibility for developing strategy, coordinating product development, and for participating in joint research and technology programs.

Future of Engineering in Japan
MICHIYUKI UENOHARA (Executive Advisor, NEC Corporation, Tokyo, Japan).

Recently Japan became a great power in the global economy, second only to the United States. At least its industrial technology has reached World-class recognition. And we help many advancing countries by transfering technology and also by promoting basic research in order to contribute to the advancement of science and generic technology.

Japan is well committed to accomplising these missions. However, the nation now possess such material wealth that the interests of its younger generations are shifting away from manufacturing to service industries. Young engineers are more apt to favor basic research rather than product design or manufacturing.

It is said that "History repeats itself." And Japan may well follow the patterns observed in the United States. If Japan is to maintain its product engineering strength, how should its younger generations be motivated to pursue engineering as a career for advancing technology for the betterment of World welfare and peace?

This presentation discusses the current trend in Japanese engineering policy which identifies such questions and the various means for maintaining Japan's engineering strength, while promoting basic research and meeting the demands of a highly information-oriented society.

Dimensionality and the Scientific Transformation of Engineering.

EDWIN T. LAYTON JR. (University of Minnesota)

The scientific transformation of engineering involved not only applied science but engineering research and institutions to support scientific research by engineers. One important theme in engineering scientific research lay in mastering dimensional constraints (e.g., "scale effects").

Newton liberated physical science from scale effects, but his methods were of limited (though important) application to engineering. Osborne Reynolds and others discovered the principles needed to relate the behavior of a scale model to that of full-sized prototypes. He discovered the first dimensionless parameter; others, including Edgar Buckingham showed how engineering theories could be made scale independent by expressing them as functions of dimensionless parameters.

Understanding dimensional limits allowed rapid scientific advances in engineering experiment and engineering theory, in fluid mechanics, heat transfer, chemical engineering, aerodynamics and other fields of engineering. This research was associated with new methods of experiment. The result was make engineering into a "mirror image" twin of science.

Technical Sessions

12T-1. The Interaction of Science and Engineering in the Modern Age

Organized by: **Edwin T. Layton, Jr.** *(Professor, History of Science and Technology, Univ. of Minnesota, Minneapolis, MN)*

8:30 am / Sat / 16 Feb **Omni/Congressional**

Historical Analysis of Technological Rates of Improvement.

JOHN H. LIENHARD (University of Houston), CHRISTIAN L. STRUBBLE (University of Houston)

Exponential rates of technological change are well known. Lienhard has given a theory for the exponential improvement of qualities of technologies that are subject to restrictions. (Their development must be motivated, improvement cannot be restricted by physical limitations, etc.) Typical examples include effectiveness of telescopes -- both optical and radio, efficiency of steam engines, and temperature of superconductors.

The present work extends the theory with *many* new examples. These examples largely come from the 18th, 19th, and 20th centuries. They show absolute adherence to the theory *when it is properly applied*. They also suggest we are at the door of a new stage in technological change today.

Of particular interest to this session: These examples articulate the transition to technological professionalism around 1840. The present examples of exponential growth, properly delineated, reveal something of the character of what Cardwell has called "The Fourth Turning Point in Western Technology," and what Whitehead has called "The Method of Invention of Inventions."

From Wave-Lines to Stream-Lines: The Role of Engineering Science in Naval Architecture.
DAVID F. CHANNELL (Univ. of Texas at Dallas).

This paper focuses on the relationship between the science of hydrodynamics and the practical problem of hull design in order to investigate the role of engineering science in the development of technological knowledge. The demands for faster ships and the application of steam power in the second half of the nineteenth century required naval architects to develop new design principles for ships' hulls. British naval architects such as J. Scott Russell and W.J.M. Rankine drew knowledge from both the science of hydrodynamics and the established practice of designing "fair surfaces" in order to create a new body of techno-

logical knowledge based on new concepts such as wave-lines and stream-lines. These concepts, the result of engineering science, allowed naval architects to make dynamic calculations concerning the friction that would be generated by a particular hull design at a given speed. This information provided naval architects with a way to adapt their design principles to new demands of performance and speed.

Mapping Invention and Design: The Case of Bell, Edison, Gray and the Telephone.
W. BERNARD CARLSON (University of Virginia), MATTHEW M. MEHALIK (University of Virginia)

It is well known that in the course of creating new technology, inventors and designers utilize sketches, models, and written notes. They also document their inventions through letters, legal testimony, and patents. Nevertheless, historians and other scholars of technology have found it difficult to analyze and synthesize these different sources of evidence. In our efforts to investigate invention as a cognitive process, we are developing a new set of computer-based techniques for analyzing and depicting the activities of an inventor. In this paper, we will describe how these techniques permit us to analyze sketches, artifacts, and textual sources and to prepare different maps and diagrams of the invention process. We will present maps of how Alexander Graham Bell, Thomas Edison, and Elisha Gray developed telephones in the 1870s, for the purpose of illustrating and comparing their mental or cognitive activities. We will also suggest how these mapping techniques may be used to refine our overall understanding of science and engineering as intellectual enterprises.

A Cognitive Theory of Invention and Design.
MICHAEL E. GORMAN (University of Virginia)

Historians of technology have provided important accounts of invention and design, but rarely have they employed concepts which permit a rigorous analysis of the mental or cognitive processes involved in these activities. Drawing on cognitive psychology, this paper will address this theoretical lacuna and propose concepts which can be used to investigate invention as a cognitive process. I will argue that inventors combine ideas with objects, or mental models with mechanical representations. For inventors, mental models are dynamic representations based on both scientific ideas as well as antecedent devices. Inventors frequently divide their mental models into slots in order to test different components or mechanical representations. To illustrate these concepts, this paper will use examples from the history of the telephone and will discuss how Alexander Graham Bell, Thomas Edison, and Elisha Gray each developed a distinctive "speaking telegraph." At the conclusion, I will comment briefly on how these concepts allow us to interpret in new ways the similarities and differences of science and engineering in the modern age.

12T-2. Geophysical Imaging Systems: From Medical Microcosm to Outer Space

Organized by: **Anna C. Roosevelt** *(Director, Lower Amazon Project, Dept. of Anthropology, American Museum of Natural History, New York, NY)*

8:30 am / Tue / 19 Feb **Omni/Congressional**

Positron Emission Tomography: A New Imaging Tool For The Study of Parkinson's Disease

G. Ricaurte (Johns Hopkins University) and J. Tetrud (California Parkinson's Foundation)

Parkinson's disease (PD)is a progressive disorder of the brain resulting in degeneration of specific neurons which produce a neurotransmitter called dopamine. The major clinical features of the disease include slowed movement (bradykinesia), rigidity, impaired balance (postural instability) and tremor at rest. Experimental work in a laboratory model of PD and studies of post-mortem human brain has established dopamine deficiency as the prime cause of the clinical manifestations. With the advent of a newly developed imaging technique known as positron emission tomography (PET), it is now possible to measure brain dopamine in patients with PD during life. The PET scan demonstrates decreased dopamine levels in a region of the brain known as the "striatum" in patients with clinically evident disease. In addition, there is preliminary evidence that PET can detect a decrease in dopamine level in patients with PD prior to the development of symptoms; the so-called "preclinical" period. Recently, the results of several clinical drug studies suggest that progression of PD might be slowed in patients treated with a drug which inhibits the enzyme monoamine oxidase (MAO) B. Further, there is now growing support for the notion that the preclinical period of Parkinson's disease may extend many years (perhaps 15 to 20) before clinical features emerge. Thus, PET may ultimately allow clinicians to diagnose this disease before symptoms develop and provide the opportunity to slow or halt its progression by intervening with protective therapy such as MAO-B inhibition.

Airborne Geophysical Surveys for Mining, Petroleum, and Groundwater Prospecting.
WILLIAM A. SAUCK (Western Michigan University, Kalamazoo).

Geophysical systems have operated routinely from airborne platforms (both fixed-wing and helicopter) for approximately 50 years. Generally, the scale at which they are applied depends upon flight altitude, so that close-spaced flight paths draped near the surface give maximum resolution of small, shallow targets while high altitude, widely spaced lines give deeper regional and even continental-scale information.

Magnetic methods are used for geologic mapping, for direct location of magnetic mineral deposits, and for determining thickness of sedimentary basins in petroleum exploration. Inductive electromagnetic (EM) methods are used to locate conductive mineral deposits, to map soil and rock conductivities in general, and to delineate the extent of saline groundwater invasion in coastal aquifers. Radiometric surveys are useful for discriminating between different rock and soil types based on their differing natural background radioactive mineral content. It is also of direct use in prospecting for uranium and thorium mineral deposits. Thermal infrared (IR) mapping has various uses ranging from fault location to application in special groundwater problems. Airborne gravity measurements are a very recent development for reconnaissance work. Synthetic Aperture Radar has had extensive use in primary regional mapping in tropical countries.

Geophysical prospecting has given impetus to the computer revolution and in return has been greatly improved by the capability to gather 100 to 1000 times more data per line kilometer than systems of a decade or two ago. Advances in navigation and absolute flight path positioning ability have accompanied the increased speed and memory capability of onboard computers. Helical scan digital recording on conventional video-cassettes can pack more than 2 Gbytes of data on one 8-mm cassette. Data presentation has progressed from traditional contour maps to color contour maps, to combined color displays linking results of two or more surveys. Areal map data can also be presented as shaded-relief maps, with any "illumination" angle and azimuth, to search for subtle features.

Imaging Past Environments of Northeastern Africa from Space. FAROUK EL-BAZ (Center for Remote Sensing, Boston University).

Images obtained from earth orbit by manned and unmanned spacecraft are useful in interpreting environmental conditions in all types of terrain. In desert regions, due to the scarcity of vegetation and the relatively slow pace of change, these images also reveal details of palaeo-environments. This is especially true in hyper-arid regions such as the northeastern Sahara of North Africa. Photographs obtained by the unmanned Landsat and the manned missions of Gemini, Apollo, Apollo-Soyuz, Skylab, and particularly by the imaging radar of the Space Shuttle reveal evidence of previous episodes of wet climates. This evidence includes an ancestral delta of the Nile River, dry water courses along escarpments, sand-buried ancient streams, and a number of dry lakes. Field investigations of these sites uncovered numerous indications of previous human habitation in this desert dating back 200,000 years; the last wet climate prevailed approximately 5,000 years ago. Test wells drilled in the vicinity of these sites proved vast "fossil" groundwater resources stored in the sandstone substrate. These findings encourage further exploration for additional groundwater resources in this and similar deserts.

Computerized, Solar-powered Geophysical Survey at Archaeological Sites in Brazil. ANNA C. ROOSEVELT (American Museum of Natural History)

The Lower Amazon Project in northern Brazil has developed an automated system of geophysical

surveying to investigate prehistoric settlements in northern Brazil. The system unifies geophysical field data collection and analysis with portable computers and a combination of custom and commercial software. Data from resistivity, conductivity, magnetic, seismic, and radar surveys of ancient residential and ceremonial structures, plazas, earthworks, and garbage dumps is collected, copied, and manipulated on Zenith and Hewlett-Packard computers and printed with Kodak printers. Data transmission is accomplished with XTalk software, and data bases are created and manipulated with DBase, Abstat, Generic Cadd, Surfur, and other programs. Improved ground control is achieved by use of a Topcon infrared laser electronic distance measuring device (EDM), connected with the computers through a RS232 cable. Instruments are powered by an efficient and inexpensive battery charging system with Arco solar collectors. The system -- widely applicable for field research in general -- allows high resolution mapping of underground stratigraphic features and immediate display, backup, and analysis of spatial data in the field.

Photogrammetry as a Tool for Archaeology: Resurrecting Archival 3-D Photographs and Documenting Cultural Heritage Resources.
Lawrence G. Desmond (University of Minnesota-Morris).

In 1989 and 1990 two archaeological field projects were initiated to study the applicability of photogrammetry to make measurable drawings from uncalibrated 19th century stereo photographs of Maya buildings, and for the documentation of Maya architecture. During March 1989 a free standing Maya building called La Iglesia at Chichen Itza, Yucatan, now missing part of its roof comb, was photographed with a calibrated camera and surveyed. It was then drawn to scale with a stereoplotter using the 1989 photos for control and an 1875 uncontrolled stereo photo by Augustus Le Plongeon to fill in the missing part of the roof comb. Also in March 1989 and again in 1990 the 100 foot high Adivino Pyramid at Uxmal, Yucatan was documented photogrammetrically from the ground and from a small hydrogen balloon, and architectural drawings of its complicated facades were made from the photos. Both projects successfully demonstrate photogrammetry to be an important tool for archaeological research and documentation.

Geophysical Survey in Underwater Archaeological Research.
LARRY MURPHY (National Park Service).

Underwater archeological survey, site documentation and evaluation rely heavily on remote sensing technology. Historic site survey, particularly for shipwrecks, utilizes magnetometer and side-scan sonar. Inundated terrestrial site survey normally adds subbottom profiler to the instrument array. Diving limitations have fostered use of remote operated vehicles and electronics to extend site access time and maximize documentation efficiency. A review of archeological applications of survey instrumentation, positioning, aerial thermal imaging, remote operated vehicles, sonic mapping and imaging and computer integration will be presented with field application examples.

Data Visualization and Image Processing for the Geosciences
T.H. LEE WILLIAMS AND WES LEE ROBERTS (University of Oklahoma)

The Geosciences Computing Network (GCN) at the University of Oklahoma supports the diverse scientific visualization and image processing needs in the College of Geosciences. Meteorology researchers develop numerical atmospheric models that run on supercomputers and generate multivariate, three-dimensional, time varying data sets, often one gigabyte or larger, that must be rendered as images to comprehend the results. Geophysicists merge one-dimensional well-log data, two-dimensional gravity and magnetic data and three-dimensional seismic data to comprehend subsurface structures. Geographers use digital map and satellite images co-registered in geographic information systems. These diverse needs are met in a common integrated environment that incorporates conventional graphics and image display systems and specialized systems for real-time imaging, animation, rendering, and stereoscopic display of real or synthetic data.

Planetary Image Processing on Microcomputers.
ROBERT G. STROM, R. GREENBERG, and L. DOOSE (University of Arizona).

Advances in computer technology during the past 3-5 years and the development of image processing software have made it possible to do rather sophisticated image processing on microcomputers. In particular, the program "Image" developed at NIH for Macintosh II computers provides a powerful and friendly tool for planetary image processing and first order analyses. We are currently augmenting Image to include planetary-specific routines such as radiometric and geometric calibration of spacecraft images, and the USGS has added thematic mapping capability. Voyager images (and eventually all spacecraft images) are currently available on CD's and thus are readily available to the microcomputer. Now sophisticated interactive planetary image processing and analysis can be done on a relatively inexpensive microcomputer. The application of this system to planetary research is used at the University of Arizona as part of the NSF education project "Image Processing for Teaching". Technology developed for pre-college science education is having a substantial impact on planetary research methodology.

12T-3. Changing Lives: New Technology for People with Disabilities

Organized by: **Virginia W. Stern** *(Director, Project of Science, Technology and Disability, AAAS, Washington, DC)* and **Jan Galvin** *(Director, Rehabilitation Engineering Center, National Rehabilitation Hospital, Washington, DC)*

8:30 am / Sun / 17 Feb **Sheraton/Holmes**

Flexible Reading Systems
Getting Technology into the Hands of the Disabled
JAMES R. FRUCHTERMAN (Arkenstone, Inc.)

There are many obstacles on the path between the disabled and relevant new technology. The disabled markets are small and distribution is difficult. Costs soar because products cannot be mass-produced. High technology companies need to make high profits to compensate their investors for risk. Consumers lack information on what is available. This paper describes how Arkenstone was founded as a non-profit high technology company to bring a better and lower cost reading machine to the visually impaired. By negotiating special deals with high technology companies to buy hardware at low costs and by customizing only software, Arkenstone took advantage of the economies of scale of the huge commercial PC market. This reduced the cost of reading technology four-fold compared to products designed from scratch for the blind. By using technically skilled users as distributors, the problems of distribution and support were reduced. A non-profit doesn't need to make a profit; breaking even is the financial goal.

The beneficial result is that far more blind people have benefited from technology in the form of reading systems.

E-mail: a tool for the disabled scientist and student
J. Tilak Ratnanather
Department of Mathematics, City University, Northampton Square, London EC1V OHB

Information technology has made a dramatic impact on the lives of people with varying disabilities. In particular, computer networks have enabled not only disabled users but also others to correspond or exchange information with each other. As a prelingually severely hearing impaired person, I have benefited from electronic mail (e-mail) during my doctoral research in mathematics at the University of Oxford. In particular, e-mail was one of the major factors in a successful completion of a project in collaboration with a colleague at Cornell University. This presentation will describe the advantages of e-mail from the research perspective. Further examples of the educational and social benefits particularly for the hearing impaired undergraduate will be presented to illustrate the unlimited potential of e-mail and computer networks by way of electronic discussion groups, bulletin boards (BBS) which act as sources of information and distance learning.

Speaking for the Minority: An Overview of Speech Processing Interfaces for People with Disabilities
Bosco Keown (IBM United Kingdom Laboratories, Ltd. & University of Southhampton, UK).

There is considerable scope for the use of speech processing-based tools and aid to increase the accessibility and mobility of handicapped individuals. However, the limitations of such technology, particularly where speech recognition is concerned, have thwarted the success of attempts to utilise this technology in building useful and reliable interfaces for the disabled.

This report provides an overview of the capabilities and limitations of current speech processing technology as far as such tools and aids are concerned. The promise of new developments in speech synthesis and recognition in assisting disabled members of society to lead fuller lives is also discussed.

Some consideration is also given to how best to apply speech processing technology, and to the kind of aids for people with disabilities that may soon become reality.

Electroejaculation for Fertility Evaluation in Spinal Cord Injured Men. S.W.J. SEAGER, and L.S. HALSTEAD, (National Rehabilitation Hospital, Washington, D.C.)

Until recently it was thought that up to 95% of all spinal cord injured (SCI) men were infertile. An electroejaculation (EE) study was initiated in 1985 using this method to obtain semen in neurologically impaired men. We reported the first U.S. pregnancy using this technique in 1987. To date some 300 SCI men have been stimulated in over 2,700 EE procedures. The overall success rate in obtaining an ejaculate has been ±80%. To date there have been 47 reported pregnancies in the U.S. and Europe using EE in SCI men. The EE equipment includes a 60Hz sine wave stimulator which is connected to a probe placed in the rectum. The amount of stimulus currently recommended ranges from 0 to 20 volts and 0 amp to 400 milliamps. Careful notation is made of the number of stimulations and the response of the patient in relation to voltage administered. In most instances, ejaculation commenced prior to full erection and continued as full erection was achieved. Subjects comments have been very favorable. The procedure, performed in the Out Patient Clinic takes 5-10 min. The subject can then leave and return to work, etc. The animal background that led to the human utilization of the procedure will be described along with current data.

Summary of Lightweight Orthotic Brace Program
Moreno White (SPARTA, Inc.)

There is an expressed need from the orthotic, and rehabilitation community for the development of strong, lightweight external bracing for the physically handicapped. In response to this expressed need, SPARTA initiated a successful Internal Research and Development (IRAD) program based on its advanced materials Strategic Defense Initiative Organization (SDIO) interceptor work, to investigate the feasibility of using advanced composites to fulfill the requirement for strong lightweight orthotic devices. At the suggestion of the National Institute for Disability and Rehabilitation (NIDRR), a long leg brace was selected as the proof-of-concept device. The SPARTA IRAD program used a longleg brace as a prototype device and included analysis, design, fabrication, and tests of two full scale long leg graphite/epoxy orthotic braces. The prototype braces demonstrated a 65% weight reduction over state-of-the-art (SOA) steel braces, while obtaining a 100% increase in strength and a 40% increase in stiffness. An advanced lightweight co-woven, co-processed composite to metal joint was also developed in the IRAD program to facilitate joining the composite upright to the metal knee joint.

Although the SPARTA IRAD program successfully demonstrated the proof-of-concept, the graphite/epoxy composite brace could not be postformed and therefore would have limited application to the general patient population. To address this issue, NIDRR sponsored a materials development effort to develop a postformable thermoplastic composite which could be modified by the practicing orthotist to fit a wide variety of patients. Under this program, SPARTA analyzed the design requirements for a SOA steel brace for a 95% percentile paraplegic patient. These data were used to obtain the advanced thermoplastic/carbon fiber structural design. The postformability was achieved by developing a discontinuous cloth composite material using co-woven graphite/epoxy thermoplastic material. Mechanical tests of the system, demonstrated that a structural member (brace upright) subcomponent could be postformed with little or no degradation in strength.

The successful demonstration of technology transfer between advanced SDIO materials research to the medical field led to private funding of an effort to commercialize the bracing composite material for use by the general orthotist. This program was recently sponsored by General Reinsurance Corporation and managed by the National Rehabilitation Hospital (NRH). The objective of this program is to develop the advanced materials effort sponsored by NIDRR and the Army ASDIO materials laboratory to a point where the lightweight orthotic brace material can be used by the practicing orthotics allowing him the ability to offer his patients an orthosis which is stronger and much higher strength than the current steel brace now available.

Applying knowledge of the Rehabilitation Community to Urgent Problems of the Aging Community. DENNIS R. LA BUDA (Technology and Aging Group Inc.)

Health care cost for the elderly continue to escalate. Budget negotiations for FY 1991, call for cuts in both Medicare and Medicaid. To quote Leon Panetta, " ...care will need to be as inexpensive as possible, with an emphasis on compassionate, less costly alternative forms of care; and encouragement will have to be provided to those who require care to remain in their homes, with their families, or in their communities. In coming years the focus in aging health care will continue to move toward remedial chronic long-term care, in the home and community rather than institutional settings. Traditionally, care for the elderly has been highly human intensive. Other than grab bars, wheelchairs, and walkers, emphasis on technologies to promote independence have been woefully unexplored. The rehabilitation community's vast experience in the use of assistive technology to promote independence will become essential in the future care of the elderly.

13. Physics; Chemistry

13-1. Seventy-five Years of General Relativity

Organized by: Arthur B. Komar *(Professor of Physics, Yeshiva Univ., New York, NY)*

8:30 am / Fri / 15 Feb — Omni/Diplomat

Einstein's Theory of Gravitation: Historical Reflections, by PETER G. BERGMANN (Dept. of Physics, New York University, N.Y., N.Y.)

A historical review and personal reflections of the development and evolution of Einstein's ideas with regard to the General Theory of Relativity is presented.

Non-Local Variables for General Relativity, Ezra T. Newman, (Univ. of Pittsburgh), Carlos Kozameh, (Univ. of Cordoba, Argentina)

General Relativity, which is a non-linear field theory for the description of space-time geometry, has almost always been studied via local variables such as the metric tensor, the connection and the curvature tensor. The vacuum Einstein field equations are then local differential equations among these variables. It is the purpose of this note to show how one can study and reformulate the vacuum Einstein equations, in the physically important case of (simple) asymptotically flat space-times, in terms of the properties of the light-cones at extremely large distances from their apex or origin. More precisely, we first consider the two non-local concepts, 1) the collection of light-cones emanating from all space-time point as well as 2) the future null boundary of the space-time (i.e. the future end points of all light rays) which is referred to as I^+. We then consider the intersection of each of these light-cones with I^+ thus constructing two-surfaces (topologically spheres) referred to as "light-cone cuts" of I^+. There is clearly a one-to-one correspondence between space-time points and these non-local "light-cone cuts". We show that the conformal properties, i.e., metric properties up to scale, of the asymptotically flat space-time, are completely determined by knowledge of these "light-cone cuts". If an additional non-local variable, the "parallel propagator" along all null geodesics, is introduced then the scale can be determined and one can obtain the full space-time metric. Furthermore, one can find coupled integro-differential equations involving the two non-local variables, that are equivalent to the Einstein field equations. In conclusion we discuss some possible applications and the possible significance of this reformulation of General Relativity.

Experimental Gravitation, by RANIER WEISS (Dept. of Physics, Massachusetts Institute of Technology, Cambridge, MA.)

A broad review of the current status of experimental and observational work in Gravitational Physics is presented. Among the topics to be considered are the classic terrestrial and astronomical observations as well as the search for gravitational radiation.

The Problem of Quantum Gravity: How to Finish the Revolutions of Twentieth Century Physics, BY LEE SMOLIN (Dept. of Physics, Syracuse University, Syracuse, New York)

I discuss the problem of constructing a theory that unifies general relativity and quantum theory, its history and present prospects. General relativity and quantum theory are the two revolutions that have shaped the physicists conception of nature in the twentieth century. Each gives us a picture of what nature is at the most fundemental level, the problem is that what we want from a theory of nature is one picture and not two. Thus, what we want is to invent a theory of space, time and cosmology which is consistent with both Einstein's general relativity and quantum theory. I explain what the main issues are that confront us when we attempt to describe physical situations in which general relativity and quantum theory both play a role, and describe the highlights of the history of attempts to resolve these issues. In recent years some very exciting things have happened in this field such as black hole radiation, quantum cosmology, string theory and the new variables. I will briefly describe the significance of each of these developments for the main problem, then end with some speculations about the directions from which a final resolution of this problem may come.

13-2. Elementary Particle Physics: Present Status and Future Prospects

Organized by: **Paul H. Frampton** *(Professor, Dept. of Physics and Astronomy, Univ. of North Carolina, Chapel Hill, NC)*

2:30 pm / Fri / 15 Feb **Omni/Diplomat**

Overview of Theory
PAUL H. FRAMPTON (University of North Carolina at Chapel Hill)

The standard model of strong and electroweak forces, and extensions thereof, will be described at an elementary level with particular emphasis on theoretical predictions which may be tested at the highest energy existing and future accelerators.

Future of High-Energy Electron Physics
BURTON RICHTER*(Stanford Linear Accelerator Center)

Accelerator-based high-energy physics has proceeded for many years on the two frontiers of electron and proton accelerators. In this presentation, I will discuss the activities around the world in three areas: novel collisions (electron-proton colliding beams), the study of rare processes (very high-intensity electron-positron colliders), and high-energy facilities (the new technology of linear colliders). Progress in all three areas will be necessary to extend and complement the work of the present generation of accelerators and future proton machines.

*Work supported by the Department of Energy, Contract No. DE-AC03-76SF00515.

Status of Superconducting Super Collider
ROY F. SCHWITTERS (Superconducting Super Collider Laboratory)

The scientific and technical status of the superconducting super collider project will be presented.

13-3. Quantum Mechanics of Single Atoms

Organized by: **Thomas Erber** *(Professor of Physics and Professor of Mathematics, Illinois Institute of Technology, Chicago, IL)* and **D. J. Wineland** *(National Institute of Standards and Technology, Boulder, CO)*

8:30 am / Tue / 19 Feb **Omni/Diplomat**

Single Ion Mass Spectroscopy

DAVID E. PRITCHARD (M.I.T.) KEVIN BOYCE (M.I.T.) and ERIC CORNELL (M.I.T.)

We have constructed a mass spectrometer which determines the mass of a single trapped ion using ion cyclotron resonance. This has advanced the sensitivity of mass spectrometers by ~ two orders of magnitude, and the precision of mass intercomparison by a factor of ~ 6. A superconducting resonant circuit and a SQUID constitute a detector capable of detecting the axial motion of an arbitrary single ion. The cyclotron frequency can be determined to a relative precision of $\sim 2 \times 10^{-10}$ in a one minute measurement, but temporal drift of the magnet currently limits mass intercomparison to $\sim 4 \times 10^{-10}$. We shall discuss plans to increase this precision to below 10^{-11} and describe some applications of this level of precision in both Chemistry and and Physics. We are grateful for support of this work by National Science Foundation and Joint Service Electronics Program.

Experiments at N.I.S.T. with Stored Ions. D. J. HEINZEN, J. J. BOLLINGER, W. M. ITANO, J. C. BERGQUIST, F. MOORE, M. G. RAIZEN, and D. J. WINELAND (National Institute of Standards and Technology, Boulder, CO).

Ions which are stored in electromagnetic traps and laser-cooled to low temperatures constitute an almost ideal sample for spectroscopic experiments. The ions can be localized in space for many hours, nearly free from the perturbing influence of collisions, Doppler shifts, and electric or magnetic fields. Further, single ions can easily be studied with the technique of "electron shelving," in which the state of a single ion is determined by the presence or absence of a burst of scattered photons from a strongly fluorescing state. Recent experiments at N.I.S.T. have exploited these techniques to observe a variety of interesting phenomena. These include the observation of "quantum jumps" of a single atom, and the cooling of a single ion into its quantum ground state of motion. Also, spectroscopic measurements of very high accuracy have been performed. These measurements have led

to several interesting tests of quantum mechanics, and may ultimately lead to atomic clocks of unprecedented accuracy. In addition, samples of between two and 10^5 trapped ions have been observed to crystallize into ordered structures. A review of these topics, as well as a report on work in progress, will be presented.

Nonclassical Light: The Extraordinary Radiation Properties of a Micromaser. GERHARD REMPE (Sektion Physik Universität München, Am Coulombwall 1, D-8046 Garching, Germany).*

We report about the first investigation of the nonclassical photon-number fluctuations of a micromaser field. The maser cavity is cooled to a temperature of 0.5 K to exclude thermal photons and has a quality factor of $3 \cdot 10^{10}$. Single photons can be stored for 0.2 seconds. Velocity selected Rydberg atoms pump the maser. The photon statistics in the cavity are measured via the statistics of the atoms that have emitted a photon and therefore leave the cavity in the lower maser level. Their fluctuations are reduced up to 40% below the Poisson level if the field induces complete Rabi-oscillations of the atom. This corresponds to photon-number fluctuations in the cavity of up to 70% below the vacuum-state limit and gives rise to an anti-bunching of atoms. All measurements are done on a single quantum system. We show that the measurement process introduces quantum mechanical correlations in the number of atoms detected. We propose and analyse new experiments based on this maser designed to study the quantum measurement process: In a modified double-slit experiment the nonclassical maser field stores the "which-path" information and therefore destroys the interference structure.

*Present address: California Institute of Technology, Norman Bridge Laboratory of Physics, Pasadena, CA 91125.

Optical Spectroscopy of Single Ions: An Approach to the Ideal
WARREN NAGOURNEY (University of Washington), NAN YU (University of Washington), and HANS DEHMELT (University of Washington).

Recent developments in trapping and laser cooling single atomic ions have brought us closer to the realization of an "ultimate resolution" spectrometer based upon a narrow optical transition of a single, laser-cooled trapped ion. In assessing the progress made toward such a device, we first propose an "ideal" spectrometer which is totally free from all experimental errors. The spectral resolution of forbidden transitions studied with such a spectrometer would be limited only by the inherent quantum uncertainty due to the finite excited-state lifetime. We will then discuss several recent experiments involving single, laser-cooled, trapped ions which demonstrate considerable progress toward the realization of the ideal. Finally, future experiments have been proposed whose goal is an optical spectrometer with a long term absolute accuracy of one part in 10^{17}. It will be argued that such an accuracy is within the reach of a spectrometer based upon a single, laser-cooled ion from group IIIA of the periodic table. Ions from this group will be shown to possess sharp optical transitions which are not overly perturbed by external magnetic or electric fields; these ions also allow one to employ a double-resonance technique which will result in optimum signal to noise.

The Quantum Mechanics of Single Atoms
T. ERBER (Illinois Institute of Technology)

High energy physics experiments show that quantum mechanics applies to single objects. But individual trapped atoms can also be recycled through sets of states, and their coherent evolution manipulated by lasers and trapping fields. Consequently, several basic issues of quantum measurement theory can be checked by novel low energy experiments. These include: (1) The existence of distinct types of wave function collapse (Zeno paradox). (2) The narrowing of fast transitions in double resonance fluorescence (beating the uncertainty principle without breaking the rules). (3) Next photon statistics and color exchange (quasi-radiationless quantum currents). (4) Testing the randomness of quantum jumps (unbreakable cryptograms?). Comparisons with experimental results obtained at NIST (Boulder), and at the University of Oregon will be presented. Further experimental tests --- ranging from conservative to speculative --- will so be discussed.

13-4. Chemistry Rediscovers Materials Science

Organized by: George S. Hammond *(Professor, Georgetown Univ., Washington, DC)*

8:30 am & 2:30 pm / Mon / 18 Feb — Omni/Hampton

Architecture with Photopolymers
DOUGLAS C. NECKERS (Bowling Green State University)

Stereolithography couples the power of computer graphics with the formation of a gelled photopolymers to form a real three dimensional image. The work to be reported herein deals with three dimensional imaging with photopolymers of a variety of kinds. Progress in studying photopolymerization with visible light lasers and in three dimensional photochemical architecture will be detailed. Relationships will be drawn between photoinitiator type and monomer chemistry.

New Inorganic-Organic Hybrid Materials by the Sol-Gel Approach. GARTH L. WILKES (Virginia Polytechnic Institute & State University, Polymer Materials and Interfaces Laboratory and Department of Chemical Engineering, Blacksburg, VA 24061).

To meet the challenges of new material requirements, scientists must strive constantly to develop new systems. One recent approach has been to prepare inorganic-organic hybrid materials by using the sol-gel method common to ceramists. This technique allows a considerable range of chemistry to be used and may lead to the development of a whole array of systems that have potentail applications (structural, optical, etc.). This lecture will provide an overview of the general status of this approach, with emphasis on the work that comes from the speaker's laboratory.

Are Liquid Crystals Ordered Reaction Media?
ROSEANN JENKINS, ALBERTO NUNEZ, ZHIQIANG HE, PATRICIA M. VILALTA, GEORGE S. HAMMOND, and RICHARD G. WEISS (Department of Chemistry, Georgetown University, Washington, DC 20057).

Liquid crystals are a diverse class of materials that can serve as media for investigating the shape changes occurring along a solute's reaction pathway. In principle, they offer a reactant a variety of microenvironments and constraints to motion. In practice, the influence of a solute on its cybotactic region, the possibility of several solubilization sites in one medium, anisotropic diffusion, and the difficulty of comparing parameters from reactions performed in "model" and anisotropic solvents can complicate interpretations of data.

Several examples illustrating both the utility and problems of liquid crystals as ordered reaction media will be presented.

Electrical Properties of Organic Solids.

Dwaine O. Cowan, Chemistry Department, The Johns Hopkins University, Baltimore, MD 21218

Today, one of the most exciting and challenging fields that a chemist can explore is the development of organic materials with interesting solid state electrical, optical, and/or magnetic properties. Research in this area provides a challenge for the physical organic chemist interested in the correlation of structure and physical properties as well as for the organic chemist interested in developing the synthesis of new unnatural and often exotic compounds. The study of organic radical cation salts like those derived from tetrathiafulvalene (TTF) and the more recently preparted selenium and tellurium analogs has already provided a wealth of information on how low dimensionality and narrow bands affect the electrical conductivity and magnetic susceptibility of organic radical ion salts. However, the study of these materials has also provided us with a long list of unanswered or partially answered questions. How important is Frohlich (sliding charge density wave) conductivity in these materials? How can

three-dimensional interactions be increased in materials that are inherently one- or, at best, two-dimensional? What is the source of the attractive interaction for the superconductivity in the salts of tetramethyltetraselenafulvalene (TMTSF) and bis(ethylenedithiolo) tetrathiafulvalene (BEDT-TTF)? What structural modifications can be made in the organic donor to increase the superconducting transition temperature?

Acknowledgment: This work was supported by NSF through grant DMR-8921071.

Theory of Extended Structures
JEREMY BURDETT (Chemistry Dept and James Franck Institute, The University of Chicago, Chicago, IL 60637)

Until recently chemists have shied away in general from the problem of tackling the electronic structure of solids probably because of their perceived geometrical and theoretical complexity. However in the past decade chemical ideas supported by the results of computations of various types have allowed considerable insight into the electronic structure of solids. In this talk some of the new ways chemists have developed in the theoretical solid state will be described.

Exploratory Synthesis - Where Materials are Born and the Unexpected Turn Up. JOHN D. CORBETT (Department of Chemistry and Ames Laboratory-DOE, Iowa State University)

Synthesis is clearly the first step in the creation of a new type of material or the discovery of an unusual property. History shows that this first step is seldom coupled with the subsequent developments in time or in place. Continued new synthetic discoveries also make it obvious that the prediction of compositions and structures, let alone properties, of new phases in many unexplored systems is virtually impossible. The discovery of the unexpected and unprecedented is an exciting feature of exploratory synthesis.

These aspects will be illustrated for two families of nominal binary compounds, many of which are stabilized by a third element acting as an interstitial. One group involves reduced halides of the group III and IV transition metals which contain octahedral metal clusters either as isolated groups or condensed into infinite chains or double metal sheets. Possible interstitials include both main group elements (Be–N, Al–P, etc.) and other metals (e.g., Mn–Cu, Re–Au). Second, many electron-rich A_5B_3 compounds with the Mn_5Si_3 structure provide a different and diverse chemistry with interstitial elements (Z) centered within confacial chains of metal octahedra. Well investigated systems include A_5B_3Z for Zr_5Sb_3, Zr_5Sn_3, La_5Ge_3, and Ca_5Sb_3 where Z in some may range from Co through Se.

From Chemistry to New Materials. KENNETH R. POEPPELMEIER (Department of Chemistry and Ipatieff Catalytic Laboratory, Northwestern University, Evanston, Illinois)

The chemists' role in the preparation of new materials is an important one in materials science. The chemist's approach can vary widely however from that of building up solids from molecules (molecular precursors) to discovering that solids themselves can exhibit exceptional chemical reactivity.

This chemistry has influenced research world-wide on metal oxides which find widespread use as heterogeneous catalysts because of their varied solid state chemistry and exceptional stability. A review of these new chemical syntheses and materials, and their potential applications for catalysts will be presented.

Chemistry and Physics of Thin Films for Electronics. EUGENE A. IRENE (University of North Carolina).

There are a number of fundamental procedures that comprise modern microelectronics processing: crystal growth, surface cleaning, film growth, etching, and patterning. These steps are repeated throughout device and IC production. All of these processes rely heavily, if not entirely, on an understanding of Chemistry, yet there are precious few Chemists involved. Therefore, many of the chemical problems are being worked on by electrical engineers, physicists and materials scientists. In this presentation film growth by surface thermal oxidation and film removal using energetic beams and plasmas and chemical etching are discussed in the context of the relevant chemical problem, the techniques that are used to understand the problem and some solutions. The thermal oxide on Si is a single phase oxide with kinetics sensitive primarily to the ambient and the Si crystal orientation but with film stress and the electronic nature of the surface also identified as important. The oxide on InP is more complex two layer oxide with different properties for each layer. All semiconductor surfaces are damaged upon exposure to energetic ambients such as ion beams and plasmas that are used extensively in processing. Ellipsometry can be used to monitor in-situ and during the processes of film growth, etching and surface damage.

13-5. Mathematics in the Materials Sciences

Organized by: David Kinderlehrer *(Professor, Dept. of Mathematics, Carnegie Mellon Univ., Pittsburgh, PA)*

2:30 pm / Sun / 17 Feb — Omni/Hampton

Frustrated Solids
R. D. JAMES (University of Minnesota) and D. KINDERLEHRER (Carnegie-Mellon University)

Experience with Gibbs' theory of fluid phases suggests that regions occupied by different phases of a material in equilibrium should be large and should have smooth (or piecewise smooth) boundaries, so as to minimize interfacial energy. In solids, we often observe finely dispersed phases with highly convoluted interfaces. We discuss the reasons for the existence of this fine structure in solids, drawing upon examples of martensitic and magnetic materials.

Evolving Phase Boundaries.
MORTON E. GURTIN (Carnegie Mellon University).

This talk will present a coherent treatment of the mathematics and thermomechanics of evolving phase boundaries. The topics to be discussed are: basic equations, free-boundary problems, instabilities induced by supercooling, isothermal theory and curve-shortening, formation of facets, melting-freezing waves.

Extremal Microstructures: What Do We Know About Composites.
ROBERT V. KOHN (Courant Institute, NYU).

The macroscopic properties of a composite material depend in a subtle way on the geometry of the microstructure. Composites with extremal effective behavior are of special interest. They not only arise naturally, in certain coherent phase transitions; they also arise synthetically, from problems of structural optimization. Recent mathematical activity has identified some interesting new classes of extremal composites. They include isotropic polycrystals of extremal conductivity, for which the associated microstructure is self-similar; and two-component elastic composites of extremal rigidity, for which the associated microstructure is "sequentially laminated." These developments are the culmination of work by many people, including Avellaneda, Cherkaev, Lipton, Lurie, Milton, Murat, Nesi, and Tartar as well as myself. I will survey the present state of our knowledge concerning extremal microstructures, including a discussion of the examples cited above.

The Computation and Visualization of Defects and Microstructure.
MITCHELL LUSKIN (California Institute of Technology).

Relaxation and gradient methods have been developed during the past several years for the computation of molecular orientation in liquid crystals. These methods have contributed to the classification of stable defect structures and the description of some of the transitions that occur under the influence of electric and magnetic fields. Related numerical methods have also successfully computed material

microstructure in martensite and magnetization microstructure in ferromagnetics.

13-6. Status of High-Temperature Superconductivity

Organized by: **William T. Oosterhuis** *(Manager, S&T Centers Development, Office of Science and Technology Centers, National Science Foundation, Washington, DC)*

2:30 pm / Sat / 16 Feb **Omni/Diplomat**

Conclusions of the National Commission on Superconductivity
DAVID W. McCALL (AT&T Bell Laboratories)

The National Commission on Superconductivity was created through legislation (P.L. 100-418) to review major policy issues regarding U.S. applications of research advances in superconductivity. The principal conclusions and recommendations are:

- Present U.S. industrial participation in superconductivity R&D is too low. The ability of U.S. business to compete is at stake.
- Negative business climate factors (high interest rates, unfavorable tax policies, antitrust laws) need legislative attention.
- Mechanisms to encourage enhanced industrial participation in superconductivity R&D through leverage of federal investments in university and national laboratories must be extended, enhanced and emulated. (e.g. DOE Pilot Centers and DARPA programs)
- Stable, strong support of the university base, particularly individual investigators, needs to be emphasized. Positive actions are needed to reinforce support for the individual investigator.
- Two ambitious goals are identified to provide impetus for U.S. superconductivity technology: an ultra high-speed computer using superconducting electronic elements, and a high temperature superconductor wire and magnet project.
- The establishment of a standing oversight group for the field of superconductivity to provide information on the quality of the various programs, establishing support criteria and priorities.

Federally-Funded Superconductivity Programs TED BERLINCOURT (Department of Defense)

The current status of federally-funded superconductivity programs will be reviewed with attention to balance between low-temperature and high-temperature superconductivity, between basic science and applications, between small-scale and large-scale applications, and between civil and defense applications. Areas of significant accomplishment will be highlighted, and as-yet unexploited areas offering exceptional opportunity will be identified.

High T_c and High J_c in Oxide Superconductors Paul C. W. Chu (Texas Center for Superconductivity, University of Houston)

There is a continued effort emphasizing the synthesis and processing of high temperature superconductors. This discussion will focus on the most recent high temperature superconductors that have been identified, the modifications to these materials, and the efforts to find still other superconductors. The development of oxide superconductors with higher critical current densities (Jc) as well as high critical temperatures (Tc) will be reviewed.

Experimental Results on the Nature of High Temperature Superconductivity and Unusual Normal State Properties. M. V. KLEIN (University of Illinois at Urbana-Champaign).

A dominant feature of the new cuprate superconductors is their anisotropic structure featuring Cu-O planes. Normal state conduction is easy in the planes and difficult between planes; moreover the temperature dependence of the conductivity is not that of a usual metal. Scattering and absorption experiments show that upon excitation of one electron volt or less carriers (holes) responsible for conduction are strongly interacting and highly correlated. Analysis of magnetic resonance experiments shows that the low energy fluctuations that couple to nuclear spins can be described as those of an antiferromagnetic Fermi liquid--in a sense the residue from the parent antiferromagnetic insulator phase. We shall summarize results on fundamental superconducting parameters such as critical magnetic fields and the energy gap, showing how the two-dimensional non-superconducting metallic state becomes a three-dimensional superconductor. Spectroscopic probes of the gap Δ give results in reasonable agreement with one another that are higher than those predicted by BCS theory and which do not drop as rapidly with increasing temperature. In addition, such probes suggest the presence of excitations in the gap. Furthermore, there is evidence of gap-like features in reduced-carrier systems persisting above the transition to the normal state. Are these differences from conventional superconductivity merely quantitative, or do they point to a new kind of superconductivity?

Prospects for the Development of Conductors of High Temperature Superconductors, D. C. LARBALESTIER (Applied Superconductivity Center, University of Wisconsin-Madison).

Much interest has attended the prospect of a superconducting magnet technology capable of operating at temperatures above the liquid helium regime. In principle this is well within the capability of existing high temperature superconductors (HTSC). However several barriers are impeding the development of the technology: amongst the most important are the tendency of bulk samples to be granular, the strong anisotropy of the physical properties and the brittle nature of ceramics. Underlying all of this, the great complexity of the materials science of HTSC which makes it very difficult to develop a microstructural understanding of their properties. Indeed, ignorance of many crucial aspects of the defect structure of the high temperature superconductors underlies many of the mysteries of HTSC. Nevertheless significant advances are being made in understanding (and improving) the granular properties, the flux pinning and the mechanical properties of HTSC. For example, the Bi-based compounds are much less subject to granular behavior than the 123 compounds and prototype short length conductors having superior critical current density properties to the best Nb_3Sn conductors have now been made. My talk will survey the prospects for future development within the above framework.

13-7. Current Directions in Musical Acoustics

Organized by: **Thomas D. Rossing** *(Dept. of Physics, Northern Illinois Univ., DeKalb, IL)*, **Logan Hargrove** *(Office of Naval Research, Washington, DC)*, and **Mark F. Hamilton** *(Dept. of Mechanical Engineering, Univ. of Texas, Austin, TX)*

8:30 am / Sun / 17 Feb **Omni/Congressional**

Perceptual Segregation and Integration of Musical Tones. WILLIAM MORRIS HARTMANN (Department of Physics, Michigan State University, East Lansing, MI, 48824)

In polyphonic music, the signals from several instruments are acoustically summed before they reach the listener. The composite signal, together with early reflections from the room surfaces and with reverberation, appears to be thoroughly mixed. However, the listener's auditory system is often able to perform the processes of voice segregation and spectral component integration so as to extract percepts of the original instruments from the melange. This ability has been studied with psychoacoustical experiments that probe the role of synchrony in the

processing. Synchrony of transients, or of modulation, can integrate components that are spectrally intertwined with other components. Synchrony of harmonics in steady-state tones also serves to integrate, whereas asynchrony, caused by minute mistuning, serves to segregate. The data from experiments on segregation of mistuned harmonics are consistent with a model of neural processing in which synchrony is detected in tuned channels, approximately two critical bands in width. Experimental dependences on tone duration and mistuning suggest that the detector is a neural autocorrelator; its representation is possibly the interspike interval histogram.

Sound Production in the Piano
ANDERS ASKENFELT (Dept. of Speech Communication & Music Acoustics, Royal Institute of Technology, S-10044 Stockholm, Sweden.)

The sound production in the piano poses a seemingly straightforward textbook problem. A fixed string is struck by a hard hammer and the resulting string vibrations are transferred to a large plate which radiates the sound. However, the individual steps in this process are complex and by no means yet fully explored. The interaction between the hammer and string, the polarization of the string motion and its influence on the impedance matching between string and soundboard, the distribution of the modes of the soundboard and their individual radiation properties, all are examples of phenomena which still makes it impossible to compute, or with the proper terminology, to synthesize a convincing piano sound from a physical model. In particular, the hammer-string interaction featuring a strongly nonlinear hammer in contact with the string for a finite duration defines a challenging piece of physics. The piano also features an intriguing man-machine interface, the action, the dynamic response of which only recently has becomed clearer.

Aperiodicity in Oscillations of Musical Instruments
ROBERT T. SCHUMACHER (Department of Physics, Carnegie Mellon University, Pittsburgh, PA. 15213)

Acoustical musical instruments never oscillate exactly periodically. Their periods fluctuate because of intentional efforts by the player (vibrato), because of intrinsic irregularities in excitation, or even possibly because of the basic structure of the governing equations. The study of aperiodicities can help elucidate the physical processes that are responsible. Applied to different instruments, they may also reveal differences in aperiodicities between them that contribute to their identification by knowledgeable listeners. This paper explains the "feature comparison" method of studying aperiodicity, in which the changes in shape of nearly periodic waveforms from period to period are quantified and displayed visually in a "feature comparison matrix". The properties of the matrix may be further analyzed, revealing various features of aperiodicity, some of which are characteristic of the instrumental sources. Examples from bowed strings are emphasized, with other examples from woodwinds, brass instruments, and the singing voice also presented.

The acoustical properties of ancient trumpet-mouthpieces
KLAUS WOGRAM (PTB-Braunschweig, FRG)

The mouthpieces of brassinstruments serve as a coupling element between the player and the instrument. However, they show a distinct acoustical behavior which influences the musical properties of the instrument in a crucial way.

The acoustical parameter of 13 very different ancient trumpet mouthpieces have been investigated and related to their individual inner shape. It can be shown clearly that only mouthpieces with large cup volumes and a large backbore are suitable. Unfortunately they require a supreme effort by the player.

Wind Instruments and Chaotic Dynamics. DOUGLAS H. KEEFE (Systematic Musicology Program, School of Music, DN-10, University of Washington, Seattle, WA 98195).

The regimes of oscillation of conventional wind instrument tones are produced by nonlinear active processes resulting in a periodic attractor. Unconventional tones produced by woodwind and brass instruments are utilized in contemporary music, and their dynamics are more complex. A single measured time series is embedded in a higher-dimensional space with time delay coordinates chosen on the basis of information theory. Using this reconstruction of the dynamical phase space trajectories, the correlation dimension D is calculated and describes the geometrical and temporal properties of the dynamical system. The complex spectral peaks of some woodwind multiphonics are tones with a phase-locked, biperiodic spectra superposed over a broad-band spectrum. Such multiphonics possess strange attractors, with typical measured values of D in the range $2.3 - 2.9$ for the saxophone and clarinet. The Lyapunov exponents measure the rate of divergence or convergence of nearby trajectories and quantify whether the system shows sensitive dependence to initial conditions. These can be calculated from the reconstructed phase space trajectories, and preliminary results of analyses of wind instrument tones will be discussed. The attack transient of the tone extends from the threshold of oscillation to the formation of the strange attractor, and its dynamics are most conveniently described using time-varying spectral analysis.

Current Directions in Computer Music Research.
Max V. Mathews (Stanford University)

As a consequence of current digital technology, digital synthesis is both the most powerful and the least expensive way of performing electronic music. In the past, making computer music was a ponderous studio process. Today many musicians own their own computers on which they do live performances in their homes and in concert halls. Three important current research areas are (1) programming digital signal processing (DSP) chips for sound synthesis, (2) new sensors to better capture the gestures of the performer, and (3) computer programs to interpret the performers gestures in ways that are musically expressive. We will review the potentials of some of the DSP boards which plug into personal computers. As an example of a new sensor and program, we will describe the radio baton and the conductor program. The radio baton captures 3-dimensional gestures made by the performer. The conductor program converts the gestures into expressive musical controls. In addition the conductor program relieves the performer of some of the nonexpressive data processing which he must do to convert notes on printed music into muscle movements needed to play traditional instruments.

Modes of Vibration and Sound Production in Percussion Instruments. THOMAS D. ROSSING (Department of Physics, Northern Illinois University, DeKalb, IL 60115)

The primary vibrating elements in percussion instruments are bars, membranes, and plates; these elements are sometimes coupled to pipes or other air chambers that act as resonators. Since the modal frequenies in bars, membranes, and plates are not gnerally harmonics of a fundamental, the sounds of percussion instruments generally have inharmonic partials, which give them distinctive timbres. The production of sound in percussion instruments will be illustrated by considering several typical instruments, such as tympani, snare drums, marimbas, gongs, and bells.

Technical Session

13T-1. Revisionist Kinetics: New Views of Nature's Throttle

Organized by: R. Stephen Berry *(Professor, Dept. of Chemistry, Univ. of Chicago, Chicago, IL)*

2:30 pm / Tue / 19 Feb **Omni/Capitol**

Pictures of Missing Links: Quantum and Classical Visualization of Reaction Dynamics.
PETER G. WOLYNES (University of Illinois, Urbana, Illinois).

How one thing can cease to exist and become another has been a puzzle to thinkers at least since the time of the Greeks. In many areas of modern science, we also seek to find the missing links between stable entities. In recent years, there has been a renewed interest in the fundamental aspects of this question in the molecular sciences. In the past, there was a consensus that the dynamics of any chemical reaction could be understood simply by identifying a transition state or bottleneck along a reaction path. Very little was usually known about the structure of the transition state and still less about its motions. In my lecture, I will review from the theoretical point of view, how this situation is changing. I will discuss simple conceptual pictures of motion through a transition state, highlighting the importance of the environment in describing reactive events. I will also show how modern computational techniques and computer visualization allow us to describe, in detail, complicated reaction dynamics in solids, liquids, and biomolecules. Both classical motions and quantum mechanical phenomena, such as tunneling, can be captured by computer visualizations. I will show movies illustrating reactions in proteins. Finally, I will discuss truly complex transformations at the molecular level in which there are numerous bottlenecks. An example of such a challenging situation is the problem of protein folding where new pictures of the missing links are still needed.

Electron Transfer Rates Across Interfaces and Within Phases: Solvation, Tunneling and Molecular Reactants
MICHAEL J. WEAVER (Department of Chemistry, Purdue University, West Lafayette, Indiana 47907)

Some factors anticipated to regulate electron-transfer rates in heterogeneous (primarily electrochemical) and homogeneous-phase environments will be described, with an emphasis on their experimental diagnosis and dissection. Comparison will be made between the electron-transfer properties of metal surfaces and molecular redox reagents. Specific experimental examples will be discussed that illustrate the interplay between solvation energetics/dynamics, electron tunneling, and vibrational activation of reactants in electron-transfer processes. Some critical current issues in the experimental evaluation of electrochemical kinetics will also be addressed.

Unexpected Throttles in Microscopic Reaction Kinetics
JAMES T. HYNES (Department of Chemistry, University of Colorado, Boulder, CO 80309)*

We will describe several examples of unexpected slow steps, or regulatory barriers, for different reaction classes in solution, as theoretically envisioned. These include a vibrational bottleneck in the combination of atoms to form a molecule, the trapping solvent molecular barriers for ionic reactions in solution, and bond stretching and solvent rearrangement barriers for proton transfer reactions. Experimental evidence on these issues will also be discussed.

*This work was supported in part by NSF, NIH and PRF.

Activationless Chemical Reactions
GRAHAM R. FLEMING (Department of Chemistry and JFI, University of Chicago, Chicago, Illinois 60637)

Chemical reactions are typically viewed as activated passage over a barrier. However, many elementary reactions in chemistry and biology have no such barrier. Perhaps the most remarkable such process is the primary charge separation step in photosynthesis. Conventional timescale separations may break down in such processes and quantum mechanical interference effects may rear their interesting heads. Such interference effects will only occur when vibrational dephasing and relaxation processes are not rapid compared to the electronic relaxation timescale. Phase related sequences of femtosecond pulses are used to explore such ideas and to manipulate the evaluation of molecular wavepackets. The ability to generate such sequences can change the experimenter from observer to controller of events.

14. Astronomy; Planetary Science

14-1. Cosmology: Our Knowledge of the Universe

Organized by: Martin Harwit *(Director, National Air & Space Museum, Smithsonian Institution, Washington, DC)*

8:30 am / Sat / 16 Feb **Omni/Diplomat**

Observing the Universe Long Ago: The Cosmic Background Explorer.
MICHAEL G. HAUSER (Laboratory for Astronomy and Solar Physics, NASA/Goddard Space Flight Center).

Directly observable relics of the primeval universe are few. The Cosmic Microwave Background (CMB) Radiation, discovered by Penzias and Wilson 25 years ago, is interpreted in the standard Big Bang model as having formed at a very early time when the universe was filled with a hot, dense plasma. A Cosmic Infrared Background (CIB) is also expected, resulting from the cumulative emissions of luminous objects formed after the cooling of the universe allowed clumping of matter to occur. Unequivocal observational evidence for this CIB has not yet been obtained. In Nov. 1989, NASA launched the Cosmic Background Explorer (COBE)* satellite on a mission dedicated to making definitive measurements of these unique radiative backgrounds. The COBE spacecraft carries three instruments specially designed to make precise measurements of both the spectrum and large-angular scale anisotropy of the CMB, and to attempt to discern and measure the energy distribution of the CIB. Initial results of these measurements will be summarized, and their cosmological implications discussed.

*The COBE mission is supported by NASA's Astrophysics Division. Goddard Space Flight Center is responsible for the COBE development, operation, and data processing.

Motions of Galaxies and the Large Scale Structure of the Universe.
VERA C. RUBIN (Carnegie Institution of Washington).

When we use a telescope to look beyond the stars in our own Galaxy, we see a hierarchical universe composed of galaxies, clusters of galaxies, and superclusters of galaxies. Fifty years ago, it was believed that the universe was homogeneous and isotropic. However, recent observations have shown that galaxies and clusters of galaxies are not placed at random, but are arranged in a lace-like pattern of strings and chains, surrounding large regions which are void of any luminosity bright enough to be detected on earth. The gravitational ef-

fect of this lumpy distribution is to induce systematic motions over enormously large distances; such motions are superposed on the general expansion of the universe. Across large regions of space, galaxies are moving in concert toward regions of higher matter density.

Contemporary extragalactic astronomy, both observational and theoretical, attempts to answer the questions posed by these observations. Are the motions only due to gravity? Does the distribution of luminous matter follow the distribution of dark matter as well? Are regions void of luminous matter void of all matter? Is the observed non-uniformity sufficient to give rise to the observed motions? Why is the cosmic background radiation, the remnant of the initial Big Bang, so uniform, and the matter universe so lumpy? What are the implications for galaxy formation? These questions will be addressed.

The Early Universe.

ALAN H. GUTH (Massachusetts Institute of Technology and Harvard-Smithsonian Center for Astrophysics).

The talk will begin by describing the key developments in cosmology in the twentieth century, from the work of Albert Einstein to the emergence of the generally accepted hot big bang model. The successes of this model will be reviewed, but emphasis will be placed on the questions that the model leaves unanswered. The remainder of the talk will describe the inflationary universe model, which provides plausible answers to a number of these questions. It also offers a possible explanation for the origin of essentially all the matter and energy in the observed universe.

How Much Can We Learn About the Universe?
MARTIN HARWIT (National Air and Space Museum)

The history of observational discoveries in astronomy, clearly demonstrates that new phenomena are inseparably tied to the introduction of novel observational capabilities. Those capabilities, however, are fundamentally limited by the laws of physics, by the nature of our universe and by the local structure of our galaxy -- all of which impose constraints on measurements that may be carried out at least in principle. This talk shows how the number of known cosmic phenomena has grown in response to expanding technological capabilities, lists technical advances that remain to be made and promise a further expansion of our knowledge, and reviews both the financial costs and in-principle difficulties that will constrain how much we ultimately can learn about the universe.

14-2. Adverse Environmental Threats to Astronomy

Organized by: **David L. Crawford** *(Astronomer, National Optical Astronomy Observatories, Kitt Peak National Observatory, Tucson, AZ)*

2:30 pm / Mon / 18 Feb **Omni/Diplomat**

Introduction to the Issues
A. K. DUPREE (Harvard-Smithsonian Center of Astrophysics)

Astronomy is suffering from increasingly severe environmental impact. Light pollution, radio interference, and space debris are all compromising present frontier research at most observatories. Such observing sites need protection. Even future observatories in space and on the moon need and deserve protection. Most astronomical societies, such as the American Astronomical Society and the International Astronomical Union, have established committees to address the problems. Papers today will discuss the three major issues.

Light Pollution: The Theft of the Night
DAVID L. CRAWFORD (NOAO/Kitt Peak National Observatory*)

Most Americans are growing up unable to see the dark sky stars their grandparents knew so well. For Astronomy, the impact has been even more severe. Astronomers require observations of extremely faint objects at clear sites free of urban sky glow. For example, scientists interested in how the universe was formed study galaxies and quasars at vast distances from Earth. Yet, after traveling countless light years, the light can be lost at the end of its journey in the glare of our own sky. Experience over the past decades has shown that space astronomy, far from reducing the need for ground-based observations, actually increases the demand for these facilities. Such a loss might be acceptable if light pollution were the price of progress, but it's not. Most sky glow is unnecessary. The light that obscures our view of the night sky comes from inefficient lighting that does little to increase nighttime safety, utility, or security. It produces only glare and clutter, costing more than $1 billion annually in wasted energy in the United States alone. There are solutions to these problems. Quality lighting is the key. These solutions preserve dark skies for all of us, improve the quality of nighttime lighting (better visibility, better safety and security, more attractive surroundings), and save money as well, for we use light rather than waste it. We all win!

*Operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

Keeping the Radio Sky Quiet--Limited Future Options
PAUL A. VANDEN BOUT (National Radio Astronomy Observatory*)

Radio astronomy is seriously threatened by increasing utilization of the radio frequency spectrum and the resultant interference with astronomical signals. The heaviest spectrum pressure is building at frequencies up to a few gigahertz, where ground radars and navigation and communications satellites find their preferred operating frequencies. Examples are given of interference problems in various important frequency bands. The means radio astronomers use to limit radio frequency interference are discussed, both in the frequency allocation regulatory process and in radio astronomical instrumentation. Examples are presented of successful initiatives to limit interference.

*Operated by Associated Universities, Inc., under a cooperative agreement with the National Science Foundation.

The Growing Threat of Orbital Debris
DAVID L. TALENT (Lockheed Engineering and Sciences Company @ NASA-JSC, Houston, TX)

Since the advent of the space age, the number of objects in earth orbit has steadily grown. By the beginning of 1990 the United States Space Command Catalog of earth satellites stood at a net count of about 7000 orbiting objects. Of these, only about 5% are active satellites. In addition to these cataloged objects, typically having diameters of 10 cm and greater, recent evidence suggests an uncataloged population of about 17,500 objects with diameters between 1 and 10 cm, 3,500,000 objects in the 1 mm to 1 cm range, and tens of millions of smaller particles. The threat to astronomy ranges from that of an observational nuisance to catastrophic -- such as the outright destruction of an earth-orbiting telescope (e.g., Hubble) in a collison. The likelihood of such events will be illustrated using a model for orbital debris evolution that allows for an assessment of a broad spectrum of future use scenarios for the space environment. Suggestions for reducing the rate of debris growth and the magnitude of the problem will also be presented.

14-3. The Human Exploration of Space

Organized by: **Richard C. Hart** *(Space Studies Board, National Academy of Sciences/National Research Council, Washington, DC)*

8:30 am & 2:30 pm / Sun / 17 Feb **Omni/Diplomat**

Roles and Responsibilities of the U.S. Space Research Community L.J. LANZEROTTI (AT&T Bell Laboratories and Chairman, Space Studies board, National Research Council)

A decision by the Nation to undertake a program of human exploration of the nearby solar system will be based on political choices, and not on scientific imperatives, as a recent report from the National Research Council, ***Toward a New Era in Space***, NAP, 1988 emphasized. Nevertheless, the research community has advisory responsibilities to ensure that the necessary scientific information exists so that responsible choices can be made. In particular, the research community can provide unique advice in several areas, including the following: a) advice on scientific knowledge that must be in place before an extended program of human exploration can responsibly be undertaken, and b) advice on those research activities that might be uniquely facilitated by the presence of humans. Research in this last area, however, must also be evaluated in comparison with other ways in which one might acquire the same knowledge. The political process must also understand its responsibilities and relationships to the Nation's research community when a human exploration program is contemplated and planned: the political arena must recognize that the research community wishes to advance the frontiers of human knowledge in the most expeditious and cost-effective manner. It is this motivation that causes researchers to view with skepticism the combining of frontier scientific research with human exploration programs. The Nation's multiple research and political objectives related to human exploration can best be addressed when all participants engage with good will in a continuing dialogue on the difficult questions, searching for joint best solutions.

The Role of Solar and Space Physics in the Space Exploration Initiative MARCIA NEUGEBAUER (Jet Propulsion Laboratory, California Institute of Technology)

Galactic cosmic rays and energetic particles from solar flares pose a significant risk to humans in space. Because the optical brightness of a flare is not well correlated with the release of energetic particles, further research into the flare process is required for the development of a predictive or warning capability for potentially lethal events. Additional research is also required on effective shielding of heavy cosmic-ray ions and on the biological effects of these particles. Several types of space physics research could be enhanced or enabled by the capability for observation from a lunar base. And advanced propulsion systems developed for SEI might be of enormous value to the scientific exploration of the distant heliosphere and the local interstellar medium.

Astronomy from a Lunar Base.
A. K. DUPREE (Harvard-Smithsonian Center for Astrophysics)

The moon offers a promising site from which to make astronomical observations. The range of scientific problems to be addressed by a lunar-based observatory complex is rich and varied. The absence of an atmosphere allows access to the entire electromagnetic spectrum. The lack of seismic activity provides a stable platform. The lunar regolith can provide radiation shielding for sensitive detectors. The disadvantages of a lunar-based observatory as compared to instruments in Earth orbit include extreme thermal excursions, and potential for damage or contamination from dust, micrometeorites, and cosmic rays. However, adverse impact from these conditions can be prevented. Several instruments will be described for which lunar siting would be scientifically advantageous. These experiments include: interferometric telescope arrays for the optical and infrared regions, multi-frequency transit telescopes, a large filled-aperture optical telescope, arrays of telescopes sensitive to low frequencies, and a laser interferometric gravity wave detector.

15. Geoscience; Climate

15-1. Human Response to Sea-Level Rise

Organized by: **David R. Stoddart** *(Professor and Chairman, Dept. of Geography, Univ. of California, Berkeley, CA)* and **Joanna C. Ellison** *(Doctoral Student, Dept. of Geography, Univ. of California, Berkeley, CA)*

2:30 pm / Sun / 17 Feb **Omni/Capitol**

8:30 am & 2:30 pm / Mon / 18 Feb **Omni/Capitol**

Global Eustatic Sea Level Changes: Causes, Trends and Perspectives. NILS-AXEL MORNER (Paleogeophysics & Geodynamics, S-10691 Stockholm, Sweden).

Relative sea level changes are a function of the combined changes in the level of the sea and in the level of the crust and/or land surface. A number of different factors control these two levels, in the long-term as well as in the short-term perspective. The rates and amplitudes of the different controlling parameters often differ significantly, and provide a means of discriminating between different mechanisms. Short-term and present day sea level changes must be seen not only in their own perspective but also in the long-term perspective and in an integrated multi-parameter perspective. Present sea level change is not a simple and strait-forward problem but a multifaceted problem. Certainly, there is no globally identical eustatic sea level component. Eustasy or ocean level changes are quite regional because of differences in gravity potential, rotational potential, ocean circulation and various meteorological-hydrological-oceanographic changes. The trends (local, regional and global) of sea level changes at present and during the last centuries will be analyzed from various angles, the most significant one of which has not previously been used.

Sea-level rise and small-island states. DAVID R. STODDART (Department of Geography, University of California at Berkeley, Berkeley, CA 94720).

Many tropical oceanic states comprise atoll-islets which apart from coastal sand-dunes are less than 3 meters above present mean sea-level. Most show consistent histories of shoreline retreat consequent on known rates of sea-level rise over the last century. States such as the Maldives, Marshall Islands, Kiribati and Tuvalu face extinction if predicted rates of sea-level rise over the next 50-100 years are realised. As atoll-islets most are elongate and narrow and thus maximize shoreline length with respect to area. None have the resources to protect their shorelines against accelerated erosion. Possible strategies for small-island states to deal with this situation are discussed.

Sea-level Rise and the Maldive Islands, Indian Ocean. ALASDAIR EDWARDS (Centre for Tropical Coastal Management Studies, Department of Biology, University of Newcastle upon Tyne, UK).

The Republic of Maldives consists of approximately 1300 low islands (total land area 298 km^2) in a chain of 26 coral atolls lying along the 73°E meridian between 7°06'N and 0°42'S in the Indian Ocean. The population is about 190,000 and is spread over 275 islands which are used for habitation, tourism, or industrial purposes. The nation lies almost entirely within 2.7 m of highest astronomical tide (HAT) and most economic and social activity occurs within 1.3 m of HAT. The two mainstays of the economy are fishing and

tourism. The latter is entirely dependent on a single airstrip (Male International Airport) about 0.5 m above HAT. Mining of reef flats for coral for construction purposes, inter-island causeway construction, land reclamation and other coastal engineering works have created many coastal management problems which any rise in global mean sea-level will exacerbate. These problems are outlined and some of the political and infrastructural responses planned by Government of Maldives to tackle both present coastal management shortcomings and anticipated effects of rising sea level are discussed.

Consequences of Sea-level Rise in Bermuda. JOANNA C. ELLISON (Department of Geography, University of California at Berkeley, and Bermuda Biological Station for Research).

Bermuda is a densely populated low limestone island of rolling hill topography, with tropical climate and ecosystems despite its latitude owing to its position in the warm Gulf Stream. Analysis of tidal records for Bermuda 1932-80 shows that mean sea-level has been rising at a more rapid rate than other tropical islands, of 28 cm/100 years. This is increased from the Late Holocene rate of 4 cm/100 years. Bermuda therefore offers a precursor of impacts to be expected globally in the next several decades. Most significant has been retreat of mangroves, with mechanical erosion of peat from around root structures, causing trees to be highly susceptible to windthrow. High losses of leaf litter from the swamp surface render impossible the peat buildup that allows mangrove ecosystems to keep pace with slower rates of sea-level rise. Beach erosion and sand deposition on mangroves and sea-grass beds is also a problem. It would seem that in conditions of sea-level rise natural coastal systems are impacted before significant inundation of constructed areas, and loss of these natural barriers will compound later problems. Bermuda has an active coastal conservation and research program, which serves as example to other tropical islands in how to respond to the sea-level rise threat.

Social, economic and political projections in small-island states. T.P. BAYLISS-SMITH (Department of Geography, University of Cambridge, Cambridge, England).

Projected rates of sea-level rise caused by the 'greenhouse effect' imply profound social, economic and political consequences for small-island states. Most of these have a narrow resource base, dependent on tourism, fishing and copra, and none have the capital resources to meet the cost of anticipated coastal defence works. National and international strategies for small-island states to cope with sea-level rise are discussed.

Coastal Zone Management in The Netherlands. ROBBERT MISDORP (Ministry of Transport and Public Works Rijkswaterstaat, Tidal Waters Division, The Netherlands).

The Netherlands (40,000 km^2, 14 million inhabitants) is, for a large part, the product of the deltaic interplay of the rivers Rhine, Meuse and Scheldt and of the wave climate and meso-tidal regime of the North Sea. More than half of The Netherlands lies below Mean Sea Level and can be considered as coastal zone. The largest part of the Dutch GNP (US$ 250 billion) is earned in the coastal area. The coastal zone has important ecological values and many different functional uses. At present, 3500 km primary protection works have to be maintained. Besides large scale flood protection works, Coastal Zone Management (CZM) now involves good management of water quality. Therefore with the increase of environmental awareness, results of applied research of "new" scientific disciplines, such as physical planning, biology and chemistry are incorporated. The multiple functions in the densely populated coastal zone sometimes lead to conflicts between different sectors, all dealing with water, like gas/oil exploitation, fishery, nature, recreation, agriculture, and drinking-water supply. CZM is directed towards the sustainable development of functional uses by means of coordinative planning and execution. The Dutch CZ Managers act at four different levels of administrations. The Dutch Delta Project will be highlighted as an example of Dutch CZM practice. This US$ 10 billion project, 1953-1987, is shortening the coastline by about 900 km by closing off three estuaries.

Human Responses to Sea-level Rise in the British Isles. R.J.N. DEVOY (University College Cork, Ireland).

The last ten years has seen an almost unprecedented increase in interest and concern over the development and concommitant management of the coastal zone, both at a global level and, as in the case of the British Isles, within specific regional contexts. This interest has embraced both those working in the fields of science and technology, as well as those in government, planning and administration, although scientific work upon the understanding of coastal process-functioning remains at a relatively fragmented and low key level in many countries. Evidence of this interest comes from work in areas as diverse as schemes for tourist use of coastal zones, national park development, engineered responses to problems of coastal change to fish farming and the management of other coastal biological resources. Causes for the work and associated concerns are diverse, though an increase in people's awareness of potentially hazardous changes in the coast through problems of erosion and pollution, coupled with a move of people and infrastructure--industrial development to the coastline have been important contributors. However, society's response to the prospect of future rises in sea level, as a consequence of changing climate, and its potentially disruptive and damaging impact upon the coastline has been a major stimulus to current interest.

Defence Against a Sea-level Rise, Venice, Italy. PAOLO ANTONIO PIRAZZOLI (CNRS [URA-141] Laboratoire de Geographie Physique, 1 Place Aristide Briand, 92120 Meudon-Bellevue, France).

Already flooded several times a year by ordinary storm surges, the Venice area would be greatly endangered by even a very small additional rise in sea level. In this paper, after a brief presentation of the geo-hydrologic context of the coastal plain of northeast Italy and of the lagoon of Venice, computation of the frequency and return periods of present-day extreme tide levels in the city of Venice and beyond the lagoon, at sea, is discussed. If a rise in sea-level occurs in the next century, as predicted by certain models, the construction of mobile gates at the lagoon passes could help maintain harbour and other activities in the lagoon and protect the historical city from flooding. This protection, even with navigable locks, would be adequate only if the sea-level rise is less than 0.3 m, however, and if at the same time the lagoon is completely cleared of existing water pollution. In order to avoid floodings during the periods when the lagoon has to be closed provisionally to the sea, fresh-water discharges from minor rivers and drains received in the lagoon, attaining up to 1000 m^3/s at the time of extreme rainfall events, must be collected and pumped away. For a sea-level rise greater than 0.3 m, a system of powerful dykes, permanently separating the lagoon from the sea, will be necessary if the area is to remain inhabited.

Stabilization Versus Retreat: New York and Eastern Mediterranean Examples. VICTOR GOLDSMITH (Department of Geology and Geography, Hunter College, City University of New York).

New York City has 578 miles of shoreline. Although most of this shoreline is considered "hard," it does include 82 parks. One of these parks, the Coney Island beaches, has more visitors on a hot summers day than the total population of the three smallest states (Delaware, Wyoming, and Alaska). These beach areas are maintained by extensive sand nourishment (e.g., the Rockaway peninsula has received more than 12,000,000 cubic yards of sand between 1926 and 1962) in response to the measured sea level rise of 30 cm in the last 100 years from downwarping of the wide continental shelf. Most of the New York shoreline is developed, and will not be severely impacted during a modest SLR. However, the sewage system of pipes and plants that have been built to the present sea level may require adaptation under a severe SLR. For the exposed beaches, land use planning and/or retreat are not practical options, as land is expensive in NY and highly developed. Hardening of the shoreline and beach nourishment, could continue if SLR accelerates.

The eastern Mediterranean is largely "natural," not as well built up as New York, geologically variable, and tectonicly quite active. Measurements indicate that sea level changes are concomitantly highly variable, ranging from a sea level

rise of 1.9 cm/yr in northeastern Sicily to a fall in sea level of 0.3 cm/yr in southwestern Turkey.

Future Sea-level Rise in Chesapeake Bay: Implications for Shore Erosion and Marsh Loss in a Rapidly Urbanizing, Subsiding Coast. MICHAEL S. KEARNEY (Department of Geography, University of Maryland, College Park, MD 20742) and J. COURT STEVENSON (Horn Point Environmental Laboratories, University of Maryland, Cambridge, MD 21613).

By the early decades of the next century, coastal development in Chesapeake Bay will reach unprecedented levels. The deleterious consequences of this burgeoning growth for the Bay's ecosystem have already gained wide notoriety; however, the potential economic losses that will surely accompany further clustering of development along flood- and erosion-prone shorelines have not been fully recognized. The Chesapeake Bay is presently characterized by one of the highest rates of relative sea-level (RSL) rise of the U.S. Atlantic Coast, ranging from 30 to 40 cm per century. If world sea levels rise dramatically in coming decades, shore erosion rates in the Bay, almost 3 m yr^{-1} in some areas, will accelerate. Elsewhere, in more wave-protected areas, low-lying fastlands (often < 1 m above mean tide level along the Eastern Shore) will simply be submerged. Nevertheless, few new marshes will be created as former uplands are inundated. Marsh losses in the Chesapeake, presently at historically high rates, will jump as RSL rise increasingly outpaces vertical accretionary budgets. Bay-wide policies addressing the sea level threat have yet to be formulated.

Human Response to Sea-level Rise: The Louisiana Experience. DENISE J. REED and DONALD BOESCH (Louisiana Universities Marine Consortium, Chauvin, Louisiana).

Louisiana is already experiencing rapid rates of relative sea-level rise caused by subsidence of the Mississippi deltaic plain. Much of the coastal zone of Louisiana is composed of these deltaic sediments and the natural environment is one of marshes and swamps with isolated sandy barrier islands. The natural levees of bayous provided the only high land available for building during settlement of this area, but expansion of towns and cities into lower lying areas has required the impoundment and drainage of formerly waterlogged areas. Compactions and oxidation associated with drainage cause local subsidence within these areas which is compounded by broader scale subsidence of the recent deltaic sediments. The latter presently causes relative sea-level rise rates on the coast of Louisiana to exceed 1 cm/yr. As relative sea-level continues to rise, towns and cities which are now below sea-level, are required to maintain their levee systems and pumping stations not just to prevent flooding during storm surges but in order to remove rainfall. Parts of New Orleans, are as much as 2 meters below sea-level. Although coastal land loss in Louisiana is occurring at an alarming rate, there are only two areas where coastal erosion directly impacts local communities. These settled coastal barrier islands are subjected to coastal erosion rates of over 10 m/yr and consequently the battle against the Gulf has become a major issue in local politics.

Human Response to Sea Level Rise in S.E. Asia. ERIC BIRD (University of Melbourne).

A metre sea level rise in the coming century will cause submergence and erosion of large areas of low lying coast in S.E. Asia. Mangrove areas converted to fish and prawn ponds will be inundated by the sea unless protective walls and drainage systems are built to maintain them. If allowed to migrate landward they will invade rice farming areas.

Possible responses included (1) abandonment of the submerging areas and landward movement of people and their land use systems; (2) local piecemeal building of walls to preserve selected areas; (3) sea walls along the present coastline to maintain existing uses at great expense; (4) sea wall construction offshore, reclaiming additional land to meet construction costs. Option 4 is being considered for intensely developed areas such as Bangkok: it will require re-designing of river and irrigation systems. Prospects for conserving coastal wetlands (mangroves) are very bleak in S.E. Asia.

Sea-level Rise in Yellow River Delta--Implications and Response Strategies. REN MEI-E (Department of Geo and Ocean Sciences, Nanjing University, Nanjing, PR China).

The Yellow River delta consists of 3 deltas: ancient delta, modern delta and abandoned delta. In the ancient delta, eustatic sea level rise is greatly exacerbated by rapid land subsidence mainly due to overpumping of ground water. Rate of land subsidence was 120-150 mm/yr in early 1980s. It is planned to limit land subsidence to 15 mm/yr. Storm surges are extremely serious. Extensive areas below 4 m contour were flooded by a large storm surge in 2000 BP. In coastal hazard assessment, it is a region of high risk. Tianjin has a population 8.5 million (increasing to 9.5 million by 2000), industrial output 44 billion RMB per annum (about 10 billion US dollars). If sea level rises 20 cm by 2030, about 70% of population and 80% of industrial output will be at risk. Response strategies include heightening and proper management of sea dikes and limiting further growth of population and industry in coastal lowlands.

The modern delta, with moderate land subsidence and moderate storminess, is an area of moderate risk. But coastal oilfields, producing 15 million tons of oil a year, will be vulnerable to sea level rise. Abandoned delta is a rich agricultural region with dense population. Although it is an area of low risk, the coast, being sediment starved, suffers from serious coastal erosion. Coastal protection works should be upgraded to combat sea level rising.

15-2. Coastal Erosion Zone Management

Organized by: **Stephen P. Leatherman** *(Director and Professor, Laboratory for Coastal Research, Univ. of Maryland, College Park, MD)*

2:30 pm / Fri / 15 Feb **Omni/Capitol**

New Jersey's Rocks, Concrete & Sand -- Consequences of the Structured Shoreline Approach. STEWART C. FARRELL (Stockton State College, NJ)

Situated between two colonial cities, New York and Philadelphia, the 127-mile shoreline of New Jersey began to develop as residential communities and a vacation destination by the last third of the 19th century. Arriving by rail, people built modest towns and three coastal cities before 1900. Shore protection efforts began in the 1870's in Monmouth Co. and Atlantic City, funded by local interests. By 1922 the State government had commissioned an historical shoreline study to quantify beach changes. The federal government became involved in the 1930's as the Beach Erosion Board (BEB), the forerunner of CERC. Together, these 3 groups undertook a 50-year construction marathon on the NJ coast such that it has become a virtual museum of hard structure methodology. In their role in defending property, these structures score rather well, but in producing suitable conditions for beach preservation, they have failed. Worse yet, many of the shore-perpendicular structures have had no effect at all, rendering them monuments to wasted funds. Designing combined structures and sediment replenishment has only been operational policy since the 1970's with few exceptions. Notable successes have been projects at Atlantic City, Strathmere, Sea Isle City and Avalon.

Maintaining the Soft Interface: Florida's Commitment to Beach Nourishment. ROBERT G. DEAN (Department of Coastal & Oceanographic Engineering, University of Florida, Gainesville, FL)

Of the more than 2400 kilometers of Florida's shoreline, in excess of 1100 kilometers are high quality sand beaches. However, recent investigations have found that up to 30% of these sandy beaches will require some level of erosion control in the next decade or so. Some of the erosion is natural, presumably due to sea level rise; however, navigational entrances are reported to cause up to 80% of the erosion along Florida's east coast. There is a strong economic incentive to maintain the character and quality of the beaches due to the documented relationship between

these resources and tourism, the State's most significant industry. Consequently, a state program has been established to study and understand the beaches and to provide planning and funding for their maintenance as a recreational resource. An important element is a permanent baseline with monuments at nominal spacings of 300 m along much of the sandy shoreline, thereby providing a ready and accurate reference for repeated surveys, especially following storms. Two elements constitute the heart of the erosion control program. Beach nourishment is carried out in areas where justified by economics, upland development and the availability of a quality sand source. Additionally, a program is commencing to reinstate the natural flow of sand around navigational entrances. Program benefits include: storm protection for upland structures, improved recreational resources and improved sea turtle nesting habitats.

Louisiana's Disappearing Shores -- America's Coastal Erosion Hot Spot. MARK R. BYRNES, SHEA PENLAND, RANDOLPH A. MCBRIDE, and KAREN A. WESTPHAL (Louisiana Geological Survey, Baton Rouge, LA)

Processes affecting coastal change in Louisiana have caused the highest rates of erosion and wetland loss in the United States. Eustatic sea level rise, subsidence, hurricane impacts, sand supply, and regional geology dictate the magnitude of shoreline movement for the outer coast of the Mississippi River delta plain. Along the Isles Dernieres barrier island shoreline, average retreat rates exceed 11 m/yr. In the mid-1800s, this area consisted of one continuous barrier feature that has since evolved into a series of four islands as the result of severe storm impacts, and island breaching, insufficient sediment supply, subsidence, and eustatic sea-level rise. Presently, the island chain continues to deteriorate and is expected to become subaqueous by about 2020. Although this trend is prevalent along much of the outer coast, regions such as the Timbalier barrier system illustrate dramatic lateral shoreline migration patterns associated with slow but continuous retreat. The Chandeleur barrier island arc is also subject to significant changes in island morphology and shoreline position but post-storm recovery and island maintenance benefit from substantial shelf sand supply. Although spatial variability in coastal erosion is common, trends indicate a chronic problem that will potentially devastate natural, and therefore cultural, activities in the coastal zone.

California Sun, Surf and Sand -- The Myth and Reality of Shoreline Maintenance. REINHARD E. FLICK (California Dept. of Boating & Waterways, Scripps Institution of Oceanography, La Jolla, CA)

The beaches are the essence of California and provide it's most important aesthetic and recreational asset. The steep coastal mountains, climate and wave forcing of the Pacific, only sustain a relatively thin veneer of sand on the majority of California's cliff backed beaches, making California an erosional coast. Even before dams blocked much of the sand supply, many beaches were marginal. Occasional large floods provided substantial quantities of sand on an episodic basis, but pronounced fluctuations frequently resulted in rocky shorelines and breached spits. Most sand beaches in Southern California are now maintained by man's activities. This fact seems "radical" to many Californians who often regard any engineering works on the beach as an unnecessary intrusion into "nature," regardless of the type or degree of development in the upland. Sand supply to the region's beaches over the past 40 to 60 years has been up to 10 times the natural rate, mainly due to harbor construction. This has resulted in many fine, wide recreational beaches that will, in time return to narrow, rocky areas. Since the rate of harbor building has slowed dramatically, it is obvious where sand will not come from. Since recreational and other pressures on the beaches can only increase, it is also obvious that increased use of beach nourishment and carefully engineered structures to keep sand in place, will be required.

Living on the Edge -- A Great Lakes Dilemma. WILLIAM L. WOOD (Great Lakes Coastal Research Laboratory, Purdue University, West Lafayette, IN)

During the past two decades Great Lakes coastlines have been exposed to a period of continuous high lake level, including record high levels in 1974 and 1986. However, shoreline development continues, fueled by the optimistic view that periods of low lake level will lead to significant restoration of the beaches. Unfortunately, there are three major concepts that render this view incorrect. First, serious conditions of recession and erosion occur at all lake levels. Second, coastal beaches are not simply covered by water during high lake level stages. Approximately 80 percent of the original beach profile is eroded with only 20 percent recovery anticipated during typical low lake level periods. Third, harbor and jettied inlets, constructed at any lake level, may create coastal erosion and deposition effects that exceed the impact of high lake level. It is important, therefore, to establish regional coastal development policy independent of existing lake level trends.

15-3. Impacts of the Climate During the 1980s in the United States

Organized by: **Stanley A. Changnon** *(Chief Emer., Illinois State Water Survey, Champaign, IL)*

8:30 am / Fri / 15 Feb **Omni/Ambassador**

Major Climate Events of the 1980s in the United States THOMAS R. KARL (NOAA/NESDIS/National Climatic Data Center), RICHARD R. HEIM, JR. (NOAA/NESDIS/National Climatic Data Center).

Beginning in the late 1970s, with the three consecutive severe winters in the eastern half of the nation and the extreme drought over much of the western two-thirds of the nation during 1976 and 1977, it might have been difficult to envision climate events which could have greater impacts and invoke as much public discussion as did the climate events of the 1980s. The decade began with the 1980 summer heat wave and drought, and ended with the extremely warm and dry winter of 1989-1990. Despite the 1986 Great Southeast Drought and the extreme Summer Drought of 1988 which captured the nation's attention, there were several significant extreme climate events pertaining to severe cold and wetness. For example, the early January cold event during the winter of 1981-82 began what was to be a series of winters with extreme outbreaks of Arctic air far into the deep south. The three most spectacular of these events occurred during December of 1983, January of 1985, and December of 1989. During the early 1980s a prolonged period of excessive precipitation in the Great Salt Lake Drainage Basin resulted in even higher lake levels than those observed during the 1860s. Similarly, nearly two decades of wet weather culminated in record high levels of the Great Lakes by 1986 and 1987 only to be followed by unprecedented declines associated with the extreme drought of 1988. All these events and others are reviewed and put into context with the historical climate record.

Dealing with Climate Surprises: Lessons from the 1980s. WILLIAM E. RIEBSAME (University of Colorado).

Among the unusual climatic conditions in the 1980s which affected natural resources management were a period of markedly increased precipitation in the desert Southwest, a sharp switch from dry to wet conditions on the west coast, record Colorado River runoff and Great Salt Lake level rise in 1983, record high levels of the Great Lakes in mid-decade, and the cumulative drying that culminated in severe drought during 1988 in the Midwest, Southeast and northern Rocky Mountains. Under these conditions, climate-sensitive natural resource systems behaved in unusual, often counter-intuitive ways as controlling variables crossed critical thresholds and systems entered new, perhaps quite temporary, dynamic states. The 1983 western runoff and 1988 drought and fires in the northern Rocky Mountain forests especially illustrate how rare and unusual conditions, interacting with more slowly evolving system characteristics, can affect resources and their management. The role of catastrophe in determining the social and natural properties of natural resource systems is discussed in light of climate impacts in the 1980s.

Climate and Agricultural Comparative Advantage in the Western Corn Belt: Patterns and Prospects.
WILLIAM E. EASTERLING (Resources for the Future)

The climate of the western Corn Belt is a vital resource to agricultural production. Adequate summer rains, abundant solar radiation for photosynthesis and the right mixture of winter cold and summer warmth for wheat vernalization are among the reasons that the region has a natural comparative advantage in agriculture. In this paper, I describe the agroclimatology of the major field and forage crops in the region encompassed by the states of Missouri, Iowa, Nebraska and Kansas (MINK). I discuss the role of climate in determining the regional distribution of cropping systems and how common agroclimatic hazards such as drought and hail storms affect such systems. I conclude with an overview of the possible effects of a recurrence the Dust Bowl droughts on the future agricultural comparative advantage of the MINK region.

Agribusiness Use of Climate Information in the 1980s.
STEVEN T. SONKA (University of Illinois)

For Midwestern agriculture, the 1980s have been a period of stress and variability. Although economic and financial pressures have been profound, climatic variability has been a major source of uncertainty for managers in the sector. Given this heightened climatic variability, effective climate predictions would seem to have considerable potential value for the sector. This paper will present results of a series of studies investigating climate prediction use in the sector. Currently climate prediction use is best characterized as general in nature. Impediments to more extensive use of climate predictions are identified. Although accuracy is a major concern, intriguing differences among user in the accuracy needed to attain economic usefulness are noted.

Can We Do Climate Impact Analysis?
PETER J. LAMB (Departments of Atmospheric Sciences and Geography, The University of Illinois)

It will be argued that climate impact analysis is essential for improving the nation's climate information supply, and the necessary research progress has hitherto been rather slow. To improve this situation, it will be essential to identify the key weather and climate sensitivities of a region's economic and related activities, and particularly their non-linearity and associated critical thresholds. Our current knowledge of these sensitivities is probably rather superficial. However, the scientific "tools" needed to sharpen this sensitivity information are available. They include: (a) automatic weather station networks that measure the most relevant parameters with the fine temporal resolution needed; (b) a range of detailed process models (physiological crop models, hydrological basin models, farm-to-regional scale economic models) capable of translating weather and climate anomalies into quantitative biological, environmental, and economic impacts; (c) many years of agronomic data from field trials conducted at land-grant universities that traditionally reflect the interannual variability of both weather/ climate and cultural practices, but in some cases now include the capability to control-rainfall; and (d) the potential for "expert systems" analysis techniques to contribute valuable information where other approaches have not been sufficiently fruitful. The presentation will emphasize the potential of these "tools" for enhancing our understanding of climate impacts.

Technical Sessions

15T-1. Impacts of Climate in Regions of the United States

Organized by: Stanley A. Changnon *(Chief Emer., Illinois State Water Survey, Champaign, IL)*

2:30 pm / Mon / 18 Feb **Omni/Calvert**

How Climate Affects Activities in the Southeast United States.
PETER J. ROBINSON (University of North Carolina)

Climate affects almost all human activities either directly or indirectly. In a particular geographical region and social context climate can be seen as a resource or a problem. Early in the development of the southeast United States climate was a resource which led to the dominance of King Cotton. Technological and social change thereafter transformed the climate resource to a problem, and then, notably with the rise of air conditioning, back to an opportunity. Today climate information is used to enhance that opportunity for a variety of activities in the region. Information use in agriculture, water resources, energy and tourism is discussed, and the impacts of climate and climate variations on these activities are reviewed. Climatic variations leading to drought, heatwaves, and frost are of most concern. The current frequency of these events and potential changes in frequency resulting from possible climatic changes are considered along with their economic and social consequences.

An Assessment of the Impacts of Recent Climate Variability on the Northeast.
W.W. KNAPP and K.L. EGGLESTON (Northeast Regional Climate Center, Cornell, University)

Predictions of global warming and other climate changes has stimulated interest in the possible economic and societal impacts of such changes. Significant climate anomalies experienced over the past 10-15 years in the northeastern U.S. have had both positive and negative impacts on transportation, water supplies, energy use, agricultural production, and recreation. Recent climate events such as record breaking low temperatures in December 1989 followed immediately by unusual warmth in January 1990, periods of significant drought and high temperatures in the spring and summer months of 1988, exceptionally heavy rainfall in May and June 1989, etc., provide an opportunity to directly observe the economic and other impacts of climate variations. We examine several recent climate anomalies and report on their impacts on energy consumption, snow removal costs, revenues from recreational skiing, and returns on agricultural crops.

Aspects of Soil Moisture in the Midwestern U.S.
KENNETH E. KUNKEL (Midwestern Climate Center, Illinois State Water Survey, Champaign, IL).

Soil moisture status, which directly affects the growth of crops and forests, is an integration of several climatic factors including precipitation, temperature, wind, and humidity. Since timely measurements of soil moisture in the Midwest are only available at relatively few locations, an operational soil moisture model, driven by measurements of the above climatic factors, was developed to provide up-to-date estimates of soil moisture status throughout the Midwestern U.S. A climatology of soil moisture, as estimated by this model, illustrates several aspects of importance to crop production including: 1) cold-season (Oct.-Apr.) precipitation is sufficiently large and reliable that nearly the entire Corn Belt is virtually assured of entering the growing season with fully recharged soils; 2) year-to-year variability of soil moisture during the critical mid-late summer period is very large, although soil moisture supplies are usually high enough for favorable crop development. A comparison of two recent contrasting summers (1988 and 1990) illustrates the role of soil moisture in explaining the large differences in crop yields. An earlier start to the spring-summer depletion of soil moisture reserves, as some climate models project for the future, would greatly increase the probability of soil moisture stress conditions during mid-late summer, particularly in the western portions of the Corn Belt.

Regional Climate Center Monitors Weather Impacts on the High Plains. K.G. HUBBARD, S.J. MEYER, and A.L. DUTCHER (High Plains Climate Center, University of Nebraska).

The High Plains Climate Center's monitoring capabilities have been expanded to include near-real time weather stations over a 7 state region. A subset of weather network sites (8-10 sites in the region) observe soil and crop conditions to provide resource information against which climate model outputs can be compared on a real-time basis. Real-time assessments of soil water in the root zone of corn, sorghum, soybean and wheat crops are then made and maps are drawn for the area covered by the network. Assessments of the impact of climate on soil water, and the subsequent crop yields, was studied in order to test the predictability of climate impacts on agriculture in the region.

Climate Issues in the Western United States.
KELLY T. REDMOND (Western Regional Climate Center, Desert Research Institute, Reno, Nevada)

Mirroring its rugged and varied topography, the West is characterized by extreme variations and large gradients in climate. Hydrologic regimes are complicated by the dominant influence of snowmelt on streamflow. Population centers are separated, often by large distances, from their natural resource bases. Climate records are longer and more dense in valleys, where people live, than in remote regions, which supply water, timber, minerals and other necessities. Livelihoods and recreation are often closely tied to the outdoors. Important river basins have been shown to have significant linkages with global climate behavior, such as El Nino/Southern Oscillation. These and other fluctuations in climate lead to a wide variety of social and economic impacts. In many cases these impacts are felt nearly as forcefully outside the region of the actual climate event as they are locally. The effects of global change on this region would be complex and may prove difficult to detect. About half the West is under federal stewardship. Many agencies monitor one or more important aspects of the climate to effectively fulfill their resource management missions. Logistics problems arising from the harsh western climates are slowly being overcome. Greater coordination of these monitoring efforts, and the marriage of human, automated and satellite methods, will benefit each agency and the public at large.

Our Climate Is Perfect, ARNOLD COURT (California State University, Northridge)

Perfection of our present "global climate," and of all its components, is implicit in the current campaign to prevent or diminish any change in it, and to estimate the assumedly dire effects of any such change or variation.

Climate, however, is the totality of weather conditions over at least a hectare (2.5 acres) during a specified interval of at least 5 years. Spatial variation of climate has been recognized for millenia, temporal variation only in the present century.

Climate is the frequency and succession of many "elements", from the temperature and humidity of the air to its motions (wind) and composition (gasous and particulate), from the intensity and spectral distribution of incoming and outgoing radiation to the frequencies and amounts of precipitation and evaporation. The combined occurrences and sequences of these elements as storms and fair weather make up the varying climates in which mankind lives.

While climates vary slowly and similarly in nearby places, at widely separated locales they differ not only in present character but in time variation. Drouths are not worldwide, and polar glaciers may wax while those in tropical mountains wane. Any change in Earth's energy balance, one presumed effect of adding "greenhouse gases" to the air, will act differently in different regions. Some results may be advantageous, others deleterious.

15T-2. Earthquake Prediction and Validation

Organized by: **Paul Switzer** *(Professor, Dept. of Statistics, Stanford Univ., Stanford, CA)* and **Allan G. Lindh** *(Seismologist, U.S. Geological Survey, Menlo Park, CA)*

8:30 am / Mon / 18 Feb **Omni/Calvert**

Optimization in Earthquake Prediction
G. M. MOLCHAN (Inst. of Earthquake Prediction Theory and Mathematical Geophysics, Moscow, USSR), Y. KAGAN (Inst. Geophysics and Planetary Physics, UCLA, Los Angeles, CA (90024).

Earthquake prediction is considered as a problem of optimization of a certain loss function γ. Function γ is defined by specific social, economic or geophysical goals. This problem can be fully solved for the loss function γ dependent on only two parameters: fraction of failures to predict n and fraction of alarm time, τ. For such a loss function the tasks of geophysicists and decision makers are clearly defined and can be separated; the requirements to the prediction algorithm can be completely formulated in terms of the hazard function.
We also consider a more complex model of γ by introducing a finite number of various alarms and losses for each changing alarm type. For this model we find strategies which optimize the losses for each time unit (locally optimal). We determine the conditions under which the locally optimal strategy becomes globally optimal. We emphasize that for this complex case of γ the tasks of geophysicists and decision makers in prediction are intertwined.

Stochastic Models of Seismicity and Risk
DAVID VERE-JONES (Institute of Statistics and Operations Research)

Any risk forecast requires a stochastic model framework within which the forecasting task can be precisely formulated and resolved. In the context of earthquake occurrence, point processes provide such a framework. A wide class of problems can be handled by explicitly modelling the conditional intensity function, which allows likelihood fitting and analytic calculation of risks in principle, and evaluation of risk by simulation in practice. In effect, the distribution of the time to the next event, or of the risk in a future time period, are conditioned by current available information, including information about the past of the processes. There are close analogues with statistical techniques such as Cox regressions for medical diagnoses and risk evaluation. Work of the author and colleagues on modelling historical data sets in China, Persia and Japan will be used to illustrate these ideas. Here the model (stress-release model) is a simple stochastic version of the elastic rebound model which exhibits quasiperiodic behaviour and appears to substantially aid the interpretation of the historical data, despite their many shortcomings.

Current Limits to Earthquake Forecasting
S. P. Nishenko (U.S. Geological Survey, Golden, CO.)

Studies of recent large and great earthquakes along simple plate boundaries have demonstrated that the combined temporal and spatial uncertainties in earthquake occurrence appear, at this time, to prohibit accurate long-term earthquake prediction. Over the last few years, probabilistic earthquake forescasts have become a recognized and generally accepted method of expressing the liklihood of future events. Recognition of the current limitations in earthquake forecasting is essential for the development of successful mitigation programs. Spatial variability in the mode of great earthquake reccurrence has been demonstrated for many plate boundary segments including Chile, Peru, Colombia-Ecuador, Mexico, Japan, and the Aleutians. Subsequent events along any given plate boundary segment to not always replicate prior events. Hence, it is difficult to

accurately predict the size (i.e. location and displacement) of a future event within a given seismic gap. Records of earthquake recurrence spanning more than one seismic cycle do not exist for many plate boundaries, and many of the current recurrence models in use are based on the extrapolation of recurrence behavior documented in a few areas. The intrinsic temporal variability observed in historically documented sequences ranges from 10 to 35% of the average recurrence time. For those areas with limited or non-existent recurrence histories, even greater uncertainties are associated with the application of the "direct" method (displacement divided by slip rate).

Probabilities of Earthquakes in the San Francisco Bay Region, California. ALLAN G. LINDH and JAMES H. DIETERICH (U.S. Geological Survey, Menlo Park, CA)

Following the magnitude 7.1 Loma Prieta earthquake of October 17, 1989, a reassessment was made of the probability of one or more additional magnitude 7 earthquakes occurring in the San Francisco Bay region in the coming decades. The result of this work was an estimate that there is at least a 67% chance of additional large earthquakes in the Bay area in the next 30 years. In this talk we will present the data and the models that went into this calculation, as well as the limitations and uncertainties that are endemic to this kind of work at this time. We will also discuss the degree to which the occurrence of the Loma Prieta earthquake can be taken as confirmation of earlier forecasts, and what other kinds of evidence suggested a large earthquake might be imminent. And finally we will discuss the question of whether, strictly speaking, long-term earthquake forecasts should be considered statistical formulations, or should they rather be treated as subjectively derived "Summaries of Expert Opinion".

Do seismicity patterns predict California mainshocks? MARK V. MATTHEWS (Department of Statistics, Stanford University)

Over many decades, seismographic networks have recorded California's earthquakes, large and small, with ever increasing coverage and accuracy. The cumulative record of times, locations, and magnitudes for many thousands of events represents a massive and complex data set that may be of great value in the quest to recognize foresigns of damaging mainshocks. A wide variety of models and techniques have been applied to the study of earthquake distributions with an eye toward mainshock prediction, and various studies have resulted in description of seismicity "patterns" with claimed predictive ability. The credibility of prediction schemes derived from retrospective empirical analysis depends essentially on the soundness of the analytical method of derivation, and the value of nominal seismicity patterns is questionable in the same degree that they are based on deficient methodology. I will discuss the principles and results of a systematic, retrospective analysis of California seismicity. I will try to identify useful point process models and briefly to describe techniques for estimation and inference. I will also evaluate seismicity-based prediction algorithms for California mainshocks in general and for the Loma Prieta earthquake of October 1989 in particular.

15T-3. Global Change and the Carbon Cycle in Terrestrial Ecosystems

Organized by: **Robert K. Dixon** *(Team Leader, Global Change Research Program, U.S. Environmental Protection Agency, Corvallis, OR)* and **David P. Turner** *(Project Leader, Global Change Research Program, NSI Technology Services, Inc., Corvallis, OR)*

2:30 pm / Sun / 17 Feb **Omni/Executive**

Greenhouse-Gas Induced Climate Change. MICHAEL E. SCHLESINGER (University of Illinois at Urbana-Champaign)

Our expectations of what a greenhouse-gas-induced climatic change will look like are based on supercomputer simulations performed with mathematical models of the atmosphere-ocean-sea ice system. These simulations reveal a cooling of the stratosphere, which increases with altitude; a warming of the trophosphere, which also increases with altitude in the tropics; a surface warming, which increases with latitude toward the winter pole; an increase in the global-mean precipitation and evaporation rates; large increases and decreases in precipitation between 30S and 30N latitudes with smaller increases in the high latitudes of both hemispheres; and a dessication of the northern hemisphere continents during summer. These and other aspects of the greenhouse-gas-induced climatic change that may impact terrestrial ecosystems will be presented.

Response of Global Vegetation to Climate Change: Modeling Temporal Patterns. ALLEN M. SOLOMON, (School of Forestry, Michigan Technological University)

Accurate prediction of future biospheric properties requires understanding the temporal responses of global vegetation to environmental change. These responses will determine whether the terrestrial biosphere becomes a source for carbon or a sink for carbon. Temporal responses will also define the amount by which greenhouse gas emissions must be reduced if we are to avoid extinctions of many currently-endangered plant and animal species, and whether or not life cycles of common slow-growing trees can be completed before climate changes are too severe for reproduction and growth. Numerical models which mimic temporal responses of vegetation at the level of stands, where reproduction and growth take place, must be extended to the global scale where biogeochemical cycles are being measured and climate models operate. A research team associated with the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria, has been developing such a model since 1988. The model is unfinished and will require several years for completion. Results from the completed static portion (IIASA Biome Model) define a serious global dilemma for the 21st century in the absence of international mitigative actions.

Climate Change and Disturbance Regimes: Potential Carbon Fluxes to the Atmosphere. RONALD P. NEILSON (Oregon State University).

Five different climatic scenarios from General Circulation Models were applied to the Holdridge Biome Classification scheme to assess regional impacts of climate change and potential feedbacks from the biosphere to the atmosphere. Under an equilibrium, doubled CO_2 environment, all scenarios indicate more global vegetation biomass than is currently supported. Overall the world would be warmer and wetter, with losses of biomass in the combined temperate and boreal forests and gains in the tropical forests. Thus, under equilibrium conditions, the biosphere appears to be a net sink for carbon due to climate change. However, the extra-tropical forests are expected to shift toward the poles by very large distances. This shift would produce large dieback zones at the southern extents of forest regions and regeneration zones at the northern extents. Dieback would likely be driven by widespread, regional drought and associated wildfire, producing large and rapid injections of CO_2 into the atmosphere. Regeneration, however, would proceed much more slowly, such that the released carbon would not be immediately drawn back into biomass. We have modeled this process, including increased growth in the tropics. The size of the pulse of CO_2 to the atmosphere could range from non-existent to about 130 Gts of carbon. Thus, in the transient response to climatic change, the biosphere could act as a significant positive feedback to climatic warming.

CO2 Fertilization: A Potential Negative Feedback on Rising Global CO2. BERT G. DRAKE (Smithsonian Environmental Research Center)

Recent field studies of perennial vegetation exposed to twice normal ambient CO2 in open top chambers show that long-term CO2 fertilization may have the following effects on physiological, whole plant andecosystem processes: increased photosynthetic capacity, primary production and water use efficiency; decreased specific respiration and decomposition (g/gdw); increased net carbon accumulation. The effects of CO2 on photosynthesis, transpiration, and relief from stress increase with temperature. These and other data suggest that the combined effect of increased CO2 and high temperature may result in large increases in carbon accumulation in terrestrial ecosystems.

Reforestation to Mitigate Rising Carbon Dioxide
ROGER A. SEDJO (Resources for the Future).

Our understanding of the global carbon cycle is still crude. Recent attempts to account for the fluxes by identifying the sources and sinks have resulted in evidence of a missing carbon sink located somewhere in the temperate region of the northern hemisphere. This paper suggests that temperate area reforestation may go explain a significant portion of the missing carbon. Forest volumes have been expanding in most places in the temperate region in the past several decades. Biomass growth, together with the buildup of forest soils and detrital material, may account for a significant portion of the missing sink. In addition, the role that long-lived forest products and waste dumps may play in the cycle is discussed.

16. Global Change

16-1. Making Informed Decisions for Planet Earth: The Role of Satellite Observations

Organized by: **Philip H. Abelson** *(Science Advisor, AAAS, Washington, DC),* **Gerald Soffen** *(National Aeronautic and Space Administration, Washington, DC),* and **Paul F. Uhlir** *(Senior Program Officer, National Academy of Sciences, Washington, DC)*

2:30 pm / Fri / 15 Feb — **Omni/Ambassador**

8:30 am & 2:30 pm / Sat / 16 Feb — **Omni/Ambassador**

Global Change -- The View from Space. D. JAMES BAKER (Joint Oceanographic Institutions Inc.)

Satellite-borne instruments provide an essential complement to surface-based measurements of global change. The first two decades of the space program demonstrated the feasibility of measurement and data distribution for processes ranging from the sun's energy input to the drift of continental plates. Today's operational environmental satellites and research missions are providing regular, but limited, data on atmospheric, oceanic, and land surface properties. For the 1990's a series of new research missions including a new U.S. series "Earth Probes" will describe and monitor processes ranging from a stratospheric chemistry to tropical rainfall to ocean circulation. In the late 1990's and into the 21st century, NASA in partnership with ESA and the Japanese Space Agency, NASDA, is planning a 15-year Earth Observing System consisting of several satellites primarily in polar orbits. The satellites will carry sets of instruments optimized for global change research. The first series will focus on clouds and radiation, the hydrologic cycle, and biogeochemical processes. A complementary set of smaller satellites will monitor, for example, ocean circulation, stratospheric and tropospheric chemistry, and surface properties. A major data and information system is being developed for EOS and precursor data. Later missions will include advanced geostationary satellites.

The Vital Signs of Global Change. JOHN A. EDDY (Office for Interdisciplinary Earth Studies, UCAR, Boulder, CO)

Concerns regarding the impacts of climatic or other global environmental changes call first for a clear accounting of (A) what is changing (or likely to change) and at what rate. We need also to know (B) what is behind it and whether the change is more than ephemeral or within the bounds of the ups and downs of natural variations of short or long term. Finally, we need to know (C) whether the change has practical significance and what the anticipated impacts will be. An effective Global Change Research Program must be able to answer all three of these in a timely and responsible way. A fuller understanding of the coupled Earth system and a more complete knowledge of what has happened within that system in the past (B and C above) are now addressed in the seven science priorities of the USGCRP and its international counterpart, the IGBP. What is not yet so well defined, beyond a spaceborne concept, is the documenting of significant change in a whole-Earth, whole-system sense. This critical need requires a solid consensus in a difficult realm: the identification of a necessarily limited set of the most vital signs of the Earth, agreed-upon priorities among them, identified methods for measuring them, and the scientific and fiscal will to put in place a lasting international global environmental monitoring system. We shall review the status of this unaccomplished effort, and suggest ways of accelerating progress toward its end.

The Data Management Challenge. LISA R. SHAFFER (The George Washington University)

Satellite and ground-based measurements are useful in solving global change problems only to the extent that the data they generate are available and are used. This paper will review key existing and planned systems in the US, Europe, Japan, and possibly elsewhere, focussing on data management and access policies. Questions such as what data will be archived, in what form, and with what user access policies will be examined across different systems. Key policy questions will be analyzed, emphasizing the need to establish technical and policy-level linkages to ensure easy, fair, and complete access by the international scientific community to data from the extensive suite of observing systems operated by many different entities around the world. Some of the issues include whether scientists should have preferential treatment compared to commercial users, and how continued operational global weather forecasting could be threatened by data policy options now being debated in Europe. The problems created by the attempted commercialization of remote sensing systems have the potential to spill over into the study of global change. The author will suggest some policy options in response to these challenges.

Relating Satellite Data to the Needs of Climate Models
ROBERT E. DICKINSON (Institute of Atmospheric Physics, The University of Arizona, Tucson, AZ).

Climate models are the primary tools for evaluating the possible climate change from increasing greenhouse gases. These models are largely derived from basic physical principles and so have some reality even without data. However, many aspects of the models, especially those involving the role of features acting on spatial scales too small to be resolved by the model, may be of questionable validity, until they are calibrated or checked with observational data. The climate system and its models span the globe so that global observations, only readily obtainable from satellite platforms, are essential for such model validation. Some of the present and future applications of satellite data to this need include the following measurements: radiative fluxes from clear and cloudy sky, depending on atmospheric structure including water vapor; year-to-year variations in ocean surface temperatures and winds; atmospheric temperature, water vapor and wind profiles as input to numerical data assimilation schemes; precipitation patterns, both large-scale monthly means, and time and space distribution functions for inputs to climate model land hydrology; year-to-year variations in the seasonal coverage of snow and ice; solar radiation incident at the surface; seasonal and year-to-year variations in vegetation coverage, evapotranspiration and soil moisture. Examples of the application of such data to improving climate models is given.

Integrating Diverse Data Sets for Policymakers
CAROLYN AUTREY-HUNLEY (University of Michigan, CIESIN), ERIC KASISCHKE (Environmental Research Institute of Michigan, CIESIN), WILLIAM KUHN (University of Michigan, CIESIN), JACK LOUSMA (CIESIN), MICKEY TRICHEL (Environmental Research Institute of Michigan, CIESIN)

Human society is now commonly seen as being endangered by environmental changes and reducing and directing the anticipated changes may be essential to achieving and maintaining a reasonable global quality of life. Reduction and redirection of anticipated changes can be achieved by a combination of policy changes by governments and similar bodies and education of the public. However, making such policy changes and educating the public require prediction not only of the outcome of biogeophysical processes as a function of input scenarios, but also the human response to environmental change, policy changes, and changes in public perception. Predicting the human response requires, in turn, that we be able to combine data on the social sciences (e.g. economics, demographics, public health) with data on the physical environment. The Consortium for International Earth Science Information Network (CIESIN) has undertaken the development of such data sets and the implementation of means to support informed policy decisions and to transfer knowledge on global change and its causes to the public. This paper sets forth our plans in these areas.

Employing Remote Sensing And GIS In Environmental Management: Examples From North America. JAMES W. MERCHANT (University of Nebraska-Lincoln).

Public agencies charged with protecting environmental quality and managing natural resources are confronted with a host of complex, interrelated issues with which they must deal. Because most environmental policy and management decisions involve evaluation of spatial information, automated means to acquire and analyze spatial data, especially remote sensing and geographic information systems (GIS), have attracted increasingly great interest. It is shown that these technologies are becoming ever more closely linked to, and integrated with, one another. Synergistic relationships are reviewed. Attention is given to (1) remote sensing as a data source for GIS, (2) GIS as an aid in digital image analysis, (3) animation, and (4) presentation graphics. Methods, prerequisites and future prospects for improving environmental decision-making via the application of remote sensing and GIS are presented. It is argued that enhancements in environmental decision-support will require greater attention to development and utilization of objective-directed strategies for data analysis, broad training of data analysts in the spectrum of spatial analytic tools available, and improvements in techniques for information delivery to decision-makers.

The Use of Satellite Observations for Improving Environmental Decision Making in Less Developed Countries. DR. JONATHAN T. OLSSON (U.S. Agency for International Development)

Many varieties of satellite data are used for a variety of land management and environmental purposes throughout the developing world. To a great extent, however, its use is irregular and often only at the demonstration level. Africa provides an interesting insight into the problems and possibilities for the use of satellite imagery. Data acquisition and dissemination systems are still being set up (with a current emphasis on coarse resolution imagery). The advent of PC-based software and software tools is greatly facilitating the adoption of this technology. Among the constraints to broader use are: a) the cost of data, b) a relatively poor infrastructure for utilizing the data, and c) the degree of complexity encountered in trying to utilize the data. There are also constraints at the managerial level. Environmental issues often cannot be given the same priority as issues like: food security, unemployment, over population, or AIDS. In addition, many managers are either unaware of how to use imagery, or have experienced the 'pretty picture' syndrome. A final group of constraints is at the scientific level. Particularly in the case of AVHRR data, the applications are still being worked out; and scientific results may lack precision or be controversial. This means those results have a significant discomfort level in terms of decision-making.

The Role of Earth Observation Satellites in the Development and Enforcement of International Environmental Agreements
PAUL F. UHLIR (National Academy of Sciences)

Earth observation satellites have been instrumental in the process of developing and enforcing arms control agreements between the United States and the Soviet Union since the 1960s. Commonly referred to as the National Technical Means (NTM) of verification, these highly classified systems have provided the information necessary for negotiating agreements on strategic weapons and troop deployments, and for providing subsequent evidence of the parties' compliance with or breach of the terms of those agreements. A similar function for Earth observation satellites, but on an unclassified and multilateral basis, can be applied to the development and enforcement of regional and global environmental protection agreements. Satellite data have already played a role in the formation of an international consensus for protecting the Earth's ozone layer. The sensor and related data processing technologies, however, are now sufficiently mature and internationally accessible to warrant the expansion of their use in the development and enforcement of other broad areas of formal environmental protection. Large-scale problems that can be addressed in this way include tropical deforestation, preservation of the Arctic and Antarctic regions, ocean pollution, and climate change. It is therefore appropriate to begin planning for the design, operation, and use of specialized Earth observation systems dedicated to the monitoring and enforcement of specific environmental legal regimes.

16-2. Humankind in Global Change: Indicators and Prospects

Organized by: **Elizabeth J. Kirk** *(Senior Program Associate, Directorate for International Programs, AAAS, Washington, DC)* and **Thomas Malone** *(Scholar-in-Residence, St. Josephs College, West Hartford, CT)*

8:30 am & 2:30 pm / Sun / 17 Feb	**Omni/Ambassador**
8:30 am & 2:30 pm / Mon / 18 Feb	**Omni/Ambassador**
8:30 am & 2:30 pm / Tue / 19 Feb	**Omni/Ambassador**

The Labor Force of the Future and the Role of Women in It. T. PAUL SCHULTZ (Yale University).

The secular trend of declining labor force participation rates by men in high income countries is spreading to developing low income countries, and is increasingly offset by the rising participation of women. Analysis should distinguish among market work, investment in schooling, home work, and leisure, but the latter two states are frequently combined in available data. Microeconomic models of family labor supply provide an interpretation of the sources of variation in these patterns of participation, across societies and over time, and therefore are useful for forecasting future participation. Most nations and regions that have deviated from these general labor market trends have invested relatively less in the education of women than in men, which explains why women's entry into market work has been retarded, specifically in South and West Asia and North Africa. Countries that have invested more equally in women and men's education, but encouraged women to concentrate their activities in the family, are coming under increased social and economic pressure to utilize more efficiently female labor in a wider range of market employments, as evident in Japan, Netherlands, and Switzerland.

Technological Change and Global Change: The Role of Impact Assessment
ALAN L. PORTER (Georgia Institute of Technology)

Sustainable development considers the life cycle of new technologies and how they will directly or indirectly affect the environment. That charge relates intimately to technology assessment, defined by J.F. Coates as: the systematic study of the effects on society that may occur when a technology is introduced, extended, or modified, with emphasis on the impacts that are unintended, indirect, and delayed.

This presentation overviews developments in impact assessment (the expanded version of technology assessment) over the past two decades. It indicates how impact assessment can help manage technological change in the context of global change. Two key points are that (1) we must understand the complex of interactions among technology, society, and the environment; and (2) we need to develop analytical skills for this purpose. Present impact assessment methods and institutions provide a helpful, but inadequate, base. The U.S., in particular, needs to direct resources to improve these skills.

Intergovernmental Institutions
PETER M. HAAS (University of Massachusetts/Amherst and Harvard University Center for International Affairs)

How effective have international responses been to global environmental threats?

This paper analyzes the programmatic response since 1972 of UN specialized agencies to 11 global environmental problems. Responses have taken the form of programmatic changes sensitive to the dimensions of environmental problems closest to the traditional mandates of the organizations. Such a response reveals single-loop institutional learning. The assessment of whether such organizational learning is adequate to deal with the most salient dimensions of contemporary environmental problems ultimately hinges on the analysts's belief about the extent to which these problems are causally discrete or whether they are tightly coupled.

National, Provincial and Local Institutions and Global Change: Roles and Challenges for the Future. CHADWICK F. ALGER (Mershon Center and Department of Political Science, The Ohio State University).

Human history can be viewed as a dialectic between territorial institutions and human proclivity to transcend all borders. The employment of new technologies in trans-border efforts to explore, exchange, dominate, proselytize, produce and destroy has created an array of global problems which now require global institutions. But these global problems also reach across national borders into the villages, towns and cities of the world. Thus they are also local problems. In many towns and cities throughout the world citizens are responding to local manifestations of global issues by creating nuclear free zones, adopting UN human rights standards, disinvesting in firms investing in South Africa, and establishing transnational ties for coping with environment and development issues; many provinces, and some cities, have permanent representatives abroad. These local initiatives are challenging scholars to reassess traditional assumptions about the actual and appropriate roles of local, provincial, national and international institutions for coping with global problems.

Implications for the Educational System.
ALLAN MAZUR (Syracuse University)

Issues of the organization and content of training and research in the universities. How do interdisciplinary concerns fit into the present disciplinary format of higher education? How do the universities deal with scientific and technical uncertainty that is relevant to policy?

16-5. What Are the Effects of Human Activity on the Global Ecosystem?

Organized by: **Warren M. Hern** *(Assistant Professor Adjunct, Dept. of Anthropology, Univ. of Colorado, Boulder, CO)* and **Priscilla Reining** *(Adjunct Professor, Center for African Studies, Univ. of Florida, Gainesville, FL)*

2:30 pm / Fri / 15 Feb **Omni/Palladian**

Global Climate Change: Ecosystems Effects STEPHEN H. SCHNEIDER (National Center for Atmospheric Research*).

Human activities which produce greenhouse gases, acid rain, and other atmospheric disturbances have long been postulated to pose a potential threat to natural ecosystems. Much debate surrounds the possible range of climate changes, its timing and geographic distribution, possible effects on natural and managed ecosystems, and, most contentious of all, whether present information justifies an immediate policy response. These issues will be reviewed for the state-of-the-art as of this talk. The most serious threat to natural ecosystems, I believe, comes from rapid rates of change (for example, several degrees C or more of warming in a century or less time). Such changes are reasonably probable, that is, say, have an even odds change of occurrence, and could threaten the viability of forest and coastal habitats in particular. Examples will be given.

*The National Center for Atmospheric Research is sponsored by the National Science Foundation.

Nonlinear Dynamics and Chaos: Implications for a Brave New World.
WILLIAM M. SCHAFFER (University of Arizona)

Chaos enthusiasts are firmly convinced that recent insights from nonlinear dynamics have already materially affected the way in which mankind views his world and the universe. The present talk reviews the theoretical essentials and discusses some of the possible implications. Among the topics to be considered are the notion that there is a Balance of Nature to which ecological systems tend in the absence of disturbance. This idea, which has been enormously influential in the realm of politics and policy making, turns out to have little theoretical or empirical basis. Other topics to be discussed include Pleistocene climate oscillations, recurrent patterns of infections in human diseases and the role of nonlinear dynamics in forecasting the behavior of complex systems.

Catastrophe or Maturity in Century 21?
KENNETH E. BOULDING (University of Colorado at Boulder)

There are certain parallels, inexact but suggestive, between the growth of an organism and the development over time of an ecosystem, or even the global ecosystem. An organism always has a life pattern that starts from the initial conception, whether a fertilized egg or a divided cell, or even the idea that starts a social organization in the mind of its creator. After the conception there is a period of growth in both overall size and in structural organizational complexity. Thus a human passes through the stages of the fetus, the baby, the child, the adolescent, at varying rates of change. At some point however an organism reaches maturity, after which growth in overall size or weight tends to be fat. Physical maturity however does not preclude growth in knowledge and skill, which might be called structural growth. An important question is whether the economies of the rich countries have now reached this point of maturity, and therefore must pass into a pattern of structural growth very different from the past few centuries. Whether the world as a whole can achieve economic and social maturity without catastrophe, in the light of the human population explosion, is a difficult and agonizing question. Physical maturity cannot be achieved in an organism without inputs of food and other "growth builders," and the same is true of societies. We must work to avoid catastrophe and, if in some degree it cannot be avoided, to look beyond it.

Description and Diagnosis of a Planetary Ecopathological Process. WARREN M. HERN (University of Colorado)

The most striking characteristic of the human species is rapid growth of the human population, which is now doubling in size every 40 years or less. This is coupled with colonization and destruction of all previously intact ecosystems. The human species, through culture, has transcended the boundaries of local ecological adaptation and is now changing the global ecosystem. Colossal human communities containing millions of individuals are heterotrophic settlements that are growing rapidly and replacing adjacent natural ecosystems. In order to explain these various phenomena, a hypothesis is presented that draws on ecologic, epidemiologic, anthropologic, and pathologic

theory. The hypothesis is that the human species manifests all four characteristics of a malignant neoplasm: rapid, uncontrolled growth, invasion and destruction of adjacent normal tissues (ecosystems), metastasis, or distant colonization, and de-differentiation. The human species is perceived as a predatory, omniecophagic, malignant epiecopathologic process converting all plant, animal, organic, and inorganic materials on the planet to human biomass or its adaptive adjuncts.

17. Environment

17-1. The Role and Responsibilities of Scientists and Engineers in Environmental Debates

Organized by: **Amy Crumpton** *(Program Assistant, Directorate for Science and Policy Programs, AAAS, Washington, DC)* and **Sheldon Krimsky** *(Professor of Urban and Environmental Policy, Tufts Univ., Medford, MA)*

2:30 pm / Mon / 18 Feb **Omni/Executive**

Speaking Truth to Power: Communicating Environmental Risks to the Public. ELLEN K. SILBERGELD (University of Maryland and Environmental Defense Fund)

Public discussion of environmental risks represents a great challenge to democratic discourse in the US because both knowledge and risk are inequitably distributed. In many cases, those with the least access to information are the most at risk. The new field of "risk communication" is often seem as a methodology of propaganda. Goals in risk communication differ for "vendors" of risk — standard setting or siting decision makers -- as compared to "consumers" of risk — the general public. Acknowledging these differences is critical. Also, strict adherence to the truth is required, including expanding freedom of information. Third, the public's ability to participate in discussions of environmental risks must be increased. This is not solely an educational need but also a power-balancing need. The Technical Assistance program under Superfund and ATSDR's work in community health studies are examples of more comprehensive powerbalancing. Finally, it must be acknowledged that the often-castigated NIMBY reaction can serve as a powerful incentive for technological and social change. The replacement of phosphate detergents and the widespread implementation of recycling are examples where public refusal to accept the status quo has resulted in major advances in environmental protection.

Government Scientists and Engineers in Environmental Disputes
HOWARD WILSHIRE (U.S. Geological Survey)

Government scientists and engineers command a vast array of information relevant to environmental issues, but public access to this information has become increasingly dependent upon political agendas that may change with each new administration. During the past two decades, political control has increasingly obstructed release of peer-reviewed scientific information gained at taxpayer expense. Federal scientists at every level have been threatened, and often punished *sub rosa*, by political managers, who want to change the direction and impact of scientific reports. Issues over which this political control is exercised include acid rain, global warming, offshore oil, endangered species, toxic waste, mechanized recreation on public lands, old-growth forests, and other topics. Not only are official releases of information and interpretation controlled, but also policies and regulations are used to restrict public access to the expertise of government scientists, even when speaking as private citizens. There is in general a marked contrast between public access to information that supports development such as mining, dam-building, or lumbering, as opposed to information that indicates severe consequences of environmental degradation. This imbalance must be redressed if the public is to properly benefit from its investment in government science. The right of government scientists to participate in public affairs, guaranteed by the Constitution, needs to be reaffirmed by the agencies that employ them.

17-2. Science: A Basis for Environmental Policy?

Organized by: **S. Fred Singer** *(Professor of Environmental Sciences, Univ. of Virginia, Charlottesville, Va)*

8:30 am / Mon / 18 Feb **Omni/Congressional**

Science Base for Global Warming.
PATRICK J. MICHAELS (Univ. of Virginia).

Any significant policy intervention because of global warming requires reasonable evidence that such a warming is due to human causes and is of a highly deleterious nature. An increasing body of observation and literature suggests that this likelihood is becoming remote. The rise in global temperatures (before 1940) precedes the major trace gas emissions and is well below levels suggested by the penultimate generation of climate models. (Anthropogenerated sulfates in the Northern Hemisphere are in fact mitigating some warming and may explain why there has been no net warming of that hemisphere for the last half century.) Northern hemisphere records appear to show relative warming at night with some cooling during the day, which would lengthen the growing season and not increase evaporation disastrously. There is considerable evidence that cloudiness is increasing, which would create such a day/night differential in a world of increased greenhouse gases, and some evidence that the cloudiness is caused by anthropogenerated sulfates. Finally, newer climate models suggest that most of the warming of greater than 4°C will be during polar night, which would minimize any significant ice melting.

Science Base for Acid Precipitation

JAMES R. MAHONEY
National Acid Precipitation Assessment Program

The National Acid Precipitation Assessment Program recently completed a 10-year, $500 million analysis of acidic precipitation causes, effects and control strategy options, as required by Public Law 96-294 (1980). The NAPAP studies have greatly increased the information base and decreased the uncertainties about acid rain. Many (but not all) of the scientific concensus views reported in the early 1980's have been supported by the NAPAP studies, but the more extreme views (in both directions) expressed by some scientists and in some of the media have been rendered unlikely. This presentation summarizes NAPAP's key findings, and describes the principal lessons learned from the NAPAP experience, for consideration in the planning and conduct of other major environmental assessments.

Stratospheric Ozone: Time Trends and Mechanisms
S. FRED SINGER (Univ. of Virginia)

The idea that global ozone is currently declining as a result of the release of chlorofluorocarbons (CFCs) has gained wide popular currency and is resulting in international action to amend the Montreal Protocol and phase out CFCs altogether. But the reported decline (1) in northern-hemisphere ozone of about 2% per decade covers only 1.5 solar cycles, starting at a solar activity maximum (1970) and finishing at a solar minimum (1986). Furthermore, the value of the decline is found to depend sensitively on the chosen starting and finishing dates (2). Since the observed solar-cycle variation of ozone is generally much greater (3), the "decline" could be, in part, an artifact of the analysis, depending on the particular choice of time interval.

Various natural and anthropogenic mechanisms could cause a secular trend in ozone (4). But according to the standard CFC-ozone theory, the release of CFCs should not produce a significant effect until sometime in the next century.

1. NASA Ozone Trends Panel Executive Summary, R.T. Watson, Chm., March 1988; and press release. See summary by R.A. Kerr, Research News, Science, March 25, 1988.

2. L. Bishop, W.J. Hill, and M.A. Marcucci, "An Analysis of the NASA Ozone Trends Panel Dobson Total Ozone Data over the Northern Hemisphere". Center for Applied Mathematics, Allied Signal, Inc., Aug 3, 1988.

3. J.K. Angell, "On the Relation between Atmospheric Ozone and Sunspot Number". Journal of Climate (1989).

4. S.F. Singer, "What Could Be Causing Global Ozone Depletion?" Eos (submitted 1990)

New Controls for Urban Ozone: The Role of Science in the Congressional Debates. ROBERT M. FRIEDMAN (Office of Technology Assessment, U.S. Congress).

The goal of the Clean Air Act is to achieve national air quality necessary "to protect the public health ... with an adequate margin of safety." Twenty years after the Act became law about 100 cities do not meet the standard for urban ozone, the toughest air pollutant to control. New amendments to the Act hope to change this over the next twenty years. Scientific and technical information played a role in the Congressional debates but, of course, was only one of many factors considered. I shall review how science contributed to the design of the new amendments.

The Health Benefits of Air Toxics Legislation. JOHN D. GRAHAM (Harvard School of Public Health).

The air toxics provisions of the new Clean Air Act will mandate new controls on "toxic" air pollution from mobile and stationary sources. This talk will address the public health benefits that can be expected from the new legislation, including a candid discussion of the gaps in scientific knowledge about emissions, human exposure, and health effects. Specific issues to be addressed include: cancer and noncancer endpoints; population versus maximum individual risk; approaches to determining acceptable residual emissions; and the need for improvements in risk assessment.

Economics and the Regulation of Environmental Risks. PAUL R. PORTNEY (Resources for the Future).

Economics has an ambiguous role in the management of risks to health and the environment. Some federal laws require regulatory officials to balance benefits and costs in establishing environmental standards, while other statutes explicitly prohibit such tradeoffs. In his presentation, Portney will discuss: the role(s) that economics can play in environmental regulation; the current uses of such analysis in real-world decisionmaking; and the apparent trends that have recently emerged with respect to economic analysis.

17-3. Is Superfund Working?

Organized by: **William F. Isherwood** *(Project Leader, Livermore Site Restoration Group, Lawrence Livermore National Laboratory, Livermore, CA)*

8:30 am / Tue / 19 Feb **Omni/Hampton**

Superfund: Environmental Progress?
HENRY L. LONGEST II (U.S. EPA, Office of Emergency and Remedial Response).

Superfund, the Nation's environmental program to clean up abandoned and uncontrolled hazardous waste sites, has been in operation for 10 years. During that period, thousands of actions have been taken to reduce risk to humans and the environment near those sites. Cleanup of hazardous waste sites is complex and often takes place over a number of years. Substantial progress toward reducing risk is often accomplished long before a site is finally depleted from the National Priorities List (NPL). Similar risk reduction occurs when cleanup actions to control acute threats are undertaken at sites that never become part of the NPL. The legacy of problems posed by hazardous waste sites is a formidable challenge. These problems are both more numerous and more complex than originally thought when CERCLA was enacted in 1980. To achieve a maximum number of sites within available resources, EPA's Superfund program has adopted a strategy of immediately making sites safe from acute threats to human health and the environment, and then progressing toward permanent cleanup of the worst problems first at NPL sites. A tremendous amount of incremental work has been done to make sites safe and clean, as we move to the ultimate step of deletions from the NPL.

Using Improved Technologies for Superfund Cleanups Remains a Critical Need. JOEL S. HIRSCHHORN (EnviroSearch-East)

Many points of conflict, stress, and disappointment for the Federal Superfund program detract attention from cleanup technology. From the beginning, legal, bureacratic, and economic issues have created far more obstacles to using advanced and innovative cleanup technologies than incentives. Though the enormous sums of money clearly needed for the national cleanup effort has caused technology companies to introduce new technologies, there has been slow, limited increases in their use. Good information on comparative effectiveness, safety, and cost of technologies remains a problem. The general Superfund atmosphere continues to promote use of land disposal options even though they are impermanent remedies and portend future re-cleanup costs. Mobile incineration tends to be more favored by certain EPA regions than responsible parties, but it is often opposed by communities. Certain waste destruction technologies are being largely ignored, such as the KPEG dechlorination technology for PCBs, dioxins, pesticide contaminants. Novel low cost technology that recycles cleanup wastes into aggregate and vitrifies wastes if toxic metals are present is also underutilized.

Improving Superfund Through the Remedy Selection Process. THOMAS P. GRUMBLY (Clean Sites).

The key to getting a larger number of sites cleaned is making the remedy selection process work as effectively and rationally as possible. The choice of a remedy determines the total cost of cleanup and the level of protection it will afford. The current process has been widely criticized. Clean Sites drew together more than 100 experts representing diverse interests to help us analyze the current process. A key finding was that the current process of selecting remedies works backwards—EPA explores, in-depth, all the alternative cleanup methods it plans to consider and then decides the level of protection it is seeking. EPA instead needs to define a site's risks, set a target level of protection and then select a remedy from among only alternatives that could meet the selected level of protection. EPA also must clearly define the goals that the Superfund law has mandated for remedies, including permanence and long-term effectiveness. These goals or criteria must be applied consistently and explicitly at appropriate points in the process. Citizens and states must be given all technical information as it becomes available. EPA should elicit and respond to citizens' and states' comments before selecting a preferred alternative.

Environmental Protection, Resource Allocation, and CERCLA: A Practitioners Perspective.
RICHARD B. WEISS (Weiss Associates), MARVIN FELDMAN (Resource Decisions).

Accepting Superfund's mandate of protection of human health and the environment in a timely manner, critics often overlook cost/benefit analysis, the technical complexities of contaminant transport and treatment in natural materials, and the limited technical resources in this rapidly expanding field. Adequately addressing these issues takes not only funding, but expertise, time, and appropriate resource allocation. As noted in the 1989 Senate subcommittee report, progress has been made, although there are some additional areas where CERCLA implementa-tion, in practice, misses the mark.

In theory, NCP regulations identify the most potentially hazardous sites and guide selection of effective risk reduction alternatives. In practice, the EPA Hazard Ranking System often identifies less hazardous sites while passing over sites posing greater risk. Moreover, remediation methods prescribed for site cleanup may not be most beneficial in balancing risk reduction with costs to industry and society. Prescribed investigation and remediation protocols may also lead to inefficient allocation of scarce human and natural resources.

For several case histories, we compare the selected investiga-tions and remediations with some often overlooked risk and cost factors which could lead to different remedial alternatives. A social cost-benefit framework is proposed which could lead to better allocation of national resources.

Implementing CERCLA.
WILLIAM F. ISHERWOOD (Lawrence Livermore National Laboratory).

With the passage of SARA and the placement in 1987 of Federal facilities on the National Priorities List, EPA accepted a new and unique role of overseeing its sister Federal agencies. DOE and its contractors were particularly unaccustomed to close scrutiny of its work by agencies outside the defense complex. Despite this initial unease, DOE has undergone a change in culture to allow closer oversight and to elevate the priority of environmental protection.

Problems encountered by parties attempting to clean up sites under CERCLA derive from (1) failure of the law to provide guidance on how clean is clean and how to balance small residual health risks against other national priorities; (2) the rigidity with which the law is administered by the use of staffers without the experience or authority to judge the merits of specific, unique cases; and (3) the administrative failure within EPA, which expresses itself as heavy reliance on outside contractors for document review, without developing a cadre of expertise related to individual sites or situations.

17-4. Assessing the Impacts of Nuclear Waste Facilities: The State of the Art Updated

Organized by: **Roger E. Kasperson** *(Professor, Center for Technology, Environment, and Development, Clark Univ., Worcester, MA)*

2:30 pm / Sat / 16 Feb **Omni/Executive**

Overview: The Social Amplification Process.
ROGER E. KASPERSON (Clark University)

Environmental impact analysis and risk assessment have proven to be inadequate assessment methodologies for assessing the social impacts of controversial and risky facility siting. The social amplification of risk provides a framework capable of integrating the technical assessment of risk and the social processes that amplify or attentuate the risks. This paper overviews this conceptual approach and summarizes how the various papers in this session relate to the framework. Implications for needed state of the art changes are summarized.

The Importance of Imagery as a Causal Factor.
PAUL SLOVIC (Decision Research)

The images that people hold of places and facilities can affect greatly their attitudes and behavior. Negative images of places have been known to develop due to risks or perceived noxious attributes. This paper reports on a series of studies examining the images that members of the public have of a nuclear waste disposal facility and the relationships between these images and potential social and economic impacts. Particular attention is given to a methodology for exploring image formation and links to behavior.

Political Trust and the Siting of Nuclear Waste Facilities
MARILYN DANTICO (Arizona State University)
ALVIN MUSHKATEL (Arizona State University)
K.DAVID PIJAWKA (Arizona State University)

This paper examines the relationship between political trust and risk perceptions of the high-level nuclear waste repository proposed at Yucca Mountain. The dependent variable, risk perceptions of the repository, are broken into six dimensions including perceptions of: transportation risk, the effectiveness of mitigation activities, repository safety, the costs and benefits of the project, safety and health threats, transporting hazardous materials in general. Trust indices include trust in: the federal government, federal agencies and state and local government. Findings from the analysis indicates that political trust is a key element in understanding repository risk perceptions.

Economic Impacts of a Nuclear Waste Facility.
Howard Kunreuther and Doug Easterling (The Wharton School)

The proposed high level radioactive waste repository has been vehemently opposed by candidate states on the grounds of health risk and economic dislocation. Surveys of Nevada residents and a national sample reveal that the widespread opposition to the facility can be traced not only to the perceived severity of the personal risk, but also to a strong concern for future generations. In addition, surveys of convention planners and convention attendees suggest that a repository will adversely impact the Las Vegas visitor industry. We explore the role that public participation, local control, and other mitigation measures can play in reducing the perceived risks to an acceptable level.

Anticipated Social Consequences of a Nuclear Waste Facility.
JOANNE M. NIGG (University of Delaware)

The proposed high level nuclear waste repository at Yucca Mountain, Nevada--95 miles from Las Vegas--has been the subject of a great deal of public debate in Nevada. As the first such facility of its type in the United States, it has also been the subject of sustained speculation concerning its expected positive and negative consequences for the state and its residents. This paper investigates Law Vegas residents' perceptions of the anticipated consequences that this nuclear waste repository will have on their lives and on their community.

17-5. Cleaning Up the Mess at the DOE Nuclear Weapons Complex

Organized by: **Peter A. Johnson** *(Senior Associate, Oceans and Environment Program, Office of Technology Assessment, Washington, DC)* and **Robert P. Morgan** *(Professor, Dept. of Engineering and Policy, Washington Univ., St. Louis, MO)*

8:30 am / Sat / 16 Feb **Omni/Executive**

Cleaning Up the Weapons Mess: The OTA Findings.
EMILIA L. GOVAN, J.D. (Office of Technology Assessment)

In assessing the prospects for cleaning up waste and contamination at the Department of Energy's (DOE) Nuclear Weapons Complex, a key issue is whether strategies and priorities for waste management and environmental restoration being pursued by DOE and other involved parties will result in actual cleanup and attain public acceptance. This paper will discuss the Office of Technology Assessment (OTA) findings and policy analysis regarding the Weapons Complex cleanup. The discussion will be based on an OTA study (conducted at the request of the Senate Committee on

Armed Services) that focuses on the following areas: (1) evaluating problems and needs that could benefit most in the near term from additional emphasis and resources; (2) assessing technologies for waste management and environmental restoration; and (3) investigating approaches for setting priorities and allocating resources. The paper will evaluate current and proposed approaches to site characterization and remediation, storage and disposal of high-level and transuranic waste, and technological development. The discussion will also draw upon OTA's findings regarding the setting of funding priorities for environmental cleanup and discuss the importance of public involvement in making cleanup decisions. Possible policy initiatives and options that could improve the prospects for developing an effective and acceptable decision-making process for environmental restoration and waste management at the Weapons Complex will be addressed.

The DOE Weapons Complex Cleanup: Evaluation of Health Impacts.
TARA O'TOOLE (Office of Technology Assessment)

National attention has been focused on the possible health effects resulting from nuclear weapons production and associated waste management practices. Public concern has been stimulated by reports that environmental media at DOE weapons sites have been contaminated with hazardous chemicals and radionuclides, in some cases in violation of existing environmental laws, and by Congressional discussion of Department of Energy (DOE) efforts to plan and carry out the cleanup of environmental contamination throughout the Nuclear Weapons Complex. Efforts to identify, quantify, and map environmental contamination at the DOE Weapons Complex are in the early stages at most sites. There is need to characterize "uncontrolled" contamination and rank contamination scenarios according to the potential for adverse public health impacts, so that the most urgent problems can be addressed on a timely basis. OTA has identified additional health-related objectives that must be achieved if the Weapons Complex cleanup is to be successful. This paper describes health evaluation processes mandated by regulations and agreements and discusses the likelihood that health-related cleanup objectives will be realized under the current approach.

Citizen Participation in DOE Weapons Cleanup.
DAN W. REICHER (Natural Resources Defense Council)

This paper will evaluate the adequacy of Department of Energy (DOE) efforts to inform and involve the public in the development of programs and plans for environmental restoration and waste management at the Nuclear Weapons Complex, and in the preparation of a Programmatic Environmental Impact Statement for the Weapons Complex cleanup. Issues relating to information availability will be addressed. The paper will also outline possible approaches for improving formal and informal relationships between decision-makers and the public.

Public Health Assessments: Progress and Prospects.
MARK M. BASHOR (Agency for Toxic Substances and Disease Registry)

The Agency for Toxic Substances and Disease Registry (ATSDR) was created as an agency of the Public Health Service by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The ATSDR was given great expanded public health responsibilities under the Superfund Amendments and Reauthorization Act of 1986. These responsibilities include: (1) the preparation of health assessments for each site proposed or listed on the National Priorities List; (2) the conduct of epidemiologic studies and other health studies around hazardous waste sites; (3) establishment of registries of exposed persons; (4) establishment of health surveillance programs; (5) the development of toxicological profiles for hazardous substances; (6) performance of health and emergency response consultations; and other activities, e.g., health education. The presentation will discuss these ATSDR responsibilities and their implementation at the Department of Energy Nuclear Weapons Complex.

Technical Sessions

17T-1. Meta-analysis and Risk Assessment: A Tool for the '90s?

Organized by: **Resha M. Putzrath** *(Project Manager, Eviron Corp., Arlington, VA)* and **Michael E. Ginevan** *(Principal Scientist, Risk Focus Division, Versar Inc., Springfield, CA)*

2:30 pm / Fri / 15 Feb **Omni/Calvert**

A Review of Current Issues in Meta-analysis.
INGRAM OLKIN (Stanford University)

Meta-analysis is the name of a methodology that encompasses the collection and analysis of independent studies. Although combining results has been carried out for many years, its greater use started about 1975. The first set of applications dealt with effects of psychotheraphy, gender differences, and intervention programs. More recently meta-analyses have appeared regularly in the medical literature. There are currently several hundred meta-analytic studies in the health sciences with an addition of over ten per month. These have dealt with a wide range of health issues: risk assessment related to the effects of alcohol, hypertension, smoking, caffein, lead, etc. In the present talk we provide an historic review of the field, discuss some of the current issues, and offer an explication of particular methodologies relevant to risk assessment in health related applications.

Some statistical approaches to combining cancer risk coefficients. MICHAEL E. GINEVAN (Risk Focus Division, Versar Inc., Springfield, VA 22151).

Cancer risk coefficients, also known as cancer potency factors, or q_1^* values are usually obtained by taking an upper 95% bound on the linear term yielded by the multistage model of carcinogenesis applied to a particular data set. When several data sets are available, suggestions for obtaining a joint estimate of q_1^* range from averaging the q_1^*'s obtained from the individual data sets to joint analysis of the several data sets to obtain a single q_1^* value. The present discussion examines the ramifications of these approaches in light of the purpose of the modeling, and suggests an alternate approach, which is based on the idea of using Monte Carlo methods to sample the experiment-specific empirical cumulative densities of q_1^*. It is suggested that this approach may have some inherent advantages over earlier proposed methodologies, in that it is both straightforward, and easily tailored to the peculiarities of specific situations. Specific examples will be presented.

Meta-analysis of Cancer Bioassays.
RESHA M. PUTZRATH (ENVIRON Corporation) and MICHAEL E. GINEVAN (Versar/RiskFocus).

Meta-analytic theory and procedures developed to evaluate human responses can be applied to toxicity data from animals. This approach allows quantitative consideration of multiple studies (when available) rather than sole reliance on the "most sensitive" or "most appropriate" experiment. Each study can be given equal weight or expert judgment and ancillary data can be used to provide a weighted analysis. Several meta-analytic approaches to carcinogenicity bioassay data will be presented, demonstrating the effectiveness, and some potential pitfalls, of unweighted and weighted analyses. Implications of these data for evaluation of uncertainty in risk analysis and risk management will be discussed.

Meta-analysis as a Tool in Passive Smoking Studies.
A. JUDSON WELLS

The purpose of this paper is to explore some of the ways in which meta-analysis can be used to aggregate relative risk results in passive smoking studies. The author's meta-analysis, published in 1988, aggregating data from seventeen studies on passive smoking and lung cancer among females is used as a point of departure. Extension of the work to new studies that have appeared since that time is covered, and various methods of weighting the data from the individual studies are explored.

Meta-analysis of Potential Health Effects of Electric Fields. KAY T. KIMBALL (Baylor College of Medicine).

Interest in biological effects of electric fields has motivated research in a variety of areas, but summary statements have been complicated by the diversity of endpoints and by inconsistent results from similar endpoints. This paper will demonstrate how meta-analysis has been used to summarize these results. Two types of meta-analyses have been used to review experiments on hematologic responses of laboratory animals exposed to electric fields. The first combined observed significance levels over the experiments for each endpoint. This meta-analysis was based on the assumption that when no true treatment effect exists, significance levels will be uniformly distributed between zero and one. The second meta-analysis estimated an effect size (standardized mean difference between control and treatment groups) for each endpoint in each experiment and examined the relationship between effect sizes and characteristics of the studies (exposure intensities, times, investigator, sex, and field frequency) using a weighted least squares regression model. Two responses were significantly associated with levels of exposure to electric fields. Studies in human populations on the relationship between occupational exposures to electric fields and leukemia incidence and mortality have been evaluated in two meta-analyses. Summary risk estimates were calculated from standardized and proportional mortality and morbidity ratios. Consistently elevated risk ratios were shown in persons in occupations potentially exposed to electric fields.

A Meta-Analysis of Health Effects Associated with Exposure to Electromagnetic Fields. EDWARD P. WASHBURN (Harvard School of Public Health), JESSE A. BERLIN (University of Pennsylvania), WILLIAM J. NICHOLSON (Mount Sinai School of Medicine), THOMAS C. CHALMERS (Harvard School of Public Health), et al.

Meta-analytic techniques are applied to epidemiologic studies of health effects associated with exposure to non-ionizing electromagnetic radiation. English language studies measuring mortality, cancer, and reproductive outcomes associated with exposure to electric or magnetic fields, with frequencies below the infrared band, are evaluated for quality of epidemiologic methodology and adequacy of exposure assessment. Estimates of relative risk and the corresponding variance estimates are abstracted and analyzed using formal meta-analytic statistical procedures. Mechanisms of effects are assumed to be nonthermally based for exposures that are in compliance with relevant standards. The goals of this research are to determine: 1) whether there is evidence of health effects, 2) what the magnitudes of these effects are, 3) how the health effects vary with type of exposure, 4) the quality of studies in this area, and 5) appropriate directions for future studies.

A Meta-Analysis of Human Cancer Risks Associated with Polychlorinated Biphenyls. WILLIAM J. NICHOLSON (Mount Sinai School of Medicine).

A meta-analysis was performed on five cohort studies of capacitor manufacturing employees exposed to polychlorinated biphenyls. Although the plants were located in three countries, the operating conditions appeared to have been similar. Two types of analyses were performed. In one, the cause specific observed and expected deaths were combined and an overall SMR was calculated. The second analysis investigated whether observed SMR increases were in accordance with expected models of exposure-related cancer risk. This involved consideration of duration of exposure, time from onset of exposure, and age at first exposure. We found this latter analysis to be particularly useful. The results provided evidence that PCB's are a cause cancer of the liver, biliary tract and gall bladder in humans and suggestive evidence that they may increase the risk of hematopoietic cancer. No evidence was found of an altered cancer risk associated with PCB mediated enzyme induction.

18. Popular Science

18-1. Chemistry Is Fun!

Organized by: **Jean'ne M. Shreeve** *(Professor of Chemistry, Univ. of Idaho, Moscow, ID)*

8:30 am / Mon / 18 Feb **Sheraton/Sheraton So.**

Chemistry Is Fun! BASSAM Z. SHAKHASHIRI (University of Wisconsin and National Science Foundation), ETHEL SCHULTZ (National Science Foundation), LOIS NICHOLSON (National Science Foundation).

Chemistry--the central science must be communicated to audiences of all ages in effective ways. Throughout this session experienced teachers will share their excitement and concerns about teaching chemistry at the elementary, secondary, and collegiate levels as well as in informal settings. Spectacular demonstrations will be presented and hands-on experiments will be displayed and discussed.

18-2. Science for the Naked Eye; or, The Physics of Everyday Experience, XVIII

Organized by: **Rolf M. Sinclair** *(Program Director, Physics Division, National Science Foundation, Washington, DC)*

8:30 am & 2:30 pm / Sun / 17 Feb **Sheraton/Sheraton So.**

A Collection of Simple Physics Demonstrations.
ROBERT EHRLICH (George Mason University)

Many principles of Physics can be demonstrated using simple inexpensive equipment -- much of it found around the house, or obtainable at toy stores, garage sales, etc. In this talk over 20 such demonstrations will be shown taken from the author's book: Turning the World Inside Out and 174 Other Simple Physics Demonstrations. The emphasis will be on demonstrations that yield surprising, often counterintuitive, results, and those that can be performed using the overhead projector (for maximum visibility).

A Bird's Eye View of Vision. JERRY A. WALDVOGEL (Clemson University)

As visually-dominated creatures, humans are particularly sensitive to the shapes, colors and movement patterns present in the world. Artists and scientists alike have struggled for centuries to depict human visual perception, often with great success. Nevertheless, many argue that while we may be able to capture the essence of our own species' vision, documenting the visual experiences of other organisms is impossible based on both philosophical and biological grounds. Because of its unique evolutionary past, they argue, each species has its own suite of sensory channels which are finely adapted to the specific demands of its habitat and lifestyle. von Uexkull used the word Umwelt

or subjective world to emphasize this apparent problem. Recent work with bird vision, however, serves to question the long-held belief that the sensory world of other creatures is so unique as to be beyond the limits of our detailed understanding. Through the use of comparative anatomy, physiological optics, neurobiology and behavior, sensory biologists now have a rather robust view of avian vision. This "bird's eye view" will be discussed with special emphasis on features such as the enormous size of the avian eye, UV and polarized light sensitivity, high visual acuity and motion detection, extremely large visual fields in combination with multiple foveas, precise underwater accomodation, and in some cases highly-developed nocturnal vision.

Mozart's Starling.
MEREDITH WEST (Indiana University) and ANDREW KING (Indiana University).

On May 27, 1784, Wolfgang Amadé Mozart purchased a starling. Three years later, he buried it with much ceremony. Scholars who have reported on this incident have known much about Mozart, but little, if anything, about starlings. To provide a new perspective, we provide a profile of the vocal capacities of captive starlings. We argue that Mozart's talents rendered him especially susceptible to the starling's diverse vocal skills. We also propose that the funeral and the poem are not the end of the story. Mozart may have left another memorial to his starling, a requiem for rebels. The relationship between Mozart and his mimic also suggests the need to study vocal behavior as an exploratory skill used by animals to probe the contingent properties of the social environment.

Technoscience Art. DONNA J. COX (National Center for Supercomputing Application, University of Illinois)

Supercomputing coupled with high-end computer graphics afford new opportunites for collaborations between the sciences and other disciplines such as art. Through this coupling of computer art and computational science, a new technoscience art has emerged. Several projects will be described where art and science join with computer graphics to engender these new forms. Such efforts provide interesting examples of human interactions and interdisciplinary research dynamics as people work toward a common goal: visualization of invisible.

Lightning and How to Avoid It.
C. B. MOORE (New Mexico Institute of Mining and Technology)

Lightning was man's introduction to electricity but, despite our long observation of the phenomenon, we do not have a satisfactory explanation of the processes that cause these discharges. The thunderclouds that produce lightning have been studied extensively in this century and we have learned much about their behavior. We now know that they extract negative charges from the upper atmosphere and maintain about 500,000 coulombs of negative charge on the planet. Many of these clouds accumulate large quantities of negative charge in their lower regions and produce potentials in excess of −100 megavolts relative to the earth. The resulting electric fields often exceed the dielectric strength of the air so that electrical breakdown occurs with the development of plasma streamers which export negative charge away from the electrified cloud. The resulting lightning carries a current usually ranging from 5 to 100 kA with releases of electrostatic energies sometimes equivalent to about one ton of high explosive.

The existence of strong electric fields can be detected simply by use of the point discharge phenomenon discovered by Kinnersley and Franklin. With variations of another of Franklin's techniques, we now have adequate means of protecting ourselves and our structures against lightning. This protection can be extended to our electrical devices with the use of suitable transient suppressors.

II. Life Sciences & Technology

20. General Life Sciences and Technology

20-1. Consciousness in Life

Organized by: **Roger Payne** *(President, Whale and Dolphin Conservation Society, Lincoln, MA)* and **Lynn Margulis** *(Distinguished University Professor, Dept. of Botany, Univ. of Massachusetts, Amherst, MA)*

2:30 pm / Mon / 18 Feb — **Sheraton/Sheraton So.**

Are Whale Songs Evidence of Consciousness?
ROGER PAYNE (Whale and Dolphin Conservation Society).

At least 4 species of baleen whales sing songs. Those of the humpback (Megaptera novaeangliae) are highly complex, and are constantly modified. Some of the laws of composition of the songs bear striking resemblance to the laws of composition used by human composers. When humpback whales breathe during the performance of a song they usually do so between phrases called "surface ratchets." However, breaths can be taken anywhere and when humpbacks breathe at other moments, they always do so in such a way as to leave the performance of the song intact. Humpback whales sometimes construct their songs so that the endings of adjacent phrases rhyme. Because humpbacks change their songs in so many ways (there are no obvious limits to the variability) the task that they face in creating new rhymes under the myriad of different circumstances which arise seems not to lend itself to simple, syntactical rules. Given the consistency with which humpback whales; 1)select points at which to breathe which will not interrupt song performance, and (2)manipulate their constantly changing sounds so as to create proper rhyming phrases, it seems most parsimonious to assume that singing by humpback whales is a conscious act.

Bacterial consciousness.
PROF. LYNN MARGULIS (University of Massachusetts).

If cognition is provisionally defined as the reorganization of sensory input to produce meaning that is coupled to action (i.e., swimming away from toxic materials) then bacteria are cognizant. If consciousness is provisionally taken to be a process involving information and memory that produces emotions and behavior adjusting organisms to their environment then all animals and many microbes are conscious. In spite of our protestations to the contrary, cognition and consciousness are not the manifestations of the superior being "man". As can be seen in films of the microcosm, they are intrinsic to the motile organisms of a vast biosphere.

Neuropeptides and their Receptors in the Central Nervous, Endocrine and Immune Systems: A Psychosomatic Network CANDACE B. PERT(Integra Institute and NIMH) The seventies saw the use of the term "neuropeptides" to describe the 50 or so peptides synthesized, stored and released from vesicles in brain , spinal, and intestinal neurons to each act at its own specific cell surface "receptors" distributed throughout the brain and body. Receptor molecules store the information required for distinguishing physiological signals carried by neuropeptides often intermingled in the blood, lymph or cerebrospinal fluid in the form of the ability to recognize classes of small molecules. Specific receptor "binding", which can be studied in vitro, can be interpreted as resulting in the stabilization and increase in time spent in certain favored conformational states. The term "receptor" had evolved in parallel in pharmacology and endocrinology to reflect molecules where "action at a distance" resulted when drugs or hormones diffused or were actively transported throughout brain and body compartments to bind to tissue constituents at some distance from the site of original release. More recent is the realization that immune cells also communicate with each other and other cells sharing these communication components by secreting peptide informational molecules called"lymphokines".The eighties saw the realization that classical hormones like insulin are neuropeptides by all definitions except historical tradition, that the immune system contains and is modulated by endorphins and other classical neuropeptides and their receptors, that even the most recently discovered lymphokines have been shown to be neuropeptides, that viruses and tumor cells also share these components. Based upon distributional considerations and the fact that many psychoactive drugs are analogs of peptide ligands, we have postulated that this intersystem intercellular communication network is the biochemical correlate of emotions which also occur in another realm, that of consciousness. This perspective suggests that consciousness is a property of the entire body, not just of the brain, and is consistant with many non-Western medical traditions which suggest that emotions play a profound role in health and disease.

Inherited Memories and Learned Beliefs
Peter Frank Allport

An inventory of subconscious, inherited memories that influence human thinking, behavior, and learning are identified and compared with memories inherited by other living things. Reasons for the existence of various pieces of inherited information are considered. The effects of inborn memories or biases on learned beliefs are discussed along with the consequences for freedom of belief and free will. A primary conclusion is that the chances for true freedom of belief and free will are nil without an awareness of the inherited memories that influence our consciousness. Related opportunities for improving human consciousness are considered.

Sensory Processing in Simple Nervous Systems.
R.K. MURPHEY (University of Massachusetts).

The sensory systems of insects are, in many ways as sophisticated as our own, yet insect brains contain many fewer and larger neurons than our own. These features make them amenable to study with a number of electrophysiological and anatomical methods and thus they serve as "model" systems for the sensory physiologist. I will discuss the assembly of the sensory systems that control insect behavior and will describe the plasticity in this assembly process that adapts insects to their ever changing environment. Finally, I will describe the genetic control of these processes and show how similar they are across the animal kingdom.

21. Molecular and Cellular Biology

21-1. The Revolution in Developmental Biology

Organized by: **Arthur S. Levine** *(Scientific Director, National Institute of Child Health and Human Development, Bethesda, MD)*, **Igor Dawid** *(Chief, Laboratory of Molecular Genetics, NICHD, Bethesda, MD)*, and **Heiner Westphal** *(Chief, Laboratory of Mammalian Genes and Development, NICHD, Bethesda, MD)*

2:30 pm / Fri / 15 Feb — **Sheraton/Sheraton So.**

8:30 am / Sat / 16 Feb — **Sheraton/Sheraton So.**

Pattern Formation and Tissue Differentiation in Amphibian Embryogenesis: Growth Factor Action and Gene Expression.
IGOR DAWID (Laboratory of Molecular Genetics, National Institute of Child Health and Human Development, Bethesda, Maryland).

In vertebrate development the establishment of the body plan depends to a large extent on cell interactions. The earliest interactions that occur in the amphibian embryo are responsible for the specification of mesodermal tissues. Recent studies have shown that peptide growth factors belonging to two families of molecules are involved in this process. Several members of the fibroblast growth factor (FGF) family are capable of inducing ventral mesodermal derivatives in

responsive tissue. One form of FGF (basic FGF) has been shown to occur in the embryo, and at least two forms of FGF receptors have also been identified in this system. Certain members of the transforming growth factor beta (TGF-β) family are potent inducers of all types of mesoderm including dorsal derivatives like notochord. The most effective mesoderm inducers known are the activins which are distant homologs of TGF-β. Among the TGF-β isoforms, TGF-β2 and especially TGF-β3 are active in mesoderm induction while TGF-β1 and β5 are inactive. The nature of the natural inducing signals and some of the early molecular consequences of inducer action in the embryo will be discussed.

Developmental regulation in a simple multicellular organism.
ANDREW FIRE (Dept. of Embryology, Carnegie Institution of Washington)

C. elegans is a simple roundworm which is well suited for the study of cellular differentiation. The newly hatched animal has only about five hundred cells. These include many of the cell types seen in higher organisms: muscle, skin, intestine, and a simple nervous system. The ability to self fertilize and a rapid life cycle (3 days) led *C. elegans* to be chosen by Sydney Brenner in 1964 as a model multicellular organism for genetic studies. Extensive knowledge of normal ("wild type") animals underlies analysis of the genetic variants obtained by Brenner and others. White et al used electron microscopy to construct a spatial map of cells in the animal, including a complete connectivity map of the 302 neurons and 148 muscles. Sulston et al used direct observation under the light microscope to follow all cell divisions starting with fertilization; the identity of each resulting cell was catalogued, yielding a full description of the "cell lineage". Most recently, physical maps of the six chromosomes have been constructed, as a prelude to determining the complete structure of the genome.

My laboratory and others have developed technology for gene transfer into *C. elegans*: purified DNA segments are injected into oocytes and a variety of genetic and biochemical tools are used to follow DNA structure and expression in successive generations. We are currently using these techniques to study signals leading to the production of muscle cells. *C. elegans* has two muscle types: 'pharyngeal' muscles are used to pump and grind food and 'body wall' muscles are used for locomotion. High level production of the muscle structural components begins only after the cells have undergone their last division. In one set of experiments, we characterized a set of tissue specific 'enhancer' and 'promoter' signals which at the late stages of muscle cell differentiation allow specific genes to express at very high levels. To our surprise, we also discovered a second expression mechanism active in the same lineages much earlier in development. The latter mechanism is of great interest because it can direct certain genes to express in muscle cell precursors, many divisions before the appearance of overt features characteristic of muscle cells.

Dictyostelium: Using Hormone Signals to Regulate Development.
ALAN R. KIMMEL (National Institutes of Health), JOHN M. LOUIS (National Institutes of Health), and GAIL T. GINSBURG (National Institutes of Health).

Dictyostelium discoideum grows as a unicellular, amoeboid organism. When amino acids become depleted from the growth medium, cells initiate a developmental pathway which leads to the formation of a multicellular aggregate. Cells within this aggregate differentiate into prestalk or prespore cells and segregate into a defined pattern. These are the precursors to the terminally differentiated stalk and spore cells found during culmination of development in the mature fruiting body. Aggregation and subsequent differentiation are directed by secreted (extracellular) cAMP which serves as both a chemoattractant and a hormone-like, primary signaling molecule. The regulation of genes that are expressed at specific times during development and/or in specific cell types may also depend upon a signal response to extracellular cAMP. During development, different cAMP receptor subtypes become expressed with distinct temporal and spatial patterns. These receptors are members of the family of cell-surface receptors that interact with GTP-binding regulatory proteins. In Dictyostelium they can stimulate a variety of effectors to promote the accumulation of intracellular messengers such as cAMP, IP_3, diacylglycerol, Ca^{++}, and cGMP. The ultimate targets of these signals reside in the nucleus and regulate gene expression and development.

21-2. New Perspectives on Cellular Signaling

Organized by: Maryanna Henkart *(Program Director, Cell Biology Program, National Science Foundation, Washington, DC)*

2:30 pm / Sat / 16 Feb **Sheraton/Sheraton So.**

Signalling Systems For Inducible Plant Defensive Genes.
CLARENCE A. RYAN (Washington State University).

Proteinase Inhibitor genes are among several plant defensive genes that are activated in cells nearby sites of pathogen or insect attacks. In a number of plant species, proteinase inhibitor genes are also activated systemically. Studies of the transduction mechanisms for both localized and systemic gene activation have revealed that several signalling components are involved. Oligouronide fragments of intracellular proteins, and methyl jasmonate all activate proteinase inhibitor genes. The latter volatile chemical can also mediate interplant activation of proteinase inhibitor genes via the atmosphere. The possible roles of these molecules in localized, systemic and interplant signal transduction pathways will be presented.

Chemical Signalling through Cell To Cell Junctions: Lessons From A Primitive Organism.
KATHLEEN DUNLAP (Tufts Medical School), PAUL BREHM (SUNY, Stony Brook).

A century of biological research has taught us that breakthroughs in our understanding of the fundamental mechanisms controlling physiological processes often come from studies on seemingly unlikely organisms. The mechanisms of action potential generation and propagation, for example, were discovered in experiments on the squid. I will focus on what one primitive hydrozoan coelenterate, Obelia geniculata, has taught us about the ways in which cells communicate with one another. Despite the fact that Obelia has no nervous system, the animal coordinates a series of behavioral responses such as tentacle contration, mouth opening, and bioluminescence. We have studied the excitation-luminescence coupling and have discovered that 1) chemical communication through cytoplasmic bridges between cells (gap junctions) is required for the behavioral response and 2) facilitation of light emission with successive stimuli (similar to that observed for neurotransmitter release in higher organisms) involves the recruitment of previously unresponsive regions of the liminescent cell. Such mechanisms are likely to play important roles in the control of physiological responses in more complex organisms as well. In this way, research on this primitive animal has offered a new perspective from which to view cellular communication in more highly evolved species.

Chemosensory Receptors and Signal Tranducers Controlling Settlement and Metamorphosis in Planktonic Abalone Larvae.
DANIEL B. MORSE (Marine Biotechnology Center, University of California, Santa Barbara, CA 93106).

Larvae of the abalone (a marine molusc) provide a uniquely tractable system for analyses of basic molecular and cellular mechanisms of signal recognition, chemosensory transduction, and their control of behavior and development. The larvae are induced to settle from the plankton and metamorphose on specific algae. This site-specific metamorphosis is controlled by two convergent chemosensory pathways that recognize two distinct classes of chemical signals from the environment. The inducer of settlement and metamorphosis is a GABA-mimetic oligopeptide produced by the recruiting algae. Binding of this peptide to externally accessible GABA receptors of the morphogenetic pathway is transduced by changes in cAMP, Ca++, and PKA activity, leading to an efflux of K+ across the chemosensory membrane. The resulting excitatory depolarization transduces the exogenous chemical signal to one propagated by the larval nervous system. Sensitivity or output of this morphogenetic pathway can be amplified 100-fold by low concentrations of lysine in seawater, presumably enhancing settlement in favorable areas. The amplifier pathway includes transmembrane lysine receptors reciprocally coupled to a G protein-diacylglycerol-PKC cascade. These components of the amplifier pathway have been shown to function in vitro, in chemosensory cilia purified from the larval epithelium.

Calcium Signals and Cellular Clocks Control Cell Division. Robert B. Silver (Cornell University).

Regulation of cell division requires precise control of intracellular free calcium (Ca^{2+}). Using echinoderm embryos, we have shown that transient elevations of Ca^{2+}, controlled by a Ca^{2+}

pump and Ca^{2+}-channel present within endoplasmic reticulum of the mitotic apparatus, regulate specific mitotic events. We have developed a technique for quantitative imaging of Ca^{2+} with the photoprotein, aequorin, and single photon video microscopy which permit study of the patterns of localized Ca^{2+} releases that control mitosis. Individual Ca^{2+} transients occur as discrete 100 msec events Limited to regions of 2.5 μm in diameter. Ca^{2+}transients occur in a circumferential pattern around the nucleus 6 min prior to nuclear envelope breakdown. Rapid Ca^{2+} emissions are localized at the region of the mitotic poles during mitosis, and at the contractile ring region prior to and during cytokinesis. Microinjection studies on single mitotic cells demonstrate that a cell cycle clock coordinates the timing of the Ca^{2+} transients required for mitotic regulation. Analyses of the Ca^{2+}signals indicate that location, feedback loops, timing, frequency, and amplitude of Ca^{2+} signals are essential to the regulation of mitosis and cell function.

Technical Sessions

21T-1. New Interactions Between Topology and Science

Organized by: De Witt L. Sumners *(Professor, Dept. of Mathematics, Florida State Univ., Tallahassee, FL)*

2:30 pm / Mon / 18 Feb **Sheraton/Idaho**

The Topology of Trypanosome DNA.
SYLVIA J. SPENGLER (Human Genome Center, Lawrence Berkeley Laboratory, Univ. of California, Berkeley, CA 94720), CAROL A. RAUCH (Dept. of Biological Chemistry, Johns Hopkins School of Medicine, Baltimore, MD 21218), NICHOLAS R. COZZARELLI (Dept. of Molecular and Cell Biology, Univ. of California, Berkeley, CA 94720), JAMES H. WHITE (Dept. of Mathematics, UCLA, Los Angeles, CA 90024), PAUL ENGLUND (Dept. of Biological Chemistry, Johns Hopkins School of Medicine, Baltimore, MD 21218).

Kinetoplast DNA is the mitochondrial DNA in trypanosomes and related parasitic protozoa. It has an unusual quaternary structure in many species, forming a persistent network of covalently closed DNA circles linked in an array. The network contains about 5000 minicircles and 25-50 maxicircles. Current efforts are focused on analyzing network topology. The covalently closed monomeric minicircles are fully relaxed. The extent of interlocking within the network is being analyzed by two methods: by limited digestion (following the proportion of monomeric circles) and by identification of the oligomeric forms following sonification. The structure of oligomers and their frequencies should help distinguish among the models for network structure.

The Topology of DNA Recombination.
DE WITT L. SUMNERS (Dept. of Mathematics, Florida State Univ., Tallahassee, FL 32306).

In site-specific recombination, two recombination sites in the DNA *substrate* are bound to the enzyme, forming the DNA-enzyme synaptic complex. While bound to the enzyme, the DNA is broken apart at the sites and recombined to different ends, and then the DNA *product* is released by the enzyme. In the experimental protocol known as the *topological approach to enzymology*, one performs recombination on circular substrate molecules in order to study the structure of the synaptic complex and its changes due to recombination. The circular form of the DNA traps some of the geometric and topological changes caused in the DNA by the enzyme. An observable quantity in such an experiment is the recombination-induced change in topological state (knotting and linking) of the DNA. This talk will discuss a mathematical model (the tangle model) for site-specific recombination, which computes the topology of the pre-and post-recombination synaptic complex from knowledge of the topology of the substrate and the DNA knots and links which occur as recombination products. This model affords mathematical proof and algorithmic calculation of enzyme mechanism and synaptic complex structure.

Topology and Chemical Synthesis.
JONATHAN L. SIMON (Dept. of Mathematics, Univ. of Iowa, Iowa City, IA 52245).

Geometry deals with the rigid properties of objects such as length, thickness, angles. Topology deals with properties that do not depend on rigidity, such as the difference between linked vs. unlinked, or knotted vs. unknotted rings. During the past 30 years, a number (still fairly small) of topologically novel molecules have been synthesized. Generally, the approach has been: Topological motivation (Can one make linked rings? Can one make a knot? Can one make a Mobius band?), followed by geometric control (Hold everything in just the right position before the final cyclization; or limit the products based on the lengths of the chains involved and other rigid stearic factors that can be seen through modeling), followed by proof of structure that says: If the topology were such-and-such, then chemical/physical properties (molecular weight, compactness as revealed in electrophoresis or chromotography, chirality) of the suspected species (or its products under test reactions) would have to be thus-and-so. We can see this three-step process in syntheses of catenanes, Mobius ladder graphs, and knots. What seems to be lacking in the world of complete synthesis are situations where the stearic control is primarily topological.

Random Knots in Ring Polymers.
STUART G. WHITTINGTON (Dept. of Chemistry, Univ. of Toronto, Toronto, Canada M5S 1A1).

Long flexible polymer molecules in dilute solution can be highly self-entangled and, if the polymer undergoes a ring-closure reaction, these entanglements can be trapped as knots in the resulting ring polymer. This talk is concerned with the probability that a ring polymer is knotted. Under good solvent conditions the polymer can be modelled as a self-avoiding polygon on a regular three-dimensional lattice, analogous to the self-avoiding walk model of a linear polymer. It can be shown rigorously that , in the limit of infinitely long polygons, almost all polygons are knotted and, indeed, the knot probability goes to unity exponentially rapidly. We also discuss some recent Monte Carlo results which estimate the value of the constant in the exponential term. The influence of solvent quality can be simulated by incorporating a near-neighbor attractive or repulsive potential between vertices of the polygon which are on adjacent sites of the lattice. As the solvent quality decreases the polygon becomes more collapsed and the knot probability increases. This increase is apparent in the Monte Carlo results.

Knot Theory and Physics.
LOUIS H. KAUFFMAN (Dept. of Mathematics, Univ. of Illinois at Chicago, Chicago, IL 60680).

This talk will survey how concepts and techniques from statistical physics and quantum field theory have revolutionized the way we now think about topological invariants for knots, links and three manifolds. We shall consider how these points of view are related to DNA research. The relationships are direct (generalizations of the approach to twist and writhe of James White) and indirect (speculations about the information content in a knot, link or three dimensional space, and the relation of that information content to biology). To paraphrase Warren McCulloch: What is a knot that a man may know it, and what is a man that he may know a knot?

22. Medical Sciences

22-2. Gene Therapy: Scientific Prospects and Societal Implications

Organized by: W. French Anderson *(Chief, Molecular Hematology Branch, National Heart, Lung, and Blood Institute, NIH, Bethesda, MD)*

2:30 pm / Mon / 18 Feb **Sheraton/Cotillion So.**

Treatment of Adenosine Deaminase Deficiency by Gene Transfer.
R. MICHAEL BLAESE (National Cancer Institute, National Institutes of Health)

Adenosine deaminase (ADA) deficiency is the cause of about 1/4 of cases of severe combined immunodeficiency (SCID). This rare autosomal

recessive disease is characterized by profound dual system immune deficiency with death common in infancy from overwhelming infection. Alternative treatments for affected patients lacking a compatible sibling donor for bone marrow transplantation have not been completely successful. Enzyme replacement with PEG-ADA has resulted in some clinical improvement and partial immune reconstitution, although the patients residual immune defect may put them at continued risk of opportunistic infection and/or lymphoid malignancy. In an effort to achieve more normal immune function in these patients, we have initiated a trial of therapy using autologous T lymphocytes which have been genetically corrected by the insertion of a normal ADA gene using retroviral-mediated gene transfer. T cells are obtained by apheresis and induced to proliferate with OKT3 + IL2 in culture. The cells are then repeatedly exposed to the retroviral vector LASN over a 4 day period. These gene modified T cells express normal levels of ADA enzyme activity and exhibit enhanced survival *in vitro*. The patients are then treated by simple transfusion with these cultured gene-corrected T cells. Since this approach to gene therapy uses gene insertion to correct the metabolic defect in already differentiated T cells rather than stem cells which have not yet become committed to a particular immune specificity, we will sample the patient's peripheral blood lymphocyte population and treat monthly. This will permit correction of a broader array of immune specificities than would be present in the blood at a single point in time.

The Gene Therapy of Cancer
STEVEN A. ROSENBERG (National Cancer Institute, Bethesda, Maryland 20892)

Attempts are underway to develop new immunotherapeutic approaches to the treatment of patients with advanced cancer. Tumor infiltrating lymphocytes (TIL) which can be isolated from both murine and human tumors are T lymphocytes that can recognize unique cancer antigens in an MHC restricted fashion. In a pilot trial using TIL plus IL-2 to treat patients with advanced melanoma, 40% of patients underwent an objective remission of their cancer. We have now conducted clinical trials utilizing TIL modified by gene transfer (New Engl. J. Med. 323: 570, 1990). Genes coding for the bacterial enzyme neomycin phosphotransferase have been inserted into human TIL using retroviral gene transduction and these TIL have been administered to nine patients with advanced cancer. These studies have enabled us to identify adoptively transferred TIL in the circulation at 189 days and in the tumor at 64 days after cell infusion. We have now introduced the gene coding for tumor necrosis factor into TIL and can achieve levels of TNF secretion that are 100 times greater than that of nontransduced cells. Clinical studies with these TNF gene modified TIL are being planned.

Potential Applications of Human Gene Therapy.
W. FRENCH ANDERSON (National Heart, Lung, and Blood Institute, NIH)
The previous two speakers discussed the scientific basis for human gene therapy and described the clinical protocols now underway. What is the future of gene therapy? After many years of thinking of gene therapy only as a way to treat a genetic disease (such as ADA Deficiency), investigators have broadened their outlook considerably. There are now four broad areas of medicine in which gene therapy will probably play a significant role: 1) genetic diseases, including hemophilia, sickle cell anemia, thalassemia, cystic fibrosis, diabetes and others; 2) cancer; 3) viral diseases, specifically AIDS; and 4) cardiovascular diseases. In many applications, gene therapy is not just a way to treat genetic or other diseases, but rather it is a sophisticated drug delivery system. The "drug" in this case is a biologic: e.g., a protein or peptide. In the next century, many of the agents that are now given, or contemplated to be given, by daily injections will probably be administered instead by a one-time insertion of the patient's own gene-engineered cells. After a discussion of these applications, the next major goals in gene therapy research will be analyzed. These include: 1) development of a safe inexpensive injectable vector that can target a specific organ, 2) site specific integration of the vector, and 3) engineering of the vector to provide appropriate regulation of the inserted gene.

Human Gene Therapy: Ethics and Public Policy.
LeROY WALTERS (Kennedy Institute of Ethics, Georgetown University, Washington, D.C.).

The ethical issues surrounding somatic-cell genetic intervention for the cure of disease are rather conventional. They include the familiar topics of risk-benefit analysis, informed consent, fairness in the selection of patient-subjects, and privacy and confidentiality. From 1983 to the present, the NIH Recombinant DNA Advisory Committee (RAC) has developed a public national review process to ensure that these ethical issues are carefully considered before gene therapy is attempted with human beings. As of September 1990, one human gene-transfer protocol and two human gene-therapy protocols had been reviewed and approved by the RAC. In the future, germ-line intervention for the cure and/or prevention of disease may be proposed. Further, genetic intervention may be suggested as a means for enhancing human capabilities rather than merely curing or preventing disease. If so, will these novel types of human genetic intervention raise qualitatively new ethical questions, and will the existing review mechanism be adequate to evaluate the next generation of research?

22-3. Molecular Determinants of Human Cancers

Organized by: **Albert H. Owens, Jr.** *(Director, Johns Hopkins Oncology Center, Baltimore, MD)*

2:30 pm / Fri / 15 Feb **Sheraton/Cotillion No.**

The Cancer Cell Phenotype
Donald S. Coffey (The Johns Hopkins Oncology Center, The Johns Hopkins University School of Medicine, Baltimore, Md.)

The cancer cell is diagnosed by both the variation in the shape of the cells and the nucleus. This shape is determined by the interaction of the matrix network within the cell that may also determine the cells organization and differentiation. Cell structure appears to have an integral role in the organization of the DNA and chromosome and also in the disorganization that is central to the carcinogenic process and the generalized genetic instability. The instability in cell structure is parallelled by instability in the DNA that leads to a wide variety of cells expressing different genes and having different properties, a process called tumor cell heterogeneity. Tumor cell heterogeneity permits the tumor to escape therapeutic control as resistant cells were selected for continued growth. In addition to growth, cancer cells also spread and metastasize and it now appears that this is the result of a dynamic event regulating cell structure and cell motility. Cell motility has been shown to be an essential feature of the metastatic cell and growth factors are involved in cell signalling events that regulate this motility. Aberrant oncogenes also produce cell signalling events that permits the cells to have sustained motion. The cell integrates its signals from the cell surface to the nucleus with the involvement of important structural elements and this process will be reviewed and correlated with the overall phenotype of the cancer cell.

DNA Methylation and Malignant Transformation.
STEPHEN B. BAYLIN, M.D. (The Oncology Center, The Johns Hopkins University School of Medicine, Baltimore, MD 21205).

Abnormalities of DNA methylation are a consistent molecular feature of human cancers and include widespread hypomethylation and more regional areas of hypermethylation or novel methylation sites. These changes are found in early stages of tumor progression such as the pre-malignant colonic polyps which may be precursors of colon cancer. Recent studies show that expression of the gene for human DNA methyltransferase, which encodes for the enzyme catalyzing DNA methylation,

is markedly increased in multiple types of human cancer cells. These increases occur early in the progression events for colon cancer prior to histologic changes in colon mucosa and prior to appearance of DNA methylation abnormalities. Insertion and expression of a prokaryotic DNA methyltransferase gene into rodent 3T3 derived cells exerts phenotypic changes, including induction of cell lethality and increased tumorigenicity of surviving cells. Site directed mutagenesis studies indicate that these cell changes result from enzymatic activity of the inserted DNA-methyltransferase gene. All of the above data indicate that changes in regulation of DNA methylation in neoplastic cells could play a critical and early role in the chromosomal structural changes and alteration of gene expression events which underly the progression of human neoplasia.

Altered Growth Factor Signalling Pathways in Human Cancer Cells
STUART A. AARONSON, M.D. (Laboratory of Cellular and Molecular Biology, National Cancer Institute, Bethesda, MD 20892)

It has become increasingly evident that the pathologic expression of growth limiting genes in mitogenic signalling pathways plays an important role in the neoplastic process. The amplification and/or overexpression of genes encoding growth factors or their receptors contributes to a wide variety of human tumors. Other genes that act early in the intracellular transduction of growth factor signals have been implicated as oncogenes as well. Efforts to dissect the biochemical cascade initiated by growth factor triggering of receptors will be discussed as well as new approaches aimed at identifying limiting genes in these pathways. Understanding gained from such approaches should be useful in efforts to develop new modalities of therapeutic intervention with cancer cells.

Molecular Genetics of Colorectal Tumors.
BERT VOGELSTEIN (The Johns Hopkins Oncology Center, Baltimore, MD)

Colorectal tumors provide an excellent system to study the genetic alterations associated with the initiation and progression of human cancer. Such studies have suggested that colorectal neoplasia results from accumulated alterations in both oncogenes and tumor suppressor genes, with the latter predominating. At least four to five genes need to be altered to form a malignant tumor; fewer alterations suffice for benign tumorigenesis. In several cases, the genes involved and the precise nature of the mutations which alter these genes have been identified. Furthermore, correlations with clinical features suggest that these alterations underlie specific aspects of tumor development. Further studies of these mutations should lead to a better understanding of the pathogenesis of human malignancy and suggest ways to intervene in the neoplastic process in an informed fashion.

22-4. The Aging and Cancer Interface: Multidimensional Research Perspectives

Organized by: **Rosemary Yancik** *(Assistant Director for Liaison and Applied Research on Aging, National Institute on Aging, NIH, Bethesda, MD)*

8:30 am / Sun / 17 Feb **Sheraton/Cotillion So.**

Cancer in the Aged: An Epidemiologic Overview
ROSEMARY YANCIK (National Institutes Of Health, National Institute on Aging, Bethesda, Md)

Advancing age is the greatest risk factor for most major cancers. Of all cancer deaths in the U.S., 65% occur in the age group 65 years or older. Lung and bronchus, colon, rectum, pancreas, urinary bladder, and stomach cancers are common to both sexes. Prostate cancer contributes to high incidence and mortality for older-aged men; for older-aged women, breast cancer presents special problems. A dramatic expansion expected in the elderly population in the U.S. By 2025, one in every five citizens will be 65 years or older. Thus, there is high potential for even larger proportions of the population to be affected. This paper joins perspectives of cancer epidemiology and the epidemiology of aging, drawing on summary statistical data, to demonstrate the magnitude of the cancer burden for the elderly and the implications for the health care system. Age/stage relationships at initial diagnosis for breast and ovarian cancers are also discussed. Epidemiologic data on the cancer/aging interface suggest that management of cancer in the elderly requires distinguishing between changes that occur as a result of aging and those attributed to cancer and other disease processes for improved detection and treatment.

Senescence and neoplasia:two sides of the same cellular coin.
VINCENT J. CRISTOFALO (Medical College of Pennsylvania, Philadelphia)

Human fibroblast-like cells in culture exhibit senescence during serial subcultivation. Senescent cells are characterized by a series of changes, prominent among which are the loss of replicative capacity, increased cell size and the accumulation of secondary lysosomes and residual bodies. Many studies have been directed at the mechanisms underlying the loss of proliferative capacity. Some laboratories have reported the appearance of an antiproliferative factor in senescence which suppresses the ability of cells to enter DNA synthesis. Other laboratories, including ours, have reported the senescence-associated absence or impairment of specific proliferation-associated molecules. For example, in senescent cells, the protooncogene c-fos is not transcribed, mRNA for PCNA is transcribed but not processed, calmodulin mRNA is transcribed and processed but is not translated in the cell cycle dependent way that it is in young cells. At least one enzyme, the tyrosine kinase activity of the EGF receptor, is more labile in older cells.
Thus, both positive and negative factors seem to be involved in the regulation of cell proliferation and senescence. Perhaps well-defined mechanisms for senescent changes in proliferative regulation is the price human cells pay for their relative resistance to immortalization and presumably the longer life span of humans.

Supported by AG00378.

Geriatric Oncology: Early Detection and Diagnosis
HARVEY JAY COHEN, M.D. (Geriatric Research, Education and Clinical Center, VAMC and Center for the Study of Aging and Human Development, Duke University Medical Center, Durham, N.C.)

Since most cancers occur with increasing frequency with advancing age, the index of clinical suspicion for early detection and diagnosis should be quite high. However, this is made more difficult by a number of factors. With respect to early detection of asymptomatic disease, there is very little data specifically relevant to the older population, especially people over age 75. Recommendations for the common cancers for which screening may be useful, including colon, breast, prostate, and cervix, and their rationale will be reviewed. Aspects of lung cancer in the elderly which suggest possibilities which need to be investigated for screening of this cancer will also be discussed. Early diagnosis of cancer in older persons may be confounded by the perception of patients and health professionals that certain findings are attributable to aging. Areas in which this confusion may arise and general principles regarding the approach to early diagnosis in the older patient who has changes due to age and chronic disease will be addressed.

Cancer in the Elderly: To Treat or Not To Treat

PAUL P. CARBONE (University of Wisconsin Clinical Cancer Center) and POLLY A. NEWCOMB (University of Wisconsin Clinical Cancer Center)

Cancer diagnosis and treatment in the elderly (70 years or older) are often less than optimal. These patients are less likely to seek appropriate screening measures (i.e., mammograms), less likely

to be referred to major cancer therapy centers and often receive less optimal therapy. Little is known about the reasons for these deficiencies, however, data are available on outcome as it relates to specific diseases as well as toxicity to treatment. To understand some of the reasons for the lack of access to modern treatment, a pilot control study is now underway. Better understanding of some of the barriers to appropriate care will help develop effective strategies to improve access.

22-5. The Progesterone Antagonist RU-486: Science and Science Policy

Organized by: **Sheldon J. Segal** *(Director for Population Sciences, The Rockefeller Foundation, New York, NY)*

8:30 am & 2:30 pm / Sat / 16 Feb **Sheraton/Cotillion So.**

The Progesterone Receptor and Its Molecular Actions.
BERT W. O'MALLEY, M.D. (Baylor College of Medicine, Houston, Texas)

Progesterone acts by combining with a specific receptor in target cells. Authentic progesterone causes dissociation of heat shock proteins from the nascent receptor and converts the receptor into an allosteric form capable of binding to DNA and regulating transcription. This activated progesterone-receptor complex binds tightly to a 15 bp recognition sequence (PRE) at the 5'-end of target genes. The receptor then recruits and stabilizes general transcription factors at target gene promoters (TATA box) and causes RNA polymerase II to repetitively initiate transcription at the adjacent gene. Compounds such as RU-486 fail to provide a receptor conformation which induces efficient gene expression, thereby acting as antihormones. During the course of progestin action, new mRNAs are generated which code for the cellular proteins required for the physiologic actions of progesterone.

RU-486: The French Experience.
ANDRE ULMANN (Roussel-UCLAF, Romainville, France)

RU 486 plus prostaglandin (PG) is marketed in France for early pregnancy termination (PT). By law, the drug is used only in centers approved for voluntary PT, and its distribution is strictly controlled. Before being marketed, it had been distributed to more than 20,000 women as part of a training program for the prescribers. Interim analysis in 10,000 cases confirmed an efficacy rate of 95.0%. Failures included incomplete ovular expulsion (2.7%), premature vacuum aspiration (0.8%) and ongoing pregnancy (1.1%). Pelvic pain and malaise were reported as side-effects in 1.9 and 1.3% of the cases, respectively. Infectious complications were reported in 0.2% of the cases. Two severe reversible vascular adverse events occurred immediately after administration of PG, justifying a careful medical monitoring in the center 3-4 hours after PG administration. The distribution procedures were adequately followed by the prescribers and the patients. Prospective studies are under way to evaluate the criteria of choice between the surgical and the medical methods by women, and to evaluate the outcome of pregnancy in case of failure in the absence of follow-up.

Abortion in the United States.
JACQUELINE DARROCH FORREST (The Alan Guttmacher Institute)

The current system of abortion services delivery in the United States, and the characteristics of women having abortions, present particular difficulties and advantages for the use of a method such as RU-486. Ninety-eight percent of all abortions currently are outpatient procedures. Eighty-six percent of abortions take place in the 885 freestanding nonhospital clinics, but another 1,040 hospitals and 657 private physician offices also provide abortion services. Service facilities are highly concentrated in larger metropolitan areas, however. In 1988, 98 percent of all abortions took place in metropolitan areas and 31 percent of all U.S. women lived in counties with no abortion provider. Roughly 40 percent of women obtaining abortions travel outside their home county for services. Abortion is relatively common in the United States, three percent of women aged 15-44 have an abortion each year and at current rates, almost half of all women will have at least one before age 45. Half of all abortions occur within the first eight weeks from the woman's last menstrual period, and nine in ten within the first 12 weeks. The majority of women having abortions are under age 25 (58 percent), unmarried (82 percent) and want to have children in the future (70 percent). Equal proportions have weekly family incomes below $212, between $212 and $481, and higher. The average fee in a clinic or physician's office for an abortion at eight weeks gestation is $231.

Anti-Progesterone Drugs: Ethical and Legal Issues.
R.J. COOK (Faculty of Law, University of Toronto)

This presentation will address the ethical and legal issues that countries will have to resolve as they consider the introduction of anti-progesterone drugs for abortifacient and other purposes. Application to the introduction of this drug of the ethical principles of justice (treating like cases alike) and beneficence (the positive duty to do good) will be discussed. The ethical principle of respect for persons (including autonomy and protection of persons incapable of autonomy) will be explored by reference to legal determinations of personhood, privacy and human rights. In conclusion, the legal and regulatory status of RU-486 when used in combination with prostaglandin in France will be explained, and issues in constitutional, criminal, patent and product liability law that need to be addressed to facilitate its introduction into the United States and other countries will be covered.

Antiprogestins: Probability of Multiple Indications in Reproductive Medicine. GARY D. HODGEN (The Jones Institute for Reproductive Medicine, Department of Obstetrics and Gynecology, Eastern Virginia Medical School, Norfolk, Virginia)

The so-called "antiprogestins" possess multiple activity expressions which depend on several variables: (1) the particular analog used; (2) the dose regimen; (3) the target tissues and their physiological status; and (4) the hormonal milieu into which the compound is introduced. These multiple activity expressions include: (1) competitive antagonism of progesterone binding; (2) progestin activity; (3) noncompetitive antiestrogenic activity; and (4) sometimes, antigluco-corticoid activity. Clinical indications that may derive from these activities depend on the combination of factors cited above. Besides the well-known early pregnancy termination, "antiprogestins" can accommodate rapid cervical dilation and myometrial responsiveness to contractile agents, as an adjunct to labor and delivery management. As an active progestin, these compounds can inhibit ovulation. The non-competitive antiestrogenic actions of "antiprogestins" prevent estrogen-induced mitogenesis (proliferation) of the endometrium, potentially useful in the treatment of endometriosis and estrogen-dependent neoplasia, such as certain breast cancers.

RU-486: Antiglucocorticoid Research.
M. GAILLARD-MOGUILEWSKY (Roussel UCLAF, Romainville, France)

Besides its antiprogestin activity, RU-486 has also a potent antiglucocorticoid activity related to a high affinity for the glucocorticoid receptor. It was shown to fully antagonize the action of glucocorticoids in different *in vitro* or *in vivo* animal models. This is also true in humans, since RU-486 is able to block the effects of glucocorticoids at the hypothalamo-pituitary level as well as at the periphery level. The antiglucocorticoid property of RU-486 has been widely used around the world to elucidate physiological processes mediated by glucocorticoids. Moreover, several clinical applications appear promising, either to counteract by systemic route the multiple deleterious effects of corticoids drastically increased in states of severe stress (large burns, traumas, etc.) or in Cushing's syndrome, or to inhibit by local applications certain effects of glucocorticoids such as wound healing retardation. Parallel to this clinical investigation, active chemical and biochemical research is in progress to obtain potent antiglucocorticoids devoid of antiprogestin activity.

RU-486: Anti-Cancer Activity.
H.H. SEDLACEK (Beringwerke AG, Germany)

Various investigators have shown that RU-486 has significant antitumor activity on steroid-receptor-positive transplanted breast carcinoma (MTX) in mice, on DMBA or NMU-induced breast carcinoma in rats, and on human breast carcinoma xenograft (T61) in nu/nu. Data in the standard human breast carcinoma xenograft (MCF-7) are contradictory: RU-486 has no reproducible antitumor effect; however, combination with a pure antiestrogen seems to improve antitumor activity. The way RU-486 acts as an antitumor agent is unclear. It is speculated that programmed cell death is induced. In the first clinical study, RU-486 seemed to induce objective responses in mammary carcinomas with progressive growth under progestin or Tamoxifen therapy. RU-486 seems to be worth evaluating as a new approach for treatment of endocrine-dependent tumors.

RU-486 and U.S. Science Policy
CORY RICHARDS (The Alan Guttmacher Institute)

Antiabortion political pressure has resulted in the establishment over the last decade-and-a-half of a complex web of federal funding bans and moratoria that, together, block U.S. government involvement in biomedical research efforts that could lead to the development and marketing not only of new abortion techniques, such as RU-486, but also of improved contraceptive and infertility technologies, as well as potentially groundbreaking therapies for such diseases as diabetes, Parkinson's Disease and perhaps even AIDS. The development of these policies and their implications for U.S. leadership in birth control research and development, and in biomedical research generally, will be detailed. Near-term political prospects for these policies' repeal or revision will be discussed.

22-6. Prospects for Immunocontraception

Organized by: John C. Herr *(Associate Professor of Anatomy and Cell Biology, Univ. of Virginia, Charlottesville, VA)*

2:30 pm / Fri / 15 Feb — Sheraton/Cotillion So.

Molecular Genetics of the Mouse and Human Zona Pellucida Genes: Strategies for Immunocontraception. JURRIEN DEAN (Laboratory of Cellular and Developmental Biology, NIDDK, National Institutes of Health, Bethesda, MD, 20894).

The zona pellucida is an extracellular matrix that surrounds growing oocytes, ovulated eggs and pre-implantation embryos. The mouse and human zonae pellucidae are composed primarily of three glycoproteins, ZP1, ZP2 and ZP3. The genes encoding mouse and human ZP2 and ZP3 have been isolated. Each gene is present in its respective genome in single copy; mouse zona transcripts are detected only in growing oocytes and the resultant zona proteins are 65-70% conserved between the two species. Anti-ZP2 or anti-ZP3 monoclonal antibodies bind to the zona pellucida and effectively inhibit fertilization in mice. The binding sites (B-cell epitopes) of these antibodies were determined by screening expression libraries of randomly fragmented ZP2 and ZP3 cDNAs. A sixteen amino acid peptide containing a ZP3 B-cell epitope (7 amino acids) and a partially overlapping T-cell epitope (10 amino acids) was coupled to KLH and used to immunize NIH Swiss female mice. Long-term contraception occurred in 75% of the animals and was reversible in a third. Although no adverse effect was initially noted, peptides containing the T-cell epitope induce significant ovarian autoimmune disease in susceptible inbred strains of mice. Studies are underway to determine if vaccination with alternative peptides can result in contraception but not induce ovarian histopathology. The zona genes are conserved among mammals and this strategy of immunizing with "self" may be applicable to other species.

Epitope Mapping of the Zona Pellucida (ZP) Protein Antigens for Human Contraceptive Vaccine Development. BONNIE S. DUNBAR (Department of Cell Biology, Baylor College of Medicine, Houston, Texas 77030).

The ZP is a complex immunogen which elicits antibodies to protein sequences as well as carbohydrate and conformational determinants. Some of these determinants are shared among most species, while many others are unique to individual species. The development of a contraceptive vaccine for humans using ZP antigens has three major requirements: 1) Autoimmune tolerance to ZP proteins must be broken following immunization, therefore, antigenic determinants must be sufficiently "foreign" to elicit a significant immunogenic response; 2) the molecular configuration of the immunogen must contain some specific epitopes which are identical or sufficiently similar to those found in the human ZP itself in order to elicit antibodies which will recognize the human ZP; 3) the antibodies must effectively inhibit the fertilization process without interfering with normal ovarian function. In order to design an effective vaccine which satisfies these criteria, a molecular approach has been undertaken using "cross-species" antibody affinity purification. Antibodies from infertile animals immunized with ZP of different species of ZP protein have been used to identify specific epitopes on cDNAs isolated from ovary cDNA expression libraries. The expressed proteins of these cDNAs have been used to identify specific epitopes which are shared among different mammalian species as well as non-human primates and human ZP. The expressed recombinant ZP antigens are currently being tested for their efficacy in several mammalian species.

Sperm Surface Proteins as Antigens for a Birth Control Vaccine that Blocks Sperm Function. PAUL PRIMAKOFF (University of Connecticut Health Center, Farmington, CT 06030

Developing a contraceptive vaccine has received extremely limited research attention, although vaccination represents a potentially elegant, convenient and safe approach to birth control. A contraceptive vaccine using a sperm surface protein has two theoretical advantages: it might work in both males and females, and it would not raise problems of auto-immunity in the female if a sperm-specific protein is used. The sperm surface protein PH-20 has an essential function in sperm-egg adhesion. 100% effective contraception has been achieved in male and female guinea pigs immunized with PH-20. After 6-18 months, immunized females regain fertility. Males immunized near puberty regain fertility after 6-12 months whereas most older, immunized males remain infertile for longer periods or indefinitely. All immunized male animals develop focal auto-immune orchitis, an unacceptable effect for a vaccine. Strategies to eliminate orchitis in males and for testing PH-20 immunization in primates will be discussed.

Contraceptive Vaccine Candidate SP-10 Associated with Human Sperm Acrosomal Membranes. JOHN C. HERR (Department of Anatomy and Cell Biology, University of Virginia, Charlottesville, VA, 22908)

The protein SP-10 lies within the acrosome, an organelle which undergoes exocytosis during the acrosome reaction prior to fertilization. SP-10 is associated with the acrosomal membranes and remains displayed on the sperm head following the acrosome reaction. SP-10 has been detected in sperm of all individuals tested and to date all data indicate SP-10 is expressed in no tissue other than the testis, suggesting auto-immunity elicited by innoculating this protein in females is unlikely. SP-10 is present in rhesus monkeys and baboons affording primate models for infertility testing. A monoclonal antibody to SP-10 inhibits the penetration of hamster eggs by human sperm. This monoclonal antibody detects microheterogeneity of SP-10 peptides on Western blots. Amino acid sequencing of the amino termini of several of these peptides indicates endoproteases contribute to the microheterogeneity. cDNAs cloned from human testis show that SP-10 consists of 265 amino acids with a predicted isoelectric point of 4.5. Recombinant vaccine fusion proteins consisting of 125 amino acids of SP-10 linked to either glutathione transferase or beta galactosidease have been innoculated into baboons. These 125 residues span a region of hydrophilic repeat motifs, included the epitope recognized by the monoclonal antibody. The recombinant vaccine fusion proteins elicited strong baboon polyclonal antibody responses which recognized the native human SP-10.

22-7. Development of Medications for the Treatment of Brain/Behavior Disorders

Organized by: **Frank J. Vocci** *(Chief, Developmental Therapeutics Branch, National Institute on Drug Abuse, Alcohol, Drug Abuse, and Mental Health Administration, Rockville, MD)* and **Betty C. Tai** *(Pharmacologist, Medication Development Division, National Institute on Drug Abuse, Alcohol, Drug Abuse, and Mental Health Administration, Rockville, MD)*

8:30 am / Tue / 19 Feb **Sheraton/Cotillion So.**

History of Medication Development and Brain/Behavior Disorders
FREDERICK K. GOODWIN (Alcohol, Drug Abuse and Mental Health Administration)

From an historical perspective, the discovery and development of new psychotropic medications has continually expanded the scientific knowledge of brain and behavior disorders. Today, research on the neuroscience of brain disorders is also influencing the development of new medications. The first finding--approximately 30-35 years ago--that a mental disorder could be ameliorated or controlled by medication was a milestone in human social history because it established a biological basis, as opposed to "moral failure," for mental illness. Since that time, the advent of a spectrum of psychotropic medications has revolutionized the treatment of mental illness. In addition, one of these medications, methadone, has opened the door to pharmacotherapy as a promising approach to the treatment of addictions and a new generation of such medications is now being developed. However, for a number of reasons, the discovery and development of medications specifically designed for the treatment of addictions and serious mental illnesses have "fallen through the cracks" in recent years. The history of medication development to date has been written by the cooperative interactions of the pharmaceutical industry, academia, U.S. Congress, and Federal regulatory agencies. The Alcohol, Drug Abuse and Mental Health Administration, through its research institutes--the National Institute on Drug Abuse, the National Institute on Alcoholism and Alcohol Abuse, and the National Institute of Mental Health--has now undertaken a proactive, catalytic role in fostering the development of new psychotropic medications for such much-needed therapies.

FDA's Interactive Role in the Review of Drugs for Treating Addictive Disorders, MICHAEL KLEIN, Ph.D. and JOHN G. HARTER, M.D., Director (Pilot Drug Evaluation Staff, Food and Drug Administration).

The FDA continues to maintain its basic responsibility in safeguarding the public health by enhancing its responsiveness to public needs and ensuring the highest quality review of drug efficacy and safety data that are available. Within FDA's Pilot Drug Evaluation Staff of the Center for Drug Research and Evaluation, recent changes reflect an emphasis on research and innovation. FDA's mission in the drug review and approval process is responding to advances in science and shifts in attitudes about health care. In addition, increased and enhanced FDA consultation with drug sponsors is being sought in order to improve the quality of the studies that become part of the NDA submission. Such consultative processes can be applied to areas, such as those for treating addictive or behavioral disorders, by interaction of diverse groups in guideline development and by incorporating the appropriate studies into the research process early in drug development. Successful performance could result in significantly reducing the number of later stage clinical trials and more timely drug approval. The intent of this approach is also to provide better products and descriptions for use at the time of marketing.

Medication Development for Drug Addiction
CHARLES O'BRIEN, JAMES CORNISH, GEORGE WOODY
Univ. of Pennsylvania/VA Medical Ctr., Philadelphia

Both theory-driven and empirical strategies have been used for developing effective pharmacological treatments of addiction. Methadone, the most useful treatment of opiate dependence is based on the phenomenon of cross-tolerance. In contrast, naltrexone, a specific opiate antagonist, illustrates the principle that pharmacological effects may not immediately translate into clinical efficacy. However, recent studies suggest specific treatment settings where naltrexone can be clinically useful.

Empiricism has dominated the search for medications effective in cocaine dependence. If a specific drug has a replicatable clinical effect, this would in turn suggest theories of cocaine dependence. Controlled studies of pharmacological treatments for cocaine dependence will be presented. Medications tested include desipramine, amantadine, carbamazepine, buprenorphine, and gepirone. The potential usefulness of a screening test to determine whether a new medication can suppress precipitated craving in cocaine addicts will be examined.

Current Approaches to Medication Development for Alcoholism. MARKKU LINNOILA, M.D., Ph.D., Chief, Laboratory of Clinical Studies, DICBR, National Institute on Alcohol Abuse and Alcoholism, Bethesda, MD, USA.

Recent advances in understanding ethanol's mechanisms of action, pathophysiology of alcohol abuse and alcoholism, and their complications have opened up new, promising avenues for pharmacological interventions. These can be roughly categorized in five groups: 1) Compounds to antagonize acute intoxication produced by ethanol; 2) Compounds to treat withdrawal from ethanol; 3) Compounds to reduce craving for alcoholic beverages; 4) Compounds to treat alcohol dependent patients with concomitant mental disorders; and 5) Compounds to treat ethanol-induced organic brain disorders. Acute intoxication by ethanol can be antagonized by manipulating benzodiazepine and α_2 noradrenergic receptors. Withdrawal from ethanol can be affected by benzodiazepine receptor agonists, and possibly by NMDA and serotonin $_3$ receptor antagonists. Serotonin uptake inhibitors and μ opiate receptor antagonists have been reported to reduced alcohol consumption in healthy drinking humans. Ethanol-induced amnesic disorder may be partially ameliorated by serotonin reuptake inhibitors.

Current Approaches to Medication Development for Mental Illness. DONALD S. ROBINSON, M.D. (Bristol-Myers Squibb Research Institute, Wallingford, CT 06492)

Drug discovery and development in the field of psychopharmacology is receiving increasing attention and effort by the pharmaceutical industry. This therapeutic area is regarded as one offering the greatest potential for scientific breakthroughs and opportunities within a market that is currently unsatisfied. Capability of characterizing specific receptor subtypes for each neurotransmitter within the central nervous system (CNS) represents a major facilitating factor in drug design. Molecular and cellular biology techniques also offer promise for future drug discovery for treatment of mental illness. The major focus in the 1990s is development of new CNS compounds that are innovative and offer the potential of significant therapeutic advances.

22-9. Scientific and Statistical Inferences in Modeling Animal Research

Organized by: **Ethel Tobach** *(Curator Emer., American Museum of Natural History, New York, NY)*

8:30 am / Fri / 15 Feb **Sheraton/Baltimore**

Animal Organisms as Individuals: Implications for Research STRACHEN DONNELLEY, Ph. D. (The Hanstings Center)

In scientific research involving animals, there is a tension between viewing the animal as an object of scientific inquiry, a biological or behavioral system, and as a living indidiual in its own right, with its own particular capacities and rlatins to other animals. The latter perspective is required for the ethical consideration of the research protocol. Moreover, consideration of the animal as a potentially suffering individual or self, with the impact of its suffering on physiological or behavioral responses, may be required for judging the scientific merit of the protocol, particularly the validity of its results. To judge animals as individuals requires a judicious use of critical anthromorphism and a general everyday understanding of what it means to be an individual or a self.

Interesting Errors Caused by the Use of Animal Models. LEO VROMAN (Columbia University, Department of Chemical Engineering)

Biomaterials intended to be compatible with human blood ex vivo (e.g., for dialyzers and oxygenators) and in vivo (e.g. for artificial blood vessels and valves) have been developed on the basis of rather vague notions originating from occasional observations involving implantations in various mammals. Our study of protein deposition and platelet adhesion to membranes was supported for many years on the basis of finding that during dialysis, dogs deposit platelets on these surfaces. Belatedly we rediscovered that humans deposit granulocytes rather than platelets. Recently, we found that human blood, containing high molecular weight kininogen (HK), deposits a sequence of proteins onto many surfaces, ending with fibrinogen being displaced by factor XII and by HK. Dogs appear to have less HK, so that their fibrinogen resides longer on these membranes. Platelets adhere to surfaces only where they find fibrinogen, human platelets apparently arriving too late to find adsorbed fibrinogen and to adhere. Other species (pig, cow, goat, rabbit, baboon) are often preferred as models for rather trivial reasons. Some effects of admixing plasma from different duck species for the study of human blood coagulation will also be described.

Statistical Aspects of Animal Modeling Research WILLIAM DUMOUCHEL (BBN Software Products)

Interpretation of results from animal data is often ambiguous. Controversy often centers on whether the animal data are relevant to research questions about humans, and how to extrapolate down from the large doses often used in animal experiments to the low doses experienced by human populations. These questions are typically unresolvable in the context of just one or a few experiments, since too little is known about the mechanisms being studied. A statistical approach to theproblem of interspecies extrapolation requires data from a large ensemble of experiments, in which many biological systems are each studied as they respond to several conditions or experimental treatments. A statistical metaanalysis combining all the data can build on consistencies (and characterize inconsistencies) between the different experimental results, and produce a statistical model for estimating effects in human populations. Obtaining realistic standard errors for these estimates is often more important than having the estimates themselves. To do this one must be sure that the statistical model has specific componoents of variation corresponding to a) expected differences between studies, b) unpredictable differences between studies, and c) sampling variability within each study. Examples will be given.

The Concept of "Alternatives" to the Use of Animals in Research: Slogan or Useful Tool? JERROLD TANNENBAUM (Tufts University School of Veterinary Medicine).

The concept of "alternatives" to the use of animals in research is often touted as the "solution" to ethical dilemmas relating to the employment of animals in experimentation and testing. This presentation will demonstrate that, as usually defined, the concept of alternatives is antithetical to certain basic values of society and the scientific community. Further, much talk about "alternatives" tends to substitute for, rather than stimulate serious ethical deliberation. Two of the three Rs of "replacement, reduction, and refinement" will be criticized. A concept of "alternatives" that is both ethically defensible and scientifically useful will be proposed.

23. Health Care and Policy

23-1. Consequences of HIV/AIDS in Eastern Africa

Organized by: **Priscilla Reining** *(Adjunct Professor, Center for African Studies, Univ. of Florida, Gainesville, FL)*

2:30 pm / Sat / 16 Feb **Sheraton/Baltimore**

HIV Transmission: Men are the Solution. CHRISTINE OBBO (Wayne State University).

This paper argues that the success of the AIDS control educational programs can only be measured in the changed practices that follow rather than in the mere knowledge. With regards to A HIV transmission, the majority of Africans now know that it is spread through heterosexual sex, but in the absence of condoms this knowledge is redundant. "Zero Grazing"--Celibacy--and "loving carefully" at this critical juncture require condom backup. It has been vital to sensitize people at all levels of society about the types of behavior and practices that are responsible for HIV transmission. What is needed now is the political will by political, civic, and religious leaders to positively promote the use of condoms and reforms that will empower women to become economic and social actors able to make autonomous decisions that affect their sexuality, reproduction and their health. This paper is an immodest proposal that men must take action in connection to the support they conveniently and unreflectedly accord to the dominant societal values and practices that keep them in ascendancy and control with regards to the vital resources and symbols of domestic and national power. Men must therefore recognize the important role they have in controlling the transmission of HIV and must take responsibility for maternal and child health.

AIDS Control and History in Northwestern Tanzania FREDERICK J. KAIJAGE (University of Florida, Gainesville)

Northwestern Tanzania is the region worst-affected by the AIDS pandemic in Tanzania where it is heterosexually transmitted. Efforts to come to grips with the problem have been constrained by ill-founded notions about the native people's culture relating to sexuality. The AIDS crisis is generally attributed to prostitution and general moral laxity among the Bahaya, the natives of the region. Analysis of historical evidence indicates that the single most important factor in the spread of HIV in this area is the secular decline of the region's economy based on the banana-coffee farming system. The economic decline of the region, which was once one of the most developed in the country, has engendered demographic and social processes that favour a rapid spread of HIV within and beyond the boundaries of the region. Efforts to change sexual behaviour must therefore go hand in hand with a program of economic and social reconstruction if the AIDS control effort is to succeed.

Mapping the Politics of AIDS: Illsutrations from East Africa. GORAN HYDEN, University of Florida, and KIM LANEGRAN, University of Florida.

On the basis of an exmaination of the available literature, this paper tries to determine what questions have been raised by political scientists studying HIV/AIDS and apply these to the three East African countries -- Kenya, Tanzania, and Uganda -- with a view to assessing how far

they help us understand the political and policy implications of this epidemic. The mapping exercise is based on a set of basic questions relating to four variables: (1) policy, (2) risk perception, (3) institution, and (4) structure. The study expects to demonstrate more firmly what we already should know about the politics of AIDS and what issues ought to be given greater priority in future research on the subject in East Africa as well as elsewhere.

Designing Appropriate Intervention Strategies for HIV/AIDS in Southern Africa.
SUBHASH K. HIRA, M.D., University Teaching Hospital, Lusaka, Zambia. PETER L. PERINE, M.D., Uniformed Services University of the Health Sciences.

Up to 10% of antenatal women attending Zambia hospitals or clinics are infected by HIV; prevalence is as high as 25% in STD clinics. Health and educational resources devoted to the epidemic are severely limited and expenditures must be prioritized. We believe that the most cost-effective intervention strategy is to focus HIV therapeutic and educational intervention activities on persons attending STD clinics. These persons are at high risk both for HIV and for other genital infections believed to facilitate HIV sexual transmission. Syphilis, chancroid and other causes of genital inflammation may provide a portal of exist and entry for HIV patients and their sexual partners, respectively. Effective treatment in STDs and other infections in HIV-infected persons can be more easily monitored in these clinics which can prescribe expensive antibiotics and other drugs not available elsewhere. Treatment of sexual partner(s) of HIV infected persons can be carried out at subsequent clinic visits. We have found that discordantly HIV-infected couples are willing to use condoms and vaginal spermatocides provided by the clinic to avoid sexual transmission of HIV. Audio-visual programs on prevention of STD/HIV by behavior modification have been developed for viewing by STD patients waiting for their appointment. These make counseling more effective and can be adapted for use by HIV-infected blood donors and antenatal women.

How Bad Will it Be? Modeling the Epidemic in Eastern Africa

PETER O. WAY and KAREN STANECKI (U.S.Bureau of the Census)

The demographic impact of an AIDS epidemic on a typical African country is assessed using a dynamic mathematical projection model. The population impacts are substantial, even at moderate levels of infection. In this scenario, infection in urban areas grows from 4 to over 16 percent of the total population. This more than doubles the drude death rate and substantially decreases population growth. Nevertheless, population growth in both urban areas and the country as a whole remains positive.
In urban areas, substantial increases in infant and child mortality are noted, and mortality rates for adults 30 to 50 yearsold are up to 7 times the expected level. The urban epidemic results in a decrease in life expectancy by nearly one-third, the number of survivors from birth to age 50 is less than one-half the expected number.
The effect of alternative interventions strategies is examined. Universal blood screeing has little impact, since the majority of trans mission is sexual. Use of condoms, reduction in rates of casual sexual contact, and reduction in the duration of STDs all have the potential to substantially reduce the epidemic. The choice of the most effective of these interventions may be dependent on the cultural and practical feasibility of alternatives.
The implications of these impacts for various social and economic sectors are discussed.

The Impact of HIV/AIDS on Mothers and Children in East Africa. LINDA A. VALLEROY *,**, JEFFREY R. HARRIS *, and PETER O. WAY ** (* U.S. Agency for International Development) (** U.S. Bureau of the Census).

In East Africa, the rising HIV-attributable mortality of mothers and fathers threatens to increase the prevalence of orphanhood. In addition, the rising HIV-attributable mortality of young children threatens the recent gains made in increasing child survival. However, the extent of these impacts are not known.
Methods: Using a mathematical projections model and HIV-1 seroprevalence data from samples of pregnant women, we estimate current increases -- due to the existence of HIV -- in the mortality of mothers and young children, and in the prevalence of orphanhood.
Results: The table below presents estimates of current increases in selected rates due to the existence of HIV at these locations. Column titles are: (1) increase in the mortality of mothers; (2) increase in under-5 mortality; and, (3) increase in orphanhood (loss of mother) by age 5.

Location	(1)	(2)	(3)
Dar Es Salaam	27%	6%	21%
Lusaka	109	18	83
Kampala	162	31	124

Conclusion: Our analyses show that in certain areas the HIV pandemic is having a significant negative impact on mothers and children. As well as causing substantial increases in mortality, in some of the worst-hit areas -- such as Lusaka and Kampala -- HIV/AIDS is approximately doubling the number of orphans.

23-3. Modeling the Geographic Diffusion of the AIDS Epidemic

Organized by: **Peter R. Gould** *(Professor of Geography, Pennsylvania State Univ., University Park, PA)*

2:30 pm / Fri / 15 Feb **Sheraton/Baltimore**

Introduction: AIDS in its Geographic Dimensions
PETER R. GOULD (Penn State University)

For a variety of reasons, modelling the geographic diffusion of AIDS has been virtually ignored during the first ten years of the epidemic. Only when questions of predicting numbers down the time line have been approached by traditional methodologies employing statistical extrapolation, or essentially unparameterizable sets of differential equations. The greatly heightened understanding achieved upon considering the epidemic in the spatial domain, upon posing the geographic where questions, has been unavailable for improving forecasts, intervention strategies, or planning expanded health care. A rich tradition of spatial modelling, grounded in the early 50s as the first computers became available, is available to analyze the structure of spatio-temporal (x, y, t) series.

Geography's Role in the Decline of AIDS Cases Growth Rates
ANDREW GOLUB (Carnegie Mellon University), WILPEN L. GORR (Carnegie Mellon University), and PETER GOULD (The Pennsylvania State University)

Exponential growth rates of cumulative AIDS cases have been declining on national and smaller scales. Reasons generally cited for this trend have included the approach of saturation of high risk groups; abstinence from or reduced participation in risky activities; a distortion caused by the HIV-to-AIDS conversion lag time distribution; and, more recently, the use of AZT and other drugs for HIV seropositive patients to delay the onset of AIDS. Spatial diffusion theory, however, predicts two additional factors contributing to declining growth rates. The first is due to the continued seeding of HIV/AIDS cases in a region through contacts with external, HIV-infected populations. The second is a direct consequence of spatial diffusion from densely to sparsely populated geographic areas. An empirical investigation using county-level, annual AIDS counts provides some evidence supporting the geographic theories.

Expansion Modelling of the Spatial Spread of AIDS
EMILIO CASETTI (Ohio State University)

Mathematical models of the spatial spread of the AIDS epidemic discussed in this paper are constructed as follows: (a) an 'initial model' of the dynamic of the epidemic is specified; (b) its letter parameters are redefined by 'expansion equations' into functions of spatial variables and/or random variables; and (c) these expanded parameters are replaced into the initial model to produce a 'terminal model' encompassing both the dynamic of the epidemic and a specification of the variation of this dynamic across space.

The paper discusses alternative initial models and expansion equations; presents empirical estimates obtained from state level data for the US; and evaluates the predictive performance of the models investigated.

The Bronx is Dying: Urban Burnout, Forced Migration and AIDS
RODRICK WALLACE, PH.D (NY State Psychiatric Institute, NY)

15 years ago the BBC's documentary 'The Bronx is Burning' focused public attention on a massive process of building fire and abandonment which, following reductions in critical fire-related municipal services, left large sections of the Bronx as desolate as the cities of Europe after WW II. Associated forced migration disrupted the social networks of the poor, causing social disintegration which seriously exacerbated a nexus of deviant behavior now closely associated with transmission of HIV, and which has now begun to feed back into yet further loss of housing and community. Burnout, in the words of one public official, "Shotgunned AIDS all over the Bronx." Here we examine disruption of a minority community and the subsequent pattern of the AIDS epidemic as coupled geographic phenomena, finding that focus on 'race factors' in the spread of AIDS is an unsatisfactory surrogate for understanding complex and subtle spatio-temporal processes and interactions. Analysis of public policies which triggered 'South Bronx' burnout suggests modalities of intervention to control AIDS which take us beyond public education.

Predicting the Next Maps: Parametric Tracking from Spatial Adaptive Filtering in Pennsylvania.
JOSEPH R. KABEL (The Pennsylvania State University).

A recently introduced methodology, spatial adaptive filtering (SAF), is combined with the technique of parametric tracking to predict future spatio-temporal trends for the diffusion of AIDS. With this approach, accurate modeling of the spread of AIDS does not depend on hypothesized contact and transmission rates between and within population subgroups. Instead, it identifies and models the spatial dynamics inherent in the diffusion of the epidemic. It also provides accurate predictions using more general, available, and reliable surrogate data. Given an initial parameterized filter at one point in time, SAF iteratively revises the parameters that vary spatially. Parameters adapt to the spatial structure that strengthens as the epidemic unfolds. Spatial structure can be hypothesized beforehand as a pre-specified contiguity or connectivity matrix, or identified by the SAF algorithm itself without prior specification. Analysis of a specific spatial structure chosen by SAF offers insight into the possible geographic pathways of AIDS transmission. When SAF is employed at many different points in time, spatio-temporal forecasts can be generated by analyzing the temporal trends of the spatially revised parameters. An application of SAF and parametric tracking using county level AIDS data for the state of Pennsylvania illustrates the forecasting potential of this approach.

23-4. The Father and the Fetus: Facts and Fallacies

Organized by: **Gladys Friedler** *(Associate Professor of Psychiatry and Pharmacology, Boston Univ. School of Medicine, Boston, MA)*

8:30 am / Sun / 17 Feb **Sheraton/Baltimore**

Paternal Influence in Mid-Nineteenth and Early Twentieth Century Hereditarian Theories.
JOY HARVEY (University of Oklahoma).

Attitudes about male and female influences on heredity went through a process of change from the mid-nineteenth century through the first decades of the twentieth century. While the "degeneracy" theories of the mid-nineteenth century claimed hereditary effects from paternal as well as maternal alcoholism, opiate use and malnutrition, the later influence of Darwinism incorporated in Weismann's closed hereditary system changed that interpretation. The role of nineteenth century stereotypes of female passivity linked to sexual selection and social Darwinist theories were coupled to a new form of degeneracy theory. The combination of these factors helped to reinforce cultural concepts of relative male and female roles even for gametes.

Protecting Fetal Health Through Legal Constraints on the Behavior of Women: A Flawed Public Policy.
RENEE M. LANDERS (Boston College Law School).

The legal system in the United States has tolerated recent attempts to constrain the behavior of pregnant women and women capable of bearing children in several contexts. For example, an employer policy that bars women from workplace positions involving exposure to substances that affect reproductive health has been approved by one court and is being reviewed by the U.S. Supreme Court. This policy was approved by the lower court without taking into account scientific evidence that male exposure to hazardous substances also can affect fetal and neonatal development. Policies such as this one are at odds with women's rights to physical autonomy and to equal employment opportunity guaranteed by federal and state law. Such policies are generally adopted to discriminate against women in "traditionally male" jobs, while hazards affecting workers in "traditionally female" jobs have been overlooked or minimized. This paper will examine the response of the legal system to various fetal protection policies. The paper will conclude that while society has a substantial interest in promoting healthy fetal and neonatal development, scientific research, governmental health care programs, and employer practices aimed at promoting worker health and safety will be more successful in protecting reproductive health than coercive and discriminatory employment or other practices.

Toxicants That Affect Sperm Cell Function May Have Fetal Consequences. LEONARD NELSON (Dept of Physiology & Biophysics, Medical College of Ohio, Toledo, 43699).

Conditions encountered in the workplace, home, portal-to portal and recreational environments may be hazardous to your reproductive health. Toxic agents include radiation, heat, metals, agricultural chemicals and pesticides, organic solvents and anesthetics, PCBs, and hormones as well as food additives and drugs. Many of these factors which specifically target the gonads and gamete production may induce subfertility, teratogenicity, low birth weight, growth retardation, developmental physical and mental defects. While a "normal" semen specimen may be defined as ranging between 2 - 6 ml in volume, contain 20 - 60 million sperm cells/ml, of which more than 40% are motile and at least 40% exhibit normal morphology, only one is required to fertilize the egg. Developing evidence indicates that men employed in manufacturing or agricultural enterprises that utilize hazardous materials or who otherwise encounter toxicants may be responsible for induction of fetal defects if that one sperm cell is adversely affected. Exposed germinal epithelia may generate chromosomal abnormalities such as trisomy, deletions of genes and even abortion of the fetus. To avert these problems, policies promulgating research on warm-blooded vertebrates and human fetal tissues must be restored and fostered and men as well as women must be afforded protective measures.

The Effects of Paternal Exposure to Xenobiotics on Subsequent Progeny. GLADYS FRIEDLER (Boston University School of Medicine).

The incidence of reproductive anomalies in humans is relatively high. Of the 3-7% of children born with deficits detectable at birth, over 60% are of unknown origin. There is increasing speculation that drugs and other xenobiotic agents play a significant role in the etiology of these alterations. Because of the periodic nature of human reproduction, a variety of environmental factors including drugs and chemical agents in the workplace may impair reproductive success or postnatal development and remain undetected. Reproductive studies have focused primarily on the effects of maternal exposure during pregnancy. Until recently, investigations on the sequelae of paternal exposure have been minimal. Evidence from both epidemiologic and experimental animal studies now indicate that paternal exposure to therapeutic and recreational drugs and to chemical hazards in the workplace can adversely affect the functional as well as structural integrity of the fetus and neonate. This growing body of evidence which documents male-mediated effects on reproductive outcome and postnatal development suggests the importance of more vigorous exploration of the influence of paternal variables on progeny.

23-5. Challenges to Dentistry for the '90s

Organized by: **William H. Bowen** *(Professor and Chair, Dept. of Dental Research, Univ. of Rochester, Rochester, NY)*

8:30 am / Mon / 18 Feb **Sheraton/Baltimore**

Manpower Needs for the '90s and Beyond. RICHARD R. RANNEY (University of Alabama at Birmingham).

After excesses of the '70s, applicants to enter dental schools and enrollment precipitously declined in the '80s. Five schools closed predoctoral programs. Despite this, projections do not indicate a shortage of dentists in the '90s. The American Association of Dental Schools (AADS) forecasts shortages after 2000, perhaps regionally severe; but the Health Resources and Services Administration forecasts 12,000 more active dentists in 2000 than does the AADS (Solomon, 1990). At issue is whether a false sense of security may be engendered by HRSA projections, and whether modes of practice, factors which generate demands, and issues of access as they operate now are appropriate bases for forecasting manpower needs. Many believe that a new vision of dental practice is needed; if realized, it would make present projections moot. Numbers of specialists are increasing faster than general practitioners. Policy makers will need to decide whether intervention is warranted. Crises as perceived by dentists emerged during the late '80s with respect to numbers of dental hygienists. Shortening of programs, movement to off-campus sites, and a return toward preceptorship models have been suggested. Numbers of clinical faculty in dental schools declined in the past decade but have not been as much as enrollment reductions. Nonetheless, the proportion of tenure-track faculty who have achieved tenure increased from about one-half to about two-thirds while mean age remained stable. Nearly twice as many deans in 1989 as in 1978 forecast difficulty in finding faculty capable of meeting future tenure requirements; less than half of the estimated annual need for new faculty with post-doctoral research training are in training programs (Kennedy, 1990). The greatest manpower need in dentistry for the '90s may be for clinical faculty capable of meeting scholarship expectations of universities.

Fluoride Reassessment. PRESTON A. LITTLETON, JR. (American Association of Dental Schools).

Community water fluoridation has been identified as the most effective and efficient means to prevent dental decay. Currently, approximately 132 million Americans drink water with at least 0.7 ppm fluoride. The Year 2000 Health Objectives for the nation call for the continuation and expansion of water fluoridation.

In April 1990 peer review of the U.S. DHHS National Toxicology Program (NTP) study of the toxicity and carcinogenicity of sodium fluoride in drinking water of rodents was completed. There was no evidence of carcinogenic activity in female rats or in male or female mice. Finding a marginal increase of neoplasms, the NTP concluded that there was equivocal evidence of carcinogenic activity in male rats. The NTP study did not address the potential risks to humans from fluoride.

As part of a wider analysis by DHHS of the appropriate use of fluorides in human health, a subcommittee of the PHS Committee to Coordinate Environmental Health and Related Programs (CCEHRP) has undertaken a thorough examination of scientific, peer-reviewed studies of the risks and benefits of fluorides. This has incorporated analysis of all available data, both experimental and epidemiological. The CCEHRP report is scheduled to be completed by December 1990. The study and its major findings, particularly as related to the continued use of fluoride to prevent dental caries, will be discussed.

Dry Mouth--An Aging Problem. LAWRENCE A. TABAK (Cariology Center, Departments of Dental Research and Biochemistry, University of Rochester, Rochester, New York).

The salivary secretions that bathe the mouth play a significant role in maintaining the health of its hard and soft tissues. Many of the problems faced by patients who complain of xerostomia (dry mouth) may be attributed to a loss of the "tissue coating" functions of saliva. Their masticatory surfaces do not slide well over the oral tissues leading to difficulty in phonation, mastication, and deglutition. Moreover, the absence of a demulcent coating between soft and hard surfaces may lead to frictional irritation of the mucosa which may contribute to overgrowth of opportunistic pathogens such as *Candida albicans*. In medically uncompromised subjects, aging, per se, does not lead to xerostomia. However, the high use of pharmaceuticals by the elderly which cause dry mouth as a side effect makes them susceptible to salivary dysfunction. In addition, the prevalence of Sjögren's disease, an autoimmune disease which leads to salivary hypofunction, has been estimated at several million in this country. Other individuals suffer oral dryness as a secondary effect of irradiation and/or surgical management of head and neck carcinomas. Numerous salivary substitutes have been proposed to replace salivary function in compromised patients. Our lack of understanding regarding the mechanisms responsible for oral lubrication have lead to a largely empirical approach which have met with only limited success. Recent evidence suggests that specific salivary molecules are responsible for oral lubrication. Thus the potential for a rational design of a salivary substitute exists.

Caries - Another Extinct Disease? WILLIAM H. BOWEN (University of Rochester, Rochester, NY).

Results from recent epidemiological studies reveal that the prevalence of caries in young persons has declined in many Western countries. A tidal wave of euphoria has arisen as a result because the perception has grown that dental caries is no longer a public health problem. Although close to 50% of children examined in a recent survey were free of dental decay, this observation also means that 50% had one or more areas of decay. It cannot be satisfying to know that, despite considerable success, half of our children still have dental disease. It is of particular interest to note that 60-80% of all caries lesions occur in 20% of the population. Clearly, one of the major challenges is to establish reasons for this phenomenon. Perhaps even more importantly, we need to develop methods to identify persons who are particularly susceptible. A survey conducted in adults revealed that dental caries is far from being extinct. The mean number of decayed or filled surfaces (DFS) was 23.2. In addition, more than 60% of persons over age 60 had at least one root-surface lesion. Because we are an aging society and persons are retaining their teeth longer than heretofore, the prevalence of root-surface caries is likely to increase. The likelihood of developing root-surface caries is probably enhanced by the widespread use of prescription drugs such as β blockers and mood altering drugs which affect salivary secretion. The available data show very clearly that although the prevalence of caries has been reduced in some communities, very significant levels of caries remain and provide significant research challenges for the nineties.

Mercury Amalgams - Where Are We?

THOMAS W. CLARKSON (University of Rochester School of Medicine)

Stock, in the 1930s, was the first investigator to report that amalgam fillings could release mercury vapor. Frykholm in the 1950s, by using radioactive mercury, demonstrated that insertion of amalgams in humans could give rise to uptake of mercury as evidenced by finding radioactivity in urine samples.

In the last decade, a considerable body of evidence has confirmed these early findings. Stress on the amalgam surface, such as produced by chewing, causes the breakdown of a barrier layer and the release of mercury vapor into the oral cavity. When this coincides with inhalation through the mouth, mercury is taken into the body.

In this paper, an attempt will be made to estimate, based on literature reports, the rate of release of mercury from amalgams. Estimates will be made of the daily amount absorbed and the contribution to tissue, blood and urine concentrations as a function of amalgam fillings. Data on brain levels at autopsy will be compared with estimated values.

Reports on possible adverse effects on health associated with mercury amalgam fillings will also be considered.

Technical Sessions

23T-1. Balance and "Dizziness": Assessment and Rehabilitation

Organized by: **Neil T. Shepard** *(Director of Vestibular Testing Center, Dept. of Otolaryngology, University of Michigan, Ann Arbor, MI)* and **Robert G. Turner** *(Associate Professor, Dept. of Otolaryngology, Univ. of California, San Francisco, CA)*

8:30 am / Tue / 19 Feb — **Sheraton/Baltimore**

Basic Science of Postural Control LEWIS M. NASHNER, D.Sc. (NeuroCom, Inc.)

Human posture is a complex integrative control process. To have an accurate sense of body position in space, a person needs the ability to organize the senses providing orientation information; namely, the visual, vestibular, and somatosensory (orientation in relation to the support surface) inputs. To make effective use of this orientation information, a person must also have the ability to move the body in a coordinated way in response to perceived changes in orientation. Maintaining one's posture and sense of orientation is possible within a variety of conditions, because the brain, in advance of performing an action, can select from a number of alternatives those sensory references and movement strategies which are appropriate to the environmental conditions.

Clinic Assessment of Postural Control and Rehabilitation of Balance NEIL T. SHEPARD, PHD. (Department of Otolaryngology, University of Michigan)

The clinical assessment of postural control has for years been overlooked as an integral part of the evaluation of a balance disorder patient. Recent advances in understanding of normal function of postural control has led to clinically appropriate methods to quantify postural abilities. An overview of these methods and their clinical utility will be presented. Along with advances in assessment of the balance disorder patient, significant changes are occurring in the physical therapy management of these patients. These management techniques are showing good success as a stand alone intervention, as well as an adjunct to medical/surgical methods. A recently completed, designed retrospective study showing symptom reduction in 80-85% of 152 patients, with a wide variety of balance disorders will be discussed.

Oculomotor Control: Basic Science and Clinical Implications
CHARLES W. STOCKWELL (Providence Hospital, Southfield, MI)

Eye movements are required to hold visual images steady on the foveas. There are four major eye movement control systems, each with a distinct function and anatomic substrate: (1) the *vestibular/ optokinetic* system, designed to generate compensatory eye movements during head movements on the basis of inputs received from vestibular receptors in the labyrinths and optokinetic receptors in the retinas; (2) the *pursuit* system, designed hold visual images steady during visual target movements or inappropriate eye movements that would otherwise cause image slip across the retinas; (3) the *saccade* system, designed to place new visual targets promptly on the foveas; and (4) the *vergence* system, designed to hold visual images at the same location on both foveas.

Assessment of eye movement control often helps in the localization of disease processes that cause balance disorders. Clinicians routinely examine eye movements at the bedside and monitor them electronically in the laboratory as the patient undergoes a test battery known as *electronystagmography*. All control systems are evaluated, but the pursuit and vestibular/ optokinetic systems are studied intensively, since these systems are found most often to be dysfunctional in patients with balance problems. Eye movement tests are repeated at periodic intervals to assess the effects of rehabilitation.

Title: Central Vestibular Physiology: Basic Science and New Clinical Horizons
Joseph M.R. Furman, M.D., Ph.D (University of Pittsburgh)

Central Vestibular physiology has implications regarding the assessment of balance disorders in humans. The central nervous system processes information from both the semicircular canals and the otolith organs. A recent focus of vestibular research has concerned the otolith organs, the linear acceleration and gravity sensitive organs of the inner ear. Stimulation of the otolith organs is known to influence both descending, i.e. vestibulo-spinal and ascending i.e. vestibulo-ocular pathways. Advances have also been achieved in the area of semicircular canal - otolith interaction especially as it pertains to the vestibulo-ocular reflex. Another area of interest concerns the interrelationship between the vestibular system and the autonomic nervous system including the importance of the vestibulo-cerebellum.

New clinical tests are being developed to evaluate the vestibulo ocular reflex including the otolith- ocular reflex and the horizontal semicircular canal - ocular reflex during natural head movements. The implication of these new tests will be discussed. Another clinical test on the horizon is that of vestibular evoked potentials, which will be discussed briefly.

23T-2. Firearm Injury Prevention: Scientific and Public Policy Directions

Organized by: **James A. Mercy** *(Chief, Epidemiology Branch, Division of Injury Control, Center for Environmental Health and Injury Control, Centers for Disease Control, Atlanta, GA)*

2:30 pm / Tue / 19 Feb — **Sheraton/Baltimore**

Firearms and Health in the United States
GAREN J. WINTEMUTE, M.D., M.P.H. (University of California, Davis)

This presentation reviews recent epidemiologic and health services research which has provided a clear aggregate picture of the impact of firearms violence in the United States. Firearm mortality rates are at historically high levels. Firearms rank among the nation's leading causes of death, are the second leading cause of injury death, and are the number one cause of death for some segments of the population. Each year there are more than 30,000 firearm deaths, close to 200,000 firearm injuries, and many episodes of firearm violence which do not involve firearm injury. For some populations, the incidence of these injuries is rising rapidly. The lifetime costs of one year's firearm injuries were $14.4 billion in 1985. Most firearm deaths are suicides; fewer than 5% are unintentional. These proportions vary greatly among demographic groups. The data have suggested new approaches to firearm injury prevention.

Do Guns in the Home Increase or Decrease a Family's Risk of Violent Death? A Case-Control Study. AL KELLERMANN (University of Tennessee), FP RIVARA (University of Washington)

Although the great majority of suicides and homicides in the United States involve guns, the effect of readily available firearms on the incidence of suicide and homicide is extremely controversial. In order to assess the strength and direction of any association between firearm ownership and violent death, all suicides and homicides occurring in the home of the victim in two demographically distinct metropolitan counties (Shelby County, Tennessee and King County, Washington) were identified over a three year period. Detailed scene data were obtained from investigating police officers and/or medical examiner personnel.

This information was later supplemented by a structured interview with the next-of-kin. Each case household was matched to a comparable neighborhood control by the age, sex and race of the victim. Residents of control households were interviewed in an analogous fashion to case next-of-kin. Responses of cases and controls to interview questions regarding firearm ownership and storage practices, alcohol consumption, a variety of home security measures, past experience with family violence and other variables were compared using standard matched pairs methods. Preliminary results of this analysis will be presented and their implications discussed. Through use of the case-control method, an objective assessment of the risk (or protective) effect of gun ownership can be made at the level of an individual household. Successful application of this methodology can provide criminal justice and public health officials with a powerful new tool for studying the epidemiology of suicides, homicides and injuries due to violence.

Firearm Regulation and Community Rates of Homicide and Suicide. FRED RIVARA, MD (University of Washington), JOHN SLOAN, MD (Stanford University), ARTHUR KELLERMANN, MD (University of Tennessee).

To investigate the possible association between handgun regulations and community rates of homicide and suicide, we compared the incidence of homicide and suicide in Seattle, King County Washington with that in Vancouver, British Columbia. Seattle and Vancouver are very similar in many ways, but Vancouver has adopted a more restrictive approach to the regulation of handguns.

Rates of criminal activity and assaults in the two cities were similar. However, the relative risk of death from homicide, adjusted for age and sex, was significantly higher in Seattle than Vancouver (RR 1.63, 95% CI 1.28 to 2.08).

In contrast, the overall risk of suicide was not different in the two communities. The rate of suicide by firearms was higher in King County (RR 2.34, 95% CI 1.90 to 2.88) because the rate of suicide by handguns was 5.7 times higher. The difference in the rate of firearm suicide was offset by a 1.5-fold higher rate of suicide by other means in Vancouver. Persons 15-24 years old had a higher suicide rate in King County (RR 1.38, 95% CI, 1.02 to 1.86). Virtually all the difference was due to an almost 10-fold higher rate of handgun suicide in King County.

We conclude that restricting access to handguns may reduce the community rate of homicide, but not of suicide except for persons 15-24 years old.

Estimating the Effects of Firearm Regulations COLIN LOFTIN (University of Maryland at College Park), and DAVID MCDOWALL (University of Maryland at College Park).

Firearms laws are thought to alter the patterns and incidence of homicide and other forms of injury by two mechanisms: altering (1) the availability of guns, and (2) patterns of gun use. Existing estimates of the effects of firearms laws are of limited value. Estimates from cross-sectional studies of cities and/or states are sensitive to slight variation in the sample and the measured variables. Interrupted time-series studies are easier to interpret, but do not reveal anything about between-case variation in the size of effects. By combining estimates from multiple time-series studies, one can overcome this problem and derive better estimates of the intervention effects.
Estimates from several studies of the impact of mandatory sentence enhancements laws are used to illustrate the research strategy.

Policy and Legal Implications of Scientific Findings from Firearm Injury Research. STEPHEN P. TERET, J.D., M.P.H. (Johns Hopkins Injury Prevention Center).

Policy formulation and legal regulation of the availability of firearms are among the most vigorously contested issues in public health. Questions regarding constitutionally protected rights, the relationships among federal, state and local laws, and the regulatory authority of health and safety agencies arise when considering gun policy. The role of the courts in assessing guns as dangerous consumer products is crucial. All of these considerations are dependant in part upon the data assessing the relative risks and benefits of guns, and the effectiveness of gun regulations.

This session will discuss policy alternatives, including legislation, regulation and litigation, based upon scientific evidence of guns as a public health problem.

23T-3. Improving Drug Development and Regulation via Pharmacokinetic/ Pharmacodynamic Procedures

Organized by: Meyer Katzper *(Senior Staff Fellow, Center for Drug Evaluation and Research, Food and Drug Administration, Rockville, MD)*

2:30 pm / Mon / 18 Feb — Sheraton/Baltimore

Optimal Integration of Pharmacokinetics and Pharmacodynamics in Drug Development and Regulation
CARL PECK (Center for Drug Evaluation and Research, FDA)

Rational drug development entails early determination of relationships between dosage, pharmacokinetics (PK), and pharmacodynamics (PD) in order to design kinetically sound clinical trials defining both effectiveness and adverse effects. Animal PK data can be used for rapid dosage escalation in phase I maximum tolerated dose (MTD) studies. PK and PD studies allow the unique opportunity to map PK/PD after doses up to MTD. In Phase II the randomized concentration controlled clinical trial (RCCT) represents a powerful alternative to the traditional dose-controlled clinical trial (RDCT). In the RCCT, subjects are randomized to targeted plasma drug concentrations, achieved by PK-control. The RCCT overcomes drawbacks of the RDCT by minimizing overlap of achieved blood levels among comparison groups. Correlation of observable subject features (weight, organ dysfunction) with PK and PD enable derivation of dosage individualization strategies. Correlation of drug concentrations and clinical effects establish effectiveness/toxicity relationships and a framework for individualization of dosage. PK/PD studies in special populations (elderly) in Phase III or use of the pharmacokinetic screen, further enhance the database on individualization of dosage.

Pharmaceutical Industry View of the Role of Pharmacokinetics and Pharmacodynamics in Drug Development. Robert E. Desjardins, (American Cyanamid Co., Medical Research Division, Pearl River, N.Y.))

Modern drug development is a complex, lengthy and expensive process. Errors in dose selection and clinical trial design often contribute to the cost and time required to get a new drug to the marketplace. In the worst case such errors may cause unnecessary adverse experiences and failure to develop a potentially useful product. Greater attention to scientific excellence early in the development process may reduce the risk of costly errors later. One example of the adoption of this principle is the use of pre-clinical and clinic pharmacokinetic (PK) and pharmacodynamic (PD) measurements as a guide to dose selection and clinical trial design.

While interspecies variability imposes some limits on the ability to extrapolate preclinical PK and PD findings to man, considerably more can be done usefully than has generally been practiced in the pharmaceutical industry. In its haste to "get into man" and begin "definitive clinical trials" sponsors often neglect or postpone the kind of studies which are needed to optomize the chance for success and minimize the risk of error. A greater appreciation for the value and power of detailed PK and PD studies in relation to activity and toxicity in animals and in vitro studies and their correlation with comparable early studies in man would benefit the industry, its regulators and ultimately the patient.

Thinking About Drug Testing: Models and Meaning
LEWIS B. SHEINER (University of California San Francisco)

To choose drugs and doses intelligently, clinicians must know a drug's Pharmacokinetics/Pharmacodynamics (PK/PD): the expected dose response (and variability) for a drug's efficacies (there may be more than one) and toxicities (likewise), as modified by physiology (age, size, etc), and pathophysiology (disease severity, renal function, etc). Studies of

PK/PD fall on a continuum characterized by two extremes: (i) Ignore prior knowledge (make few assumptions), and do complete, and well-controlled experiments. A prototype is the Randomized Controlled Trial (RCT). (ii) Maximally use prior knowledge (make all reasonable assumptions) to analyse observational data. A prototype is a case-controlled epidemiologic study. Advantages of (i) are objectivity and high certainty of conclusions; disadvantages are high cost and and low relevance (RTCs can only ethically and practically be performed in a limited subset of the real target population). Advantages of (ii) are low cost and high relevance; disadvantages are subjectivity and low certainty (assumptions can be questioned; if they are wrong, conclusions may be affected). While current practice is to accept virtually only (i) for pre-marketing FDA approval, and often to settle for only (ii) for post-marketing sureveillance, an appropriate balance between the extremes, considering the moral, clinical, and other constraints for each case separately, is preferable. Parametric PK/PD models can express knowledge of physiology, biotransformation, receptors, pharmacology and much more. They provide a rational framework for studies of either type, and a natural way to smoothly vary the number and force of assumptions reciprocally with the demand for data. Routine use of such models for drug studies will have profound implications for design and analysis.

Using Meta-Analysis in the Determination of Pharmacokinetic and Pharmacodynamic Parameters.
JOHN. G. HARTER (Center for Drug Evaluation and Research)

A new drug application (NDA) submitted to the Food and Drug Administration (FDA) contains multiple studies which are evaluated in the approval process. Pooling the results to make decisions about approvability and labeling recommendations is usually based on qualitative clinical judgement. Combining studies in a quantitative manner, when pooling was not planned and when the studies did not follow the same protocol, is relatively new and controversial in the scientific literature and at the FDA. One difference between meta-analysis based on published studies vs NDA studies is the availability of raw data in the case of the latter. Experience to date suggests that with the availability of raw data it is possible to examine a sample of data randomly drawn from a pool and use the data driven findings as hypotheses for testing in the remaining datain the pool. It is still uncertain as to how avoid bias (systematic error) in the analysis. Bias may be reduced by choices made in the division of the pool, by criteria used for selection of studies or individual patients for pooling or exclusion from the pool, by algorithms used in combining pharmacometric data which used different assay methodology and by adjustments to outcome measures based on control group results. We have used an approach which attempts to analyze the consistency of the results across studies and the influence of subsets, including individual studies, on the overall results. We believe such an approach is a logical addition to, or perhaps substitute for, the qualitative clinical judgement used in reaching conclusions based on multiple studies.

Planning the Future Computer Assisted Review Environment.
MEYER KATZPER (Center for Drug Evaluation and Research, FDA)

Computer platforms are being developed and installed to assist and enhance the review process. Review tasks encompass more than is generally realized. Evaluation of the safety and efficacy of drugs on the basis of submitted information depends on the knowledge and astuteness of reviewers from various disciplines. Guidance for the public with respect to an approved drug is encapsulated in the labeling information which must accompany the drug. Critical modeling of pharmacokinetic and pharmacodynamic data allows improved specification of dosing regimes and individualization of therapy. To assist reviewers in answering the many complex questions that arise in the course of characterizing and assessing a drug, the Center for Drug Evaluation and Research (CDER) has established mechanisms for ongoing regulatory research. The research projects are intended to serve as prototypes for designing and developing conceptual frameworks, methodologies and tools to enhance the review process. Increased use of computer assisted drug applications, along with the economic availability of computer hardware and software, are facilitating analyses which were not previously feasible. Current CDER research and methodology planning projects encompass establishment of data bases to facilitate comparative drug studies, design of software filters to uncover anomalous situations, visual exploration of data, development of rapid exploratory modeling techniques, researching the physiological bases of pharmacometric parameters, and the evaluation of alternate approaches for establishing clinical trials and determining optimal dosage regimes.

24. Agriculture

24-1. Economically Useful Plants for Developing Countries: From Research to Market

Organized by: **Barbara N. Timmermann** *(Associate Professor of Pharmaceutical Sciences, Univ. of Arizona, Tucson, AZ)* and **Robert H. Maybury** *(Executive Director, International Organization for Chemical Sciences in Development, Falls Church, VA)*

8:30 am / Fri / 15 Feb **Sheraton/Annapolis**

Bioassays as Guides to Fractionation of Natural Product Extracts. J. R. PLIMMER (USDA, ARS, NRI, Environmental Chemistry Laboratory, Beltsville, Maryland 20705).

The International Organization for Chemistry in Development seeks to provide assistance to chemists in developing countries through its activities. Types of assistance provided include instrumental analysis, biological assay, and support for participation in programs of research that are coordinated through IOCD working groups. The Working Group on Plant Chemistry is the most recently-established working group, formed in March 1988, and its aim is to stimulate the search for pesticidal, medicinal, or other useful types of biological activity in the varied and exotic flora of developing countries. To achieve this objective, its initial activity has been to plan and conduct a workshop held at the International Centre for Insect Physiology and Ecology, Nairobi, Kenya. The purpose of the workshop was to demonstrate and teach simple bioassay techniques that may be useful indicators of biological activity. The attendees were selected as chemists who will utilize these techniques in fractionating extracts of plant materials and who will disseminate this information to their colleagues.

Chemistry and Biotechnology-Important Avenues for Development of Waste By-Products for Commercial Utilization -
JAMES P. KUTNEY(Dept. of Chemistry, University of British Columbia, 2036 Main Mall, Vancouver, Canada V6T 1Y6

Chemistry and biotechnology, particularly when the latter is coupled with chemistry can play extremely important roles in developing efficient utilization of waste by-products for commercial production of refined commodities. The lecture will focus on several areas under study in my group in Canada to illustrate this approach. The forest industry is one of largest in this country. Its major focus, at present is to utilize the "wood" (stem) portion of the harvested trees for the production of paper and construction materials An enormous waste generally termed as "foliage" (branches, needles, etc is generally removed by burning or allowed to rot thereby creating an environmental problem. Obviously such foliage containing valuable chemicals(essential oils) can be processed via steam distillation, for example, to provide such chemicals for the production of perfumes, skin care cosmetics, agrochemicals. An example involving foliage of W. red cedar (thuja plica) will be discussed. Such an approach can be utilized with forests in developing countries.
The use of Biotechnology in converting the waste component (pitch) of Canadian tall oil to valuable steroids will be discussed.

24-2. Advancing Biotechnology: International Issues Regarding Biosafety Policy and Practice

Organized by: **Joel I. Cohen** *(Biotechnology and Genetic Resource Specialist, Bureau for Science and Technology, Office of Agriculture, U.S. Agency for International Development, Washington, DC)*, **Judith A. Chambers** *(AAAS Science and Diplomacy Fellow, Office of Agriculture, U.S. Agency for International Development, Washington, DC)*, **Marshall Phillips** *(Principal Scientist, Office of Agricultural Biotechnology, U.S. Dept. of Agriculture, Washington, DC)*, and **Robert F. Barnes** *(Executive Vice President, American Society of Agronomy, Madison, WI)*

8:30 am & 2:30 pm / Sat / 16 Feb **Sheraton/Annapolis**

International Collaborative Research Programs in Biotechnology and Biosafety. JOEL COHEN and KERRI ANN JONES (Agency for International Devel.)

Increasing requests placed upon donor agencies to support collaborative research in biotechnology present opportunities and a complex array of challenges. The opportunity presented is clear: applications of biotechnology present new approaches to a multitude of constraints upon agricultural productivity in developing countries. The challenges include: assembling adequate technical, regulatory, and international expertise; determining a balance between technology transfer and building indigenous capability; developing regulatory protocols addressing donor and host country concerns; and, securing resources within a highly competitive funding environment. With science progressing rapdily, regulatory concerns loom as a hurdle which must be addressed if the applications of biotechnology are to impact upon priority constraints of agricultural productivity. A number of collaborative projects, supported by the Agency for International Development, are reviewed in this context. They demonstrate the need for direct involvement between development agencies and regulatory agencies. Fulfillment of domestic biosafety requirements in an international setting is essential for all involved: scientists, and, donor, regulatory, and host country agencies.

Domestic and International Regulatory Responsibilities of USDA—Global Harmonization. TERRY L. MEDLEY (U.S. Department of Agriculture)

Development of new technology brings with it decisions regarding regulations for technology transfer, technology application and trade, both nationally and internationally. Traditionally, regulations are for public protection and are based on scientific principles. This approach underscores the General Agreement on Tariffs and Trade (GATT) which insists on science based risk assessments. The field testing of certain products/organisms of biotechnology is regulated by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), based upon an analysis of the organisms, the affected environment, and the precautions, if necessary, for protecting the environment. APHIS' approach is consistent with the U.S. Coordinated Framework for the Regulation of Biotechnology and the draft U.S. document on principle for Federal Oversight of Biotechnology. On April 23, 1990, the Council of the European Communities (EC) issued its directive on the deliberate release into the environment of genetically modified organisms. This paper will address from a USDA/APHIS perspective some of the differences between the U.S. policy statement and the EC directive.

African Perspective On International Issues Regarding Biosafety Policy and Practice
THOMAS R. ODHIAMBO (International Centre of Insect Physiology and Ecology, ICIPE)

Innovative approaches to environmental introduction of any organisms, genetically modified or not, should not be discouraged, but needs to be undertaken within a framework that has adequate safeguards for the protection of environment and human health. The implication being that ecological consideration is essential to the assessment of risks associated with any introduction. Lessons, both positive and negative, should be drawn from such familiar examples as vaccines, agricultural varieties and biological control. However, there is much that still needs to be known about such topics as systematics; community structure; the factors governing the survival, growth and spread of populations of introduced organisms; and techniques for monitoring. While much attention has been focused on the methods used to modify organisms, it is the products of these technologies and uses to which they will be put that should be the objects of attention, rather than the particular techniques employed to achieve those ends. Each introduction of an organism, whether modified or not, must be judged on its own merits, within the context of the scale of the application and the possible environmental costs and benefits.

Collaborative Vaccine Development for Thailand: Transfer of Technology and Biosafety Issue

CHARIYA RATANARAT BROCKELMAN (Mahidol University, Bangkok, Thailand)

Vaccine development is a lengthy and complex process for which basic research is required to initially identify candidate products. This goal can be reached only when sufficiently reliable information on the biological and biochemical properties of target agents in endemic areas is available. Thai scientists have been using advancing biotechnology to make direct and indirect contributions to the development of human antifertility vaccine, dengue, cholera, malaria, anaplasmosis-babesiosis vaccines. These activities are being carried out in the government sectors, particularly state universities, where efforts are being made to mobilize and strengthen research and development capacity. Thai researchers are enouraged to work collaboratively with already established foreign groups on clinical testings and field trials of the needed vaccines. Biosafety regulations are in the framework of the Expanded Programme for Immunization (EPI) of the Ministry of Public Health which includes extended guidelines of the Food and Drug Committee. Hence, preclinical toxicity tests, clinical tests including evaluation of immunogenicity, tolerance and efficiency trials in a selected population are required prior to large-scale trials and to subsequent registration and marketing of the vaccines.

Biotechnology and Biosafety at International Agricultural Research Centers. RICHARD L. SAWYER (International Potato Center, Lima-Peru).

The International Research Centers have moved rapidly into the field of biotechnology on a number of fronts. They have built linkages into both private sector capabilities and advanced public sector research institutions. Collaborative approaches now exist in programs of pest and disease identification and control. Rapid multiplication of plant material, new methods of germplasm conservation, and the development of new varieties and populations with characteristics undreamed of in the past are already underway. Centers are giving due concern to the problems of ownership of information and materials emerging from their programs and their biosafety. A survey of present program and practices at the centers are covered in the paper.

USDA Guidelines: An Approach for Evaluating Risks of Field Tests and Commercial Releases. A. YOUNG and M. PHILLIPS (Office of Agricultural Biotechnology, USDA), Washington, D.C.

There are a multitude of potential agricultural applications for the tools of biotechnology: improving yields,

quality, consumer acceptance of traditional agricultural products, producing new products, and reducing adverse environmental impacts of current agricultural practices. However, the implementation of any new technology, particularly one that has a diverse and widespread applications, may create new risks to the environment and public health. The U.S. Department of Agriculture (USDA) is committed to providing appropriate scientific review of all research funded by the Department that involves the field testing of organisms with deliberately modified hereditary traits. The goal is to provide safe field testing of genetically modified organisms and subsequent commercial release of new products. If biotechnology is to be successfully commercialized, the national and international community must agree on the scientific principles which underpin sound decision making. Hence, the USDA program consists of a comprehensive review system based on a set of scientific principles developed by the Agricultural Biotechnology Research Advisory Committee. The presentation will provide applications of the principles to current field tests and potential commercial releases.

EPA and Its Regulation of Biotechnology; Domestic Responsibilities and International Perspective. ELIZABETH MILEWSKI (US Environmental Protection Agency) LAWRENCE ZEPH (US EPA), and ELIZABETH ANDERSON (US EPA).

Society is experiencing a revolution in the application of biotechnology. Scientific advances in biology have already provided several breakthroughs in medicine and development of pharmaceuticals. Now this technology is beginning to fulfill its promise in other areas such as the chemical industry, agriculture, mining and pollution control. The wide range of potential and actual applications present challenges to countries as they establish, or extend existing, oversight systems. These challenges extend into the international arena. An example of the challenges presented to the various countries is the need for a "harmonized" approach to oversight. Countries engaging in trade or other exchanges should possess a common understanding in a number of areas; e.g., the definitions underpinning an oversight system, what risk issues should be evaluated, what data are important in the evaluation.

An Environmental Perspective on The International Regulation of Genetically Engineered Organisms. MARGARET MELLON (National Wildlife Federation).

Government researchers and commercial entities are developing numerous genetically engineered organisms for release into the environment. From an environmental standpoint, releases of engineered organisms pose varied and uncertain risks, especially in large scale, commercial use. To avoid and control such risks international efforts are needed to control the testing, export, monitoring, and evaluation of genetically engineered products. Fora are also needed to critically evaluate the social and agricultural impacts of genetically engineered products and compare them to alternatives. Neither the risks of the release of engineered organisms nor the regulatory issues are easily confined to national boundaries. Ideally, international oversight mechanisms would be built on strong national regulatory programs. Unfortunately, even in the United States, Europe, and Japan, the environmental regulatory programs for genetically engineered organisms are weak or still undeveloped. International efforts to spur the development of the technology should be discouraged until sound regulatory programs are in place.

International Biosafety Arrangements

John H. Barton

In deciding whether to permit release of genetically-engineered organisms, developing nations are fearful of being taken advantage of by firms seeking to test new products. At the same time, many firms and development agencies are unwilling to test products that have not received adequate regulatory review. Moreover, developing nations often lack independent scientific capability to evaluate the environmental impacts of a new product. The result is a legal barrier to the responsible application of biotechnology to developing nation agriculture. One resolution is to strengthen local regulatory and scientific decision-making capabilities. A second is for the home nations of development agencies and multinational firms to require these entities to live up to specified standards. A third approach, which is the most feasible for most developing nations, is use of a multinational advisory panel, an international advisory RAC, so to speak, which would be available to assist developing nation governments.

24-3. Biological and Biotechnological Alternatives to Chemical Insecticides

Organized by: **Brian Federici** *(Professor of Entomology, Univ. of California, Riverside, CA)*, **Richard Weinzierl** *(Associate Professor of Entomology, Office of Agricultural Entomology, Univ. of Illinois, Champaign, IL)*, and **Ron Arp** *(Manager, Fleishman-Hillard, Inc., Kansas City, MO)*

8:30 am & 2:30 pm / Sun / 17 Feb **Sheraton/Annapolis**

Classical Biological Control: Successful Examples and Perspectives. JAMES R. NECHOLS (Department of Entomology, Kansas State University, Manhattan, Kansas).

During the past 100 years, classical biological control has proven to be an effective, efficient (low-cost, low-input) method for solving many problems resulting from the introduction of exotic pests. The documented record of more than 300 examples of complete or substantial successes is even more striking considering the low investment in biological control historically, the few attempts to conserve, augment, or otherwise manipulate introduced and established natural enemies, and the infrequent efforts made to integrate biological control with other conventional management tactics. Existing examples of successful biological control for short-term crops, crops with low-pest tolerance, and multiple pest situations suggest that novel and traditional forms of ecologically-based biological control will play an increasingly greater role in modern pest management along with emerging, genetically-based biotechnologies for natural enemies. Neither approach will be universally applicable to all pest problems or agroecosystems; thus, alternatives to the 'classical' approach will be needed in some cases. However, like biotechnology, the future success of classical biological control will depend ultimately on critical factors such as sustained funding and grower/consumer education.

Emerging Technologies with Predators and Parasites in Biological Control. MARJORIE HOY (University of California, Berkeley).

The use of parasites and predators to achieve biological control of arthropod pests in agriculture faces formidable challenges. While this method of pest management has numerous past successes, we are now being challenged to rapidly increase its role in agriculture. Developing and implementing reliable, cost effective, and efficacious methods with parasites and predators demands that we improve organization of research programs, enhance research funds and infrastructure, improve coordination between research and greatly enhance technology transfer. The new focus on biological control offers opportunities and challenges: Can we improve the success rate of classical biological control? Can we develop cost effective mass rearing methods and guidelines for augmentative releases of parasites and predators? What rapid, predictive, and cost effective monitoring techniques can we use to reassure the farmer or pest control advisor about the reliability of parasites and predators? How can biological control agents be conserved and utilized compatibly with other pest control methods? How quickly can we develop rDNA techniques to genetically improve parasites and predators for enhanced efficacy? How can we effectively, and rapidly, train farmers to incorporate biological controls in their cropping systems? These questions must be answered, and soon, if biological

control by parasites and predators is to become a mainstream pest control strategy in U. S. agriculture.

Uses and Limitations of Conventional Microbial Insecticides. ROBERT R. GRANADOS (Boyce Thompson Institute, Ithaca, New York USA).

In spite of decades of intensive research, few biological control methods--microbial agents in particular--have made it into the commercial biological pesticide market. Estimated total sales of biological control agents account for less than 1 percent of world pesticide sales; *Bacillus thuringiensis* alone accounts for 0.6 percent. Some important factors constraining the wider commercial use of microbial pesticides include environmental persistance, host range, virulence, and production and registration costs. Traditional approaches in microbial insect control will continue to have much to offer, especially in the developing world where grower cooperatives and international agencies can assist in low technology methods of pest management. However, among the developed nations, there is a growing recognition that new biotechnological processes will be necessary to significantly expand the utilization of microbial control methods.

Recombinant Microbial Insecticides: Actual and Potential
BRIAN FEDERICI (University of California, Riverside)

Recombinant DNA technology provides a valuable tool for developing a highly selective and cost-effective insect control agents. To date, this technology has been used primarily to make relatively simple recombinant bacteria and insect-pathogenic viruses that have better insecticidal properties than wild-type strains. For example, both endophytic and epiphytic bacteria have been engineered to express insecticidal proteins obtained from the insect pathogen, *Bacillus thuringiensis*. Engineered strains are more selective than chemical insecticides, grow in or on the plant in areas difficult to reach with conventional microbial insecticides, and are more persistent. In the case of viruses, the *Autographa californica* nuclear polyhedrosis virus, a virus highly selective for various caterpillars, has been engineered to express proteins from non-viral sources that enable the virus to kill target pests more quickly. Though reasonably effective, these recombinant insecticidal agents must be viewed as comparatively primitive with respect to more effective agents currently under development. Advances in our understanding of the molecular biology of insects and pathogens that selectively cause disease in insects are providing knowledge that is being used to develop a wider range of highly selective, environmentally safe protein insecticides. These proteins, which will be useful in microbial insecticides as well as in transgenic plants, are chimeric and engineered to include functional domains that reside in proteins from viruses, bacteria and other organisms.

Transgenic Insecticidal Crops
DAVID FISCHHOFF (Monsanto Company)

The control of destructive insect pests is a major goal for both farmers and plant breeders. The ability to introduce and express heterologous genes in plants has opened new possibilities for the development of insect resistant crops. We have utilized genes encoding lepidopteran specific insecticidal proteins from *Bacillus thuringiensis* var. *kurstaki* (*B.t.k.*) to develop cotton plants resistant to cotton bollworm, tobacco budworm and pink bollworm. Optimization of the expression of these *B.t.* genes in plants was required to achieve commercially acceptable levels of insect control. This has been achieved through a novel strategy involving specific modifications of the structural gene sequence in order to enhance gene expression in plants. Cotton plants expressing these modified *B.t.k.* genes show a very high level of protection from boll damage by cotton bollworm in greenhouse tests under conditions of high insect pressure. Preliminary results from field tests of these cotton plants show similar insect control in the field. The same strategy, utilizing a coleopteran specific gene from *B.t.* var. *tenebrionis* (*B.t.t.*), has led to the development of potato plants resistant to Colorado potato beetle in both laboratory and early field tests. These *B.t.* proteins offer many advantages for use in genetically modified plants such as high potency, insect selectivity and safety to nontarget organisms. Insect resistant crops such as these will offer new opportunities for the control of important insect pests while reducing the load of chemical insecticides on the environment.

Microbial Pesticides: Making Promises Match Reality
RUEDI B. SANDMEIER (Sandoz Crop Protection)

The key to practical success of biotechnology-based pest control in the 1990s will lie not so much with technology and science, but rather with how we as a society are able to handle and perceive those products based on this new knowledge. Although there is much progress to be made in the laboratory, we all recognize the opportunities and realize their value in an environmentally compatible pest management system. However, despite many good intentions, federal biotechnology policy has not yet been able to show the leadership needed to give business a solid framework to make investment decisions. It is our task as involved scientists to become much better at public discourse by providing clear and understandable scientific background to win the confidence of the public needed if genetic engineering and other advanced technology are to reach the marketplace.

Commercial Criteria for Biopesticide Development
WENDY GELERNTER (Mycogen Corporation)

Which factors influence industry decisions to either develop or discard a new biological control technology? Which factors contribute to the success or failure of a product once it has been commercialized? Are these factors the same for biopesticides and chemical based products? To illustrate the many interacting variables which are considered in the development of a new biopesticide, case studies of specific viral, bacterial, fungal and nematode based insecticides developed over the past 30 years are reviewed. Differences and similarities among products based on naturally occurring vs. genetically engineered microbes, products developed in the U.S. vs. developing countries, and products developed by industry vs. publicly funded agencies are examined by comparing their commercialization histories. The comparison focuses on factors such as technical feasibility, production costs, market fit, proprietary position and regulatory requirements. In addition, the role of the expanding food safety/environmental movement and of our current education, technology transfer and implementation systems in promoting or inhibiting the development of alternative biological products is explored. Finally, the ultimate importance of university sponsored research in the effort to discover new technologies and modes of action is discussed.

US EPA Policy: Promoting or Impeding Change in Pesticide Use.
ANNE E. LINDSAY (Director, Registration Division, Office of Pesticide Programs, US EPA).

EPA endeavors to promote microbial and biochemical pesticides as effective, environmentally harmonious alternatives to certain conventional chemicals. EPA has illustrated its commitment to simplifying the registration process of biological agents by establishing a reduced set of data requirements, by expediting scientific reviews of these products and lessening processing times. To meet its commitment to facilitate the review of increasing numbers of biological applications, EPA must find additional ways to streamline these registrations. EPA is studying internal processes and the policies applied to microbial and biochemical pesticide registration applications. From a regulatory perspective, the registration process has been simplified. EPA also recognizes the need to increase outreach efforts to inform potential clients how to prepare and submit a successful registration application. Further resources, workshops, training and publication of a registration manual are under consideration. Finally, EPA must also search for ways to foster the awareness and use of such environmentally compatible pesticides.

University Extension: Changing Pest Management Education.
RICHARD WEINZIERL (University of Illinois).

Most educational programs targeting pesticide use and pest management are conducted by the Cooperative Extension

Service. If a shift away from over-reliance on conventional pesticides is to be accomplished without undue dependence on regulatory actions, Extension programs must be revised. Programs composed of publications, public meetings, and innovative delivery methods must address complex topics such as pesticide toxicology, biotechnology, biological control, agroecology, and a range of integrated pest management practices. These programs must explain important issues, not just offer recommendations for short-term pest control solutions. They also must do so in an unbiased and understandable manner. In addition, Extension specialists must communicate to basic researchers the questions to be addressed before new technologies can be implemented. This is especially critical where the products of new technology are not readily marketable by private industry. Including Extension/implementation budgets in grant proposals for research in pest management alternatives is a step that would insure the initiation of implementation efforts without dependence on unknown levels of future funding or interest. A current project underway in Illinois addresses some of the needs for changes in Extension efforts.

24-4. Pest Resistance to Control Tactics: Impact on Sustainable Pest Management

Organized by: **Robert M. Hollingworth** *(Director and Professor, Pesticide Research Center, Michigan State Univ., East Lansing, MI)* and **Mark E. Whalon** *(Professor, Dept. of Entomology and Pesticide Research Center, Michigan State Univ., East Lansing, MI)*

2:30 pm / Fri / 15 Feb **Sheraton/Annapolis**

Resistance and Its Management in IPM Systems.
MARK E. WHALON (Michigan State University).

Resistance is an evolutionary phenomena whereby over 500 insect, 100 pathogen, 60 weed and four nematode species have adapted to biocides. Five major mechanisms have been identified including: behavioral escape, metabolic degradation, altered site, changed penetration, and altered receptors. Many organisms have evolved multiple resistances to different biocides, and even multiple mechanisms of resistance. Four principles of resistance management will be discussed in the context of integrated pest management systems with illustrations in current fruit, vegetable, and agronomic cropping systems.

Impact of Pest Resistance to Pesticides on the Agricultural Chemical Industry. HOMER M. LEBARON (New Technology and Basic Research, CIBA-GEIGY Corporation)

Pest resistance to control measures is a natural phenomenon which has always occurred and will continue to be a problem regardless of methods of control. However, it has only become a problem of major and almost universal economic impact during our modern era of highly effective and fast acting ag chemicals. The problem has become especially acute as the trend in the chemical industry has been toward discovery and development of more specific pesticides aimed at single target pests or modes of action. Scientists and customers (e.g., farmers) have followed the implied assumption that replacement pesticides would be developed if and when resistance reached a high level. Although this was a reasonable assumption until now, the rapidly escalating R&D costs and difficulty of finding new chemistry with alternate modes of action have caused the number of new pesticides reaching the market to dwindle. Many ag chemical industries are terminating synthesis and screening, are being bought out, or are merging with other companies. Economic consequences of resistant pests are obvious as we see many of our most effective and valuable pesticides suddenly lose their efficacy and are removed from the market or greatly reduced in usefulness. However, there has been no comprehensive study done or report on this important matter. Such a survey is underway to quantify and define the extent that resistance has impacted the ag chemical industry. A prediction of future economic consequences on the chemical industry and agriculture will also be attempted.

Potential for Pest Resistance to Genetically Engineered Plants and Microbes.
FRED GOULD (North Carolina State University).

The use of microbes and genetically engineered plants for pest management may offer environmental and economic benefits over the use of broad spectrum pesticides. Because of the narrow spectrum of organisms each of these products affects, they are unlikely to disrupt activities of agriculturally beneficial organisms or endanger wildlife and human health. The number and diversity of such products currently available is limited, and is likely to remain limited in the near future. Therefore, it is in the interest of society to use these products in a fashion that will limit the rate at which pests adapt to them. Case studies of pest adaptation to microbes and toxic crop varieties will be described. Ongoing theoretical and empirical research aimed at assessing the utility of a number of strategies for developing and deploying these microbes and plants will be discussed with regard to pest evolution. Approaches for university, government, and industry cooperation in testing these strategies at the farm level will be presented.

Resistance Management Through Multi-Sectoral Cooperation.
DIANA M. HORNE (U. S. Environmental Protection Agency).

Over the past decade, problems of pest resistance to pesticides have surfaced as a major issue in agricultural, as well as public health arenas. A large number of formal and informal groups of academics, government officials, and industry representatives, respectively, have all been working independently to solve these problems. However, the global scale of the problems and the scarcity of financial and intellectual resources needed to address them demand a greater degree of control, direction and coordination. Toward this end, the International Organization for Pest Resistance Management (IOPRM) which has been in the planning stages for approximately two years seeks to serve as the umbrella organization to which all other groups can affiliate. Participation is multi-sectoral and includes industry, academia, governments, grower groups and the environmental community on an international level. The goals of the organization are to provide an international forum to promote the concept of pest resistance management within the context of IPM systems; facilitate implementation programs in industrial and developing nations and the emerging democracies.

Resistance Management and Agricultural Policy.
WILLIAM A. STILES, JR. (House Agriculture Committee).

Resistance to pest control tactics is an issue which has only recently come to the attention of policy makers and is not included in agricultural or regulatory policy decisions. Without a system for gathering resistance information on a national basis, without changes in pesticide regulatory law, and without adequate resources being provided for this work, resistance will continue to be ignored in policy debates. The 1990 Farm Bill has language on resistance which will help correct this situation. Also, the pesticide regulatory law, FIFRA, will be debated in 1991 providing further opportunity for change.

Technical Sessions

24T-1. The Economic Potential for Aquaculture in the United States

Organized by: **Morton M. Miller** *(Senior Economist, National Marine Fisheries Service, Silver Spring, MD)* and **Douglas W. Lipton** *(Marine Economic Specialist, Dept. of Agricultural and Resource Economics, Univ. of Maryland, College Park, MD)*

8:30 am / Sat / 16 Feb **Sheraton/Vermont**

An Assessment of the Economic Feasibility of Hard Clam Aquaculture in the Southeastern United States.
CHARLES M. ADAMS (University of Florida, Florida Sea Grant) and ROBERT POMEROY (Clemson University)

Interest in commercial hard clam aquaculture has increased in recent years. This interest has been manifested in the form of technological advances associated with a variety of hatchery, nursery, and grow-out systems. These systems have differing financial characteristics which are sensitive to environmental conditions, market changes, scale of operation, and availability of borrowed capital. In addition, the skill of management personnel can have a significant effect on the profitability of a hard clam aquaculture system. Potential investors should be aware of the sensitivity of commercial feasibility relative to these various factors.

Production Potential for United States Shrimp Mariculture
KENNETH J. ROBERTS (Louisiana State University), WALTER R. KEITHLY (Louisiana State University)

The United States produces approximately 25 percent of its tropical shrimp consumption needs. Deficit production alone has not been sufficient to stimulate development of a domestic mariculture industry. Increasing consumption during the 1980's was facilitated by imports of farm raised product. By 1990 the importation of farm raised shrimp had reached 200+ million pounds. Consumers clearly utilize farm raised shrimp and wholesale suppliers have many species choices to fulfill needs. United States shrimp farm investors likely have more invested overseas in joint venture farms than is invested domestically. Water use, water discharge, wetlands, and other policies effectively limit the availability of domestic sites. Most shrimp farming businesses are in Texas, South Carolina, and Hawaii. A mix of capital intensive and extensive approaches have been undertaken with no trend established. The nation's free trade policy regarding shrimp imports compells domestic investors to meet foreign production costs. Domestic producers can focus on more capital intensive systems using higher stocking densities. This is proposed as the only means of the United States producing significant quantities of farmed shrimp at competitive costs. The antithesis of low stocking density, extensive approach farming may provide cash flow to operators. However, the limited number of sites will prevent such operations from producing a large quantity of shrimp.

Economic Constraints and Opportunities for Salmon Culture in the United States. JAMES L. ANDERSON (University of Rhode Island).

The production of ocean pen-raised salmon is continuing to reach record levels, with expected worldwide production in 1990 in excess of 270,000 MT. However, the U.S. has lagged behind in this development with production in the range of 5,000 MT. Explanations for this slow development are related to regulatory constraints, capital availability, input supply limitation and other economic factors, such as recent price declines. The paper will explore these problems and potential remedies.

The Potential for Hybrid Striped Bass Aquaculture in the United States.
DOUGLAS W. LIPTON (Department of Agricultural and Resource Economics, University of Maryland)

In contrast to catfish, trout and salmon production, hybrid striped bass aquaculture production is in its infancy. Within the framework of the product life cycle theory we can speculate on the course this emerging industry will follow --from an introductory, to a growth, to a mature phase. The difficulty is determining how rapidly it will move through these phases and what the absolute magnitude of the industry will be. Current technology appears to limit profitable hybrid striped bass production to sites with some comparative advantage over average sites (e.g., heated water from geothermal sources or power plants). However, recirculating systems loom on the horizon as possibly being a profitable culture technique, and allow the production to take place closer to the marketplace. Thus, the diffusion of this technology will be necessary for the hybrid striped bass industry to move out of the current introductory stage and into the growth stage. The industry will be able to grow rapidly so long as there are new markets to penetrate. However, market penetration will be hindered by competing products which have already obtained market penetration such as catfish and salmon as well as capture fishery products.

Growth Prospects and Opportunities in Catfish Aquaculture.
HENRY KINNUCAN (Auburn University)

Catfish aquaculture in the U.S. during the decade of the 80s expanded nearly sixfold. Technical advances in genetics, nutrition, disease control; low opportunity costs for land associated with a depressed farm economy; low feed costs, rising fish prices, an abundant water supply, and industry advertising are factors propelling this growth. Whether the industry can continue to grow in the 90s will depend on these same factors as well as emerging ones such as labor costs, governmental regulations, and the establishment of new institutions to improve coordination of product flows, reduce uncertainty, and ensure farmers a fair price. This presentation focuses on the institutional, technological, environmental, and economic forces that will govern growth prospects for U.S. catfish aquaculture in the remaining years of the 20th century.

Demand for Seafood and Implications for Successful Aquaculture
IVAR STRAND (University of Maryland), AMY BUSS (University of Maryland).

A major consideration in the development of domestic aquaculture is the demand for seafood products. Developing optimal growout and marketing strategies for aquaculture requires understanding where, when and what will yield the greatest return. This paper examines the demand of households for seafood products, paying particular attention to the characteristics of households, the seasonality of preferences, and the form of the product. Both at-home and away-from-home purchases of several aquacultural products are examined. Particular attention is paid to the role of household size/consumption and household income in purchase decisions for fresh and canned seafood. These same characteristics are also examined for the choice among seafood items at restaurants. The price elasticity of demand is estimated for several products and product forms. An effort is then made to show how an aquaculturalist might use the information in designing advertising or in determining growout strategies.

Defining the U.S. National Aquaculture Policy.
CURTIS MARSHALL (National Marine Fisheries Service)

The potential growth of aquaculture has raised important national policy questions. The products of aquaculture compete directly with the output of commercial fishermen. Large scale aquaculture therefore poses a threat to the commercial fishing industry to which the Federal government has a long-standing commitment through legislation and custom. This raises questions about whether the government should intervene in some manner to foster competitive aquaculture development in the U.S. and should also intervene to protect and otherwise assist the established commercial fishing industry. Aquaculture policy also needs to address the question of competition for use of habitat and other land areas that are potential sites for aquaculture operations. At issue is whether policy should support the best economic use of the area or should conservation and environmental considerations be paramount. Overriding many of the policy questions is the issue of Federal jurisdiction. The National Aquaculture Act of 1980 attempted to establish

clear jurisdictional lines, but there has been much confusion about division of responsibilities.

24T-2. Knowledge-based Systems in Agriculture: A Developmental Perspective

Organized by: Stephen R. Ruth *(Professor, Dept. of Decision Sciences, George Mason Univ., Fairfax, VA)* and Adel El-Beltagy *(Ainshams Univ., Cairo, Egypt)*

2:30 pm / Fri / 15 Feb — Sheraton/Vermont

Expert Systems in Protected Agriculture Environments Dr. Adel El-Beltagy, Ain Shams Univ., Cairo, Egypt

One of the main solutions for the food problem in Egypt is to optimize the use of water and land resources through the use of desert development schemes.

This fact coupled with the scarcity of highly technical personnel in related domains requires new methods. Expert systems can be used as tools in different phases of agricultural desert development. This will insure reasonable success and offer an economical alternative for hiring consulting experts. The advantage of the expert system is that, once developed, it has the potential to improve the performance of the average worker to that of an expert.

The agricultural extension service agents will be the end users in Egypt who will convey advanced and accurate methods to the farmers and enhance agricultural productivity. The strategy of the Egyptian Ministry of Agriculture is to accelerate the production of agriculture at all levels using modern and appropriate technology, including extending current efforts in remote sensing and future initiatives in genetic engineering. Remote sensing systems as well as advanced information processing technology are already in extensive use in Egyptian agricultural programs. It is expected that this model may be replicated in other developing countries' agricultural development programs.

Experience With Specific Expert Systems Applications in Agricultural Development in Egypt Dr. Ahmed A. Rafea, FAO Country Representative, Cairo, Egypt

This presentation concerns the experience of developing expert systems for crop production management in Egypt. The project is funded by the Egyptian ministry of Agriculture and Land Reclamation (MOLAR) and the United Nations Development (UNDP) and executed by the Food and Agriculture Organization (FAO). The project's purposes are to build a local expert system development group capable of planning, development and fielding of expert systems and then to develop and package two specific expert systems to assist extension workers and farmers in their goal of maximizing crop output. The two specific crops selected for the treatment are cucumbers in protected plastic tunnel environments and management in field agriculture of citrus fruits. The achievement of these objectives requires the development of local professionals and the availability of appropriate technology transfer tools, especially hardware and software platforms. Training is provided by national and international experts through learning and doing. The technical aspects of the project's development so far will be discussed with special emphasis on the initial prototype of the nursery stage for cucumber growing. Among the technical aspects described will be use of Expert System tools, integration with other data bases, graphics, images, etc.

Low Cost Tools for Agricultural Decisions: An Agroforestry Perspective Dr. Merrill Warkentin, George Mason Univ., and Dr. P.K. Nair, Univ. of Florida, Gainesville

This presentation shows an actual example of an agricultural expert system developed for the United Nations to deal with a particularly difficult area of agroforestry, called "alley cropping." While agroforestry, the use of trees to aid in cultivation of other crops, is acknowledged to have a major potential impact in the struggle against world hunger, very little data on its specialized applications is available to regional agricultural specialists. Through expert systems like the one discussed and demonstrated in this presentation it may be possible to spread the knowledge of best practice to a wider group of researchers and users. The expert whose knowledge is represented in this system is Dr. P.K. Nair of the University of Florida. The process of gaining knowledge through knowledge engineering and being a sources of knowledge -- a domain expert in the parlance of this new AI technology -- will be discussed.

24T-3. Bovine Somatotropin: Biotechnology Product and Social Issues in the United States Dairy Industry

Organized by: Joseph J. Molnar *(Alumni Professor of Rural Sociology, Auburn Univ., Auburn, AL)* and Robert G. Zimbelman *(Executive Vice President, American Society of Animal Science, Bethesda, MD)*

2:30 pm / Tue / 19 Feb — Sheraton/Vermont

Biology of Bovine Somatotropin and the Lactational Response in Dairy Cows. DALE E. BAUMAN (Cornell University).

Bovine somatotropin (bST) is a protein hormone which must be injected to be biologically active; if consumed orally it is digested like all dietary proteins. Administration of bST to dairy cows results in a marked increase in milk yield and productive efficiency (milk/unit of feed). Composition and manufacturing characteristics of milk are not appreciably altered. The mechanism of action involves a series of orchestrated changes in the metabolism of body tissues so that more nutrients can be used for milk synthesis. It is these coordinated changes, which include altering tissue response to homeostatic signals, that allow the animal to achieve an increased milk yield while remaining normal and healthy. Bioenergetic studies unequivocally demonstrate that bST supplemented animals are not stressed. Gains in productive efficiency with use of bSt are unprecedented and occur because the proportion of nutrients used for maintenance is reduced.

Bovine Somatotropin: Human Food Safety Evaluation. JUDITH C. JUSKEVICH (FDA, Center for Veterinary Medicine)* and C. GREG GUYER (FDA, Center for Veterinary Medicine).

Scientists in the FDA, after reviewing the scientific literature and evaluating studies conducted by pharmaceutical companies, have concluded that the use of recombinant bovine somatotropin (rbST) in dairy cattle presents no increased health risk to consumers. Bovine ST is not biologically active in humans, and oral toxicity studies have documented that rbST is not orally active in rats, a species responsive to parenterally administered bST. Recombinant bST treatment produces an increase in the concentration of insulin-like growth factor-I (IGF-I) in cow's milk. However, oral toxicity studies have shown that bovine IGF-I lacks oral activity in rats. Additionally, the concentration of IGF-I in milk of rbST-treated cows is within the normal physiological range found in human breast milk, and IGF-I is denatured under conditions used to process cow's milk for infant formula. On the basis of estimates of the amount of protein absorbed intact in humans and the concentration of IGF-I in cow's milk during rbST treatment, biologically significant levels of intact IGF-I would not be absorbed. Recombinant bST also appears to have no impact on the nutritional quality of milk.

* J.C. Juskevich was formerly with the FDA and now serves as a consultant.

Bringing rbSt to the Farmer: Product Development and Regulatory Approval. JAMES W. LAUDERDALE, PH.D. (The Upjohn Company).

The New Animal Drug Application (NADA) requirements must be met for approval for a new drug. NADA requirements are that the new drug (new product) must be safe and efficacious for the labelled use, the edible products of the animal are safe for human consumption, there is no unacceptable adverse effect on the environment, and the production process for the product has sufficient quality control to assure consistency of the label with the contents of the product container. The investigational new animal drug application (INADA) establishes the guidelines for conducting the research to address the NADA requirements and assures the safety for human consumption for animal products derived from animals receiving the investigational drug. Human food safety has been addressed adequately and CVM has given permission for meat and milk derived from cattle receiving rbSt to enter the human food chain. Data published to date support an interpretation that rbSt is efficacious for increasing the efficiency of milk production of lactating dairy cows, is safe for use in cows at the doses predicted to be label doses, and there is no unacceptable adverse affect on the environment. However, all data derived from studies conducted under the INADA must be submitted to the Center for Veterinary Medicine (CVM) of the Food and Drug Administration and CVM will make the final determination as to whether or not rbSt is efficacious, is safe for use in cows, has no adverse effect on the environment, and has acceptable quality control. Each company interested in marketing a rbSt product must submit sufficient data for CVM to make these determinations.

Bovine Somatotropin: A Dairy Producer's Perspective
Frederic L. Halbert(Halbert Dairy)

A six hundred cow commercial dairy farm conducted a dose titration study using daily injection of Bovine Somatotropin. A producer's perspective of this work and implications of BST use for the typical dairy farmer.

Ethical Issues in Technical Change: The Case of BST
JEFFREY BURKHARDT (University of Florida)

BST has been the subject of political, economic, and ethical controversy for over five years. The potential health risks and socio-economic impacts are by now well-documented. Yet, the issues remain. This fact itself suggests a more basic and intriguing ethical question associated with technology: How is it possible for any conflicts of values concerning new technology or potential technical change to be resolved? Among the answers: (1) Conflicts are never really resolved, but instead dissolve through inertia; (2) Strong interest-groups win a war of attrition in the public forum and in public policy-making; (3) Political leaders assert or affirm a particular value which then functions as the "public" goal or constraint with respect to R&D or use/diffusion; (4) A community or consensus emerges with respect to the priority of a given value, and the appropriateness of some technology to it. The case of BST illustrates that (1) and (2) are the likely "resolutions." This is ethically problematical given democratic societies' commitment to the public interest and public good. Indeed, it suggests that without a renewed emphasis on normative leadership and community-building, new technology will simply appear, cause temporary conflicts, and then be induced into the socio-economic system anyway. Of all the ethical issues associated with BST or any other technology/product, the most important is whether democratic societies can control and direct technical change ex ante with an eye toward the public good, and not ex post and piecemeal (if at all), as appears to be the case at present.

bST As a Social Issue: Symbolisms, Fears, and Misunderstandings. JOSEPH J. MOLNAR, HENRY W. KINNUCAN, and AND KEITH A. CUMMINS (Auburn University)

Advances in biotechnology have lowered manufacturing costs for the substance to the point where firms are endeavoring to develop usable products, obtain regulatory approval, and market the technology to dairy farms. This paper examines bST as a case study in the advent of a biotechnology-based innovation, one of the first to enter the market. bST has been controversial over its perceived safety, attributed effect on animals, impact on farm structure, potential to shift the regional location of dairy production, and its implications for government spending for milk price supports. The evolution of this technology is reviewed in the context of the various claims, reactions, and projections of researchers, economic analysts, farm groups, and populist critics. An assessment of the bST issue in terms of its implications for the development of other agricultural biotechnologies is made.

Economics of bST: Impacts on the Farmer, the Consumer, and the Industry
RICHARD FALLERT (USDA - Economic Research Service), DON BLAYNEY (USDA - Economic Research Service).

The effects of bST on the dairy industry are likely to be less dramatic than early reports often suggested. Dairy farmers are likely to use bST since early adopters will realize significantly higher returns than non-adopters. Since little additional capital or operational changes are required and bST will be available to all operators, bST use should not dramatically alter structural trends already underway in the U.S. dairy industry. One such trend is toward fewer but larger dairy farms. Research has found that use of bST would require good management but would be economically helpful to dairy farms of any size, if the costs of using the product are more than offset by increased revenues from higher milk production. Consumers will benefit from the improved efficiency gained by the use of bST if price supports are allowed to adjust to balance milk production and commercial use. In the longer run, U.S. dairy farmers will also benefit, since milk and dairy products will be more competitive with other foods domestically and with dairy products in international markets. Use of bST will not necessarily worsen the periodic problem of dairy product surpluses if government policies allow milk price supports to adjust to changes in the market.

24T-4. Value-added Products from Agriculture

Organized by: **William H. Tallent** *(Assistant Administrator, Agricultural Research Service, U.S. Dept. of Agriculture, Washington, DC)*

8:30 am / Sun / 17 Feb **Sheraton/Vermont**

The ARS Regional Research Centers: 50 Years of Utilization Research. ARTHUR I. MORGAN (U.S. Department of Agriculture)

In 1938, U.S. farms were having trouble selling their products at a profit. Congress, with leadership from Sen. T. Bilbo, authorized the USDA to open four centers to perform demand-stimulating research. Congress then appropriated four million dollars, for which all four centers were built within about three years. Bureau chief, Henry Knight, appointed as center directors P. Wells, O. May, D. Lynch and T. Swenson. Each of these then staffed his center. For senior positions, many were transferred from Washington's Fixed Nitrogen Laboratory. WW2, and many other world events, expanded the centers' programs from the original idea, the creation of new salable, but inedible products from surplus commodities. To this was soon added creation of new processed food products. Also added, as time went by, were food safety, grading, human nutrition, environment protection, and energy production and sparing. Even the restriction to commodities having passed the farm gate was later lost. The original staffing emphasis, physical science and chemical engineering, thus was progressively changed toward biology. At present, the program seems to be returning to its origins, new product development.

Value Added Processes--Comfort and Convenience of Cotton
ANDREW G. JORDAN (National Cotton Council of America)

The Southern Regional Research Center (SRRC) of USDA's Agricultural Research Service is a premier contributor to

improvements in cotton textiles. Its inventions over the past 50 years have touched the lives of most people. This Center, best known for the chemical modification of cotton, has also developed mechanical equipment for processing. Untreated cotton fabric wrinkles upon laundering and required ironing. Chemical treatments developed at the Center give cotton fabrics wrinkle resistance and reduce or eliminate the need for ironing. This assisted cotton in retaining its market share when faced with competition from synthetics. These treatments are based upon formaldehyde derivatives. OSHA regulations now restrict exposure to formaldehyde. The Center has now developed a durable press process which is based upon butanetetracarboxylic acid and is free of formaldehyde. Durable flame retardants for cotton from SRRC provide protective clothing for both military and civilian uses. Flame retardant cotton garments prepared by SRRC processes are used by U.S. astronauts. Specialty treatments for cotton include one that produces fabrics that absorb heat when exposed to high temperatures and release heat on cooling and one that incorporates compounds containing peroxides that attack disease-causing and odor-producing bacteria that can reside in textile fabric.

Starch-Based Products for an Environmental Era.
WILLIAM M. DOANE, (U.S. Department of Agriculture, Agricultural Research Service, Northern Regional Research Center, 1815 N. University St., Peoria, IL 61604.)

Starch, due to its great abundance in nature, ease of recovery from plant sources, relative low cost and ease of chemical and biological modification, is playing an increasing role as a renewable resource for chemicals and polymeric materials. Chemicals from starch as direct replacements for or alternatives to those derived from petroleum is becoming more attractive. Worldwide interest in biodegradable polymers that are more environmentally benign than current synthetic polymers has led to activities in a host of laboratories to development new polymeric materials based on starch. Plastic compositions containing starch as a filler (up to 20% starch) or as a part of the continuous phase (from 40% to nearly 100% starch) are being developed. Polyolefin films and bottles containing starch as a biodegradable component have found special niches and are in early stages of commercialization. Starch materials with covalently bonded thermoplastic or hydrophilic polymeric side chains offer much promise commercially due not only to unique and useful properties but also to the relative ease with which structures and properties can be controlled. It is expected many new starch-based polymers and new applications will emerge as we seek petroleum-sparing, more environmentally benign materials.

Edible Fats and Oils.
TIMOTHY L. MOUNTS (Food Quality and Safety Research, Northern Regional Research Center, ARS-USDA)

The continuing research on edible soybean oil is an example of the successful combination of processing and formulation expertise and sensory evaluation methods to impact on the U.S. food market. Finished oil evaluation methods developed at NRRC over a period of 40 years are detailed. Research is reviewed which contributed to the significant change in the edible oil consumer market which occurred in the 1960s, when cottonseed oil was displaced as the principle component by partially hydrogenated soybean oil. Further research resulted in another major shift in 1985 to an unhydrogenated soybean oil in plastic bottles. An example of research to assist action agencies is the work on the flavor stability of soybean oil-based salad dressings which resulted in revised federal specifications for this food product. More recently, efforts have been directed to gaining a better understanding of the relative stability of the major vegetable oils on the U.S. market, i.e. soybean, sunflower and canola. Such research guides the efforts of soybean breeders to enhance the quality of soybean oil. End-use performance evaluation of new soybean varieties validates the results obtained through the breeding program.

Industrial Products from Fats and Oils. GERHARD MAERKER (USDA), Agricultural Research Service, Eastern Regional Research Center).

The development of oleochemicals, products of potential commercial value, from fats and oils was a major mission assigned to the four Regional Laboratories in the early 1940's. In response, a significant research effort was mounted, and the results of the ensuing studies were made known in thousands of research reports and patents describing many products with novel and useful properties. Although the potential uses for such products and processes were envisioned to be in a wide spectrum of industrial and consumer products, major areas of applications were lubricants, plastics and polymers, surface-active agents and specialty chemicals. The research on products and processes was supported and boosted by investigations that led to important advances in analytical methodology, especially spectroscopic and chromatographic techniques, to new knowledge regarding the structure and composition of raw material sources, and to basic information concerning reaction mechanisms and rates. Three examples of products of ARS fats and oils research will be cited: Epoxidized oils, soap-based detergents and hydroformylation products.

Structure-Baking Functionality Relationships Among the Seed Storage Proteins of Wheat. FRANK C. GREENE[1], OLIN D. ANDERSON[1] ([1]USDA, ARS, Western Regional Research Center, Albany, CA 94710) and GAD GALILI[2]([2]Weizmann Institute of Science, Rehovoth 76100, ISRAEL)

Wheat flour is unique among that of cereal grain crops in its ability to form viscoelastic doughs upon wetting. This characteristic, which permits the making of bread and pasta products, is a function of the general tendency of hydrated wheat seed storage proteins to form large aggregates, and of the physicochemical properties of the protein matrix which forms upon subsequent application of mechanical work to this system. Differences in viscoelastic behavior among wheat cultivars are strongly associated with allelic variation at the Glu-1 locus, which encodes the High Molecular Weight glutenin (HMW) subunit proteins. Molecular biological analysis of these genes is being used to complement physicochemical studies of the proteins to define important structure-function relations. The general structure of HMW subunit proteins, derived from nucleotide sequences of the genes, consists of a large, highly repetitive central region flanked by small, unique sequence regions. Sequence analysis of proteins coded by Glu-1 alleles indicates that both conformation and disulfide bonding potential may be determinants of differences in cultivar viscoelastic character. The significance of these indicated determinants is being evaluated by physicochemical study of proteins synthesized in E. coli programmed by both natural and in vitro modified wheat glutenin genes.

Innovations in Food Processing. JAMES C. CRAIG, JR. (USDA, ARS, NAA, Eastern Regional Research Center)

The last five decades have coincided with extensive changes in the food we eat, where we eat, and the portion of our disposable income devoted to it. Food processing has both influenced, and responded to these changes. Congress established the USDA's Regional Research Centers in 1939, and these Centers have been a central force in these changes. Since then, research in these Centers originated or critically contributed to bench marks in food processing such as frozen orange juice concentrate, potato flakes, full flavor fruit juice concentrates, controlled atmosphere storage, and low-lactose dairy products. Other studies helped control the cost of food by diverting underutilized wastes and byproducts to value-added outlets.

Fermentation: The Original Biotechnology
ARTHUR E. HUMPHREY (Center for Molecular Bioscience and Biotechnology, Lehigh University)

Biotechnology has been practiced even before man could record such activity. The earliest inscription in the pyramids describe the production of fermented beverages and foods. During the middle ages experimenters learned how to improve the taste of wine, bread, beer and cheese. But it wasn't until 135 years ago that Pasteur proved that alcoholic fermentations were due to yeast. And it was only 63 years ago, within many of our lifetimes, that Fleming discovered penicillin which initiated the age of large scale aseptic fermentations. Activities of U.S. Department of Agriculture workers at the Northern Regional Research Laboratory brought to fruition submerged aerobic fermentations which shaped the beginnings of modern

biotechnology. Clearly it was these activities of the 40's and 50's that made it possible to commercialize recombinant DNA technology. Today, literally hundreds of different pharmacologically active proteins can be manufactured in kilogram quantities utilizing fermentation systems. This talk will attempt to identify key breakthroughs in fermentation technology that made the era of the "New Biotechnology" possible.

Value Added Products for the Competitive 90's.
RUXTON H. VILLET, U.S. Department of Agriculture, Agricultural Research Service, National Program Staff, Beltsville, Maryland.

The United States agricultural system, although resilient in recovery from economic setback in the past, needs to be strengthened. Research and development can play its part toward gains in global market share. A broad diversified product portfolio must be built up. This implies expanded research toward both classes of products: food and also nonfood industrial products. The food industry, primed by consumer demands for health, safety, convenience and luxury, is in a state of revolution. There are increasing demands for freshness, nutrition and "natural" ingredients. Novel products and processes will be needed to provide for economic growth and exports. Opportunities abound for converting cereal starch, vegetable oil and dairy products to higher value products. For example, natural, biosafe pesticides will find increasing demand as future substitutes for the $16 billion pesticide market worldwide; agricultural commodities will be used in fermentation processes for their manufacture. Conversion to chemical specialties will require development of both biotechnological and chemical catalytic systems. To accelerate the flux of technology from initial research stages to the commercial sector, vibrant and efficient technology transfer systems are to be encouraged too.

25. Ecology; Evolution

25-1. Inheritance of Acquired Characteristics: Evolutionary Origins of New Significant Traits

Organized by: **David G. Bermudes** *(Postdoctoral Research Associate, Center for Great Lakes Studies, Univ. of Wisconsin, Milwaukee, WI)* and **Ricardo Guerrero** *(Professor of Genetics and Microbiology, Univ. Autonoma de Barcelona, Bellaterra, Spain)*

2:30 pm / Sat / 16 Feb — Sheraton/Arlington

Bacterial Horizontal Gene Transfer. R. Guerrero (University of Barcelona).

Genome isolation and separate evolution of species occurs in eukaryotic organisms; this phenomenon appeared for the first time around 1500 million years ago. But for at least 2000 million years before that, prokaryotes evolved by free interchange of short and long clusters of genes and even anastomosis of complete genomes. Many extant examples of bacterial "species" show recombination of traits developed independently by different bacteria and bacteriophages. Bacterial evolutionary strategy permitted rapid response to changing environments, which allowed prokaryotes access to newly available habitats.

Symbiosis and Sex: Acquisition of Partners. PROF. LYNN MARGULIS (University of Massachusetts).

As well as the accumulation of random mutations, generation of evolutionary novelty apparently involves acquisition of previously refined genetic material (e.g., from plasmids, viral genomes, bacterial genophores and entire bacterial cells to complementary genomes in meiotically sexual organisms). Although the standard liturgy claims that sex generates genetic variation it is more instructive to view meiotic sexuality in the context of cyclical symbiosis in which the fusing partners have very recent common ancestry. In some cyclical symbioses the partners can be extremely remote (e.g., bacteria+fish=luminous fish; rhizobia+legume=nodulated N-fixing plant). In such an analysis fusion (including fertilization) and disassociation (including meiosis) are recognized to generate developmental patterns including taxon-specific morphogenesis rather than that unmeasurable entity "genetic variation".

Frequency of Spontaneus Transfer of Plasmids from E.coli to Mammalian Cell Cultures under Various Conditions. D. HEITMANN, G. HACHULA and J.M. LOPEZ PILA (Bundesgesundheitsamt, Berlin)

Specific microbial mechanisms for lateral genetic transfer, like conjugation-mediated plasmid transfer, transduction, bacterial transformation etc., have been extensively investigated in the past. Conversely, events leading to gene transfer across different organisms due to unspecific interactions between their membranes are relatively poorly understood. We have studied spontaneous transfer of plasmids between *E. coli* and mammalian cells. Transfer frequency depends on factors like the growth stage in both bacteria and mammalian cells, and whether the contact between the cells takes place in a liquid or in a solid environment. Under the most favourable circumstances the transfer frequency is of the same order of magnitude as the one observed using laboratory transfection techniques such as CaPi or dextran. As the transfer relies on unspecific interactions between membranes, and is not dependent on e.g., specific DNA-uptake mechanisms, it might be a frequent event in nature and responsible for many cases of lateral transfer.

Kinetosomal inheritance.
MIKE ADAMS (Eastern Connecticut State University)

The kinetosome (also known as basal body, basal granule, or blepharoplast) and the centriole are microtubule organizing centers found in most organisms and are associated with undulopodia (cilia, flagella) and the aster structure of the mitotic and meiotic spindles. The possibility that this structure might be semi-autonomous was initially supported by the belief that new kinetosomes arose by fission. By the end of the 60s the discovery of *de novo* synthesis of kinetosomes and the inability to convincingly demonstrate the presence of nucleic acids caused the concept of autonomy to become less popular. Although there continued to be reports of nucleic acids in the kinetosome there was no new significant change in the field until the discoveries associated with the *uni* linkage group of *Chlamydomonas*. A series of temperature-sensitive flagellar mutations and another mutation that affects the formation of one of the kinetosomes were all found to be linked. The new (*uni*) linkage group shows several abnormal genetic aspects; circularity, temperature-sensitive recombination frequencies and abnormal tetratype frequencies. A report of relatively large amounts of DNA in the kinetosome has been challenged and the question of kinetosomal inheritance is still open.

Environmentally Induced Heritable Changes in Flax. CHRISTOPHER A. CULLIS (Case Western Reserve University) and RICHARD G. SCHNEEBERGER (Case Western Reserve University).

Heritable changes can be induced by the environment in some flax varieties within a single generation. These variations includes changes at both the phenotypic level and in the DNA. At the extremes stable lines, termed genotrophs, which differed from each other and the progenitor line in a number of characteristics, including plant weight, height and nuclear DNA content, were generated in a single generation. One of the outstanding characteristics of the induction process is that all the progenies from an individual inbred plant that has been grown in an inducing environment are similar to one another, and similar to all the progenies of any other plant which has gone through the same regime, but different from the original line and other genotrophs which have been induced by alternative sets of environmental treatments. A characterization of the ribosomal RNA genes has shown that the changes occur in somatic cells, during growth under inducing conditions, prior to the formation of the gametes. These changes are then transmitted to the following generations. A 5S RNA gene variant has been isolated which identifies restriction fragment length polymorphisms in the genotrophs. These results are further evidence that a specific set of DNA alterations occur reproducibly during the induction of heritable changes in flax.

25-2. Defining Ecosystem Health: Science, Economics, or Ethics?

Organized by: **Bryan G. Norton** *(Professor of Philosophy, School of Public Policy, Georgia Institute of Technology, Atlanta, GA)*

8:30 am & 2:30 pm / Fri / 15 Feb **Sheraton/Richmond**

Aldo Leopold's Concept of Land Health
J. BAIRD CALLICOTT (University of Wisconsin-SP)

The concept of ecosystem health is not new. Aldo Leopold broached and tried to define "land health" in the 1930s and '40s. Leopold was keenly aware that the concept is metaphorical and subordinate to the organismic ecological paradigm. Among the symptoms of sick land Leopold included soil erosion, loss of fertility, flashy streams, extirpation of some species and irruption of others. He defined land health globally as "a state of vigorous self-renewal." Leopold speculated that species diversity and the complexity of relations between species is the foundation of land health. While proposing wilderness as a base datum of land health, he also sought objective norms of land health in humanly occupied and exploited environments. Healthy land is not incompatible with human use or with the introduction of domestic and exotic species. However, Leopold recommended retaining as much of native communities as possible and minimizing violence and in general exercising caution and restraint in land use. He believed that predictive knowledge of responses of ecosystems to changes was not possible because ecosystems are too complex to be fully understood.

Environmentalists and Economists and Philosophers and Biologists. TALBOT PAGE (Brown University).

How we evaluate and implement environmental policy depends upon the perspectives we bring to it. This paper explores four ideas from biology and their implications, especially for their theories of evaluation. The ideas have to do with species and individual boundaries, nonsustainability, and time scales.

These biological ideas suggest problems with extensionism (advocated by Singer and others) and provide an argument for two-tier systems of valuation and management. The two-tier system sketched here differs from that of Rawls in characterization and justification (but was influenced by it).

Ecosystem Health/Integrity as Applied in the Great Lakes Basin. HENRY A. REGIER (University of Toronto), DAVID J. RAPPORT (University of Ottawa).

To assess the state of health of a human organism we may test it for relevant *capabilities* (e.g., well-structured, well-co-ordinated, robust with reserve capacity, self-realizing, energetic and productive) and *disabilities* (e.g. contaminated by poisons or intoxicants, infected by harmful organisms, wounded or crippled, unkempt and dirty). For each of these, and many other features, we can specify quantitative criteria as to what is sub-normal or unacceptable. In practice we place emphasis on correcting disabilities rather than fostering capabilities. An analogous approach has been used with ecosystems such as the Great Lakes, - it is the dominant covention.

At the ecosystemic as well as at the organismal level there are also available more integrative measures, relevant to health or "integrity" or relevant to pathological syndromes of "disintegrity". The latter may be perceived as attempts by the system to limit the harm done by disintegrative stresses. When such stresses are relaxed or "remediated", the system may reintegrate, though it may then bear permanent disabilities for which prostheses or aritificial components may be fashioned.

In the Great Lakes Basin, a formal binational commitment to *ecosystem integrity* is now being implemented. Here *ecosystem* incorporates both natural and cultural features of the Basin and *integrity* includes consequentialist and deontological considerations. We review attempts to bring these all together conceptually and operationally.

Environmental Integrity: A Positive or Privative Concept?
MARK SAGOFF (Institute for Philosophy & Public Policy, University of Maryland, College park, MD 20742)

To ascribe the quality of "health," "Integrity," or "well-being" to ecological communities is to suppose that they may have a good of their own -- rather than that they are merely good for some purpose, e.g., enhancing our long-term welfare. The concept of such a good (e.g. health) may be defined positively in terms of some norm, ideal, or criteria of flourishing, or it may be defined privatively as the absence of a fairly ad hoc list of "bads" (e.g. diseases). This paper favors the privative approach when it is qualified by a distinction between "natural" and managed or domesticated ecosystems.

Ecological Health: Problems of Scale and Context
Bryan G. Norton (Georgia Institute of Technology)

Calls for more "holistic" management of environmental resources focus attention on the concept "ecosystem health," and on "ecosystem integrity." The currency of these concepts testifies to the failure of atomistic management, and environmentalists, resource managers, and ecologists all advocate a more systems-oriented approach. While the systems approach has roots in metaphysical organicism, it can be explained more scientifically as the advocacy of a contextualist model for environmental management. While this management paradigm is guided by an organic, rather than by a mechanistic model, it need make no mystical or metaphysical claims. Definitions of health and integrity of ecosystems can be defined, within the contextualist paradigm, in terms of the "autonomy" and the complexity of those systems.

This emerging paradigm suggests a helpful medical model, or analogy, which gives a central role to health and integrity. Nevertheless, this medical model has limits. Whereas the medical profession has a longstanding tradition emphasizing the centrality of the patient as the object of therapy, environmental management can be directed at many different levels of complexly related natural systems. Problems of scale and perspective therefore pose serious issues for conservation biologists and environmental managers.

Ecosystem Health and Ecological Theories.
DAVID EHRENFELD (Rutgers University).

The popular environmental movement often justifies its idea of ecosystem health by reference to an ecosystem theory that has been abandoned by most ecologists - the organismic theory. But if ecosystems, because of the shifting nature and number of their component species, do not resemble organisms, how can we speak of ecosystem health? Is health an appropriate concept for an entity whose composition varies from place to place and does not necessarily remain stable

from one half-century to the next, even when free of significant human influence? Despite the problem posed by ecological theory, ecosystem health and illness seem to be palpably real and observable qualities, easily detected in extreme cases. Evidently, we have damaged a useful, indeed necessary, idea by associating it too closely with a particular model of ecosystem structure and function. Ecological theories come and go; fads are as common in ecology as in other branches of science. To avoid giving the appearance of sanctioning ecosystem destruction by denying the existence of standards of health, ecologists will have to define ecosystem health in a durable, empirical way that is independent of particular theories. Most such definitions are likely to involve time, the rates at which changes in ecosystems have occurred, in addition to the usual considerations of loss (or gain) of components and changes in structure.

Trophic Flow Networks as Indicators of Ecosystem Health
ROBERT E. ULANOWICZ (Chesapeake Biological Laboratory, University of Maryland).

A necessary preliminary to defining ecosystem health is to elucidate the normal progression of ecosystem development, or succession. The study of material and energy transfers in ecosystems reveals that a particular quantitative property of networks of ecological flows, called the system ascendency, appears to encompass all the various trends in ecosystem succession. It follows that stasis or retrogression of the ascendency reflects damage to the "health" of the system; however, ascendency is not the sole index of system well-being. Systems of high ascendency can also be "brittle" and vulnerable to exogenous perturbations. Resistance to and recovery from impacts is gauged by a complementary network property related to the pathway redundancy. Adequate amounts of both ascendency and redundancy are required to have a "healthy" system. Recent work indicates that a new index of system performance, created by separating the input and output terms in the ascendency, may gauge the trade off between ascendency and redundancy and thereby provide a clue to the actual state of ecosystem "health".

Fauna and Flora: Necessary Definitions of Ecosystem Health.
LARRY D. HARRIS (University of Florida).

The native fauna and flora of a geographical area or geological era that occurred prior to the occurrence of humans are the best indicators of long-term adaptation and fitness to ambient environment. Lower units of classification such as the species or ecosystem are necessary to fauna and flora, but they are not sufficient to define the selection pressures that lead to their own evolution and existence. Only the full assemblage of regional fauna and flora complete with the strong ecological interactions that led to species evolution captures the gamut of ecological processes necessary to define ecosystem health. Wide-ranging species such as large predators perform necessary ecosystem functions as do long-distance migrant species that disperse nutrients, energy, and propagules. Nothing short of regional conservation strategies that use fauna and flora assemblages as the standard against which to assess management activity and success will maintain ecosystem integrity in the long term.

Alternative Models of Ecosystem Restoration. SUSAN P. BRATTON (Institute of Ecology, University of Georgia, Athens, GA)

Early attempts at restoring natural ecosystems used either an agricultural model or a climax community model emphasizing productivity and stability as indicators of ecosystem health. Current restoration efforts utilize community structure or ecosystem function models favoring biotic diversity, presence of rare or unique elements, system complexity and maintenance of natural processes. Naturalness as demonstrated by the self-maintenance of the system or by the reestablishment of elements present prior to disturbance are also common indicators of health. Present models are inadequate to deal with semi-natural landscapes and highly fragmented biotic communities, as well as those that have lost keystone species and those that can not be completely restored. Our concepts of naturalness usually assume health is a return to a previous state and do not consider the possibility of new permutations. Naturalness also precludes complex or repeated interactions with human managers.

Toward an Operational Definition of Ecosytem Health
ROBERT COSTANZA (Coastal and Environmental Policy Program, Center for Environmental and Estuarine Studies, University of Maryland, Solomons, MD 20688)

Ecosystem health is a "bottom line" normative concept. It represents a desired endpoint of environmental management, but the concept has been difficult to use because of the complex, hierarchial nature of ecosystems. Without an adequate operational definition of the desired endpoint effective management unlikely.

This paper investigates some of the previous and currently employed operational definitions of ecosystem health, weighs their advantages and disadvantages, suggests alternatives that synthesize these past definitions, and suggests research paths aimed at allowing these new definitions to be put into practice.

Existing definitions of ecosystem health can be summarized as:

1. Health as stasis (all change is bad)
2. Health as the absence of noticeable disease (if it ain't broke don't fix it)
3. Health as stability and/or resilience (maximum ability to recover from stress)
4. Health as diversity (maximum number of system parts)
5. Health as vigor (maximum community metabolism)

All of these concepts represent pieces of the puzzle, but none is comprehensive enough to adequately serve. This paper elaborates on the concept of ecosystem health as *multiscale, hierarchical system organization.* A healthy system must be defined in light of both its context (the larger system of which it is a part) and its components (the smaller systems that make it up). The degree of organization of this hierarchical system is a measure of its degree of departure from equilibrium, its degree of order, and its health.

25-3. Strategic Approaches to Conserving Genetic Resources in Natural Habitats

Organized by: **Joel I. Cohen** *(Biotechnology and Genetic Resource Specialist, Bureau for Science and Technology, Office of Agriculture, U.S. Agency for International Development, Washington, DC)* and **Christopher S. Potter** *(Research Associate, Dept. of Biological Sciences, Stanford Univ., Stanford, CA)*

8:30 am / Mon / 18 Feb **Sheraton/Richmond**

Strategies for Plant Conservation Worldwide
PETER H. RAVEN (Missouri Botanical Garden)

Implementation of national biological diversity and national biodiversity inventories similar to INBio in Costa Rica, with the application of the knowledge resulting for sustainable use is a signal importance as a strategy for managing biodiversity. Coupled with surveys of natural habitats and determination of the protected status of each, such inventories can serve as a means for managing the natural diversity of the countries involved. Networks of botanical gardens and seed banks established on a national basis but with international connections will complete the strategy. There is no need for any additional plant species to become extinct if we have the will to prevent it.

Managing Wild Biodiversity Resources for Economic Development in Costa Rica. DANIEL H. JANZEN (University of Pennsylvania).

How to conserve tropical biodiversity? Through nondestructive sustainable use. This demands complex, expensive, and currently unavailable management. There are three necessary steps for this management: save it, know it, and use it sustainably. Costa Rica is a national pilot project. Saving it began with Costa Rica's burgeoning National Park Service, recently evolved into the Sistema Nacional de Areas de Conservacion which covers 25% of the country through eight areas. Knowing it began in Costa Rica's strong tradition

of field biology, and has evolved into a national biodiversity inventory conducted by parataxonomists and curators. Using it sustainably is done by the conservation areas themselves, the ecotourism industry, the educational system and the Instituto Nacional de Biodiveridad. This Institute facilitates biodiversity prospecting, biological literacy, use of the conservation areas as centers of biological diversity research, and other actions promoting incorporation of biodiversity into Costa Rica's social fabric. There has been a strong need to redefine the rôle played by science in biodiversity management. The scientist is stripped to essentials, and reconstructed such that the 'new' one is responsible to biodiversity management.

Diversity and Economic Enrichment in Managed Forests of Kalimantan and Amazonia.
CHRISTINE PADOCH (The New York Botanical Garden).

Traditional swidden fallows and other managed forests have, until recently, been virtually dismissed as abondoned fields and have been unstudied. Recent research in the humid tropics, however, has shown that these areas of mixed spontaneous, cultivated, and managed vegetation are often rich repositories of economically important genetic material, as well as sources of considerable household income. Examples from traditional systems in Amazonia and Kalimantan that emphasize the management of fruit tree species in diverse forest-orchards are presented.

Development Strategies for African Forest and Primate Conservation
WILLIAM WEBER
(WIldlife Conservation International)

The need to incorporate development interests into conservation planning has been a major theme of the past decade. The concept is especially attractive in Africa, given the stark contrast between the continent's great biological wealth and its staggering economic poverty. Practice has lagged behind theory, however, and applied models for the integration of conservation and development are sorely lacking. Approaches which appear to hold some promise in this regard include the promotion of ecotourism, the establishment of buffer zones, and the increased application of multiple-use management strategies. This paper examines the current effectiveness of these approaches for improved conservation of African rain forests in general, and primates in particular. While certain successes are noted and future improvements can be expected, serious reservations are expressed about the potential for the complete satisfaction of both conservation and development interests at many field sites.

Biological Diversity and Conservation of Ancient Forests of the Pacific Northwest. DAVID WILCOVE (The Wilderness Society) and JEFFREY OLSON (The Wilderness Society).

Protection of the ancient coniferous forests of the Pacific Northwest has become one of the most heated environmental issues in the United States. In western Washington and Oregon, at least 87 percent of the ancient forests have been destroyed due to logging and development. These forests provide essential habitat for a number of species, including the northern spotted owl. They also protect watersheds, sustain commercially valuable salmonid fishes, and are a valuable source of genetic diversity. Although it has been alleged that preservation of the remaining ancient forests would create tremendous economic hardships, doing so would, in fact, benefit the region's long-term economic base. Short term hardships affecting local communities could be mitigated by reducing log exports and simultaneously increasing value-added manufacturing, improving management of privately owned forestlands, and diversifying rural economies.

25-4. Nonrandom Evolution: Matter, Life, Mind

Organized by: **Sidney Fox** *(Distinguished Research Professor in Plant Biology and Electrical Engineering, Southern Illinois University, Carbondale, IL)*

8:30 am / Tue / 19 Feb **Sheraton/Arlington**

Cosmological Conditions Necessary for Biology
JOHN D. BARROW (Astronomy Center, University of Sussex)

One of the most surprising discoveries of modern cosmology is that there exists an intimate connection between the Universe and the conditions required for life to evolve in it. We shall examine some of the features of the universe which are the prerequisites for the evolution of complexity and life of any sort.

Nonrandom Protein in Prelife -->Life Transition*
SIDNEY W. FOX (Southern Illinois University, Carbondale)

Without relevant data, concepts of random matrices in evolution were attractive. As continuing research permits forward extrapolation of evolutionary sequences from precursor stages, the possibility of nonrandom matrical steps is increasingly in purview. Amino acids (Herrera, SCIENCE, 1942; Miller, SCIENCE, 1953), some since shown by NASA-supported studies to be extraterrestrially available, have yielded in the laboratory a model of prebiotic protein under geological conditions. The condensation product, thermal protein, was reported in 1959 (AAAS, Chicago, SCIENCE, 1960) to organize itself into cell-like structures. Since 1959, various laboratory cells of this type have been found to possess primitive analogs of biofunctions including metabolism, growth, proliferation, arrays permitting selection, ability to synthesize polynucleotide and peptide bonds, electrical discharges from various stimuli, etc. The integrated view states that the transition from the prebiotic realm was through protein ordered by its evolutionary precursors, appropriate mixtures of amino acids. The initial source of bio-information is identified as the self-sequencing of amino acids.

*Supported by grants from NASA

Studies on the Origin of the Genetic Code
CYRIL PONNAMPERUMA (University of Maryland)

In our studies on chemical evolution we have concentrated recently on the interactions between nucleic acids and proteins and their components to look for stereochemical clues for the origin of the code. In one set of studies, we examined the association constants for the various interactions between nucleotides and amino acids. NMR spectroscopy has indicated that the strongest association of all the amino acids investigated were observed with their respective anticodonic nucleotide sequences. The strength of associations seem to increase significantly with the increase in the chain length of the anticodonic nucleotide from monomer to dimer to trimer. The association of amino acids with different phosphates of nucleoside suggest that a definite isomeric structure of the nucleotide is required for association with an amino acid. The conclusion reached from these studies is that there is a possible anticodonic basis of the origin of the genetic code.

In a second set of studies, we ask the question whether the intrinsic reactivity of the amino acids, the nature of the nucleotide in the anhydride, or the complementary nucleotide template influences the specificity of the peptide synthesis. We observed that the differential reactivity of the amino acids results in nearest neighbor preferences during the peptide synthesis. The nature of the nucleotides and the presence of complementary polynucleotides had no influence on the specificity. This result suggests that some peptides would have been more abundant than others on the prebiotic Earth.

Both these results have a profound implication for our understanding of the origin of the genetic code and protein synthesis.

Biological Form and Organization in Evolution
MAE-WAN HO (Developmental Dynamics Research Group, Open University, Walton Hall, Milton Keynes, MK7 6AA, U.K.)

The neo-Darwinian paradigm of evolution depends on the conceptual separation between organism and environment, and on the supposed randomness of the variations on which natural selection acts. Both these assumptions have been invalida-

ted in the light of contemporary knowledge. The emerging framework of 'evolution by process' concentrates on the non-random dynamic properties of living systems evolving in unison with all nature.
I describe two aspects of non-randomness in evolution: the first on the generation of form in the process of development, which makes possible a rational taxonomy of forms; the second on quantum coherence as the basis of biological organization and biological reality.

Determination of Human Psychological Traits: Convergent or Divergent Processes?
THOMAS J. BOUCHARD, JR. (University of Minnesota)

Different species attend to different features of their environment, revealing intrinsically organized species-specific characteristics that reflect their differing evolutionary histories and common genetic inheritance. Behavior geneticists have also demonstrated that much of the variation in behavior within species is also guided by the genome (unshared genetic inheritance). These findings do not imply that the environment is unimportant in its effects on behavioral development. Instead, these findings suggest that a sufficiently rich environment facilitates both the expression of species-specific genetic characteristic as well as the unique genetic characteristics of individual organisms. Unlike most other species, human beings undergo an extended period of parental care. In addition, they demonstrate a highly developed capacity to learn. Given these facts, as well as the great diversity in human behavior, it has been widely assumed that the acquisition of most psychological traits is due to learning through experience and that genetic factors are, consequently unimportant. This view confuses distal and proximal causes of behavior. The effective proximal cause of much of the variation in psychological traits probably does involve learning through experience. The experiences of people are, however, largely self-selected. Studies of a wide variety of psychological traits (i.e., mental abilities, personalty traits, vocational interests, social attitudes, values) in identical (monozygotic) twins reared apart from early in life demonstrate quite high levels of similarity suggesting that the effective experience of human beings must be significantly influenced by distal causes (the genome) that inexorably move them toward similar and converging end states. This work will be described in detail.

25-5. Seeds Since Columbus: Crop Germplasm of the Americas

Organized by: **Douglas H. Boucher** *(Western Hemisphere Cooperation Program, AAAS, Washington, DC)*

2:30 pm / Sun / 17 Feb **Sheraton/Richmond**

Crop Migration Between the Old and New Worlds
HUGH POPENOE (University of Florida, Gainesville)

The discovery of the New World by Columbus resulted in the two way introduction of new crops which resulted in major transformations in agricultural systems. Of the top fifteen crops in the world in terms of tonnage, 5 were introduced into the Old World, 9 were introduced into the New World, and grape species moved in both directions. With current public interest in exotic and ethnic foods, the production of new crops is continuing.

American Crops That Didn't Make the Columbian Interchange
CALVIN R. SPERLING (USDA).

Since Columbus's arrival in America crop genetic resources have been exchanged to mutual benefit of both the Old and New World. Many American crops were introduced to the Old World either as curiosities or potential crops. However, only a few crops were successfully introduced. Left behind in America were a number of crops which never became established in the Old World. Some of these, such as Quinoa, Tarwi and Amaranth, had been staples in the New World but were subsequently displaced by introduced Old World Crops. Other crops, such as the Andean tubers Ulluco, Oca and Mashua weren't introduced to suitable climates in the Old World, yet continued to be important New World Crops. Some relatively minor American crops were probably already in decline when the Columbian Interchange began, examples include Sumpweed and Mauka. These "forgotten" crops, some of which are still neglected, represent opportunities for crop improvement and future exchange. Preservation of germplasm of these neglected and forgotten American crops has received little attention at a time when genetic diversity of cultigens and their wild relatives is decreasing. The current status of these and other underexploited New World crops is outlined.

The Spice Trade Before and After Columbus.
JAMES A. DUKE (USDA).

Before Columbus, peppercorns from Piper nigrum were so expensive as to be used for currency, perhaps because they were used to "overcome the odours of bad food and unwashed humanity." German spice traders paid tenth-century Englishmen ten pounds of pepper to trade with London merchants. Pepper and spice merchants were forerunners for apothecaries, spices being vital to occidental medicine. By the 13th century, Venice and Genoa had grown wealthy on the spice trade. Portugal and Spain were envious. In 1453, Constantinople fell to the Turks. Shortly thereafter, certain spice traders imposed overland taxes, making a sea route more appealing. In 1492, Columbus sailed, seeking black pepper and other spices. Columbus found Amerindians and red pepper (Capsicum spp) instead of Asian Indians and black pepper. Today, the hot cuisines we treasure from south China, Louisiana, Pakistan, and Thailand, for example, are indebted to Columbus, the New World, and its capsicums. At the AAAS meetings in 1989, we learned that "Red pepper... is the most used condiment and spice in the world, replacing the black pepper for which Columbus tried to find a route west to the Indies." Other post-Columbian changes in the world's distribution and trade in spices are outlined.

The "Difficult" Seeds: Perspectives on their Conservation, with Special Reference to the Palm Family.
DENNIS V. JOHNSON (Tropical Research and Development, Inc., Gainesville, Florida).

Dormancy is uncharacteristic of the seed of most humid tropical plants. These "recalcitrant" seed cannot be dried and stored at ambient temperature to conserve germplasm for breeding purposes or to maintain biological diversity. As one of the most useful plant families, the Palmae represents an excellent example of the difficulties inherent in both breeding and conservation. Palm seed generally are planted immediately after being harvested. Seed sources include natural areas, selected stands, seed orchards and botanic gardens. Natural areas and selected stands of palms are in jeopardy because of tropical deforestation and an eroding germplasm pool. Seed orchards must be located in the tropics, require large land areas and are expensive to maintain. Palms in botanic gardens are relatively poor sources of seed because the provenance and representativness of parent plants often are unknown and seed quantities are very small. Emphasis needs to be placed on conserving tropical forests and the development of permanent seed orchards.

Conservation of Useful Crop Diversity: What has to be done?
J. TREVOR WILLIAMS, (International Fund for Agricultural Research)

It is impossible to conserve every genetic variant of every crop, whether major staple or minor and under exploited. Programs have been put in place to address just what to conserve and how to do it; but many gaps remain both in programs and methods. A perspective of current activities and immediate needs will be given.

25-6. Stakes in the Tropical Forests

Organized by: **Robert L. Randall** *(Director, RainForest ReGeneration, Washington, DC)*

8:30 am & 2:30 pm / Sat / 16 Feb **Sheraton/Richmond**

Tropical Forests and the Global Carbon Cycle. RICHARD A. HOUGHTON (The Woods Hole Research Center)

Tropical forests cover only 13% of the land surface, but contain about 20% of the carbon of terrestrial ecosystems, approximately 60% of that held in the atmosphere. Tropical forests account for about 20-25% of the annual exchange of CO_2 between terrestrial ecosystems and the atmosphere. In contrast to this annual exchange, where the release of CO_2 from respiration and decomposition is balanced each year by the uptake of CO_2 through photosynthesis, the carbon released from deforestation is not balanced by accumulation of carbon in regrowing forests. Deforestation releases carbon because of the burning and decay of trees following clearing of the land.

In the last 10 years, the rate of tropical deforestation has almost doubled from 11.3 million ha/yr in 1980 to almost 20 million ha/yr currently. This conversion releases between 1.5 and 3.0 Pg of carbon to the atmosphere, 25-50% as much as released from world-wide combustion of fossil fuels. A halt to deforestation would reduce total anthropogenic emissions of CO_2 to the atmosphere by as much as a third. Massive reforestation could reduce total emission by another 15-20%, and substitution of sustainably harvested wood fuels for fossil fuels could reduce total emissions to zero. Thus management of tropical forests can play a major role in stabilization of the atmospheric concentration of CO_2.

Atmospheric chemistry. PETER S. BAKWIN (Harvard University)

Recent observations made during the NASA/INPE ABLE-2 program have helped to elucidate the role of tropical forests in regional and global atmospheric chemistry. Tropical forests are large sources of many gases of importance to atmospheric photochemistry, such as reactive hydrocarbons and nitrogen oxides (NO_x). Photochemistry proceeds most efficiently in the atmosphere above these forests due to high temperature, humidity, and solar irradiance. The forests are also strong sinks for photochemical oxidation products such as ozone (O_3), carboxylic acids, and nitric acid. Forest health may be affected by changes in the abundance of these gases. In pristine conditions, photochemical oxidant production (O_3 and OH)is suppressed by low levels of NO_x and high levels of hydrocarbons. Addition of NO_x to the tropical atmosphere by anthropogenic activity associated with development (biomass and fuel burning, and agriculture) has broad implications for regional and global atmospheric chemistry and forest health.

Climatic Impacts of Amazon Deforestation. JAGADISH SHUKLA (Center for Ocean-Land-Atmosphere Interactions, Univ. of Maryland)

A computer simulation with complex models of global atmosphere and biosphere shows that if the Amazon Basin tropical forests were replace by pasture, there would be significant increase in surface temperature and decrease in precipitation. This could increase the length of the dry season and the frequency and intensity of forest fires. These climatic changes could make it particularly difficult for the forest to regenerate.

Organizer's note: Dr. Shukla's paper Amazon Deforestation and Climate Change[1] was a pioneering effort at modelling regional climate changes in the tropics.

[1] J. Shukla, C. Nobre, P. Sellers, Science, 16 March 1990, pp 1322-1325.

Soil types and productivity. PEDRO A. SANCHEZ (N.C. State University)

The soils underlying tropical forests are a fixed geophysical endowment. Soils vary considerably in chemical and physical properties, which determines their erosion propensity when exposed by deforestation and their productivity when converted to agricultural, grazing, or industrial forestry uses.

Soils under remaining tropical rainforests are mainly acid and of low native fertility, but have, contrary to common beliefs, large amounts of organic matter and low erosivity. Other misconceptions include the belief that, when cleared, such Oxisols and Ultisols turn into a latent, hard brick-like substance. Most nitrogen and phosphorus stocks are in the soil, not in the forest biomass. Sustainable agricultural and forestry alternatives to shifting cultivation must consider the fertilizer value of the ash, maximization of nutrient cycling, and minimization of external inputs by using plants tolerant to soil acidity constraints.

Organizer's note: Dr. Sanchez is the author of the chapter on Soils in the encyclopedic Tropical Rain Forest Ecosystems, Vol 14B, published by Elsevier in 1989.

Bio-Hydrological Coupling. HELMUT ELSENBEER (Institute of Geography, University of Bern)

The hydrological response of rainforest watersheds is much less understood than the forest-atmosphere interaction. A brief review of rainforest hydrology and the importance of the soil-vegetation complex will be presented. The expected ecosystem response to climate change will be examined with respect to possible hydrological implications. In this context, Quaternary climatic fluctuations in the Amazon Basin and the consequent vegetation changes will be considered as an analog model. To provide a mechanistic insight into the bio-hydrological coupling, the crucial role of soil properties in the cause-and-effect relationship between climate, vegetation, and hydrology will be emphasized, with due consideration of spatial and temporal scales.

The Urgent Transition to Sustainability: Policy Options. ROBERT GOODLAND (World Bank)

Presents the case for urgent transition to sustainability by (1) improving forest management at least to "best practice," (2) deflection of logging from primary forest to secondary forests, (3) phased transition to plantations, rehabilitating degraded lands. The transition should be rapid in those countries where forests are rapidly disappearing and logging is a main cause (e.g., Ivory Coast, Nigeria, Ghana, Papua New Guinea). The transition is less urgent if there are any countries in which tropical moist forests are extensive and stable. Specific detailed policy recommendations will be provided for governments, timber companies, and international finance agencies.

Organizer's note: Dr. Goodland recently addressed the Vatican's Pontificia Academia Scientiarum in Rome on the ethics of tropical deforestation, i.e., on the linkages between the Church's teachings, population growth, poverty, and pressures on natural resources such as tropical forests. Dr. Goodland was principally responsible for the environmental assessment for the Trans Amazon Highway in Brazil in the mid-1970's, the largest project undertaken in the tropics.

Tropical Forest Economics. JAN K. LEWANDROWSKI (USDA Economic Research Service).

In many tropical countries, deforestation imposes long-term costs while producing modest short-term gains. The links between tropical deforestation and possible global warming and loss of biological diversity suggests large costs to the world in general. That tropical forests are disappearing at an annual rate between 1% and 2% shows that many in the tropics benefit from deforestation. Most tropical governments do little to conserve their forests, suggesting that the short-run benefits of deforestation are often viewed as being worth the long-term costs.

This paper focuses on economics of tropical deforestation, first describing the economic motivations driving forest destruction. These include the need of governments to acquire foreign exchange and the will of people living at the margin to survive. Next, the economics of different forest uses are examined. Included here are "mining" of the forests for a one-time yield of timber, plantation forests, and sustained yield management. Finally, the economics of various forest preservation strategies are discussed. These include debt-for-nature swaps, foreign financial assistance, and payments to restrict forest access.

Non-Wood Forest Products. ROBERT O. MENDELSOHN (Yale School of Forestry and Environmental Science)

This paper will discuss the role of non-wood forest products in conservation and development. The virtues and limitations of extractive reserves will be reviewed. The paper concludes by emphasizing what focus future research should take to best support policy in this area.

Organizer's note: Dr. Mendelsohn's Valuation of an Amazonian rainforest[1] was a pioneering effort to catalog varieties, measure yields, and ascertain the value of the marketable produce output of a tropical forest near Iquitos, Peru.

[1] Peters, Gentry, and Mendelsohn, Nature, Vol. 339, 29 June 1989, pp 655-6.

Debt-for-Nature Swaps. THOMAS E. LOVEJOY (Smithsonian Institution)

Today, most of the capital of developing countries goes to pay the $1.2 trillion external debt owed to the developed countries. Not only is there little money left for growth, but their efforts to generate hard currency to meet interest payments have degraded the natural resource base, particularly tropical forests, upon which the future growth of the developing world ultimately depends. To alleviate the debt and deforestation crises, conservation groups have implemented over $100 million of debt-for-nature swaps that allow debtor countries to swap their debt for conservation and research activities. This paper will discuss the development of debt-for-nature swaps and their growing potential to reduce both the debt burden and environmental problems of developing countries.

Organizer's note: Dr. Lovejoy was the originator of debt-for-nature swaps for Third World countries, expanded to debt-for-education and debt-for-health swaps. Several non-profit conservation organizations have been instrumental in arranging the swaps.

Making Development and Conservation Compatible: The Nichare Project in Venezuela. Brian M. Boom (New York Botanical Garden)

Over 35 percent of Venezuela is within declared protected areas, nearly half as forest reserves. Despite nominal protection, hundreds of thousands of hectares have been clear-cut within their boundaries for lumber, cattle, and agriculture.

The New York Zoological Society, New York Botanical Garden, and ECONATURA, a Venezuelan NGO, are working together in the Río Nichare watershed of the Reserva Forestal del Caura to (1) inventory the natural resources present, (2) determine how local people are using the resources, (3) explore how sustained harvesting and marketing of such resources can provide an economically viable alternative to the present destructive practice of clear-cutting for timber or pasture.

On a national level, we hope to show Venezuelan policymakers that marketing "minor forest products" can prove healthier for the country's economy than using forest reserves as one-time woodlots. On a local level, we hope that the indigenous peoples will benefit from the greater autonomy as a result of more widespread appreciation for the value of the plant resources they control. Finally, by demonstrating economic and ecologic viability of a sustainable extractive forest preserve, this project will provide a model for other areas.

25-7. Science and Management of Large Marine Ecosystems

Organized by: **Kenneth Sherman** *(Director, NOAA, National Marine Fisheries Service, Northeast Fisheries Center, Narragansett Laboratory, Narragansett, RI),* **Lewis M. Alexander** *(Director, Center for Ocean Management Studies, Univ. of Rhode Island, Kingston, RI),* and **Barry D. Gold** *(Director, Center for Ocean Management Studies, National Academy of Sciences, Washington, DC)*

8:30 am & 2:30 pm / Mon / 18 Feb **Sheraton/Annapolis**

Biomass Yields and Management of LMEs. WILLIAM W. FOX, Jr. (Asst. Administrator for Fisheries, NOAA, National Marine Fisheries Service, Washington, DC)

Within the Exclusive Economic Zone, activities are underway by the National Marine Fisheries Service to support: (1) fisheries resources management, (2) habitat protection and restoration, (3) protection of marine mammals and endangered species, and (4) fisheries monitoring, assessment, and prediction. Examples are given of studies conducted from an ecosystems perspective to encompass these broad legislative mandates.

Intervention by humans on marine resources can have a stabilizing or destabilizing influence on the natural variability of the large marine ecosystems (LMEs) within the EEZ by causing or accelerating species shifts within the systems. Studies underway by NMFS provide a national quantitative information base on marine resources. The information is used to develop options for maximizing long-term benefits of resource management. NMFS, in cooperation with other components of NOAA, and other agencies (e.g., EPA, DOE, DOI, DOT, NSF) provides systematic updates on the changing states of large marine ecosystems, their fish and mammal populations, and the biomass yields of important species dependent on the continued health of marine ecosystems. Special attention is being given by NMFS to accelerate studies and management actions aimed at rebuilding depleted fish stocks within the EEZ of the United States.

The Science and Management of the Antarctic Ecosystem. R. TUCKER SCULLY (U. S. State Department, Washington, DC)

The Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) represents an international effort to apply an ecosystem-wide approach to the conservation of living resources. It is the first international agreement that defines its area of application and objectives by specific reference to a marine ecosystem. CCAMLR applies to the populations of all species of living organisms found south of the Antarctic Convergence or Polar Front. Its conservation objective includes maintenance of the health of populations of species that are the targets of harvesting; maintenance of ecological relationships between harvested, dependent and related populations and restoration of the health of the depleted populations; and prevention of changes in the marine ecosystem that are not potentially reversible over two or three decades. Achievement of CCAMLR's management objectives depend critically upon adequate scientific information and data and upon properly utilizing such information and data as a basis for decisions. Based on CCAMLR experience, the LME methodology suggests a number of areas of emphasis in establishing these bases for achieving these management objectives. These include establishment of base-line and time-series data to distinguish between natural variation and human-induced change; identification of indicator species; integration of monitoring into scientific research activities; pooling of effort and division of labor in research and monitoring efforts; ensuring an independent scientific advisory function; and development of interactive relationships between scientific advisory and decision-making institutions.

Legal Mandates for the Management of LMEs. MARTIN H. BELSKY (Albany Law School, Albany, NY)

Until recently, the resources of the oceans have been managed on an ad hoc basis. Nation-states acted individually, if at all, to manage their ocean space, and opposed cooperative multinational action over marine areas of concurrent jurisdiction or the high seas. When states did take action, either unilaterally or collectively, they did so in response to particular problems and crises. Separate policies and regulations were established for different types of pollution problems and separate management regimes were established for particular species and these policies, regulations, and regimes were premised on national sovereign rights. Scientific evidence has demonstrated that a holistic or comprehensive approach is essential for the conservation and exploitation of living resources and for the protection of the ocean space, which is the habitat for these resources. In response, a new rule of international law has evolved that requires a comprehensive ecosystem approach to management of the ocean space. Under this model, the resources and activities in large marine ecosystems are to be viewed as interconnected. Research and regulatory decisions are to be premised on the pattern of relationships between species and activities affecting those species and their habitats in the series of such ecosystems making up the ocean space. This paper will look at this new legal regime and how the ecosystem model can and should lead to sensible resource and pollution management. It will focus on the kinds of laws and policies, whether domestic or multinational, which could best incorporate the ecosystem model and how the various members of the ocean constituency, whether involved in coastal zone, estuarine, fisheries or high sea exploitation or protection can and must work together.

A Regional Geographic Strategy for LMEs. LEWIS M. ALEXANDER (University of Rhode Island, Kingston, RI)

Future research on more than two dozen LMEs of the world ocean which to date have been investigated in terms of variety of biomass yields, as well as identification and researching of new LMEs, is a world-wide issue, including global monitoring, new types of modelling, and the need for inclusion of developing as well as developed states in the process. Through comparative ecosystem studies, it will be possible, in specific cases, to determine whether large-scale changes over time in biomass yields, are primarily the result of overexploitation, environmental perturbations, pollution, or other factors. Clearly, research, monitoring and analysis of LMEs is a long-term effort, as is the task of devising management strategies, once a clear assessment of the problem has been obtained. A coordinated approach is required. One potential move in this direction might be to establish an international LME Committee, composed of representatives from the Food and Agriculture Organization (FAO), Intergovernmental Oceanographic Commission (IOC), United Nations Environment Programme (UNEP), and perhaps one or more other agencies outside the UN framework. The Committee would also include a number of world experts on LME issues. Such a Committee would meet periodically, establish working groups on LME research and management to report to it annually, support symposia on specific LMEs, and every few years convene an international conference of experts to assess the status of LME research and management efforts. Only through the continuous interchange of information and ideas by experts and international agency representatives can genuine progress be made in the growing field of LME science.

The Utility of the LME Concept to Ocean Management. ROBERT W. KNECHT and BILIANA CICIN-SAIN (Center for the Study of Marine Policy, University of Delaware, Newark, DE)

Application of the LME concept to the management of ocean resources and space, while potentially a highly desirable notion, must overcome a number of obstacles related to existing political and jurisdictional realities. Creative measures are needed to ensure that these political and jurisdictional realities do not impede the timely application of the LME concept to ocean management in individual nations as well as to multinational efforts at ocean management.

The paper first explores the extent to which the LME concept is useful for addressing core questions of multiple use ocean management. The area-based nature of the LME, together with its scientific coherence, will be central to its utility in multiple use management approaches. Second, the paper explores various strategies which could be used to encourage the application of the LME model to different ocean management situations. The potential application of the LME model to the management of ocean resources and space at the level of the nation-state (i.e., a nation's Exclusive Economic Zone) is examined with specific reference to the U.S. case). Next, the potential applicability of the LME model is explored in the context of regional groupings of nation-states which share or have similar interests in a common ocean area. Third, the paper explores the potential role of international entities in encouraging the use of the LME concept given existing political and jurisdictional realities both at the national and multinational levels.

Global Ecosystem Dynamics and Large Marine Ecosystems. BRIAN J. ROTHSCHILD (Chesapeake Biological Laboratory, Univ. of Md., Solomons, MD)

Variability in the ecological metabolism of the upper ocean plays a key role in global ocean ecosystem dynamics and hence in Large Marine Ecosystems. The conventional way of understanding ecological metabolism is by measuring ecosystem inputs and outputs. Information on inputs and outputs, however, is not sufficient to understand causes for variability. Rather, it is necessary, in addition, to understand the dynamics of the populations that mediate the inputs and outputs. This paper describes models capable of providing insights to variability in ecological metabolism.

The Ecological Basis for the Management of Living Marine Resources in Large Marine Ecosystems of Western European Seas. K. VAGN HANSEN (Danish Institute for Fisheries and Marine Research)

The biomass yields of large marine ecosystems of western European seas support substantial fisheries and aquaculture operations. Over the past several decades the number and extent of episodic plankton bloom events have been implicated in massive mortalities of fish, marine mammals, and other organisms. Considerable variability in the abundance of fish stocks has also been reported. The principal driving forces leading to these changes are not fully understood. Recent studies in four large marine ecosystems within western European seas--the Baltic ecosystem, the Skagerrak-Kattegat ecosystem, Faroe Plateau ecosystem, and the North Sea ecosystem--have been focused on the causes of the changes. Information resulting from the studies is presented and discussed in relation to the optimal research strategies for supporting management decisions designed to mitigate adverse impacts of pollution, exploitation, and natural perturbations on future biomass yields of these LMEs.

Research and Management in the Northern California Current Ecosystem. D. L. BOTTOM, K. K. JONES, J. D. RODGERS, and R. F. BROWN (Research and Development Section, Oregon Department of Fish and Wildlife, Corvallis, OR)

Research cannot provide precise predictions about the effects of human disturbances in complex marine ecosystems. The goal of research and management in Large Marine Ecosystems is to minimize the risk that human impacts may cause large-scale and irreversible change. The Northern California Current Ecosystem (NCCE) illustrates the unpredictable environmental conditions that occur in regions of eastern boundary currents. We prepared a research plan for the entire NCCE to identify information needed to evaluate the risks of proposed mineral development. The plan defines three major categories of research need: (1) biological inventories to define habitats and communities that could be exposed to proposed development activities, (2) experimental studies to evaluate the sensitivity of selected species or groups if exposed, and (3) studies of physical and biological processes to understand the possible outcomes of disturbance at the ecosystem level. We conclude that environmental assessment in the NCCE will be advanced most significantly by research that improves understanding of natural variability. Maintaining the resilience of the NCCE to change will require regional planning to direct local actions. Research and evaluation should be built into a regional management program to ensure that results are timely and that decisions reflect the degree of environmental uncertainty and risk.

Management of Insular Pacific LMEs. JOSEPH R. MORGAN (Environment and Policy Institute, East-West Center, Honolulu, HI)

The Pacific Rim is characterized by varied hydrography and bathymetry, with generally "open seas" and ocean current-dominated large marine ecosystems on the eastern side and semi-enclosed sea systems in the western Pacific. Management of the eastern Pacific LMEs depends primarily on an understanding of the ecological relationships involved and is, in general, not hampered by political considerations. In the western Pacific, an understanding of both trophic relationships of the commercial species and the nature of the international relationships among the coastal countries are important. Claims to overlapping maritime jurisdictions, latent hostilities, lack of diplomatic relations, and, in a few cases, technical states of war make the problems of large marine ecosystem management much more difficult. This paper will provide examples of both "easy" and "difficult"LME management problems.

The Ecological Basis for the Management of Living Marine Resources of the Northwest Atlantic Continental Shelf Ecosystem. KENNETH SHERMAN (NOAA, NMFS, Narragansett Laboratory, Narragansett, RI)

The Northeast Continental Shelf (NCS) ecosystem is one of seven large marine ecosystems (LMES) presently under investigation by NOAA's National Marine Fisheries Service within the Exclusive Economic Zone of the United States. The NCS ecosystem is being subjected to increased stress from growing exploitation of renewable resources, the dumping of urban wastes, and the fallout from aerosol contaminants. The principal stress on the Gulf of Maine subsystem of the NCS is excessive fishing mortality. The response of the fish component to "overfishing" has been a significant "flip" in the dominance of species, with an increase in non-marketable finfish stocks in the Gulf of Maine-Georges Bank subsystems of the NCS ecosystem. Based on evidence from the North Sea, these changes are reversible if fishing effort is redirected as a management measure.

NOAA is presently developing an ecosystem indexing system to the point where this will reflect future probabilities of environmentally driven impacts on the ecosystem such as toxic plankton blooms or the failure of a year class of a commercially important fish stock. Development of the predictive aspect of any ecological indexing for use in management is, of course, contingent on increased understanding of the workings of the marine ecosystem.

Technical Sessions

25T-1. Policy Issues in Coastal Zone Management

Organized by: John H. Cumberland *(Professor Emer., Center for Environmental and Estuarine Studies, Univ. of Maryland, Solomons, MD)*

2:30 pm / Tue / 19 Feb **Sheraton/Richmond**

Interactions of Science and Policy: Comparisons between the Gulf of Mexico and the Chesapeake Bay. DONALD F. BOESCH (CEES, University of Maryland System).

Major management initiatives for the Chesapeake Bay began in the late 1970's and have been accompanied by extensive environmental research programs. Despite the fact that initial research efforts were relatively diffuse, they led to identification or convincing documentation of the major factors degrading environmental quality, e.g. excessive nutrient inputs and turbidity causing loss of submersed aquatic vegetation. These findings have undergirded the main management strategies now applied to the Bay, nutrient reduction and sediment control. Now science is being asked to address second order questions such as how much and from what sources and to what status may ecosystems be restored. The Gulf of Mexico, on the other hand, is just beginning to receive attention for comprehensive environmental management. Allied research programs are few and less advanced. Despite the fact that the Gulf is a much larger and more diverse system, important lessons in how scientific information can obtained and used in environmental policy can be learned from the successes and failings of the Chesapeake Bay science-management programs. Suggestions are being made which could allow short-circuiting of development process to allow earlier focus on the "how much," "where," and "how natural" questions which must ultimately be addressed.

Economic Instruments for Coastal Zone Management
SCOTT FARROW (Council on Environmental Quality and Carnegie Mellon University.

Economic instruments are compared with legal and technological instruments for coastal zone management. The use of auctions, marketable permits, user fees and information provisions are discussed as evolving tools of coastal zone management. Materials drawn from estuary management and outer Continental Shelf leasing are presented as examples of economic instruments.

Estuarine Science and Public Health
DR. RITA R. COLWELL (University of Maryland)

There are many ways to diagnose the health of an estuary, most of which require extensive analysis of inorganic and physical/chemical parameters. Estuaries are in a crisis resulting from environmental degradation. The tragedy is that the major and most productive estuaries receive both point and nonpoint sources of pollution. For example, 96% of the 2000 estuarine and coastal ocean point sources categorized in the United States discharge to estuaries. Thus, estuaries, unfortunately, act as reservoirs for human pathogens, including hepatitis A and Norwalk viruses and bacterial pathogens, including Vibrio cholerae, Vibrio parahaemolyticus, Vibrio vulnificus, Aeromonas, Salmonella, Escherichia, and Campylobacter spp. Shellfish rank as the number one cause of water-borne disease in the United States, with the most frequent etiological agent being viruses. Because of the increasing problem of public health safety, a more reliable indicator of fecal pollution is needed and new indicator systems should be adopted. The most effective are those based on molecular genetic methods, including gene probes, which are now used in clinical laboratories to detect pathogenic bacteria and viruses. Gene probes are highly specific and capable of detecting genetic sequences that are common to pathogens found in estuaries. The amplified nucleic acid sequences, using the newly developed PCR (polymerase chain reaction) permit detection of a single bacterium or virus in water or sediment samples. Monoclonal antibodies are also useful for direct detection of pathogens in estuarine samples. In fact, results, employing fluorescent antibody, show this to be an effective means to detect Vibrio cholerae and Campylobacter spp. in estuarine and brackish waters. It is important to utilize these modern methods of detection to provide a more accurate assessment of public health safety of estuaries. However, even more importantly, biotechnology should be used to reverse the trend of estuarine and coastal health degradation.

Economic Incentives in Coastal Zone Management.
Wallace E. Oates (University of Maryland and Resources for the Future).

This paper explores the potential role for economic incentives in the regulation of coastal zones. It considers the use of such policy instruments as taxes on damaging activities and transferable (marketable) rights. Such policy instruments provide direct incentives to individuals to reduce activities with adverse environmental effects and promise to achieve this objective at relatively low cost. While the general properties of economic incentives are well understood, there are some formidable obstacles to their use in a coastal zone setting. The paper considers ways to deal with these obstacles.

Marine Debris. JAMES R. KAHN (SUNY-Binghamton).

This paper examines several key issues which must be resolved in order for effective policy to be formulated with respect to marine debris. The current state of knowledge, availability of data to test hypotheses, and current practice is discussed with respect to each issue. The issues examined include the measurement of damages associated with marine debris (particularly beach debris), the choice of policy instruments (economic incentives versus direct controls), conflict with other environmental policies, the municipal government as a polluter, and inter-jurisdictional conflict.

Policies for Sustainable Development of Coastal Regions
ROBERT COSTANZA (Coastal and Environmental Policy Program, Center for Environmental and Estuarine Studies, University of Maryland, Solomons, MD 20688)

Understanding and managing coastal regions for sustainability requires an integrated "ecological economics" approach. This implies: (1) a recognition of the economy as a subset of the larger ecological life support system; (2) a pluralistic and comprehensive set of modeling tools for understanding the system; (3) a recognition of the high degree of uncertainty inherent in our understanding of these systems; and (4) a focus on policy instruments that can effectively modify the local incentives that guide individual behavior while at the same time recognizing and accomidating the large uncertainty.

This paper discusses this approach with respect to the Chesapeake Bay drainage basin, the nation's largest estuary and the world's best studied coastal region. New spatially articulate landscape modeling tools are being applied in this region to give us a better picture of the possible implications of our actions on the combined ecological economic system. New policy instruments are being proposed based on a flexible assurance bonding system that can translate this understanding (and especially the degree of remaining uncertainty) into appropriate action. The bonding system modifies local incentives to incorporate long term goals and uncertainties and allows economic forces to improve rather than degrade the environment and lead to sustainable development.

The Effect of Coastal Land Use Restrictions on Housing Prices: A Repeat Sale Analysis. GEORGE PARSONS (University of Delaware).

The Critical Areas Commission of the state of Maryland established a set of land use restrictions that limit residential development on land abutting the Chesapeake Bay. I estimate the effect of these restrictions on housing prices in one community on the Bay. I use a repeat sale analysis -- inferring the effect of restrictions by observing price changes on houses that sold both before and after the restrictions were enacted. Housing prices near but not in the Critical Area increased by 10-15% due to the restrictions; prices in the Critical Area increased by approximately 20-30% (houses without water frontage) to over 50% (houses with water frontage).

Marine Environmental Policy in Louisiana
LEON E. TAYLOR
(Tulane University)

This paper will examine the possibility that jurisdictions are myopic in their long-run tradeoffs between jobs and

environmental quality. An impoverished jurisdiction might try to attract industry by offering it the right to pollute. Over time, industrialization will raise the per-capita income of the jurisdiction's residents. So they will demand more environmental quality, a normal good. Unfortunately, many environmental insults cannot be reversed. This paper will apply the analysis to coastal policy in Louisiana, a state that traditionally has pursued industrial development aggressively.

25T-2. Ecosystem Perspectives of Multiple-Use Management

Organized by: **Wayne T. Swank** *(Project Leader, Coweeta Hydrologic Laboratory, Southeastern Forest Experiment Station, U.S. Forest Service, Otto, NC)* and **David H. Van Lear** *(Professor, Dept. of Forestry, Clemson Univ., Clemson, SC)*

8:30 am / Tue / 19 Feb **Sheraton/Richmond**

Philosophy, Aims, and Structure of New Perspectives for Managing the National Forest System. H. SALWASSER, J. CAPLAN, C.W. CARTWRIGHT, JR., AND W. B. KESSLER (USDA Forest Service, Washington, DC).

New Perspectives is operational management of lands and resources at the state-of-the-art in scientific knowledge. It is also management that is consistent with people's expectations for a high quality environment that provides for sustainable uses of natural resources. Significant changes are occurring in Forest Service programs in response to changing expectations of the American people and advances in scientific knowledge, especially knowledge about the roles of ecological structure and function in the diversity and productivity of ecosystems. New approaches to environmentally sensitive land and resource management, coupled with stronger roles for science in that management, characterize the 1990 RPA Recommended Program. New Forest Plans, our Research Strategy for the 90's, and initiatives with partners in the private and public sectors--such as Change on the Range, Rise to the Future on fisheries, the National Recreation Strategy, and Stewardship with the State Foresters--carry out the philosophy and direction of the Program. The principles of sustainability, participation, and integration also bring forest users, scientists, educators, communicators, political leaders, and cooperating State and Federal agencies into partnership roles in revitalizing the multiple use ideal through actual results on the land.

New Forestry Principles from Ecosystem Analysis of Western Forests. F.J. SWANSON (USDA Forest Service and Oregon State University, Corvallis, OR), and J.R. FRANKLIN (University of Washington and USDA Forest Service, Seattle, WA).

Twenty years of ecosystem analysis in the Pacific Northwest and major public debate about the future management of natural resources are leading to substantial change in management of forests and stream ecosystems in the region. Research has revealed the complexity and function of ecosystems at stand landscape scales. Recent shifts in management of Federal forest land include: 1) managing stands for higher levels of structural diversity, such as by retaining standing dead trees, down woody debris, and mature live trees in cutting units to better meet biological diversity objectives than was the case with clearcut and broadcast burning techniques; 2) aggregation of successive cutting units to manage for larger blocks of continuous forest interior habitat and reduced amounts of forest edge compared with the past program which emphasized dispersion of cutting units; and 3) management of stream and riparian networks within a drainage basin context rather than solely on the basis of site-specific criteria. These changes are an effort to improve the balance between commodity production and ecological objectives. Specific management approaches based upon ecosystem and landscape research will vary, depending on ecological, social, and historical factors. However, the common themes are that management should recognize the natural complexity of ecosystems and the broad time and space scales necessary in dealing with natural resources.

Gradient Analysis of Ecological Change in Time and Space: Implications for Multiple Use Management. J.R. GOSZ (Univeristy of New Mexico, Albuquerque, NM).

A broad ecosystem view is essential when examining the multiple factors affecting ecosystems. Focusing on a variety of scales of time and space is needed to detect changes in those factors. All ecological systems are complex, nonlinear systems that share the properties of being: 1) hierarchically structured, 2) far from equilibrium, and 3) metastable (O'Neill et al. 1989). The processes and characteristics that are important in understanding change in forest ecosystems exhibit these properties. Gradient studies, in both time and space, identify the behaviors that have important implications for multiple use management. Ecotones along elevational gradients and biome transition zones are especially valuable for demonstrating the nonlinear spatial gradients across a range of scales. These margins also are likely to demonstrate thresholds and nonlinear, chaotic temporal dynamics. They provide areas for studying the interactions between physical and biological processes and between time and space scale dynamics. This paper will utilize southwestern forests and watersheds to demonstrate nonlinear, scale-dependent characteristics of hydrology, productivity, disturbance and species change. Many of these characteristics may demonstrate thresholds, bifurcations and amplification phenomena.

Watershed Ecosystem Analysis as a Basis for Multiple Use Management of Eastern Forests. J.W. HORNBECK (USDA Forest Service, Durham, NH), and W.T. SWANK (USDA Forest Service, Otto, NC).

There is ever increasing competition for the many uses and natural resources of forests in Eastern United States. Multiple use management has long been a stated goal for these forests, but application has been problematic and seldom satisfactory to all users. There is a need to incorporate more science into management decisions for eastern forests, and in so doing, to convincingly demonstrate to forest managers and the public why certain combinations of uses may or may not be compatible. One approach for doing this is to use watershed ecosystem analysis. Small watersheds, usually less than 100 ha in area, serve as a convenient ecosystem boundary for studying how forests function in terms of cycling energy, nutrients, and water. Results of these studies allow assessments of forest health and productivity, and evaluations of impacts of both natural and human related disturbances. This paper provides an illustration of how watershed ecosystem analysis can be used to study individual and cumulative effects of current harvesting practices, atmospheric deposition, and past land use. The paper also discusses the need and methods for putting these results in a context that can be readily understood and used by forest managers and the public.

Principles of Landscape Ecology in Natural Resource Management of Southern Forests. R.R. SHARITZ (Savannah River Ecology Laboratory, Aiken, SC), L.R. BORING (University of Georgia, Athens, GA), J.E. PINDER (Savannah River Ecology Laboratory, Aiken, SC), and D.H. VAN LEAR (Clemson University, Clemson, SC).

Natural resource management must integrate the commercial development and use of forest resources with the maintenance of ecological values. There are new public and scientific mandates for resource management, research and educational institutions to respond to increased public recognition of more diverse forest values. An integrated approach to the management of southern forest resources is needed in which nontraditional, nontimber values are developed along with commodity forest uses. Such an approach must couple scientifically based ecological principles with increasingly broadminded management perspectives, focusing on the forest as a whole ecosystem within the spatial context of the regional landscape. Management of the southern landscape must focus on problems of ecosystem restoration, riparian and nonriparian wetlands and the importance of large scale disturbance events (e.g., hurricanes, tornadoes, floods and fire). Long-term multidisciplinary research programs on southeastern ecosystems and on changing regional landscape patterns serve as a valuable base for examining the potential of resource management to integrate forest uses and ecological values.

25T-3. Tropical Biology: Historical Perspectives and Contemporary Issues

Organized by: **Joel Hagen** *(Assistant Professor of Biology, Radford Univ., Radford, VA)*

8:30 am / Sun / 17 Feb **Sheraton/Richmond**

European Visions: Science, the Tropics, and the War on Nature. MICHAEL A. OSBORNE (University of California, Santa Barbara).

The concept of the tropics is inextricably linked to European notions of a colony. This is especially so for the French, who in the nineteenth century measured a colony's value by the degree to which its products were "exotic" or different from those of metropolitan France. So pervasive was the conviction that colonies should provide exotic "tropical" products such as coffee, spices, and sugar, that French policy was to create a tropical agricultural regime in arid and semi-arid French Algeria. While the scientific and economic ideas which informed this effort to transform, rationalize, and master colonial environments have changed, the technical and ideological legacy of this "war on nature" continues to animate human interaction with tropical ecosystems.

Biological Exploration of the New World Tropics in the Nineteenth Century. George R. Angehr (Smithsonian Tropical Research Institute)

The South American journey of Alexander von Humbolt in 1799-1804 began a century of extensive scientific exploration of the Neotropics. Travels and collections by Darwin, Wallace, Bates, and many others established that the tropics held an extraordinary number of species, many very similar to one another. These discoveries provided important evidence for the development and elaboration of evolutionary theory in the latter half of the nineteenth century.

Tropical Biology and Research Institutions in Southeast Asia, 1870-1930
David G. Frodin (2401 Pennsylvania Avenue, Philadelphia, PA 19130)

Biological research in Southeast Asia, both pure and applied, has a long history but apart from primary exploration remained small in scale until after 1860. About the only centers were botanical gardens, established mainly for economic reasons from early in the preceding century. Transportation developments, increased demand for tropical products and resources, economic, political and social changes, public health, and metropolitan rivalries created a need for intensified studies and more resident professionals and other staff. Governments strengthened local institutions and created new ones, and the climate for fundamental as well as applied research improved. The relative success of any given center in the years to 1914 is considered to have depended on three main factors: political-economic situation, institutional and professional climate, and personalities. As the 20th century advanced, however, many centers were weakened or eclipsed by specialization, changing needs and interests, administrative and political developments, and especially World War I and the economic depressions which followed. By the 1930s tropical biology had become concentrated in the more fortunate centers, the few universities, and those specialized units most closely connected with biological resources: the forestry institutes.

Castles in the Air: Laboratories, Research Stations, and the Emergence of Tropical Biology. JOEL B. HAGEN (Radford University).

Tropical biology has gained considerable attention during the past decade. However, for most of the twentieth century it existed on the periphery of the life sciences. Intellectually, tropical research was often ignored or treated as a marginal activity by other biologists. And tropical research stations had great difficulty establishing themselves as viable institutions. In this paper I analyze the intellectual and social problems faced by the nascent specialty of tropical biology, and I consider the changing conditions that ultimately allowed tropical research institutions to flourish.

OTS: A U.S. Initiative in the Late 20th Century to Develop Training and Research Programs in Tropical Biology. DONALD E. STONE (Duke University).

The Organization for Tropical Studies, Inc. is a consortium of universities and research institutions, now 53 strong, that was chartered in 1963 to provide leadership in education, research and the wise use of natural resources in the tropics. Earlier efforts along these lines by individual institutions had met varying degrees of success. However, with the impetus of several conferences sponsored by the U.S. National Science Foundation and initial funding to the University of Southern California for a "Fundamentals of Tropical Biology" course in Costa Rica, six U.S. and one Costa Rican university banded together to establish the consortium. The initial focus was to train a cadre of temperate-based faculty in the ways of tropical biology so that they could, in turn, serve as instructors to graduate students. OTS was viewed as an extension of the university's graduate school into the tropics for unique training in field biology. The 8-week courses developed a distinctive format that exposed students to an exciting mix of ecological theory, natural history, and problem-solving exercises. As course alumni gained experience in tropical studies, Costa Rica became a focal point for graduate and post-doctoral research. The research focus, while rooted in basic science, has broadened in recent years to include such relevant issues as the retention of soil nutrients and the reforestation of abandoned pasture.

25T-4. Advances in Zoo Biology and Conservation

Organized by: **Benjamin B. Beck** *(Associate Director for Biological Programs, National Zoological Park, Smithsonian Institution, Washington, DC)*

2:30 pm / Mon / 18 Feb **Sheraton/Richmond**

Species Survival Plans: Cooperative Efforts to Save Endangered Species
MICHAEL HUTCHINS (American Association of Zoological Parks and Aquariums)

Professionally-managed zoological parks and aquariums provide a haven for some endangered species, thus increasing their chances for continued survival. Long-term viability of small populations requires intensive management. In 1981, the American Association of Zoological Parks and Aquariums developed the Species Survival Plan (SSP). A major goal of the SSP is to retain as much of a population's original genetic diversity as possible, with the ultimate goal of providing a hedge against extinction. Detailed computer records are maintained on individual animals, including age, sex and genealogy. Sophisticated software programs help avoid excessive inbreeding or demographic swings that can lead to population crashes, and to maintain animal populations within the limits of available space. Participating zoos act cooperatively in the best interest of a species, moving animals from one location to another to meet breeding recommendations. Some programs have been so successful that efforts are currently underway to reintroduce captive-bred animals into the wild. The purpose of this paper is to describe the goals and biological principles underlying the SSP, and to show how the program is being used to enhance wildlife conservation.

The Umwelt: Biologically Salient Features of Zoo Environments. ELIZABETH FRANKE STEVENS (Dept. of Conservation & Research, Zoo Atlanta).

Traditional animal cages are becoming endangered in the zoo world - biologically relevant environments are taking

their place. The succession of enclosure designs reflects changing attitudes of the caretakers, Homo sapiens. We are fast approaching the climax stage of this succession with the emergence of biologically appropriate zoo environments, demonstrating a switch from an anthropocentric perspective to a focus on the biological needs of a specific taxon. Whereasprevious designs of zoo cages focused on nutritionally correct diets and antiseptically clean enclosures, current ideas in habitat design consider the dynamics of a species' social organization, its foraging behavior and its interaction with its natural physical environment. The achievement of a biologically appropriate zoo environment promotes species-typical behavior in the captive setting, which enhances reproduction and the psychological well-being of the animals. An animal's external environment, or "Umwelt," is made up of particular stimuli perceived by the animal. The key to success in designing an animal's environment is the ability to pinpoint those particularly relevant stimuli. As wild environments are managed more extensively, knowledge of biologically salient features of an animal's Umwelt will certainly aid in effective decision-making concerning the conservation of that particular species.

Mortality Patterns in Neonatal Giant Pandas: Methods to Improve Survivability. R. MONTALI (National Zoological Park, Smithsonian Institution), A. STEUER (Biotech Research Lab.), and N. PAPADOPOULOS (National Institutes of Health).

Of all neonatal animals in the Order Carnivora, the giant panda cub is the most altricious, being almost fetal-like at birth. Enormous investment is made by the dam to nurture the cub during its first year. Twinning is common but only one cub is raised by the dam; handrearing of rejected twins has not been successful. Pathological studies of 9 captive-born giant panda cubs from different parts of the world implicate pre and postnatal opportunistic bacterial infections as important factors in their mortalities. Unlike humans, major passive immunity in giant pandas is conferred via the colostrum. Studies of serum by special chromatography (HPLC) and electrophoresis (HRE) methods indicated insufficient IgG levels (<10mg/dl) in an NZP cub dying in 1987. Concentrated immunoglobulins prepared from normal adult giant panda serum by ion exchange produced high circulating levels (462mg/dl) of IgG in the NZP cub in 1989. Application of this technology in fortifying neonatal immunity may improve the survivability of giant pandas born in captivity.

Reproductive Endocrinology of Captive and Free-ranging Gorillas. NANCY M. CZEKALA (Zoological Society of San Diego), PASCALE SICOTTE (University of Montreal).

The reproductive endocrinology of the captive lowland gorilla has been investigated during the past several years. Using a noninvasive approach to sample collection, random daily urines have been collected and analyzed for gonadal, adrenal and pituitary hormones in both males and females. The reproductive endocrinology of fertile and subfertile individuals has been compared. Differences in hormonal dynamics between these two groups have been identified. In captivity 65% of mature female gorillas can be considered subfertile. In an effort to determine the reproductive endocrinologic parameters of gorilla populations existing without the constrains and stresses of captivity, daily urine collections were initiated on free-ranging habituated mountain gorillas. Urines were collected daily from 3 nonpregnant, nonlactating mature females and randomly from males during a one month field study based at the Karisoke Research Center in Rwanda. Behavioral correlates to reproductive function were compared to hormonal values. This study to determine endocrine parameters in the non-captive mountain gorilla is the first of its kind. The results of this and future studies will further our understanding of reproductive function in the captive gorilla and permit endocrine correlates to behavioral variables. (Support: National Geographic Soc., Leaky Fdn., Kelco-Merck Fdn., Zool. Society of San Diego, The Digit Fund).

Reintroducing Zoo-Born Animals to the Wild. BENJAMIN B. BECK (National Zoological Park, Smithsonian Institution).

Reintroduction is one rationale for maintaining stocks of endangered animals and plants in zoos and arboretums. Reintroduction can begin when the captive population is self-sustaining, there is suitable protected habitat within the species' historic range, there would be no detrimental competition with or threats to the health of the remaining wild population, and when the local human populace understands and supports the recovery effort. Mortality of reintroduced zoo-bred animals is high (at least 50%), and successful breeding among reintroductees is slow to begin. Reintroduction is expensive (at least $20,000 per individual). But scientific findings about reintroduction are now emerging that promise increased cost-effectiveness. For example, for birds and mammals, subadult reintroductees survive longer than adults. Training in specific food-finding, anti-predator and orientation skills does not appear to increase survivorship, although general acclimitization to the release environment does. Enthusiasm for reintroduction as a conservation tool must be guarded, and matched by a determination to study the process to assemble a science of reintroduction.

Public Education and Professional Training in Conservation LOU ANN DIETZ (World Wildlife Fund)

Today's zoos are among leaders in the conservation community who have recognized that public education and professional training are essential elements of biodiversity conservation. As humans become more removed from natural ecosystems, zoos are becoming an increasingly important link in providing the public direct experience with elements of the natural world which are difficult or impossible to observe in the wild. This direct experience is essential to educate the public and thus involve them in direct actions they can take to contribute to the conservation of the world's biodiversity. The large number of visitors attracted by zoos worldwide are thus the target of an increasing number of effective conservation education programs. Many zoos are also utilizing the direct experience they can provide as a basis for valuable practical training for professional conservationists. Examples of effective zoo public education and training programs both in the United States and abroad will demonstrate specifically the important contribution zoos are making to tropical forest conservation.

26. Biomedical Ethics

26-1. Alternative Approaches to Clinical Trials in AIDS: Ethics and Methodology

Organized by: Kenneth F. Schaffner *(Professor of History and Philosophy of Science and Co-director, Center for Medical Ethics, Univ. of Pittsburgh, Pittsburgh, PA)*

8:30 am & 2:30 pm / Sun / 17 Feb **Sheraton/Arlington**

Controlled Clinical Trials and Expanded Access: Can We Do Both? ELLEN C. COOPER, M.D. (Division of Antiviral Drug Products, Office of Drug Evaluation II, Food and Drug Administration).

The goal of investigational new drug development is marketing approval. This goal, even for drugs intended to treat serious or life-threatening diseases, must be reached by developing sufficient safety data and substantial evidence of efficacy from adequate and well-controlled trials. Expanded access, that is, allowing the use of experimental agents for patients with serious or life-threatening diseases who have no satisfactory alternatives, makes limited contributions to this goal and may impede the ability to conduct

controlled clinical trials. In the treatment IND regulations and the proposed parallel track policy, both mechanisms for providing expanded access, the paramount concern is that drug development is neither delayed nor otherwise compromised. However, it is not clear how the impact of expanded access on the pace or quality of controlled clinical trials is to be assessed, or whether actual termination of expanded access protocols because of interference with controlled trials can be implemented. Creative methods for designing expanded access to encompass some controlled studies should be pursued.

Developing New Approaches to Clinical Trials in AIDS. SUSAN S. ELLENBERG (National Institutes of Health).

The planning of clinical trials of AIDS therapies has proceeded in an atmosphere of intense pressure to produce results quickly. The expectations and demands to increase efficiency, while at the same time providing wide access to experimental drugs, is unprecedented in the history of clinical research. These pressures have forced those who design, conduct and evaluate trials in AIDS to reassess many aspects of trials design, and to consider alternative approaches that might improve efficiency while maintaining reliability. One approach frequently suggested is a greater use of "surrogate" endpoints--outcomes that can be used to evaluate drug effects but which are observed much earlier than the clinical events usually required in clinical trials. Laboratory markers such as CD4 are the most obvious candidates. Despite the clear prognostic value of these markers, it is not yet known whether any can serve as a valid primary endpoint in pivotal studies. They may be more useful in early screening trials as a means of prioritizing new agents for further study. The possibility of widening access to new drugs in the context of simple clinical trials should be seriously explored. Even very limited data on toxicity and efficacy, in a large and diverse group of patients, could be used to assess the likely "real-world" effect of the drug. Such trials would complement traditional data-intensive trials and could conceivably accelerate the introduction of effective new therapies to the marketplace.

Design Options for AIDS Trials. DAVID P BYAR (National Cancer Institute, Bethesda, MD)

Before clinicians and biostatisticians choose a research design for answering some specific question(s) concerning prophylaxis or treatment of patients with HIV infection, they need to consider and debate a variety of possible options. The best choice of design should balance the needs of the patients with the requirements for producing reliable scientific information. Patients and their advocates should participate in these discussions. I will discuss the role of randomization, the use of placebos and blinding, choice of what to compare with a new treatment (standard therapy or no treatment, different doses of the new drug, or two or more new drugs), and present some possible new options including randomized phase I and combined phase I/II designs. Factorial and reciprocal control designs will be presented as ways for answering more than one question in a single trial, particularly for studying potential immunostimulants or prophylaxis for various opportunistic infections. Finally I will review criteria for deciding whether in some unusual situations a non-randomized study might be appropriate.

Large, Simple Trials--An Unexploited Opportunity. PAUL MEIER (University of Chicago).

In 1954 a low budget study enrolled a million children and demonstrated the benefit of Salk vaccine in the prevention of Polio. Thirty years later, low budget studies have enrolled tens of thousands of heart attack patients and have demonstrated the benefit of thrombolytic drugs in reducing mortality. To date, AIDS trials have been small and high budget. Although we have learned much from these small trials, the pace of testing could be markedly increased and the benefits of participation could be extended to a vastly larger group if we were to exploit this highly effective methodology. The paper will discuss the advantages and limitation of large sample trials for AIDS therapies.

Community Consultation in Clinical Trials. ROBERT J. LEVINE (Yale University School of Medicine).

Community consultation (CC) is a formal meeting between investigators, prospective subjects, intended beneficiaries and other interested persons convened during the design of a clinical trial (CT). Its purpose is to negotiate the design and plans for execution of a CT to assure a suitable balancing of the relevant values; ie, social beneficence, autonomy, individual beneficence and distributive justice. Trade offs are anticipated on such often contentious topics as placebo controls, narrow inclusion criteria, and exclusion of (e.g.) women who could become pregnant, abusers of illicit intravenous drugs and persons who self-medicate with nonvalidated therapies. The principal result of CC should be an agreement regarding the CT's design and conduct which will not only measure up to scientific standards but also be acceptable to most members of the population of prospective subjects and intended beneficiaries of the CT.

Use of CC in CTs of new drugs for the treatment of HIV infection should enhance recruitment for these CTs and cooperation during their conduct.

How AIDS Will Change the Way We Test Drugs JIM EIGO (ACT UP/NY)

AIDS is both an underlying disease and a susceptibility to secondary diseases. There are no satisfactory treatments for the disease and few for its sequelae. For every person with symptomatic AIDS there are a few who are asymptomatic but infected with HIV. All this contributes to the urgency to find effective therapies swiftly. Because of AIDS, FDA has initiated a policy of approving drugs for marketing after only two phases of testing, a basic safety/pharmacology study and a pivotal efficacy trial. Parallel Track makes an investigational AIDS drug of acceptable toxicity available to people without therapy. Toxicity information formerly gained in clinical trials (such as drug interactions) can be gathered on subsets of Parallel Track patients. Under NIAID, a committee of biostatisticians, activists, researchers and regulators are discussing many further changes in clinical trials for AIDS drugs. Among these are: efficacy screens for rival antivirals, standardized "rollover" trials in which study drugs are changed as they become available, and ways of capturing efficacy data on randomized subsets of patients on the Parallel Track.

An Ethical Assessment of Clinical Trials of AIDS Treatments JAMES F. CHILDRESS (University of Virginia)

This paper will offer an ethical assessment of standard clinical trials of AIDS treatments, such as AZT, identifying key ethical issues in planning, starting, conducting, and stopping such trials. The paper will then compare the ethical issues that arise in alternative approaches to determining the safety and efficacy of AIDS treatments, before offering an overall assessment.

Patient Demands, Therapeutic Obligations and Clinical Trials. LORETTA M. KOPELMAN, Ph.D., (East Carolina University School of Medicine).

People with AIDS are demanding more control over clinical trials and greater access to experimental therapies. They believe that their individual interests are sometimes sacrificed to research goals, and that FDA rules are rigid and overly demanding. Patients may be willing to

take risks of harm that FDA seeks to preclude especially in life-threatening illnesses. They decry the FDA's paternalism. Clinical investigators fear that easier access to experimental drugs or more subject control of trials slows progress by subverting proven research methods. One response to these issues is the FDA "fast track" for drugs for life-threatening illness. Global controversies about methodology, consent, control, or how to balance risks of harms and possible benefits, however, remain. An important part of the problem has received no attention. The standard formulation of the so-called "therapeutic obligation" is that physicians must provide the best treatment available for their patients, even in clinical trials. This formulation heightens the conflict between investigators and patients because it is paternalistic and presupposes that there is typically a single best treatment. Exposing this formulation's weaknesses and offering a more justifiable statement of therapeutic duties may help address these controversies by removing one stumbling block in the way of investigators', clinicians' and patients' negotiating about risks, benefits and duties. Such negotiations befit partners in a joint venture to control a deadly epidemic.

26-2. Ethical and Clinical Issues in Carrier Screening for Cystic Fibrosis

Organized by: Jeffrey R. Botkin *(Assistant Professor of Pediatrics and Biomedical Ethics, Case Western Reserve Univ. School of Medicine, Cleveland, OH)* and Deborah Runkle *(AAAS Committee on Scientific Freedom and Responsibility, Washington, DC)*

2:30 pm / Mon / 18 Feb — Sheraton/Arlington

Informed Consent and Decisions about Reproduction
JEFFREY R. BOTKIN, M.D., M.P.H. (Case Western Reserve Univ.)

The design of a CF carrier screening program should be dictated by the intended goal(s) of the program. Three potential goals are discussed: (1) epidemiologic research; (2) informed choice in reproduction; (3) reduction in the incidence of CF. It is argued that a reduction in the incidence in CF is only acceptable as a consequence of pursuing a goal of informed reproductive choice. Therefore, the design of any carrier screening program must be dictated by how individuals would choose to use the information in making reproductive decisions. The experience of previous carrier screening programs for Tay-Sachs disease and the hemoglobinopathies is reviewed, and the limited data on reproductive decisions for CF carriers is discussed. It is argued that the potential negative consequences of a carrier screening program will deserve closer scrutiny if carriers make limited use of this genetic information for reproductive decisions.

CF, Ethics, and the New Genetics.
THOMAS H. MURRAY (Case Western Reserve University)

Cystic Fibrosis is only among the first of many diseases for which carrier testing will become available through the increased emphasis on research on human genetics. If carefully studied, the use of the test for CF carriers will illuminate the prospects and pitfalls of similar tests in the future. At least three important ethical issues will be addressed. First, what pretest information and counseling is adequate for an ethically acceptable informed consent? Public ignorance of genetics coupled with the potential gravity of a positive finding make robust informed consent vital though difficult. Second, how should the test be used? In light of consumer demand and companies' desire for profit, the CF test is already being used, without any systematic effort to determine how best to use it. At present, there is no method to fund a pilot study. Third, is population screening for CF carriers the best use of scarce medical resources?

27. Psychology; Neurobehavior

27-1. Reassessing Freud and Psychoanalysis

Organized by: Frank J. Sulloway *(Visiting Scholar, Program in Science, Technology, and Society, MIT, Cambridge, MA)*

8:30 am / Mon / 18 Feb — Sheraton/Alexandria

The Dreaming Brain: Reassessing Freud's Model of the Mind
J. Allan Hobson, M.D. (Harvard Medical School)

Freud's 1900 dream theory evolved directly from his ill-founded 1893 Project for a Scientific Psychology and thereby incorporated erroneous psychological derivatives of erroneous neurobiological assumptions into the mental model that became the nucleus of psychoanalytic theory. For example, in failing to recognize the reality of neuronal inhibition, Freud committed himself to the erroneous assumptions of perpetual and persistent memory from which evolved the assumption of repetition compulsion. In failing to recognize that the brain creates its own energy and its own information, Freud overlooked the intrinsic creativity and the novelty producing capability of the mind. The net result of these and related errors, is a mental apparatus which is reflexive and inextricably linked to its own history in a defensive and comprised batter with instinctual drives. Dreams were seen as neurotically symptomatic efforts to disquise and conceal forbidden and repressed wishes which were thought by Freud to be the driving force of dreaming. Modern neurobiology provides important correction to these views, especially in relation to the dream theory. Instead of being driven by instinctual wishes dreaming is revealed to be the result of spontaneous and automatic brain activation during sleep. Instead of concealing instinctual impulses, dreams reveal drives cleary and directly; the cognitive peculiarities of dreams are not the products of censorial concealment and symbolization but are symptomatic of the distinctive organic state of the brain in REM sleep.

Reassessing Freud's Case Histories: The Social Construction of Psychoanalysis. FRANK J. SULLOWAY (Massachusetts Institute of Technology)

A supreme irony lies in Freud's development of concepts like censorship and repression and his clinical attempts to overcome their supposedly pathogenic effects through psychotherapy. The history of Freud's movement illustrates these general distorting tendencies with a clarity and tendentiousness that are frankly extraordinary in the history of science.

This process of distortion is not just limited to the Freud legend. Freud's case histories are rampant with censorship, distortions, highly dubious "reconstructions," and exaggerated claims. Moreover, Freud's choice of cases to publish is itself unusual. Of his six principal case histories, one involved a patient who fled therapy in disgust after only three months, two were not actually treated by him, and another involved no real therapy.

The real reason Freud published these case histories was not because he considered them the empirical "pillars" of psychoanalysis, as some analysts have claimed. Rather the case histories served other functions, including the ironic one of trying to persuade his readers that psychoanalysis simply could not be learned from published case histories. To learn psychoanalysis, Freud increasingly believed, a personal analysis was required. Ultimately, Freud's decision to privatize and socially construct the analytic training process reflects serious methodological shortcomings inherent in psychoanalysis itself.

The Psychoanalytic Enterprise in Scientific Perspective
ADOLF GRÜNBAUM (University of Pittsburgh)

This paper examines critically Freud's own principal arguments for his theories of psychopathology, dream-formation and generation of slips. Besides, it offers (i) an unfavorable appraisal of the psychoanalytic method of free association qua method of causal inquiry, (ii) a negative verdict on the merits of the current neo-revisionist versions of psychoanalysis. The extant experimental evidence does not alter these critical conclusions.

The Nature of Theory Change in Psychoanalysis, Morris N. Eagle (Department of Applied Psychology, Ontario Institute for Studies in Education, University of Toronto, Toronto, Ontario, Canada)

A frequent response to cogent criticisms of psychoanalysis is that although they may be relevant to Freudian theory, they are not applicable to contemporary psychoanalytic theory. Often not made clear in this response are (1) just what contemporary psychoanalytic theory is; (2) how it escapes the epistemological difficulties characteristic of Freudian theory; and (3) on what basis theoretical modifications in psychoanalysis are proposed. This paper considers all three issues - but especially focuses on the third question of how theoretical changes come about in psychoanalysis. I attempt to demonstrate (1) that theoretical changes are not based on systematic empirical evidence; and (2) that what is viewed as contemporary psychoanalysis is as much a matter of political - sociological considerations as the substantive content of the theory.

Unconscious Person Schemas and Control Processes
MARDI J. HOROWITZ, M.D. (University of California at San Francisco)

Neurotic character disorders are the primary concern of psychoanalysts. Modern approaches to inferring unconscious knowledge structures that may contribute to such personality disorders include person schematic formulations. Person schematic repertoires of a person may consist of multiple conflicting views of self as well as sets of desired, dreaded, and ordinary role relationship models for organizing sequences of transaction with others. Any person may manifest a small variety of personality styles as states of mind change. Conscious and non-conscious control processes may effect which person schemas are active and so which state of mind may emerge. The relation of these contemporary theories to Freud's views of transference and defense mechanisms, and to modern cognitive science, will be discussed.

27-2. A Critical Examination of the Concept of Critical Periods

Organized by: **Thomas J. Tighe** *(Provost and Vice President for Academic Affairs, Univ. of Connecticut, Storrs, CT)*, **Barbara Lust** *(Professor of Human Development and Family Studies, Cornell Univ., Ithica, NY)*, and **Bert Moore** *(Dean, School of Human Development, Univ. of Texas at Dallas, Richardson, TX)*

2:30 pm / Sat / 16 Feb **Sheraton/Alexandria**

The Critical Period Concept: A Probabilistic Epigenetic Phenomenon.
GILBERT GOTTLIEB (University of North Carolina at Greensboro).

Critical (or sensitive) periods in behavioral and psychological development are not biological "givens" determined solely by genetic and/or maturational factors. The chronological and temporal aspects of any critical period are also influenced by the developing organism's (1) prior experiences and (2) the kind of stimulation encountered during the critical period. Several "imprinting" experiments with duck embryos and hatchlings have demonstrated the importance of prior experiential and current stimulative factors in the determination of the critical period for early auditory and visual attachment to the mother. In one experiment, an embryonic critical period was indefinitely extended into postnatal development. Thus, the critical period concept is most appropriately viewed as a probabilistic epigenetic phenomenon and not as a strictly biologically predetermined feature of animal and human development.

Visual and Auditory Sensitive Periods: A Search for Lessons.
RICHARD D. WALK (George Washington University).

The study of visual and auditory development provides a number of lessons that aid in understanding the development of language. My interest is in facilitating and in inhibiting influences on perceptual development. Two lines of research on sensitive periods form the background. One line followed the classical studies of Hubel and Wiesel on the effects of eye closure on the visual cortex of kittens. The other research came, mostly, from studies of birds, particularly studies such as those of Gottlieb on the effects of prenatal experience on the recognition of the maternal calls of ducklings. Both lines of research are reviewed in Rauschecker & Marler (eds) (1987); the visual work was recently reviewed by McDonald & Johnston (1990).

This paper will take the lessons from the prior research and apply it to recent research on early language development. As examples: de Boysson-Bardies et al (1989) have shown influences of the mother's language on the babbling of infants, DeCaspar & Spence (1986) have shown prenatal learning of passages read by the mother, Mehler et al (1988) have shown prenatal learning of the mother's language, and Tees & Werker (1984) and Werker (1989) have shown that the initial plasticity of human language reception is succeeded by a narrowing of some linguistic discriminations by the time the child begins to talk. These are examples of relationships that will be discussed.

Constraints and Development
SUSAN OYAMA (John Jay College, City University of New York)

The language of biological constraints grew up largely in opposition to broad claims about the generality of learning. Critical or sensitive periods, then, are typically presented as fixed, internal factors limiting the arbitrary, potentially unlimited action of external ones: They are considered an occasional assertion of "nature" that constrains "nurture."

Changes in responsiveness to stimulation, however, characterize all developmental processes. Far from being exceptions to an otherwise undiscriminating susceptibility to external influences, sensitive periods are ubiquitous aspects of phenotypic organization. They result from past interactions (within the organism and between it and its environment), and influence future interactions. As developmental products, they should be subjected to the same kinds of developmental analysis that are used to investigate any other phenotypic character. They should not be assumed to be fixed because of an unreflective reliance on ideas of static biological nature.

27-3. Critical Periods in Second Language Acquisition

Organized by: **Suzanne Flynn** *(Associate Professor of Second Language Acquisition, MIT, Cambridge, MA)* and **Barbara Lust** *(Professor of Human Development and Family Studies and Linguistics, Cornell Univ., Ithaca, NY)*

8:30 am / Sat / 16 Feb **Sheraton/Alexandria**

Brain Bases for Possible Critical Periods.
LORAINE K. OBLER (Emerson College, CUNY Graduate School, Boston VA Medical Center), PATRICK J. MCNAMARA (Boston VA Medical Center and Boston University School of Medicine)

The classic evidence for critical and sensitive periods in communication comes from the study of hemisphericity in birds. In humans discussion of critical periods often centers only on development of cerebral dominance. Although cerebral dominance starts in intrauterine life and develops over childhood, it is unclear when it ceases. Less is known about the development of language centers within the left hemisphere, but intrahemispheric organization is likely crucial to the critical period question as well.

Evidence for critical periods in monolingual acquisition comes from studies of childhood aphasia, hemispherectomies, and Genie. Geschwind and Galaburda have proposed a hormonal theory that would account for some or most of the findings.

The behavioral linguistic evidence does suggest a critical period in L2 acquisition, at least for accent. Evidence against a critical period for second language acquisition comes from studies of cerebral dominance and polyglot aphasia. To test whether age of L2 acquisition influences eventual processing, one would need to employ dynamic techniques such as PET scanning, evoked potential studies, or cerebral blood flow techniques.

The Effects of Delayed Language Acquisition on the Acquisition of Grammar and Cerebral Organization.
SUSAN CURTISS (UCLA)

A growing body of work on first language acquisition, in both spoken and sign language, indicates consistent, substantial deficits in the acquisition of grammar, particularly in the areas of morphology and syntax, if first language acquisition takes place after a maturationally defined "critical period." Related research suggests that first language acquisition of both sign and spoken language at the normal time, may be an important trigger for the establishment of normal cerebral organization. On this assumption, what happens to cerebral organization when language acquisition does not occur within its normal developmental window? This paper will discuss relevant findings and their implications.

Critical Periods in First and Second Language Learning: Evidence and Models of the Effects of Maturation on Language Acquisition. ELISSA L. NEWPORT (University of Rochester)

This paper begins by reviewing two lines of research showing evidence for a critical (or sensitive) period for human language acquisition. In the first line of research, studies have been performed on deaf adults whose primary language is American Sign Language and who vary in the age of first exposure to ASL, from birth to adolescence. The results show that grammatical competence in ASL, after 30 years of everyday use of the language, is a function of age of first exposure. In the second line of research, analogous studies have been performed on hearing adults whose first language is Chinese and who vary in the age of exposure to English (their second language), from age 3 to 39. The results are comparable to those above, showing that grammatical competence in English, after 10 years of everyday use of the language, is a function of age of first exposure. In both sets of studies, the effects appear to be the result of maturational change, and are not due to length of experience, formal instruction, or other confounding variables. Finally, two models of these maturational effects will be discussed and compared to critical period phenomena in other domains. One model hypothesizes maturational decay in the ability to learn language. The second model hypothesizes maturational increases in cognitive abilities which, paradoxically, result in decreased control over linguistic structures.

How Critical is Age in Second Language Acquisition?
SUZANNE FLYNN (MIT) and GITA MARTOHARDJONO (MIT)

Recent claims about critical periods or age-dependent effects have led some (e.g. Schachter 1988, Clahsen and Muysken 1989, Johnson 1988) to conclude that certain and in some cases, all language mechanisms responsible for determining the acquisition of a first language (L1) are no longer available to the adult second language (L2) learner. More specifically, some have argued that the biological foundations for language are significantly altered for adult L2 learning. While not denying that there are certain differences between child L1 and adult L2 learning that must be explained (e.g. Newport and Johnson 1988), we argue that conclusions reached about the precise psychological nature of those differences, viz. that the biological component for language is unavailable to the adult L2 learner, are both premature and untenable. We will present data which demonstrate that the adult L2 acquisition of complex syntactic structures by learners from distinct L1's is constrained by principles that are governed by the domain-specific program for language, suggesting that the underlying biological mechanisms remain intact during the adult L2 acquisition process.

27-4. Current Conceptions of Intelligence

Organized by: **Thomas J. Tighe** *(Provost and Vice President for Academic Affairs, Univ. of Connecticut, Storrs, CT)* and **Bert Moore** *(Dean, School of Human Development, Univ. of Texas at Dallas, Richardson, TX)*

2:30 pm / Sun / 17 Feb **Sheraton/Alexandria**

From Intelligence to Intelligences and Beyond
HOWARD GARDNER (Harvard University)

Current conceptions of intelligence can be thought of as the culmination of a seven-step, partially-ordered sequence: 1) Lay conceptions; 2) Psychometric measures of a single intelligence; 3) Pluralization of intelligences; 4) Intelligences targetted to specific contents; 5) Consideration of context; 6) Intelligence as distributed in the environment; 7) Development and nurturance of individual intellectual potentials.

Beyond IQ: A Triarchic Theory of Human Intelligence
ROBERT J. STERNBERG (Yale University)

Conventional theories and tests of intelligence represent a narrow and to some extent misleading view of intelligence. This presentation will discuss ways in which conventional views are inadequate, and suggest a new, broader theory as well as a test derived from it as replacements. The proposed triarchic theory views intelligence as comprising memory-analytic, synthetic-creative, and practical-contextual aspects. The three aspects are at best modestly correlated. Although conventional tests as well as schools emphasize memory-analytic abilities, the other two kinds of abilities become more important in later life, and indeed, the most important contributors to society in a variety of fields probably excel in synthetic and/or practical abilities. These latter kinds of abilities are quantifiable, and our research shows that they are predictive of job skills that conventional tests predict only poorly. Such tests are often grossly overvalued, for reasons that will be discussed. Ultimately, our assessments need to look at profiles of the three aspects of intelligence in various domains of mental representation, and to look at the extent to which people possess the cornerstone of intelligence, namely, the ability to capitalize upon one's strengths and to compensate for or remediate one's weaknesses in domains of importance to the individual.

Identical Twins Reared Apart: What they Reveal About Human Intelligence
THOMAS J. BOUCHARD, JR. (University of Minnesota)

The Minnesota Study of Twins Reared Apart is a comprehensive study of monozygotic and dizygotic twins separated early in life and reared apart (MZA and DZA twins). As part of the assessment battery the twins complete twenty-eight special mental ability tests, as well as two measures of IQ, the Wechsler Adult Intelligence Scale and a test composed of the Raven Progressive Matricies, supplemented by the Mill-Hill Vocabulary

test. Measures of parental education and occupational status as well as self-reports of physical facilities in the home and child rearing practices, are also obtained from the twins. The data from all ability tests were subjected to a genetical model analysis. The special mental abilities yielded an average heritability of about .50. The two IQ measures yielded heritabilites of .69 and .78, respectively. The first principal component of the twenty-eight mental abilities (an estimate of IQ) yielded a heritability of .78. Given that the sample is largely composed of adoptees, it was possible to correlate specific features of the twins rearing environments with their mental ability and IQ scores. The correlations were all very modest, some even negative, indicating that these factors had little, or no, causal influence on the traits studied. Consequently the high level of similarity between the MZA twins could not be explained by selective placement on parental or family characteristics, quality of the rearing environment or self-reported child rearing practices. Twin similarity could also not be explained by pre- or post-reunion contact between the twins. Environmental factors widely believed to have an important impact on IQ appear to be much less influential than previously believed. With respect to the heritability of special mental abilities and IQ, the findings are in very close agreement with previous studies of twins reared apart and estimates of heritability generated by other behavior genetic designs.

General Mental Ability: From Psychometrics to Biology.
ARTHUR R. JENSEN (University of California, Berkeley).

Individual differences on diverse tests of mental abilities that range in complexity from simple reaction time to abstract reasoning are all positively correlated in the population. The total covariance among all such tests can be analyzed into a number of uncorrelated components of variance, or factors, that, in terms of their generality, are hierarchical, with the most general factor, or g, at the apex. This g is common to every type of cognitive performance, whatever other ability factors may be involved (e.g., verbal, spatial, numerical, musical, etc.), and is the crucial factor in most tests' practical validity. Its correlations with various tests' heritability, inbreeding depression, heterosis, average evoked potentials, brain metabolism, and many other physical correlates indicate that as a product of evolution it is profoundly enmeshed with many organismic variables. A theory based on empirical evidence links g to neural processes involved in the speed and efficiency of information processing.

Discussion: Current Theories from a System Perspective.
DOUGLAS K. DETTERMAN (Case Western Reserve University)

The contributions of other members of this symposium will be discussed from the system perspective of intelligence proposed by Detterman. The discussion will focus on the critical issues future research and theory should address as well as strengths and weaknesses of the current approaches. There are reasons to believe that the critical questions raised by current work will be answered in the next few decades. The reason for this optimism is that new methods for the study of intelligence hold great promise for helping us to understand this elusive aspect of human behavior called intelligence. Some of these methods will be discussed as well as some of the results that can be expected from them.

27-5. Cognitive Aging Among Intellectually Able Individuals: Patterns, Precursors, and Implications

Organized by: **Douglas H. Powell** *(Coordinator, Behavior Therapy Program, Harvard Univ. Health Services, Cambridge, MA)*

8:30 am / Fri / 15 Feb **Sheraton/Alexandria**

Cognitive Aging Among Intellectually Able Individuals: Overview.
DOUGLAS H. POWELL (Harvard University)

The need to understand the patterns and implications of cognitive aging has never been greater. The reasons are three: demographic, legislative, and increasing variability in human mental functioning after age 45. These realities present challenges for educational institutions and professions. While a growing need exists for individuals to work longer, it is also true that the probability of cognitive impairment grows with every passing year after 65. The symposium will approach the problem in five ways: (1) providing statistical data on 1101 physicians who took a new computerized test of cognitive functioning; (2) examining qualitative patterns of high and lower level scores in these data; (3) comparing these findings with other longitudinal samples; (4) illuminating precursors of high level cognition among octogenarians from subjects in Terman's studies of genius; and (5) discussing the implications of these findings from the perspective of the university and professional practice.

Quantitative Patterns of Normative and Superior Aging.
DEAN K. WHITLA (Harvard University).

The Assessment of Cognitive Skills (ACS) test was administered to 1101 volunteer physicians, 28-92 years of age. The analysis demonstrated a significant decline in total mean score and in subtest scores with increasing age, while at the same time finding a monotonic increase in test scores was Poisson in shape, which was especially pronounced in the upper age groups. Statistical analyses of the highest scorers showed remarkable differences from normative patterns. Among these were a growing tendency to continue to be able to perform a number of cognitive tasks at a high level and to improve with experience. One area that is affected by aging is visuospatial memory and operations.

Patterns of Cognitive Change with Aging in Physicians: Results from Computerized Assessment of Mental State.
SANDRA WEINTRAUB (Harvard Medical School).

Cross-sectional aging studies have consistently reported progressive decline in cognitive abilities over the life span. In addition to a decline in group means, a simultaneous rise in the magnitude of the standard deviations is also often reported, implying a good deal of variability with respect to individual aging patterns. In the present study, cross-sectional comparison was made among different age groups of physicians (28 to 92 years of age) on a computerized screening test designed to detect abnormal cognitive loss that might signal neurological disease. As in previous studies, there was evidence for an overall decline in the average total score with increasing age and an increase in the magnitude of the standard deviation. Scores on subtests measuring different skills (i.e., attention, visuospatial perception, reasoning, memory) also declined but at different rates implying an uneven effect of aging on different cognitive processes. In addition to analysis of mean scores, however, a comparison was made between subjects with the top 10 scores and subjects with the bottom 10 scores in each age cohort. The results indicate that the study of individual differences in cognitive aging may be a fruitful venture for understanding factors influencing successful aging.

Some Patterns of Cognitive Aging among Superior Septuagenerians. EDWIN S. SHNEIDMAN (UCLA) and GORDON D. STRAUSS (UCLA)

A second* preliminary study of verbatim word frequencies of 161 interviews held biannually, 1981 through 1989, with 35 male subjects of the Terman Study of the Gifted (begun in 1921) -- 1,029.749 words; 26,290 unique words - is reported. The words, covering ages 65 to 85, are discussed in terms of Sears's areas of life satisfaction: family, occupation, friends etc, as well as health and death. In general the data show mild decrements in total vocabulary over the septuagenerian decade, with interesting changes in word frequencies relating to specific areas. The general implication is that life-long adult high-level cognitive functioning is a good augury for the older ages, although there seem to be important changes after age 80.

*See E. Shneidman, The Indian Summer of Life: A Preliminary Study of Septuagenarians. American Psychologist, 1989, 44, 684-694.

Biopsychosocial Approaches to Physical and Cognitive Vigor in the Aging.
CARL EISDORFER (University of Miami Medical School).

Based on work in progress with the Institute of Retired Professionals in Miami and other research, the speaker will focus on the relationships between high level cognitive functioning and physical health. Looking at an aging population from a biopsychosocial perspective, similarities to and differences from the findings of others in the Symposium as to the patterns and precursors of continued high level cognition will be identified and discussed. Speculation will be shared as to what individuals might do to enhance their probability of continued strong intllectual functioning into the later years. Priority areas requiring further research will be outlined.

27-6. Cults and the Courts: Use of "Brainwashing" Theory by Expert Witnesses

Organized by: **William H. Swatos, Jr.** *(Editor, Sociological Analysis, Silvis, IL)* and **David G. Bromley** *(Professor of Sociology, Virginia Commonwealth Univ., Richmond, VA)*

8:30 am / Sun / 17 Feb **Sheraton/Alexandria**

Voluntary Motives vs. Involuntary Causes: Conflicting Interpretations of Research on Cults and Communist Thought Reform. DICK ANTHONY (Graduate Theological Union).

Anticult brainwashing analyses of religious conversions claim to demonstrate their involuntary character by pointing out similarities between the cultic and the Communist thought reform (CTR) contexts as the latter have been described in the research of Robert Lifton and Edgar Schein. However, minimal crieria of involuntariness were not satisfied by CTR as described by either Lifton's or Schein's research: (1) CTR was not effective. None of Lifton's or Schein's subjects converted to Communism, and only a small percentage were even slightly influenced by the process. (2) Characteristics of the influence process external to the person were not sufficient to account for who would be influenced. Rather, their research, especially Lifton's, at least partially accounts for the small degree of influence within CTR through the analysis of individual differences among their subjects and through the derivative application of a tradition of theory and research that has been concerned with demonstrating the internal motivational basis--e.g., dogmatism, authoritarianism, individual totalism--of conversion that preexists contact with totalitarian movements.

The Scientific and Popular Status of Brainwashing. PERRY LONDON (Rutgers University).

Tort liability cases in which plaintiffs claim damages from so-called "cultic influences" and "large group awareness trainings" are paralleled in American courts by a smaller number of criminal cases in which defendants allege that such influences affected their perpetration of crimes. Most such claims are derivatives of an ill substantiated quasi-scientific theory of extreme social influence used popularly to "explain" some political events of the Cold War by metaphors extrapolated from scientific psychological theory and research. Fictional representations of these views have been widely accepted by an uninformed public, and the extension of the "brainwashing hypothesis" to explain some religious conversions or socially deviant conduct has sometimes been accepted by courts as suitable grounds for legal action or defense. The underlying premise of such argument is that the seductive properties of such influence processes render victims mentally helpless to resist them because they are more effective and insidious than those used by sales persons, teachers, religious and political leaders, or other socially accepted purveyors of influence. Scientific evidence to support this premise, however, is lacking. A survey of scholarly literature finds little interest in or research on brainwashing across the scientific community.

Social Scientists, The Law, and Expert Testimony. JAMES T. RICHARDSON (Univ. of Nevada, Reno) and JOHN DE WITT (Univ. of Nevada, Reno).

This paper examines the role of social and behavioral scientists as expert witnesses, using "cult cases" as an example. The "Frye Principle" versus the "Relevancy Principle" will be contrasted, and an argument will be made that a more rigorous standard of acceptance should be used for expert testimony in such controversial cases. The argument will be based on theorizing and research developed from a social psychological perspective that focuses on how jurors view expert witnesses and process information presented by them.

Methodological Issues in the Scientific Investigation of the Brainwashing Conjecture. BENJAMIN ZABLOCKI (Rutgers Univ.).

This paper examines problems in attempting to identify, measure, and investigate brainwashing in noncoercive environments. The issue of identification is by no means trivial, since there exists great controversy over whether the phenomenon can possibly exist in an environment in which there is no physical coercion. I show, first, how efforts to identify the phenomenon have foundered due to cooptation of scientific agendas by interested third parties, such as religious bodies, mental health professionals, and civil litigants. Criteria are suggested that aim at recasting the identification problem in purely scientific terms amenable to disinterested empirical inquiry. The paper goes on to raise questions as to how brainwashing could be measured in noncoercive environments, if it in fact exists. Finally, the issue of what factors might account for variation in the intensity of brainwashing is briefly discussed.

Pathways to Krishna: Conversion, "Brainwashing," and the Ethical Uses of a Cult Researcher's Insider-Information. LARRY D. SHINN (Bucknell University).

Brainwashing theories of cult affiliation are numerous and often theoretically confused, and few are grounded in the clinical fieldwork necessary to verify or refute the theoretical claims being made. This presentation begins with one extreme case history of conversion to ISKON that is most like the "snapping" phenomenon Conway describes, and analyzes it from suggestive psychological and sociological vantage points. Then a phenomenological assessment is made to show the limitations of too quick subscription to any of these methodological interpretations.
Students of NRMs are aware of the myriad ways such groups behave as they organize themselves in ever-changing social and institutional structures. How is a religious studies scholar who is aware of complex information or nuances of interpretation to act when placed in the role of an expert witness in a courtroom where the process is adversarial, the issues are reduced to black-and-white portraits, and the answers requested are "yes" or "no"? In a broader sense, how is the same person to react to public questions about the cults from parents, the media, or anticultists that would require divulging negative information often discovered in the context of research relationships? These and other questions will be addressed with examples taken from eight years' research among ISKON and three instances of serving as an expert witness in cult trials.

27-7. Fragrance Research: Effects of Fragrances on Behavior, Mood, and Physiology

Organized by: **William N. Dember** *(Professor of Psychology, Univ. of Cincinnati, Cincinnati, OH)*

8:30 am / Tue / 19 Feb **Sheraton/Alexandria**

Development of Olfactory Perception in Infancy and Early Childhood. HILARY J. SCHMIDT (Monell Chemical Senses Center and New Jersey Medical School).

Newborn infants have well developed and functioning olfactory systems that are perhaps more sensitive than that of adults. The maturity of the neonate's olfactory system in relation to other sensory systems has led to the speculation that fragrances may be of particular significance in the perceptual world of the infant and young child. Recent research suggests that some adult responses to odors may have their origin in infancy. For example, adult-like hedonic odor reactions have been shown in pre-school children and in infants, challenging a long standing view that all hedonic odor reactions are acquired via associational learning processes. Sex differences in responsiveness to fragrances are also evident in infancy. Moreover, newborns respond preferentially to maternal odors suggesting that early social interactions and attachment may be mediated by fragrance.

Effects of Fragrances on Performance and Mood in a Sustained Attention Task.
WILLIAM N. DEMBER and JOEL S. WARM (University of Cincinnati).

Data are presented on the effects of certain fragrances on performance and self-reported stress and workload in a sustained attention (vigilance) task. In our initial study, two highly pleasant fragrances, Peppermint and Muguet, when delivered in 30-sec bursts every five minutes over the course of a 40-min visual vigilance task, yielded superior overall performance (percent correct signal detections) than plain air; no effect was noted on any of several measures of stress and workload. Similar findings were obtained in a second study in which subjects delivered fragrances, or plain air, to themselves on an ad lib basis, but only for female subjects. Evidence was obtained in a third study of performance-enhancing effects of another pleasant fragrance, Heliotropine. The mechanism for these effects is yet to be determined, but additional data suggest that it does not lie either in experimenter or subject expectancy.

Effects of Fragrances on Sustained Attention and Visual Evoked Potentials.
RAJA PARASURAMAN (The Catholic University of America).

Recent evidence indicates that periodic stimulation with fragrances enhances visual sustained attention. The beneficial effects of fragrances may arise from a increase in general arousal or from a more specific sensory or attentional facilitation of the neural pathways involved in sustained visual detection. To test these possibilities, we administered a visual detection task for 40 minutes to male and female subjects who were periodically stimulated with a hedonically-positive fragrance, peppermint, or with hedonically-neutral pure air. Basal skin conductance (SC), a measure of general arousal, and the N160 and P300 components of the visual evoked potential (EP), which are sensitive to sensory-specific and attentional processes, were simultaneously recorded. Subjects receiving fragrance had significantly higher signal detection rates and showed a lower decrease in detection rate over time (less vigilance decrement) than the pure-air group. The amplitudes of the N160 and P300 components of the visual EP were greater in the fragrance group. Furthermore, while N160 declined in amplitude over time in the pure-air group, there was no decrement over time in N160 amplitude for the fragrance group. In contrast, while basal SC was higher in the fragrance group than in the pure-air group, indicating increased arousal, the trends over time in SC were the same for both groups. These results suggest that fragrances may facilitate the sensory pathway underlying visual signal detection, or, alternatively, enhance the allocation of attentional resources to visual detection. While fragrances increase a subject's overall level of arousal, the beneficial effect of peppermint on the maintenance of the subject's attention over time results primarily from sensory-specific or attention-specific mechanisms rather than general arousal.

Fragrance As a Source of Environmentally-Induced Positive Affect: Effects on Negotiation, Conflict, and Motivation
ROBERT A. BARON (Rensselaer Polytechnic Institute)

Research findings indicate that the way people feel (their current affective states) can strongly influence the way they think and the way they behave. Several environmental variables (e.g., temperature, air quality, lighting) have been found to influence current affect. In the present research, it was hypothesized that pleasant artificial fragrance would induce increments in positive affect among subjects. Hence, exposure to this variable would influence their behavior in ways similar to those observed in past research in which positive affect was induced through other means. Studies conducted to test these predictions yielded supporting evidence. Subjects exposed to a pleasant fragrance, relative to subjects not exposed to this factor, established higher self-set goals, reported higher levels of self-efficacy, made more concessions to an opponent during face-to-face negotiations, and reported weaker preferences for handling interpersonal conflicts through avoidance and competition.

Social Behavior and Fragrance Use. JOHN NEZLEK and GLENN SHEAN, (College of William and Mary, Williamsburg, Virginia 23185).

A study was conducted that examined the relationships between patterns of social interaction and the perception of fragrances in social interaction. Participants maintaied a social interaction diary that provided measures of the quality and quantity of social interaction and measures of the salience and pleasantness of fragrances in those social interactions. Social interaction quantity was unrelated to the assumed salience and assumed pleasantness of one's fragrances. Social interaction quality was unrelated to the perceived salience of fragrances in social interaction. Social interaction quality was positively related to the assumed pleasantness of one's fragrances. Individuals who thought that others perceived their fragrances more favorably had more enjoyable and intimate interactions and felt more confident in their interactions compared to individuals who thought that others perceived their fragrances less positively.

27-8. Evolution of Cognitive Functions in Ecological-Cultural Context

Organized by: **Anneliese A. Pontius** *(Associate Clinical Professor of Psychiatry, Harvard Medical School, Massachusetts General Hospital, Boston, MA)*

2:30 pm / Mon / 18 Feb **Sheraton/Alexandria**

Can Natural Selection Yield Universal Principles of Mind?
ROGER N. SHEPARD (Stanford University)

Unlike physics, which seeks laws that hold universally, psychology and biology have traditionally accepted more modest goals of characterizing the apparently accidental collection of human or other animals that happen to have evolved, on one particular planet--Earth. Perhaps the time has come for psychological science to consider raising its level of aspiration. There are reasons to believe that natural selection ultimately tends to favor minds that have genetically internalized principles that hold very generally and perhaps even universally in the world. Evidence emerging from the psychological laboratory suggests the following: (a) The representation of rigid motion (in real, apparent, and imagined transformations) is guided by internalized principles of kinematic geometry for three-dimensional Euclidean space. (b) The three-dimensionality of the human perception of colors (in terms of the three opponent dimensions: light-dark, red-green, and blue-yellow) is determined by the three degrees of freedom of natural illumination. (c) The exponential-decay fall-off of probability of response with difference of a test stimulus from the original training stimulus is a consequence of the internalization of general principles about natural kinds.

Evolutionary psychology of social exchange.
LEDA COSMIDES (University of California, Santa Barbara)

Many cognitive psychologists assume that the human mind is a general- purpose computer, performing according to uniform,

content-independent principles on every task. An evolutionary perspective suggests that this view of the mind is implausible. The more important the adaptive problem, the more intensely natural selection should have specialized and improved the performance of the mechanism for solving it. Social exchange -- cooperation between two or more individuals for mutual benefit -- has been just such an important problem for humans throughout their evolution. In order to successfully engage in social exchange, humans must be able to solve a number of complex computational problems, and do so with special efficiency. Experimental evidence indicates that the human mind does include cognitive adaptive specializations for reasoning about social exchange. This hypothesis was tested by seeing whether the predicted design features necessary to solve the adaptive problem of social exchange are present when subjects are asked to reason about social exchange, but absent when subjects are asked to reason about problems of similar complexity and familiarity that do not involve elements of social exchange.

The logic of threat: Evidence for another cognitive adaptation?
JOHN TOOBY (University of California, Santa Barbara)

Analyzing aggressive threats and choosing how to respond to them has been a problem for animals for most if not all of their evolutionary history, and numerous adaptations designed to deal with threat have been identified in various nonhuman species. An evolutionary perspective on human cognition suggests that humans have evolved cognitive adaptive specializations for analyzing threats and computing how to respond to them. Experiments were designed to test whether humans have two specific cognitive adaptations for dealing with threat: the ability to detect bluffs (the absence of the intent to carry out the threat if there is no compliance) and the ability to detect double-crosses (the intent to carry out the threatened injury even if there is compliance). The evidence indicates that people have reasoning procedures that are specialized for detecting bluffs and double crosses. In contrast, subject performance on problems that are structurally isomorphic but do not involve threat is poor. These results contribute to the debate about modularity in human reasoning, suggesting that reasoning is accomplished by a collection of evolved, relatively specialized, domain-specific modules or mental organs, rather than by a few domain-general central processes.

Natural Language and Natural Selection
PAUL BLOOM (University of Arizona)

There is considerable evidence that language is a biological specialization of humans. As such, one would expect everyone to believe that it has evolved through the process of natural selection. Surprisingly, this has turned out to be highly controversial. Chomsky, Gould, and Piattelli-Palmarini have each suggested that language has evolved as a by-product of selection for other abilities or as a consequence of as-yet unknown laws of growth and form. These arguments depend on inaccurate assumptions about biology or language or both. Evolutionary theory offers clear criteria for when a trait should be attributed to natural selection: complex design for some function, and the absence of alternative processes capable of explaining such complexity.

It is argued that natural language has a complex structure specifically suited for communication and not a recognizable epiphenomenon of other structures, laws, or processes. To show this, it is necessary to draw attention to two obvious facts about language -- that it has the capacity to convey complex information structures and that it does so through specialized grammatical mechanisms. Autonomous and arbitrary grammatical phenomena have been offered as counterexamples to the position that language is an adaptation, but this reasoning is unsound: communication protocols depend on arbitrary conventions that are adaptive as long as they are shared. Further data from anthropology and neuroscience strongly support the conclusion that a specialization for grammar evolved by natural selection.

Evolving Cognitive Potential, Fittingly Modified by Ecology.
ANNELIESE A. PONTIUS (Harvard Medical School).

A new and an old factor are taken into account in evaluating the cognitive status of eco-culturally distinct groups: 1) universally "hardwired", "innate" potentials, based on brain structure and functioning, assumed to evolve automatically in a uniform way; 2) specific modification by cognitive ecological exposure and inter-action.Re.1)Specific grouping of certain cognitive "dysfunctions" (due to underuse), "ecological syndromes" in healthy adult near stone-age populations mimick such grouping in certain neuro-pathological syndromes, thus attesting to "hardwired" aspects of brain circuitry. Re.2) Test results of intra-pattern spatial-relational representation (Block Design; Face Drawing) distinguished significantly between modernized vs. near stone-age groups of healthy adults. The latter produced disproportionately more "sensible", "non-random" errors in Block Design constructions, apparently fitting their ecological requirement for rapid overall assessment of essential configurations (of attacker/prey or food), while neglecting intra-pattern spatial relations, orientation, ratio or size -required for literacy and related skills.-Lesion effects, analogous to selected-out cognitive underuse in ecological context, may benefit by such plasticity through fittingly modified remediation.

Technical Session

27T-1. Cognitive Equilibrium

Organized by: **John N. Warfield** *(Professor and Director, Institute for Advanced Study in the Integrative Sciences, George Mason Univ., Fairfax, VA)* and **Milan Zeleny** *(Professor, Fordham Univ., New York, NY)*

2:30 pm / Tue / 19 Feb **Sheraton/Alexandria**

Promoting Cognitive Equilibrium Through Group Process: The Development of a Center for Interactive Planning and Design.
ROXANA CÁRDENAS (Instituto Tecnologico Y De Estudios Superiores De Monterrey, Monterrey, Mexico), and BENJAMIN J. BROOME (George Mason University, Fairfax, Virginia USA)

As organizations have become increasingly complex, decision makers have come to rely on group problem solving in order to involve all the relevant actors in the decision-making process. The difficulties in achieving cognitive equilibrium among the participants in a decision-making group have given rise to facilitated computer-assisted approaches to guiding groups through the steps of the problem-solving process. The Instituto Tecnologico Y De Estudios Superiores De Monterrey (ITESM) is in the process of developing a Center for Interactive Planning and Design that seeks to support group processes in a way that promotes the achievement of cognitive equilibrium through consensus, teamwork, and products that reflect shared meaning and learnings. The new Center has already begun work with major industrial leaders to assist in the development of policy for the emerging Mexico of the twenty-first century. Lessons gleaned from the experience of developing the Center will be presented for discussion purposes.

Searching for Dynamic Cognitive Equilibrium in the Operation of Nuclear Power Plants.
ALEXANDER N. CHRISTAKIS (Christakis and Associates, Wayne, Pennsylvania).

Escalation of frustration is a prevalent phenomenon among competent and dedicated professionals who work for safe operation and maintenance of nuclear power plants. One factor contributing to this phenomenon is the inability of people working in large sociotechnical organizations to arrive at a dynamic cognitive equilibrium. Examples of the application of the science of generic design in a nuclear utility are presented. Experience to date indicates that the practice of this science pro-

motes the discovery of consensual domains which are the linguistic manifestation of cognitive equilibrium. The institutionalization of this practice has become the primary mission of the author and his associates. Various barriers to the success of the mission will be presented for discussion purposes.

Complexity and Cognitive Equilibrium: Experimental Results and Their Implications . JOHN N. WARFIELD (George Mason University, Institute for Advanced Study in the Integrative Sciences)

During the past decade numerous data have been collected and analyzed relating to group performance in organizing knowledge for decision-making purposes. These data reveal results that have been viewed as surprising by scholars. Generally speaking, the data provide new insights into necessary conditions for groups to arrive at cognitive equilibrium in relation to complex issues. The data further provide insights that show how poorly past conceptualizations related to group activity have been conceived; and especially the inadequacy (and sometimes the irrelevancy) of the assumptions that have justified past approaches to group activity. When these experimental results and their interpretations are combined with prior research results of Bales, Tuckman, G. Miller, Simon, Argyris, Janis, and others; a new paradigm for people working together on complex issues emerges in clear perspective.

Decision Making as Production and Organization of Knowledge. MILAN ZELENY (Fordham University, New York, NY).

There is a new paradigm emerging which restates our notions of human decision making, decision support systems, and computer-based decision support. This new view ties decision making research directly with the theories of knowledge, theories of fuzzy sets and theories of pattern recognition. It is a new and fresh alternative to the old "utility maximization" paradigm.

We now hold the means of explaining why people remain so stubbornly and extravagantly irrational, ignoring logic, maximization principles and even self-interest postulated by conventional models. The answer appears to be strikingly simple: humans do not maximize functions, but search for recognizable patterns. Decision making is not about maximizing some components subject to postulated levels of other components, but about stable patterns of harmony among all components. So, conventional rules, algorithms, computations and logic play no causative role in this grand re-conceptualization. They are only surface structural manifestations of the underlying organization of generative processes, as for example in autopoietic (self-producing) networks.

III. Social Sciences & Science Policy

30. General Social Sciences and Policy

30-1. The Anthropology of Science and Scientists

Organized by: **Laura Nader** *(Professor of Anthropology, Univ. of California, Berkeley, CA)*

2:30 pm / Fri / 15 Feb	Sheraton/Sheraton No.
8:30 am & 2:30 pm / Sat / 16 Feb	Sheraton/Sheraton No.
8:30 am / Sun / 17 Feb	Sheraton/Sheraton No.

Conservation and Resource Management in Amazonia. DOMINIQUE IRVINE (Cultural Survival, Inc.)

In this paper I will compare indigenous conceptual systems of rainforest conservation and resource management in Amazonia with a range of Western conservation philosophies. These indigenous systems form part of Amazonian peoples' ethnoecological traditions. I will present a comparative overview of indigenous views of the rainforest in Amazonia based on a literature review and on field experience. These contrasting views of the rainforest have profound practical impacts. Despite much talk of the need to understand indigenous knowledge of the tropical rainforest and the ethnoscientific traditions that have permitted Amazonian peoples to coexist with the forest for millenia, Westerners and Western Science are far from understanding these traditions. Furthermore, misinterpretations and idealization of indigenous systems, or the assumed convergence of a Western conceptual system with an indigenous one creates a difficult climate for cooperation in conserving tropical rainforests, and can even undermine indigenous attempts to gain control of their traditional territories.

Medical Ethnobotany in Southern Mexico: An Example of Mayan Ethnoscience. B. BERLIN (Univ. of California, Berkeley) ET AL

Preliminary results of recent comparative research on the medical ethnobotany of the Tzeltal and Tzotzil of highland Chiapas, Mexico, reveal that while a large number of plant species have been collected with purported medicinal value (1500 species), a relatively small number of plants are systematically associated with a few common health conditions. Our data indicate that approximately 50 highly important plant species are tightly restricted in their application to around 14 specifiable health conditions. Most of these conditions relate to the treatment of gastrointestinal problems, with diarrhea of special concern, upper respiratory infections, and topical skin and eye infections of various sorts. These conditions conform closely to the Chiapas department of public health's epidemiological reports for morbity and mortality among the highland Maya. Our findings support the hypothesis that the Tzeltal/Tzotzil ethnomedical system is empirically based, with a limited number of species having been selected for the treatment of a few specifiable health conditions. We predict that the greater the specificity between a given plant species and a particular condition, the greater the likelihood of pharmacological efficacy.

Knowledge Construction among James Bay Cree Hunters: Metaphors and Literal Understandings. COLIN SCOTT (McGill University).

This paper explores the complementarity of figurative and literal signification in eastern Cree hunting knowledge. The analysis focuses on the way in which root metaphors of pan-species personhood, communication, and reciprocity are inflected by the literal modelling of animal behaviour and hunting practice, as experience is interpreted and actions are formulated.

Anthropology has tended to highlight the mythico-ritual framing of knowledge in non-western societies, in opposition to western scientific notions of literal-empirical rationality. The present analysis shows that mythical propositions and the literal modelling of empirical experience are mutually transformative moments in the construction of knowledge; that neither moment, properly speaking, is privileged or independent; and that premises of human/animal communication and reciprocity are productive of empirically sophisticated knowledge.

A Native System of Ocean Navigation in the Western Pacific. WARD GOODENOUGH(University of Pennsylvania)

The traditional system of navigation enabled atoll people in the Caroline Islands of Micronesia to voyage as far as 500 miles between landfalls. They used a sideral compass based on the points of rising and setting of type stars, which gave their names to the points of the compass. Directions between all known islands and sea marks, as well as of prevailing winds and swells, were memorized, in the absence of writing, in terms of this compass. Voyages were mentally divided into units called 'drags' that were based on the changing direction of a third place of reference as the voyage progressed. Imaginary places served as such places of reference where convenient real ones were unavailable. There were various ways to keep oriented with reference to the compass by day as well as by night. Navigators as well as learners had drills by which they rehearsed sailing directions with one another. Redundancy was important to maintaining the system. Although there were different navigational schools, there was widespread agreement over a 1000-mile stretch of atolls on the fundamentals of the system.

Science and/as Everyday Practice. JEAN LAVE (Univ. of California, Berkeley)

Far-reaching rationales and defenses of Western culture--including many social scientists' analyses of schooling, ethnicity, literacy, intelligence, expert knowing, professionalization, gender, and more--rest upon programmatic idealizations of mathematics, "the mathematical mind," "scientific discovery" and "scientific thinking" and their (equally programmatic) opposites "everyday life" and "common sense, concrete thinking." However, contemporary anthropological studies of everyday mathematical practices and anthropological and sociological studies of the practice of science are converging to produce accounts of mathematical practice that have more in common with each other than with the normative models that have had prevailing influence in shaping cultural rationales. Research on newcomers to a dieting system and old hands at grocery shopping offers one vantage point from which to explore these new alignments of theory and practice.

The Prism of Heritability and the Sociology of Knowledge.
TROY DUSTER (University of California, Berkeley)

In the last two decades, we have witnessed the increasing power of molecular genetics to decode human genetic defects, and notable technological improvements in the ability to assess those defects prenatally, at earlier points in the pregnancy.

There has been a parallel development of a "drift" towards a greater and greater receptivity in American society for the role of genetic explanations of an increasing variety of human behaviors. These two developments are generally unrelated except in the halo of the association of the first with the second. The sociology of knowledge is employed as a perspective to help us better understand the social base and social location and strength of these genetic claims.

Gender and The Deconstruction of the Race Concept in The Sciences.
LEONARD LIEBERMAN (Central Michigan University).

The race concept was constructed by scientists beginning in the 18th century, and is being deconstructed in the 20th century. In the first half of the century deconstruction consisted of scientific challenges to racism and to other elements of the race paradigm. Starting around 1950, deconstructionists challenged the reality of human races. Rejection of the reality of race is occurring in several scientific disciplines and at different rates. Information is presented on 1,700 respondents in comprehensive universities, four and five-year universities, and community colleges in four disciplines. The rate of rejection of race at Ph.D. granting institutions was: 20% in biology, 34% in developmental psychology, 42% in biological anthropology and 52% in cultural anthropology. Rejection of race was more frequent among women than men in all disciplines except developmental psychology. The different rates are related to differences in concepts and traditions of each discipline, biographies of respondents, and degree of exposure to the social movements of the 1960's. Emphasis is placed on the greater frequency of rejection of race by women in anthropology as compared to biology and psychology. Recent literature on the reconstruction of women's psychology is reviewed and related to the context of the disciplines. The continuing and increased rejection of race in the sciences depends in part on recruitment patterns, the concepts and traditions of the disciplines, the availability of more productive research paradigms, and newer methods of studying human variation, as well as the external political and economic milieu.

Constructing Knowledge Across Social Worlds: The Case of DNA Sequence Databases in Molecular Biology
JOAN H. FUJIMURA (Harvard University)

This paper focuses on the construction of knowledge (and technologies) through the organization of collective action across social worlds. In the context of molecular biology, I ask: how do heterogeneous elements such as people, diseases, cell lines, genes, DNA, probes, sequences and the entire human genome become connected? The answer is through a lot of work -- hands-on experimental, representational, organizational, and rhetorical work -- and heterogeneous engineering across many social worlds and through time. I use the databases of DNA, RNA, and protein sequences to tell a story of homologies constructed between laboratories, representations of phenomena, and social worlds. Sequence information is the historically latest set of representations which, through computerized databases, lie within and connects many laboratories, scientific social worlds, and other representations of phenomena.

Socialization of Scientific Discourse. ELINOR OCHS (University of California, Los Angeles)

This paper examines the process by which novices are socialized into the culturally appropriate communicative practices of scientific experts. In this discussion the focus is on the verbal construction of theories--how they are collectively articulated, evaluated, challenged, defended, and transformed through verbal interaction. The analysis considers the marking of sources and certainty of knowledge, subjectivity, and objectivity, and the use of irrealis constructions across interlocutors differing in social status.
This research is being conducted in two distinct settings. The first is a North American university physics laboratory in which professors, post-doctoral fellows and graduate students regularly interact. The second, is a family home where parents and children interact. In both settings, theories concerning events are collectively constructed and reconstructed.
How are the communicative practices of these two settings related to one another? This discussion takes issue with both the view that scientific communication does not differ from everyday communication and the view that scientific communication is categorically distinct from everyday communication. Rather it proposes that everyday and scientific communicative practices form a continuum.

Immunology and the Immune System.
EMILY MARTIN (Johns Hopkins), BJORN CLAESON (Johns Hopkins), WENDY RICHARDSON (Johns Hopkins), MONICA SCHOCH-SPANA (Johns Hopkins).

Rapidly expanding knowledge in the science of immunology is being widely disseminated into public awareness in the U.S. by means of a variety of media and technologies. The way this knowledge is taken up and made a part of practical knowledge of the body -- what it means to have an "immune system" -- varies dramatically among different social and ethnic groups. Based on participant-observation in a laboratory doing research on immunology and in several urban neighborhoods, we explore the complex interactions between science and culture, as they are differentiated by gender identity, race and class.

The Anthropology of Geography.
DAVID R. STODDART (Department of Geography, University of California at Berkeley, Berkeley, CA 94720).

Geography as a cross-disciplinary study bridges both the natural and the human sciences, and its practitioners inherit traits from both traditions. The practice of geography has also been strongly influenced over the last one hundred years by diverse national traditions. This paper explores the institutional and personal relationships in which contemporary geographical practice has developed, with particular reference to the northwest European and North American areas. Idiosyncratic characteristics of geographers within these areas will be discussed, with reference to institutional allegiances, research targets, and scholarly productivity.

The Psychiatric Discourse on Post-Traumatic Stress Disorder. ALLAN YOUNG (McGill University).

Posttraumatic stress disorder (PTSD) is represented in psychiatric research and clinical practice as being (1) a bounded nosological category whose members (diagnosed cases) share a set of criterial features and (2) supported by evidence congruent with psychiatry's own Popperian standards. This paper, which is based on ethnographic research and an analysis of the research literature on PTSD, challenges both assumptions. Three arguments are made. One, diagnosed cases of PTSD are connected by family resemblances, clinical prototypes, and institutional interests, not shared features. Two, the disorder's defining feature, its traumatic event, incorporates contradictory cultural meanings and implications. Three, the current movement of PTSD researchers and institutions to a neural-hormonal theory of this disorder is, in part, an attempt to overcome these contradictions by transforming the division of mental labor in the production of scientific knowledge of PTSD.

Political Structuring of the Institutions of Science.
CHARLES SCHWARTZ (Department of Physics, University of California at Berkeley).

The enterprise of Physics, in the United States since the second World War, has been the preemminent model of success in science. It has experienced rapid growth in membership, journals, schools and funding; it has achieved and maintained the highest level of prestige; and its production of new knowledge, relating to "fundamental" understanding of the universe as well as to "practical" inventions for human use, is apparently the envy of all.
The military and large corporate interests have been the primary sources of funding and the primary users of the products and trained personnel. What are the institutional structures of physics? How are the elites of physics related to the national elites? How do the methods of intensive training, vigorous competition and strong ideology serve to keep members of the profession in line? What do we not discuss with our students? How do we relate to "the public"?
Are there some cracks in this system? I shall present some data and tell some stories.

The Culture of Science and the Regulation of Biotechnology.
USHER FLEISING (The University of Calgary).

The cultural context for the management of biotechnology is considered in relation to perceptions of risk and technology assessment. What cultural mechanisms are used to deal with a production technology that is symbolically and mechanically tied to reproduction? Case study material, data collected in structured and unstructured interviews as well as data from a mailed questionnaire are used to describe how the value conflicts about perceived risks and benefits associated with the translation of biological theory into engineering (biotechnology) are negotiated and resolved. Culture theory is used to show how common fears and hopes are manipulated in institutional settings to make biotechnology an unexceptional way in which to provide goods and services. A study of biotechnology provides an opportunity to study social change and to consider the relationship between social change and culture change.

Rituals Of Empowerment Among Nuclear Weapons Scientists. HUGH GUSTERSON (Stanford).

Nuclear Weapons scientists see their weapons as the products of a scientific rationality which subordinates nature, and as the instruments of a rational politics which uses the products of science to discipline humans' anarchic and warlike impulses. Nuclear weapons tests are core rituals wherein scientists struggle to mediate and resolve the contradictions inherent in being human while aspiring to be rational and in being human while aspiring to live in peace. The preparation for a nuclear test may force scientists to struggle with non-rational feelings of anxiety, anger, recklessness and jealousy, all of which scientists like tomsee as the province of art and politics rather than science. Each successful nuclear test reaffirms the scientists' faith in the redemptive power of the rationality system. As a weapon is detroyed, a community is reborn.

The Role of Chaos in Creating Fishery Management Chaos.
M. ESTELLIE SMITH (SUNY-Oswego).

Since 1977 the United States has attempted to manage the fishery stocks within its jurisdiction via the use of regional fishery councils made up from a broad spectrum of interested parties. On the whole, however, such bodies are dominated by, on the one hand, researchers (e.g., marine biologists, economists, statisticians) who use linear-based modeling procedures for understanding and predicting behavior of the stocks and, on the other hand, by representatives from the commercial fishing industry (e.g., fleet owners, fishermen, processors) whose (largely out-of-awareness) view of fishery dynamics is best understood by reference to the non-linear models currently being explored by scientists under the rubric of 'chaos' (as well as that emerging from the study of 'spontaneous order'). This paper does not take sides in the debate as to which model (if either) is the closer to reality or has the greater utility for modeling fishery stock dynamics. Rather, it explores the extent to which management plan consensus has been and probably will continue to be difficult (at times impossible) to obtain, given the lack of explicitness concerning these two sharply divergent perspectives among those in the negotiating arena.

Conflicting Belief Systems of Scientists and Administrators in the Creation of a Covert Technological Surveillance System. DAVID JACOBSON (Brandeis University) and CHARLES ZIEGLER (Brandeis University)

This paper analyzes a selected incident, the U.S. detection of Russia's first atomic test in 1949, to investigate the interplay of scientists' scientific beliefs and beliefs about science held by federal administrators. It explicates the role of these disparate beliefs in processes through which key decisions were made leading to the creation of the covert technological surveillance system that identified the Russian test.

Tinkering with/in Japan: The Practice of International Collaboration in High Energy Physics at KEK, Tsukuba Science City, Japan. SHARON TRAWEEK (Rice University)

This presentation is based upon ongoing participant-observer study of a specific experimental research group at KEK, the first long-term, large-scale Japanese and American scientific collaboration to be based in Japan. I will discuss several on-going issues for the collaboration, such as (1) their different strategies for improvising, containing risk, maintaining safety, and responding to accidents and bureaucrats, (2) which tasks are done by senior physicists, technicians, and engineers, or what anthropologists would call the social allocation of knowledge and work, (3) managing their daily conflicts, especially about losing tools and time, breaking equipment, and getting angry, (4) negotiating the meaning of data and national character, and (5) working our leadership for the group, the accelerator, the lab, and science policy. I will argue first that there are different styles of designing, crafting, and tinkering with experiments, data, scientists, engineers, labs, and governments within that collaboration at KEK, secondly that these differences are shaped by class, regional, school, and gender cultures, as well as by "national" cultures, and finally that sometimes these diverse differences are combined inventively and effectively.

Japanese and Western Approaches to Primatology: Limits Set to Questions.
PAMELA J. ASQUITH (University of Calgary, Alberta, Canada).

Primatology is the behavioral and evolutionary study of our closest living relatives, apes, monkeys and prosimians. The field had a separate and nearly synchronous development this century in Japan and the West, providing a good example of cultural effects on a science. The paper will show how intellectual, religious and cultural predispositions among Western and Japanese researchers affected the development of a theoretical framework for primate studies: neo-Darwinism in the West and a more sociological, anthropomorphic approach in Japan. Cultural factors, such as the importance of the small group and individual relations within it, the individual's relationship to the larger society, assumptions about the uniqueness or not of mind in humans, are also shown to have affected the limits set to interpretations of primate behavior. Reasons for the earlier disregard for material collected by Japanese primatologists are explored, and the later vindication of their results. Implications for science of Japanese publishing in English only methods and results that are likely to be met with approval by foreign language journals, and 'burying' vast amounts of data in Japanese-language publications are assessed.

Inuit Indigenous Knowledge and Science in the Arctic: Comparative Epistemology and a Realist Model. ELLEN BIELAWSKI (Arctic Institute of North America).

Inuit indigenous knowledge is compared with Arctic science through philosophy of science. A realist approach to Inuit knowledge and Arctic science shows how each contributes to understanding the natural world. Inuit knowledge is described in terms of scientific parameters such as measurement, prediction, experiment and replication.

One contrast is that Inuit do not separate people from nature, but Arctic scientists do; this is reflected in the academic division between natural and social sciences. This difference continues to result in incomplete science, detrimental management, and conflict between Inuit and scientists in the Arctic. This research seeks to make Inuit knowledge more comprehensible to Arctic scientists who have recognized indigenous knowledge politically but rarely in practice.

Data are taken from case studies in progress: an ethnography of Arctic science; and a study of

how Inuit built knowledge when the Government of Canada resettled them in new, dramatically different hunting territories in 1953 - 1956.

31. Anthropology; Archaeology

31-1. Indigenous Peoples and the Rain Forest: Science, Marketing, and Human Rights

Organized by: Janet Gruschow *(Senior Program Associate, Science and Human Rights Program, AAAS, Washington, DC)* and Richard P. Claude *(Professor of Government and Politics, Univ. of Maryland, College Park, MD)*

8:30 am & 2:30 pm / Fri / 15 Feb — Sheraton/Holmes

The Yanomami and Land Rights. ALCIDA RITA RAMOS (Universidade de Brasilia).

The highly dispersed settlement pattern of the Yanomami is associated with the characteristics of their socio-cultural use of the Guianese ecosystem: shifting agriculture in poor soils, and wide range hunting/gathering grounds due to scattered fauna and flora species. An extensive network of trails links villages to gardens, to hunting grounds, to other villages, and to culturally relevant forest sites. For over three years the Yanomami have suffered the effects of a massive gold rush with devastating consequences to their health, nutrition, demographic equilibrium, cultural practices, and worldview. The ecological balance and indigenous communications system have been destroyed in many parts of Yanomami territory. Recovery of the environment and survival of the Yanomami, both of which are still possible, depend on the outcome of the confrontation between political forces at work involving national society, the Brazilian State, and international pressures. This paper examines some details of the Yanomami use of their environment, the impact of 40 thousand miners in their lands, and the actions and counter-actions that have been taken by the government regarding the Yanomami tragedy.

Satellite Images and Scientific Research as Tools to Assist Brazilian Rubber Tappers in Forest Management. FOSTER BROWN (Woods Hole Research Center & Universidade Federal Fluminense), IVAN PIRES (UFF), DAN NEPSTAD (WHRC), and LEDA LUZ (Conselho Nacional dos Seringueiros).

The recent creation of extractive reserves in the Brazilian Amazon has motivated rubber tappers to develop new approaches to forest management. For these approaches to be effective rubber tappers will need to combine their ecological knowledge with scientific tools. This paper discusses how rubber tappers of the Seringal Porongaba in the Extractive Reserve 'Chico Mendes', Acre, Brazil used satellite images, field methods, and experimentation to begin to assess and enrich the biological resources of their area. They combined their mental maps with satellite images and have begun to use them to inventory their natural resources. Field experiments demonstrated ways to acquire knowledge necessary for forest management. Studying forest transects introduced rubber tappers to quantitative demography of important species and provided them an opportunity to share their knowledge of forest ecology and extractive strategies. Such an exchange between scientists and forest residents, as equal contributors, encouraged discussion as to how better forest management can be achieved.

Can a "Green Consumer Democracy" Function in the Rain Forest? DARRELL A. POSEY (Museu Goeldi/Alexander Von Humboldt Stiftung).

Agriculture, ranching, mineral exploitation and timber extraction--all of which require the destruction of the forest--are currently the principal options for economic benefits from tropical ecosystems. These activities use less than 2% of the available species that currently have economic value on regional, national and international markets. The sad fact is that entire tropical rain forests are being destroyed in order to exploit this small percentage. Native peoples, on the other hand, know, classify and utilize over 99% of the rich biological diversity of tropical floral and faunal species. Traditional knowledge is the prime source of new ideas for sustained natural resource management, as well as an almost boundless new font of potential products. Fully exploiting tropical species would both give economic value to the living forest, take development pressure off "virgin" forest areas, and give local and indigenous populations an alternative source of needed income. Some very difficult problems arise, however. How can native peoples be compensated for their traditional knowledge that is key to more extensive utilization? How can consumer capitalism be controlled in order not to over-stimulate natural product demands that would in turn stimulate increased exploitation of tropical ecosystems? This paper outlines some areas in which traditional knowledge is potentially important for a "green consumer democracy," while calling attention to the dangers of such attempts to native peoples and the rain forest.

Diversity and Importance of Plants Useful to Indigenous Peoples in Amazonia. BRIAN M. BOOM (The New York Botanical Garden, Bronx, New York 10458-5126, U.S.A.).

Data are presented on the use of trees in terra firme dense forest by four indigenous Amazonian groups: the Ka'apor and Tembé, both Tupi-Guarani-speaking groups of Brazil; the Panare, a Cariban-speaking group of Venezuela; and the Chácobo, a Panoan-speaking group of Bolivia. In each case, an ethnobotanical forest inventory was conducted of a 1-ha. parcel of forest. All trees at least 10 cm diameter at breast height (dbh) were marked and voucher specimens were collected. Specimens were presented to indigenous informants to gather data on use. Based on these interviews, and the identification of specimens collected, it was possible to calculate the percentage of tree species in each hectare that is useful to each group: Ka'apor, 76.8%; Tembé, 61.3%; Panare, 48.6%; and Chácobo, 78.7%. The data support the assertion that terra firme rainforests of Amazonia contain an exceptionally large number of useful species, and that certain plant families (e.g., Palmae) deserve special consideration in terms of conservation and utilization. The fact that each indigenous group has different suites of most useful species is more a reflection of plant endemism within Amazonia than intercultural differences per se. The extensive use of plants by indigenous peoples, combined with high species endemism, has important implications for the management and potential marketing of sustainable forest resources in Amazonia.

Chemical Prospecting: Can it Pay Off for Conservation? THOMAS EISNER (Cornell University).

Nature is a vast resource of chemicals of potential use to humankind. If this resource is to be open to long-range exploration, biodiversity will need to be conserved. The need is greatest in developing nations, where species loss is most acute, and funds are least available for conservation. Commercialization of natural products generates billions of dollars per year worldwide. Some of this revenue, and in particular revenue derived from "chemical prospecting" in developing nations, should revert to these nations for investment in conservation.

Challenges for the 1990s: Tropical Forest Peoples, Conservation and Pharmaceutical Discovery. STEVEN R. KING (Shaman Pharmaceuticals, Inc.)

Nearly 500 years ago people of the New World encountered Europeans for the first time on their soil. Since that time the global pharmacopeia has been enriched by a number of important plant-derived medicines discovered by native people in the tropics. We know that tropical forests contain numerous scientifically undescribed plant species

and that tropical forest people utilize and manage a wide array of the flora as medicine. Discovering and commercializing these new compounds can and should be integrated into sustainable extractive reserve systems. The destruction of tropical forest ecosystems is often driven by the need for basic human requirements: food, shelter, and health care. The continuing loss of tropical forests also poses a significant threat to the world's future sources of new medicines. Recognizing the interrelationship of the causes of destruction and future consequences for global drug discovery suggests the need for a new alliance based on reciprocity. Inhabitants of tropical forests and the pharmaceutical industry can both benefit through increased research and development of natural products. Direct benefits for local people will also provide incentive to continue managing genetic diversity.

31-2. Evolutionary Interrelationships Between Technology, Language, and Social Behavior

Organized by: **Kathleen R. Gibson** *(Professor of Anatomical Sciences, Univ. of Texas Health Science Center, Houston, TX)* and **Tim Ingold** *(Professor of Social Anthropology, Univ. of Manchester, Manchester, UK)*

8:30 am / Sat / 16 Feb **Sheraton/Holmes**

Tools, Language, Social Behavior and Information Processing Capacities. Gibson, Kathleen R. (Univ. of Texas Health Science Center at Houston).

Westerners have long sought to define human nature in opposition to animal nature. Sharp qualitative differences such as tool-making and language have been posited as distinguishing humans from other animals. Modern chimpanzees and their scientific observers, however, have proven most such postulates wrong. It now appears that the behavioral differences between humans and apes are primarily matters of degree rather than of kind. Apes possess the rudiments of tool-use, tool-manufacture, symbolism and complex social behaviors. Human behaviors, however, are more information-rich and are organized into greater numbers of hierarchical levels. In ape populations, complex technologies occur in conjunction with social sharing and mother-offspring divisions of labor. Humans exhibit much greater cross-domain synthesis and hierarchicalization of communicatory, technological and social skills. This complex interweaving of diverse behaviors has been fundamental to the advancement of human technology, language and science. It is suggested that the increased size of the human brain and of some of its component parts are the primary factors accounting for these expanded human abilities and, hence, of the evolution of the capacity for science and technology.

From Pan to Man: The Language Link. Savage-Rumbaugh, Sue (Yerkes Regional Primate Center).

Pan troglodytes and Pan paniscus apes have been found to differentiate spoken words and pair them with written symbols if exposed to speech paired with visual symbols from an early age. Such learning occurs through observation. Later use of these symbols to communicate desires is spontaneous. By 6 years of age, such apes begin to demonstrate comprehension of simple syntactical structures such as word order, embedded phrases, and anaphoric pronouns. When tested with 676 identical novel sentences, a bonobo (Pan paniscus) of 9 years and a child of two years performed at the same level of sentence comprehension. Human children who are exposed to paired speech and symbols also learn these associations very early and can use written symbols to communicate before they begin to speak. These findings indicate that some form of protolanguage is probably present in the vocalizations of Pan and that syntax is acquired, not innate.

Language, Tools, and Brain. The Development and Evolution of Hierarchically Organized Sequential Behavior. Greenfield, Patricia Marks (UCLA).

Language and tool use are two keys to the interpersonal behavior and cultural nature of human beings. From both an ontogenetic and phylogenetic perspective, this paper explores the interrelations and neural foundations of their development. The conclusions shed light on the theoretical controversy concerning modularity of mind. Are language and other modes of cognition, such as manual intelligence, organized as functionally or structurally separate modules in the mind/brain? Or is there a single faculty that generates both language and other modes of cognition? The empirical facts and argument presented in this paper contribute to a resolution of the controversy by presenting evidence that the modularity of language and manual intelligence is a developmental phenomenon, both ontogenetically and phylogenetically. Early in the development of the individual and the species, language and manual intelligence (including tool use) appear to have a single common organization, on both the behavioral and neural levels. At a later point in both ontogeny and phylogeny, there is evidence for the emergence of modularity: distinct behavioral structures based on differentiated neural circuits in the domains of language and manual intelligence. This paper demonstrates that developmental evidence can shed light on important issues concerning the evolution of human capacities for culture and interpersonal behavior.

Early Stone Technologies and Linguistic/Cognitive Inferences Toth, Nicholas (Indiana University) and Schick, Kathy (Indiana University).

This paper focuses upon the anthropological problems inherent in attempting to deduce levels of cognition and communicative systems at various stages of human evolution based upon examination of the archaeological record, focusing upon early stone technologies. An experimental archaeological approach is a major emphasis of this research. Among the inferences of this paper: 1) That Oldowan hominids such as Homo habilis possessed higher cognitive abilities and organization skills than nonhuman primates although substantially less than that of later hominid forms; there is evidence that these early hominids were preferentially right-handed, which could have important palaeoneurological implications; 2) That Homo erectus, although cognitively superior to Homo habilis, did not possess the communicative skills to maintain the Acheulean industrial tradition as it spread through the Eurasian landmass into eastern Asia; 3) That anatomically modern humans, during the past 40,000 years, had reached a new cognitive and communicative threshold which accounts for their success on a worldwide scale after this time; the peopling of the Americas is used as a case study here. Recent ethnoarchaeological research, as well as studies directed towards teaching a modern chimpanzee to manufacture and use stone tools will also be discussed.

Tool Use, Sociality and Intelligence in Human Cultures. Ingold, Tim (University of Manchester).

Technology, language, intelligence, society, culture--all these terms have, at one time or another, been proposed as the essential distinguishing features of humanity. Yet they are also intimately connected products of a specifically 'western' tradition of thought. Characteristic of this tradition is the propensity to attribute the qualities of human action to particular properties of mind, as distinct from bodily execution. Thus, language is distinguished from (mere) communicative behaviour, technology from (mere) tool-using as forms of intentional, skilled practice. Drawing on ethnographic material from contemporary hunting and gathering societies, it is shown that there is no essential dividing line between a person's dealings with the non-human environment and with the environment of other humans, both of which may be mediated by either tools or words. Tool-use and speech, then, are not really separable, and their emergence is a chapter not

in the evolution of intelligence, but in the evolution of human beings endowed with specific capabilities of action.

31-3. The Evolution of Deception: A Biocultural Approach

Organized by: **Loyal D. Rue** *(Professor of Religion and Philosophy, Luther College, Decorah, LA)* and **Ursula W. Goodenough** *(Professor of Biology, Washington Univ., St. Louis, MO)*

2:30 pm / Sat / 16 Feb **Sheraton/Holmes**

Molecular Deception. URSULA GOODENOUGH (Washington University).

Deception can be said to have occurred when an organism's behavior derives (in part) from its failure to detect a discrepancy between appearance and reality. We propose that deception is often adaptive, both as an evolutionary strategy and as a means to achieve human goals. Considered here are examples of deceptive interactions involving cells and molecules. We discuss the nature of detection systems that have evolved to distinguish "true" from "false" (e. g. self vs. non-self) or "good" from "bad" (e.g. a nutritional blood protein vs. a viral coat protein). We suggest that parasites either disable these detection systems (e.g. by knocking out a critical event in the immune response) or else elude them by strategies that might be considered deceptive (e.g. by antigenic variation or by binding to a common cell-surface receptor). When a deceptive parasite compromises host viability, selection usually favors the evolution of increasingly effective detection systems and, in response, increasingly effective deceptive strategies; modern products of such co-evolution include mammalian immune systems and such ingenious pathogens as the rhinoviruses and Hemophilus. An alternative, important for our consideration of human interactions, is that the detection/deception dyad reaches the compromise known as symbiosis.

Deception in Evolutionary Perspective. ROBERT L. TRIVERS (Univ. of California - Santa Cruz).

Deception is an extremely common feature of relations between imperfectly related organisms in nature, whether predator and prey, plant and insect, parasite and host, or members of the same species, such as potential mates, antagonists, parent and offspring, and so forth. Continual selection to deceive has shaped the external appearance of numerous species and has sometimes entrained large internal changes as well. Within species, selection to deceive has sometimes produced specialized morphs whose route to reproductive success is dependent upon deception. There is some indirect evidence from nature that deception may often be favored when rare and less favored or disfavored when common. Likewise, there is some evidence that selection to spot deception has generated various intellectual traits (such as ability to count). Finally, within highly social species, and especially in our own lineage, selection may have generated self-deception the better to deceive others, where self-deception refers to preferentially storing true information in the subconscious.

Deception in Primates.
ROBERT W. SUSSMAN (Washington University), THAD BARTLETT (Washington University).

Primates exhibit a host of morphological and behavioral strategies which might be considered "deceptive." Generally, morphological strategies have as their target non-specifics, usually predators. Morphological deception includes cryptic coloration, defensive markings, piloerection, and pseudo-estrous. By its nature, morphological deception is involuntary. Behavioral deception, on the other hand, can be involuntary or voluntary. Many primate anti-predator strategies, such as nocturnalism, distraction displays, mobbing, and cryptic coloration, are involuntary acts of deception. These involve genetically fixed patterns of behavior. While there are analogues of anti-predator strategies employed in primates in other animals, voluntary deception may be unique to primate species. There recently has been a great deal of discussion concerning voluntary deception in primates. Unfortunately, much of this is based on anecdotal reports. We examine some of these data and discuss the role of deception in the evolution of intelligence. Finally, by around 100,000 BP there is evidence that humans were capable of self-deception in the form of religious ritual. The appearance in the fossil record of burials, burial goods, and later, cave art are the first evidence of the ability of humans to deceive themselves and to create culturally-determined perceptions of nature.

The Negotiation of Self Realities: Psychic Shootout at the "I'm OK" Corral. C. R. SNYDER (The University of Kansas).

People have theories about themselves that guide their interpretation of life events. Most self theories involve two dimensions against which people evaluate themselves: (1) linkage to act, in which people assign causal linkage, varying on a continuum from none to absolute, to given events; and, (2) valence of act, whereby people analyze an outcome on a continuum varying from very negative to very positive. Using these two dimensions together, normal people form personal self theories in which they see themselves as being increasing linked to outcomes that are more positive. The general process by which people strive to maintain such "good/in control" self theories (the "I'm OK" Corral) in the face of discrepant input is called reality negotiation. Examples of such processes are described as being analagous to "Psychic Shootouts" in which people often engage in self- and other- deceptive activities in order to preserve personal self theories.

The Saving Grace of Noble Lies. LOYAL D. RUE (Luther College)

The intellectual and moral traditions of Western culture have been characterized by an explicit and consistent bias against deception, against both deceiving and being deceived. This bias finds expression in the literature of religion, philosophy, psychology and science. Recent studies, however, suggest the thesis that strategies for deceiving and vulnerability to being deceived are very often adaptive. This thesis will be applied at the level of human culture, where it is argued that human cultures depend for survival upon their members ingesting a Noble Lie. A Noble Lie is defined as a narrative integration of cosmology and morality. This argument exposes a fundamental irony in the human condition: that which we most deeply fear (i.e. deception) is the ultimate source of salvation.

31-4. Ethnography of Drug Use in Traditional and Modern Societies

Organized by: **Willett Kempton** *(Research Anthropologist, Princeton Univ., Princeton, NJ)*

8:30 am & 2:30 pm / Mon / 18 Feb **Sheraton/Holmes**

Use of Psychoactive Plants in Amerindian Civilization. WADE DAVIS (New York Botanical Gardens).

This paper reviews the use of several stimulant and hallucinogenic plants, including coca and tobacco, by Amerindian civilization. In many Amerindian societies, the use of plant hallucinogens lies at the very heart of traditional life. This contrasts with the Old World, where far fewer such plants are known or used. Indigenous peoples have successfully used powerful drugs in socially constructive ways for hundreds if not thousands of years. Ethnographic research makes clear the distinction between the profound use of stimulant and hallucinogenic plants in the traditional context from the cavalier and profane use of drugs in contemporary society. Traditional use is distinguished

in four ways: 1) drugs are employed for explicitly positive purposes such as worship or curing, 2) a protective cloak of ritual is placed on drug use, 3) users consciously acknowledge that use of these drugs is reasonable and natural, if done judiciously, and 4) drugs are consumed in natural forms, less concentrated and often accompanied by subsidiary meditating compounds from the whole plants.

Marijuana, Pregnancy and Child Health and Development in Jamaica. MELANIE C. DREHER (University of Massachusetts at Amherst).

The study of perinatal substance use in humans has been plagued by methodological problems that have inhibited the generation of accurate findings and useful explanations. These include (1) the inability to distinguish specific drug-related effects because of wide-spread multi-drug use and the influence of confounding socioeconomic variables; (2) the difficulty in obtaining accurate estimates of consumption and, perhaps most important, (3) the inability to determine the meaning and value of drug use for women during pregnancy and lactation. In contrast to the typical clinical and epidemiological studies of perinatal drug use that have dominated this field of inquiry, this community-based exploration of marijuana use in Jamaica uses ethnographic descriptions and analyses of women and children in combination with clinical assessments of child development. The goal is to better understand the phenonmenon of perinatal substance use and its subsequent effects on child health and development and challenge the concepts and theories developed in a North American context. This paper will report the findings of a seven year longitudinal study of perinatal marijuana use in a rural Jamaican parish which compares the health and development of sixty Jamaican children, thirty of whom were born to women who smoked marijuana during pregnancy and thirty of whom were born to non-smokers.

Unintended Consequences of Crop Substitution Policy for Social Controls on Opium Use Among Highland Growers in Thailand. JACQUETTA HILL (Department of Educational Psychology, University of Illinois).

Cash crop substitution policy may export drug problems from backer nations to overseas growers, as here demonstrated in a highland Lahu village in northern Thailand. The account of earlier practices is based on ethnography--participant observation and records of events and interviews--begun a decade ago, prior to a crop substitution program. Restrictions on shifting cultivation have undermined "subsistence security" forcing Lahu into further dependence on cash economy while crop substitution projects expose them to the grand uncertainties of international commodity markets. Roads, tourism, electricity, and restricted migration cut away the remoteness that previously buffered the Lahu from coercive social and cultural changes. Social arrangements that prior to the crop substitution project limited uses of dangerous substances have lost their effect. Households, the economic units, no longer can restrict opium to normal use. Locally addiction is a near epidemic among young adults, young mothers, and villager elders and leaders. Based on a detailed ethnographic account of recent events in the village, the addiction explosion is linked to the interconnections among cash dependency and debt, tourism, and characteristic opium yields on depleted land.

The Weakening of Alcohol Policy in a U.S. Industry: Company Vs. Union. GENEVIEVE AMES (Prevention Research Center, Pacific Institute for Research).

Alcohol policy in any large U.S. industry is a complex and volatile issue, heavily influenced by other predominant agendas within the organization. Based on an ethnographic case study of an assembly plant in a large U.S. corporation, this paper identifies and explains the environmental and cultural contingencies that differentiate between corporate and shop floor perceptions of policy operationalization. These contingencies, in effect, are embodiments of the tradeoffs negotiated between two coexisting regimes--management and union--each of who hold distinctive and opposing ideological visions of work and worker's rights. To management, production and the ability to control quality is of primary importance, and it is that goal which informs their particular world view on employee behavior. To union, protection of jobs, wages, and political success are distilled into their protreatment, anti-discipline perspective on alcohol issues. Case examples of decisions and action among those who have front line responsibility for handling alcohol problems (formen and union committeemen) illustrate how political and production pressures mitigate against effective alcohol control in the workplace. Separating policy from these pressures, and bridging the lingering gulf between union and management goals, are proposed as steps towards alcohol problem prevention.

CRACK: A Vehicle for Long Denied Masculinity in the Inner City. TONY WHITEHEAD (Department of Anthropology, University of Maryland, College Park).

The concepts of "respectability" (economic provider) and "reputation" (sexual prowess and defiance) are used to assess male perceptions of the meaning of masculinity and how such meanings are expressed in drug distribution and use behavior. Both the public expression of respectability traits and the more private expression of reputational traits are effectively achieved through the supra-attribute of masculinity: POWER. Power is facilitated through the possession of money. Moral superiority is an expression of another supra masculine attribute: STRENGTH. One--but not the only consequence--of this paradigmatic contrast between public behavior and private values is to also establish an image of a moral superiority of the EuroAmerican male over non-European males. The idea of moral superiority is an expression of another supra masculine attribute: STRENGTH (through discipline). Because African-American males have, as a group, been historically denied access to money and power they have also been denied the expression of desirable attributes of masculinity valued by men of all ethnic groups in America. Thus the illegal selling of crack is providing young African-American men with the means of acquiring money and expressing long desired and denied masculinity. Data were gathered through focus group and informant interviews, and media reports of similar interviews with African-American males in Baltimore, Maryland and Washington, D.C.

Why Do Addicts Share Needles? STEPHEN KOESTER (Addiction Research and Treatment Services, Department of Psychiatry, University of Colorado School of Medicine).

Before the advent of AIDS, the sharing of syringes among intravenous drug users was of little interest to anyone besides public health workers concerned with the transmission of hepatitis. Now however, needle sharing is recognized as the primary avenue for the spread of HIV within this population. The presentation examines the reasons drug users engage in this high risk behavior and demonstrates the value of integrating ethnography with epidemiology. How do IV drug users define sharing? Is needle sharing adaptive? When, and under what circumstances do drug users exchange syringes? What social, economic and legal factors encourage this practice? These questions are addressed by analyzing data collected during an ethnographic study of IV drug use in Denver. Identifying causal factors that lead to the sharing of syringes and understanding the context in which this behavior occurs are important for improving HIV prevention efforts and for designing public policies aimed at reducing it.

Managing Addictions in an Environment of Risk: Comparisions Among Male and Female Injection Drug Users. THERESA MASON (University of Illinois School of Public Health, Chicago).

This paper explores methods used by people who habitually inject illegal drugs to manage their addictions under circumstances of extreme social disapproval and economic distress. Based on observations and interviews as part of an evaluation of a street-based AIDS prevention project, the research took place in inner city neighborhoods where poverty and open drug sales are concentrated. Unlike the successful hustler and dope fiend of earlier ethnographies, many addicts studied in contemporary scenes in an Eastern U.S. city are resistent to identification with the street life. Their options severely strained by lack of education, prison records, drug addiction and alienation from the mainstream, habitual injectors have developed psychological, economic and social strategies to sustain themselves and their families in increasingly hostile environments. Responsibilities towards children, the constant threat of violence, and male dominance of the most lucrative street

hustles place women in situations of greater vulnerability. This paper examines the contradictions inherent in survival strategies devised in structured contexts of multiple risk.

Informal Economics of Drug Distribution in the Inner City: Ganja Versus Crack. ANSLEY A. HAMID (Anthropology Department, John Jay College of Criminal Justice).

Many inner-city minority populations moved from ganja (marijuana), popular in the 1960's, to crack cocaine in the 1980's. Anthropological study of affected communities shows that this change was propelled by socioeconomic transformations of those communities over the 30-year period. Both ganja and cocaine, and the differing ways in which they were distributed, used, and experienced, played instrumental roles in these transformations. Within the affected communities, ganja had become an exemplary working model of control, capital accumulation, and neighborhood integration and upliftment. Current crack patterns have been launched by the housing crisis, exacerbated by youthfulness of crack distributors. In contrast to ganja, virtually all crack revenue flees the local community. The current crack market can be thought of as a highly efficient vacuum cleaner, going over the physical and social rubble of communities to detect overlooked wealth and extract it from these communities.

31-5. The Deterioration of Human Health in Economic and Political Development: From Ancient Egypt to 20th-century United States

Organized by: Anna C. Roosevelt *(Director, Lower Amazon Project, Dept. of Anthropology, American Museum of Natural History, New York, NY)*

2:30 pm / Sun / 17 Feb — Sheraton/Sheraton No.

The Impact Of Political Change On The Health And Nutrition Of An Ancient Nubian Population

DENNIS P. VAN GERVEN , SUSAN G. SHERIDAN , SANDRA L. KARHU (University of ColoradoBoulder, CO 80309)

Human remains from the Medieval site of Kulubnarti in Sudanese Nubia present an ideal opportunity to assess the biological impact of political change in prehistory. Preserved in one of the dryest of the earth's environments, naturally mummified individuals exhumed from two cemeteries at the site document patterns of mortality, growth and development as well as nutrition and disease spanning the Christian era.

Most notably, remains from the early cemetery represent inhabitants of the site during Nubia's Medieval period. At this time villages such as Kulubnarti were part of a far-flung peasantry politically united by an absolute monarchy. In the larger sense Nubia and its monarchy enjoyed a period of cultural fluorescense marked by political unification as well as important achievements in art and architecture. In contrast, remains from the later, cemetery represent life during the Feudal age that followed. With the collapse of Nubia's monarchy, villages such as Kulubnarti became a part of a political system dominated by regional isolation and political-economic autonomy. What, then, were the consequences of this shift on patterns of mortality, health and disease in this ancient Nubian community?

Patterns of mortality, growth and development, nutritional and age-related diseases converge on one inescapable conclusion. While Nubia's Feudal age has been charactized as a period of cultural decline -- a virtual dark age -- health at Kulubnarti improved. In our paper, we will review the evidence for this interpretation from the perspectives of skeletal biology as well as the interaction between human health and economic development in ancient Nubia.

Nutrition and Health Consequences of Prehistoric Economic and Political Centralization in North America. ALAN H. GOODMAN (Hampshire College), GEORGE J. ARMELAGOS (University of Florida) and DEBRA L. MARTIN (Hampshire College).

The biological evidence from prehistoric North America consistently reveal a lack of improvement in health and nutritional status with increased economic development. Conversely, the pattern that most frequently emerges is one of decreasing health and nutritional status with increased centralization of power and expansion of sociopolitical systems. When peasant groups in the hinterlands of the Illinois River Valley become increasingly drawn into the Mississippian sociopolitical system, their health and nutritional status declines. At Dickson Mounds, Illinois (A.D. 950 - 1300) growth faltering and indicators of morbidity and mortality increase as local involvement in a Mississippian sphere of influence intensifies. Similar patterns emerge from the North American Southwest and Northeast.

These data suggest that relations of power -- both within and between locals -- must be considered in attempts to understand the biological consequences of economic development in the prehistoric as well as contemporary world. Prehistoric economic development, like contemporary economic development, has been shown to have a profound effect on the health and nutrition of indigenous groups. As well, it was neither benign, non-ideological, nor value neutral.

Delocalization and Diets: Impacts in the Third World. GRETEL H. PELTO (University of Connecticut) and Pertti J. Pelto (University of Connecticut).

This paper examines the effects of accelerated "modernization" and "delocalization" on food use patterns in various Third World settings. Under favorable economic and political conditions, previously autonomous or semi-autonomous food systems can gain in dietary diversity and insulation against seasonal failures when integrated into larger systems of food production and distribution. Often, however, commercial penetration from global food marketing results in losses of local nutrition-rich foods accompanied by substitutions of low-nutrition imports. Increased use of Third World economies for production of animal products for sale to wealthier populations is among the major negative factors affecting food systems in developing countries. Policy makers should be aware of these complex interactions in planning food and agriculture projects in developing regions.

The Health Crisis in Africa.SAMUEL OFOSU-AMAAH (Senior Advisor, Primary Health Care, UNICEF)

The lack of technological development in many parts of the continent meant that health status was largely dominated by the prevailing ecological conditions. During the 17th to 19th centuries the effects of the slave trade undoubtedly worsened the health situation. The pacification of Africa during the later period of the colonial era had the effect of gradual improvement in living and health conditions. African health significantly improved after World War II, up to the first two decades after independence. Since the late 1970s the rate of improvement has slowed down and in some areas of the continent there has been an actual regression in the status of health. The associated factors include a combination of drought, civil and political problems, economic recession and attempts at economic adjustment programmes, population growth, and new and resurgent disease problems such as HIV infection and malaria. The crisis expresses itself in two main ways: first in the direct effects on health and nutritional status, and secondly on the modern health care system, which at its best hardly reached half of the population of Africa before coming under the strain of the various factors to be discussed in the paper. There are of course many hopeful strategies for intervention being planned or actually implemented to stem the tide.

Technical Session

31T-1. Uses of Light Stable Isotopes in the Natural and Social Sciences

Organized by: Nikolaas J. van der Merwe *(Clay Professor of Scientific Archaeology, Dept. of Anthropology, Harvard Univ., Cambridge, MA)*

8:30 am / Tue / 19 Feb — Sheraton/Holmes

Variation in the Carbon Isotopic Composition of Plants: Implications for Agriculture and Ecology. LARRY L. TIESZEN (Augustana College)

The isotopic composition of plants is influenced by genetic and environmental determinants. In addition to the significant differences associated with the pathway of photosynthesis, there is genetic variation within species. This genetic variation in C_3 plants is mediated via the control of the plants' Ci/Ca ratio, which is largely a reflection of changes in the proportional control of carbon dioxide uptake by enzymatic versus diffusional components. This variation is therefore related to differences in water use efficiency and, in some species, yield. These characters are heritable and offer the potential for selection and incorporation by classical genetic or biotechnological means. Biochemical components within plants possess different isotopic compositions resulting in different values for plant parts. This has implications for the use of natural abundances for tracing carbon through ecological systems and for climate reconstructions. Carbon in modern maize or barley is about 1.5 $^{o}/_{oo}$ more negative than prehistoric material, reflecting the anthropogenic addition of depleted carbon from fossil fuels and desertification.

Paleoclimatic Reconstructions in Ice Cores
MICHAEL L. BENDER (University of Rhode Island)

Snow falling in Greenland and Antarctica accumulates into ice sheets thousands of meters thick. Ice composition reflects climate and the chemical properties of the atmosphere during glacial cycles, as well as during the last few hundred years of Earth history.

The H and O isotopic composition of the ice reflects regional temperature. It can be used to deduce snow accumulation rates on a seasonal basis, and glacial-interglacial cycles on a long term basis. Studies of H and O isotopes thus provide basic chronological information about ice cores.

At 50-100 m depth, ice particles are sintered together by the overburden. Samples of the contemporaneous atmosphere are trapped in the process. Studies of the isotopic composition of N_2 in the trapped air provide information about the nature of the trapping process itself. The isotopic composition of carbon in CO_2 and CH_4 reflects the changing sources of these greenhouse gases. The isotopic composition of O_2 reflects isotopic fractionations associated with photosynthesis, respiration, and the hydrologic cycle. It gives detailed chronologic information, and also reflects glacial-interglacial changes in relative productivities on land and in the sea.

Light Stable Isotope Tracers of Rapid Climate Change.
FAIRBANKS, RICHARD G. (Lamont-Doherty Geological Observatory of Columbia University)

Time series analyses of stable isotope records from well dated cores of deep-sea sediments, ancient coral reefs, lake deposits and polar ice sheets provide the basis for testing theories of climate change, including the Milankovitch astronomical theory of climate change and carbon cycle models. Records spanning the past 20,000 years document a large-scale natural isotope tracer experiment in unusual detail -- an experiment which is important for isolating the role of atmospheric CO_2 in climate change. Coral reef drilling demonstrates that glacial meltwater discharge rates oscillated between 3,000 and 17,000km^3/yr over the last deglaciation. Since the meltwater was approximately 40‰ lower in $\delta^{18}O$ than ocean water, the meltwater "spikes" delivered to the North Atlantic Ocean may be traced around the ocean basins. Meltwater freshening of polar surface waters plays a critical role in the modulation of ocean deep-water production and sea ice formation -- factors critical to the oceanic and continental heat budgets of high latitudes. The fraction of the isotopic spike propagated through ocean mixing, as opposed to that redistributed by atmospheric processes, may be modeled to give insight to transient $\delta^{18}O$ signals.

Medical Epidemiological Studies of Helicobacter pylori with the ^{13}C-Urea Breath Test. PETER D. KLEIN (USDA/ARS Children's Nutrition Research Center, Houston TX), ROBERT GILMAN (PRISMA, Lima, Peru), and DAVID Y. GRAHAM (VAMC/ Baylor College of Medicine, Houston, TX)

Recently discovered Helicobacter (formerly Campylobacter) pylori is widely recognized as the organism in gastric inflammation and as the infectious agent responsible for gastric and duodenal ulcers. The analysis of risk factors and of therapeutic measures to eradicate the organism is aided by the use of a noninvasive ^{13}C urea breath test developed in our laboratory. The test, based on the high urease activity of the organism, accurately identifies the presence and level of H. pylori colonization in stomachs of asymptomatic subjects from the evolution of excess $^{13}CO_2$ in breath after ingestion of ^{13}C-labeled urea. We have used this test in Houston to show that H. pylori prevalence increases with age at a rate of 1%/yr of life in the general population; the rate is sharply higher in blacks compared with whites. Subjects born in underdeveloped countries also have high rates of infection. Analysis of familial patterns of infection strongly support within-family transmission between spouses and between parent and child. The environmental reservoir and the mode of transmission are as yet undetermined. We have used this test in large scale studies of Peruvian children from high- and low-income families. The results strongly suggest that water source is a major risk factor in the acquisition of H. pylori.

Carbon Isotope Ratios of Individual Compounds in Biogeochemical Processes. J. M. HAYES (Biogeochemical Laboratories, Indiana University, Bloomington, Indiana 47405).

It has long been known that the natural abundance of ^{13}C varies significantly among mixtures of organic compounds, and it has been *suspected* that even wider isotopic variations might be observed if isotopic compositions of individual compounds could be determined. The development of isotope-ratio-monitoring GCMS, a technique in which the effluent of a gas chromatograph is continuously combusted and the products are led to the ion source of an isotope-ratio mass spectrometer, has shown that this is indeed the case, and that the isotopic compositions of individual compounds can readily be interpreted in terms of their specific (and often diverse) origins. Pathways of carbon flow in ancient ecosystems can, for example, be reconstructed based on isotopic compositions of individual compounds extracted from sedimentary rocks. In favorable cases, it is possible to determine selectively the isotopic compositions of specific organisms or groups of organisms in ancient environments. Analyses of lipids derived exclusively from prymnesiophyte algae, for example, allow recovery of an isotopic signal related to the abundance of CO_2 in ancient environments.

Greek and Roman Marble: Provenance Determination by Stable Isotopic Signatures. NORMAN HERZ (University of Georgia).

The ability to assign a quarry provenance to the marble of a classical Greek or Roman artifact allows the association of broken pieces, helps detect forgeries, indicates ancient trade patterns, and gives information on changing sculptural styles and esthetic tastes. Various physical and chemical characteristics have been tried but generally show too high a variability within the same quarry to provide useful signatures or require too much material for analysis [museum curators are touchy about this] and lack data bases. Stable isotope ratio analysis of O and C requires extremely small amounts of material, tens of milligrams. In Carrara marble, the variation in both $\delta^{13}C$ and $\delta^{18}O$ is less than $0.5^{o}/_{oo}$ in statuary blocks and less than $2^{o}/_{oo}$ over most quarries. A stable isotopic data base of multiple samples from the principle ancient marble quarries of Greece, Italy, Turkey, and Tunisia has been accumulated and now provides the geochemical signatures needed for provenance determination. Authenticity of artifacts can be tested by source - classical Greek marble cannot come from a Roman quarry - and by comparing the weathered surface to the fresh interior - equilibration with meteoric water should decrease the surface ^{18}O. Stable isotope ratios of O have also been used to determine the source of archaeological chert in Africa and North America, and O and C have been used to test European and Chinese bronzes.

Reconstructing Ancient Human Diets.
NIKOLAAS J. VAN DER MERWE (Harvard University)

Stable carbon isotopes have been used with great success to determine certain aspects of the diets of prehistoric

humans. (Nitrogen isotopes have also been used, but to a lesser extent.) The markedly different fractionation of carbon isotopes during C_3 and C_4 photosynthesis is basic to such applications. The spread of maize agriculture in the woodlands and tropical forests of the Americas has been documented using the carbon isotope ratios of archaeological human skeletons. Maize is a C_4 plant, and its entry into C_3 biomes produces significantly more positive $\delta^{13}C$ values. Obversely, the introduction of rice (a C_3 plant) into northern China, where millet (a C_4 plant) had been the staple for millenia, produced significantly more negative $\delta^{13}C$ values. The importance of marine food sources in human diets has been similarly documented in prehistoric cultures on several continents. Recent advances in extracting biogenic carbon from fossil tooth enamel now makes it possible to study the diets of the earliest hominids from South and East African sites. In the latter case, meat from grazing animals introduces a "C_4 signature" into hominid skeletons. Although this signature cannot be distinguished from one imparted directly by C_4 grasses, it combines with toothwear evidence to characterise the different degrees of meat-eating of different early hominids.

Isotopic Evidence from Paleosols for Ecologic Change.
THURE E. CERLING (University of Utah)

Paleosols often preserve an isotopic record of climate and ecology: The isotopic composition of soil organic matter, soil carbonate, and fossil teeth can be used to reconstruct local ecology or climatic conditions for a particular geologic setting. Stratigraphic sections can sometimes record a long-term history for a particular region, which, when compared to other long sequences, can help reconstruct regional or global climatic changes.

The stable isotopic composition of paleosol carbonates of East African Miocene through Recent paleosols suggests a very late development of the Savanna ecosystem. Paleosols from the Baringo and Turkana Basins, Ft. Ternan, Olorgesailie, Olduvai, and Laetoli all have pedogenic carbonates preserved. The isotopic evidence indicates that C-4 plants appeared in significant amounts (ca. 10%) by about 8 MYR, but did not dominate (greater than 75%) any of the observed ecosystems until about 0.6 MYR ago. This indicates a late development of the full Savanna ecosystem. In contrast, full C-4 grasslands were present in the Asian subcontinent by 6 MYR ago.

32. Demography; Political Science

32-1. Scientific and Technical Personnel: Issues for the 1990s

Organized by: Alan Fechter *(Executive Director, Office of Scientific and Engineering Personnel, National Research Council, Washington, DC)*

8:30 am & 2:30 pm / Fri / 15 Feb **Sheraton/Idaho**

The Implications of Changing National Priorities.
ELI GINZBERG (Columbia University)

This presentation focuses on underlying issues rather than on statistical forecasts.

Selected earlier changes in defense budgeting, particularly the cutbacks in the late 1960's—early 1970's will be reviewed in order to assess the probable outer limits of adjustments in the years ahead.

Attention will also be focused on the probable differences of such impacts on S&E personnel depending on their level of education, age, prior employment, location; as well as on the alternative trends in the macro economy and public policy actions such as retaining opportunities.

Age and Performance in Academia
PAMELA EBERT FLATTAU (National Research Council)

Evidence from a number of studies indicates that the proportion of faculty in U.S. academic institutions over the age of 40 continues to grow. Coupled with sluggish turnover and a dwindling pool of "new entrants", the overall academic employment picture led Bowen and Sosa in 1989 to suggest that we are "now in an unsettled period for higher education...At stake is the quality of teaching and research." The relationship between age and academic performance has been explored for over a decade, but concerns about the impact of an "aging professoriate" have stepped up analyses in recent years. Sociologists, economists and psychologists have made significant advances in disentangling age effects from socio-economic and cognitive factors in understanding changes in teaching and research performance during the life-course of faculty. Application of these findings to the management of institutional resources--including faculty as a resource--is uneven (Clark and Corcoran, 1989). What is needed at this time is a thoughtful analysis of the implications of research on aging [that is, the life-course of faculty] for the allocation of institutional resources to sustain the performance of faculty throughout their academic careers.

Managing our Federal S/E Workforce
ALAN (SCOTTIE) CAMPBELL (The Wharton School, Univ. of Pennsylvania)

Difficulties currently experienced by the federal government in recruitment and retention of scientists and engineers are well known and can be expected to continue into the 1990s. Motivated by concerns about these difficulties, the Carnegie Commission on Science, Technology and Government asked the National Research Council's Office of Scientific and Engineering Personnel to conduct an exploratory study of the organizational and institutional processes associated with recruitment and retention. The committee established to conduct this investigation undertook a series of activities to deepen its understanding of these processes and how they influence recruitment, retention and utilization. This presentation will summarize the findings that emerged from this exploratory effort. It will also describe the Committee's follow-up activities.

The Education and Human Resources Budget
LUTHER WILLIAMS (National Science Foundation)

This presentation will discuss the federal role in scientific/engineering education and human resource programs. It will describe efforts being undertaken by an Office of Science and Technology Policy Interagency Coordinating Committee to develop a consistent long-term strategy for supporting a high-quality talent pool consistent with national needs. As an initial step in this process, the Committee has been compiling education and human resources program and budgetary information on the current configuration of these activities. Initial findings from this analysis will be summarized and future steps outlined.

Barriers to Careers: A Study of Female S/E Students
HENRY ETZKOWITZ (State University of New York at Purchase)

Structural barriers, cultural obstacles and covert resistance by male faculty to women's participation in the physical sciences and engineering in academia persists in the United States. The thesis of cumulative disadvantage has been developed to account for the early removal of large numbers of women from the science career pipeline. I propose the concept of marginal disadvantage to analyze the loss of additional women at later stages. The experience of women as faculty members and graduate students was studied in nine science departments at

three research universities. Having avoided the effects of cumulative disadvantage, most nevertheless suffer disadvantage at the graduate and junior faculty stages that significantly reduces the entry of women into research careers in academic science. In two departments the existence of a minimum critical mass of women faculty and graduate students reduced barriers. I suggest a strategy to develop a minimum critical mass of women in physical science and engineering departments.

32-2. The Social, Economic, and Distributional Consequences of the Rapidly Increasing Physician Supply

Organized by: Herbert Traxler *(Chief, Modeling and Technical Assistance Branch, Bureau of Health Professions, U.S. Public Health Service, Rockville, MD)* and Jerald Katzoff *(Operations Research Analyst, Division of Medicine, Bureau of Health Professions, U.S. Public Health Service, Rockville, MD)*

8:30 am / Sat / 16 Feb — Sheraton/Idaho

GMENAC Revisited: Updated Projections for Selected Specialties.
WILLIAM D. MARDER, PhD (Abt Associates Inc.) and GARY L. GAUMER, PhD (Abt Associates Inc.)

This study reports the results of a project that reexamined physician supply projections made in 1980 by the Graduate Medical Education National Advisory Committee (GMENAC) for six physician specialties (general/family practice, general internal medicine, general pediatrics, general surgery, obstetrics/gynecology, and psychiatry). For each of the selected specialties we report on the process of reviewing and updating the requirements models and the new results for the years 1990, 2000 and 2010. These requirements are compared to the corresponding Bureau of Health Professions supply projections. The resulting imbalances are discussed in light of other changing parameters affecting medical manpower in this period. Strengths and weaknesses of the GMENAC requirements approach are discussed.

How Many Physicians is Enough for Adequate Medical Care?
ALVIN TARLOV (Tufts University and New England Medical Center Hospital)

Physician manpower studies are important because variations in supply affect the availability of medical services, the outcomes of medical care (including costs and benefits), and the health of the Nation. In standard economic theory, increasing service supply is matched by increasing demand at the price consumers are willing to pay for that service. However, that tight, interlocking relationship between demand, supply and price does not pertain to the medical service market because of the potential for physician-induced demand for their services, the asymmetry of knowledge about the needed amount and kind of services needed between the physician (supplier) and patient (consumer), and the third-party reimbursement system which influences the net price patients pay for medical services. Therefore, information of high social relevance, such as on the outcomes of care and cost-benefit and cost-effectiveness have to be incorporated into deliberations about physician supply.

"How Many Physicians is Enough?" Alvin R. Tarlov, EDITORIAL, Journal of the American Medical Association, vol. 263, no. 4, January 26, 1990, pp. 571-2

Distributional Considerations Associated with Physician Supply
ITZHAK JACOBY (Uniformed Services University of the Health Sciences)

As of 15 years ago, the view emerged that, in the aggregate, the U.S. has a sufficient number of physicians. This view was promoted by the 1976 Health Professions Assistance Act, the work of the Graduate Medical Education National Advisory Committee, and other sources. Early skeptics have recently become believers. In spite of this adequate aggregate supply, distributional problems remain pervasive. Institutions such as prisons and State mental hospitals, as well as various areas of the country, lack physicians; and some population groups have no access to health services. Development of meaningful policies to alleviate maldistribution depends upon analysis of the geographic distribution problem based upon market areas defined by economic, physical, and health-related factors. The methodologic problems with this analysis are significant. Using the county as the unit of measure is inadequate, and no way has yet been found to define HSAs in a way that lends itself to such a study. New software for spatial analysis promises to assist in this evaluation by delineating physician market areas by physical features, transportation and communications links, and socioeconomic variables.

Training Physicians for the 1990's and Beyond, PAUL JOLLY (Association of American Medical Colleges)

The ratio of physicians to population promises to continue to increase to unprecedented levels; whether this will constitute a surplus remains a matter of debate. Two possible consequences of the increasing numbers are increased costs for medical care and overcrowding of the field which would discourage new entry through lower income and other negative environmental factors. Medical schools are especially concerned about the latter possibility, because it might become difficult to fill classes with qualified students. Thus, they watched nervously as applications declined by 37 percent between 1974 and 1988. Schools find it hard to reduce capacity, but that is what they must do if faced with an inadequate number of qualified applicants. Qualifications as measured by MCAT scores and grade point averages have in fact declined marginally, and the schools did in fact reduce capacity modestly. The number of new first year students declined 4.8 percent between 1981 and 1989. It is not clear that the declining applicant pool resulted from a perception of overcrowding in the profession, since there were other changes in the environment during that same period. In particular, the end of the Vietnam era military draft removed one incentive for men to pursue medical education. The curriculum has evolved to provide new ways of encouraging lifelong learning and to prepare more students for primary care practice by providing education in the outpatient setting. The greatest challenge to curricula is the preparation of students for the transformation of medical practice and health care delivery which will result from advances in information technology.

Technology and Physician Manpower Projections: Past Practice and Future Directions. LOUIS P. GARRISON, JR. (Project HOPE Center for Health Affairs).

This paper describes, through a series of examples, how technological change can affect both the supply of and the demand for physician services. Previous physician supply and requirements models are reviewed to assess (1) how the impact of technological change is incorporated into the structure of the model, and (2) the sensitivity of their forecasts to alternative assumptions about technological change. It is argued that the lack of attention given to this factor by these models is one of their major shortcomings. Possible approaches to dealing with the impact of technological change are outlined.

A Skeptic Looks at the Physician Supply
ELI GINZBERG (Columbia University)

I have been concerned with this issue for half a century and have reached the following tentative conclusions: All projections are likely to be proved wrong because changes in the supply (and financing) will affect future demand. An adequate number of physicians is an abstraction with a ratio of 1:1 in the case of the President of the United States. No matter how many physicians we train they will avoid practicing among the poor. Much of the argument about generalists vs. specialists is irrelevant. Since physicians directly influence about 75% of all health care costs, constraints on increasing the supply appear in

order. There is room for improving physician productivity through the training and utilization of other health professionals but the coordination between the health, educational and the health service systems is complex especially in a continental economy such as the U.S with its marked regional differences.

The Medical Triangle by ELI GINZBERG. Chapter 11: The Politics of Physician Supply, pp. 169 ff.

Technical Sessions

32T-1. Science Policy for Women in Science: Lessons from Historical and Contemporary Case Studies

Organized by: **Pnina Geraldine Abir-Am** *(Visiting Research Associate, Northeastern Univ., Boston, MA)*

8:30 am / Sun / 17 Feb — Sheraton/Idaho

NSF's Educational Programs for Women in Science. JUDITH S. WEIS (Rutgers University).

The National Science Foundation has developed a number of programs that deal specifically with groups of individuals who have been underrepresented in the sciences and engineering. While some of these are aimed at furthering careers of those who are already in the field, other programs are educationally oriented and are designed to nurture interest and encourage students to study and to pursue careers in science and engineering. The major grant program designed to foster education for underrepresented groups is the "Career Access" program. Within this program is a component for "Comprehensive Regional Centers for Minorities" and one for "Model Projects for Women, Minorities, and the Disabled." The first component funds very large projects involving colleges, school systems, professional organizations, community groups, etc. and focuses only on minorities. Projects for women are included only within the Model Projects program, a program that has received a very low level of funding in the three years of its existence, approximately 1/20th of the funding devoted to the Comprehensive Centers. There have, therefore, been very few model projects funded over the years, of which about half have been aimed at women and girls. Some of the reasons for this great discrepancy in funding are discussed.

Concerns of Members of the Association for Women in Science (AWIS), a Multidisciplinary Science Organization. BARBARA MANDULA (EPA) and JUDITH LAMONT (Orion Enterprises, Inc.)

The Association for Women in Science (AWIS) supports the development of professional opportunities for women. The organization, which is celebrating its 20th anniversary in 1991, has a national membership of 3,200. Almost 60% are in the life sciences, and just over half have doctoral degrees. About half the national members have also joined one of the 35 local chapters throughout the country. This paper reports the results of surveys that AWIS has carried out to learn about the concerns of the national members, as well as to get information on new members and on those who decide not to renew. Membership surveys indicate that members are especially interested in career opportunities and strategies, trends in the status of women in the sciences, and relevant legislation, as well as issues of parental leave, flexibility in working hours, child care/elder care, sexual harassment, and pay equity. Despite the increase in participation of women in science, women still experience isolation and discrimination; major reasons that women join AWIS are to support its goals and to participate in the networking opportunities provided by the chapters. Besides providing a forum for sharing ideas and experiences, many chapters carry out educational activities, encouraging precollege and college women to study science and math and to pursue science-related careers. Retention for AWIS members who participate in chapters is four times higher than for those who do not, reflecting the importance of personal interaction and support. Further analysis of the exit surveys may provide insights about women who drop out of science.

Gender and Research Productivity: Implications for Science Policy. MARY FRANK FOX (Pennsylvania State University)

The lower research productivity of women compared to men is not simply a cause of women's restricted status--but also a symptom of their position in science. First and fundamentally, research is a social process of communication, interaction, and exchange. Second and relatedly, science proceeds in institutional and organizational settings. Thus in explaining productivity and gender differences in productivity, I look to the social and organizational factors of the environments in which scientists work: prestige and degree granting level of the academic department, collaborative opportunities, patterns of interaction, teaching responsibilities, number of assistants, and work climate--and the association of these variables with scientists' individual interests, attitudes, and habits.
Policy implications follow from these relationships: Women's productivity--and status--in science are tied to the signals, resources, and rewards of the institutions, departments, and work units. Work environments do not necessarily operate uniformly or neutrally or androgynously. Resources and opportunities operate differently for women and men. And the lower productivity of women represents both a cause and an effect of their depressed status in science.

Women's Representation in Scientific Research and Intellectual Labor Markets in Developed and Developing Countries: Science or Society? BEATRIZ RUIVO (National Board for Scientific and Technological Research, Portugal).

Women's representation in the scientific labor market is not homogeneous all over the world for economic, political, social and cultural reasons. The position of women in research and in higher posts of science policy-making and funding of research is analysed with respect to several factors: processes of industrialization and their requirements in qualified manpower, valorisation of research results, and the economic and political power of women in society. The increasing representation of women in research seems to be related to the growing requirements for human-power. The availability of higher posts appears to be strongly influenced by the economic and political power of women in society.

Strategies for Improving the Representation of Women in the Medical Sciences. MERLE WAXMAN (Yale University School of Medicine).

The past decade has seen a number of striking advances with respect to women in medicine and the medical sciences. Enrollment of women in medical school has increased steadily from approximately 6% in 1960 to 36.1% in 1989. Notably, as measured by most academic yard-sticks, graduate-level women students in medicine, science and engineering perform as well as students as do their male counterparts in graduate school. Despite the remarkable growth in number of women entering academe, women remain disproportional underrepresented on academic faculties, especially at the tenured level. The absence at the senior level impacts strongly on trainees and junior faculty who lack access to women role models and mentors. It is likely that the paucity of female mentors and role models has historically had an important negative effect in making it difficulty for junior women to achieve their full potential. This paper will explore specific strategies to improve the representation of women in the medical sciences. Some specific strategies include: establishing adequate support systems such as child care centers which provide comfortable and productive movement between home environment and the workplace; flexible work schedules, and educating administrators and faculty with respect to such issues as perception bias and gender-related issues.

32T-2. Voting: Mathematical Foundations and Political Reality

Organized by: **Alan D. Taylor** *(Professor of Mathematics, Union College, Schenectady, NY)*

8:30 am / Mon / 18 Feb **Sheraton/Idaho**

Social Choice Theory: Some History and Background.
ALAN D. TAYLOR (Union College).

The general area of social choice is concerned with the question of how one "reasonably" arrives at a "socially preferred alternative" given some knowledge of the preferences of the individuals. Social choice and voting schemes represent one of the few areas that brings together non-trivial mathematics and applications of immediate significance in a setting that can easily be appreciated by scientists in all fields. The purpose of this introductory talk is to set the stage for the symposium offerings to follow. Topics covered will include some well-known historical highlights ranging from the 18th century voting paradox of the Marquis de Condorcet to the 20th century impossibility theorem by the Nobel Laureate Kenneth Arrow. Several particular examples of social choice procedures (plurality voting, the Borda count, the Hare procedure, approval voting, etc.) will be recalled. Finally, some work of the last two decades showing how the geometry of k-dimensional Euclidean space can comment on voting procedures will be mentioned.

Multicandidate Voting Systems
SAMUEL MERRILL, III (Wilkes University)

This talk evaluates--from a mathematical prospective--voting procedures designed to select a single winner from a field of three or more candidates. There is no lack of alternative procedures used in public elections and private organizations: single-vote-plurality, runoff, the Borda count, approval voting, the Hare system. These voting procedures can differ strikingly in the election outcomes they produce, the opportunities for manipulation they create, and the nature of the candidates--centrist or extremist--whom they advantage. A number of researchers have used a variety of methodologies in recent decades to assess these implications, including deduction from theoretical models of voting behavior, computer simulation, and reconstructions of historical voting from election and polling data. Of the voting procedures surveyed here, single-vote-plurality appears most often at odds with the majoritarian principle of Condorcet and with the criterion of maximizing social utility. More reliable and probably less vulnerable to manipulation in practice are approval voting and the Hare and runoff methods.

Homology, Dimension, and Graph Theory: Connections with Social Choice. WILLIAM S. ZWICKER (Union College), and ALAN D. TAYLOR (Union College).

How does an area of applied mathematics hook a pure mathematician? Certainly, it's intriguing if some sophisticated tool of mathematics bears on an important applications problem. But the fun really takes off if the process reverses, and the applications inspire new concepts related to fields of current mathematical research. Social Choice Theory provides good examples of both types of hooks.

The Marquis de Condorcet observed that certain patterns of voter preference result in a majority of voters preferring candidate A to candidate B, a majority preferring B to C, and a majority preferring C to A. This "voters' paradox" is important - it is connected with Arrow's Impossibility Theorem and with the problem of finding "fair" voting systems for multicandidate elections. Via an analogy with electrical circuits, the boundary map of Homology Theory can be used to construct necessary and sufficient conditions for avoiding the paradox. The analysis provides insight into how such collective cycles can appear, even when individual preferences never cycle.

An analysis of weighted voting has led to a general notion of dimension for finite collections of finite sets. Dimension is a type of complexity measure, and is related to the well-studied theory of the dimension of a partially ordered set. A recent application of this new notion to graphs has revealed surprising connections with Ramsey Theory.

Shall Ever the Twain Meet? A Comparison of Social Choice and Comparative Electoral Studies Approaches to Voting Systems.
JACK H. NAGEL (University of Pennsylvania).

There are two major traditions in voting systems research--social choice theory and comparative electoral studies. Until recently, the two literatures were almost entirely separate; and, with few exceptions, communication between researchers in the two areas remains minimal. The two traditions differ not only in methods, but also in agendas, data bases, and conclusions. This paper will outline a comparison primarily by juxtaposing two outstanding recent books, one from each genre--Merrill's Making Multicandidate Elections More Democratic and Taagepera and Shugart's Seats and Votes.

New Voting Systems. STEVEN J. BRAMS (New York University).

Approval voting, proposed about fifteen years ago and now used in professional societies comprising some 350,000 members, is not the only new voting system that has been proposed or recently used. "Disapproval voting"--used in Poland and the Soviet Union, among other places--is a system under which voters can cross off as many names as they like from a ballot. "Constrained approval voting" has been proposed to elect different categories of members (e.g., divided according to region and specialty) from an organization; voters can vote for as many candidates as they like, but the numbers that can be elected from each category are constrained by upper and lower bounds. "Coalition voting" is designed to induce stable coalitions in multiparty systems that use a party-list system of proportional representation. It allows the voter to cast two different kinds of votes, one to determine the seat shares of parties in a parliament and the other to determine which majority coalition of parties receives the most support as a coalition. These different systems will be described, and experience with them, or prospects for their adoption, will be discussed.

32T-3. Supply and Demand for Scientists and Engineers in Emerging Markets

Organized by: **Eileen L. Collins** *(Senior Economist, National Science Foundation, Washington, DC)*

2:30 pm / Sat / 16 Feb **Sheraton/Idaho**

BLS Projections of Demand for Scientists and Engineers in 2000
RONALD E. KUTSCHER (Bureau of Labor Statistics)

The Bureau of Labor Statistics latest projection for scientists and engineers for 2000 will be discussed. This will include expected change by field. Also, sensitivity of these demand projections to alternative assumptions will be covered. Further, these demand projections will be reviewed in light of likely supply conditions.

Sensitivity of Science and Engineering Baccalaureates to Starting Salary and Underlying Population. EILEEN L. COLLINS (National Science Foundation)

This paper will assess the extent to which the supply of new science and engineering baccalaureates by gender and major field group is sensitive to the size of the underlying college-age population, starting salaries in the given field, and starting salaries in a competing field.

Supply and Demand for Doctoral Scientists and Engineers to 2000. LAWRENCE R. FOREST, JR. (DRI/McGraw-Hill)

This paper will assess the potential supply of and demand for doctoral scientists and engineers by field and market sector to the year 2000. The analysis employs a market-based model in which wage-rate movements bring about market balance. Included in the model are shifts in the college-age population, industry and academic research activities, and retirements from the doctoral labor force.

Emerging Trends in Academic Labor Markets. JUDITH I. GILL (Western Interstate Commission for Higher Education).

This paper will assess the outlook for the academic sector. The paper will identify significant variables that determine supply and demand for academic faculty, the extent to which existing data and evidence permit quantification of these variables for projection purposes, and emerging trends in faculty supply and demand.

A Critical Look at the Ph.D. Supply Crisis
JOE G. BAKER (National Research Council)

There is developing among educators and science policy specialists a growing concern that the 1990s and beyond will usher in an era of general shortages for Ph.D. scientists. This paper critically examines recent studies and approaches related to the Ph.D. "supply crisis." The paper assesses the state of knowledge concerning the "supply crisis," including the probability and severity of future Ph.D. supply problems. The paper also critically examines proposed policy intervention to avert the crisis, if any.

Workshop

32W-1. Women of Science: Secrets of Success

Organized by: **Margaret M. Lobnitz** *(Director of Environmental Compliance Programs, ICF Kaiser Engineers, Universal City, CA)* and **Harriet H. Kagiwada** *(Rockwell International Professor of Systems Engineering, California State Univ., Fullerton, CA)*

8:30 am / Tue / 19 Feb **Sheraton/Wisconsin**

Women of Science: A View from Academe and Industry
HARRIET H. KAGIWADA (California State University)

Our society is in dire need of more scientists and engineers for now and in the years ahead. Why are not more women answering this call? Perhaps other fields look more attractive, or science is too "hard". No! A scientific career is exciting, fulfilling, and fun. The author speaks from a perspective gained during three decades in the scientific community. She will share her guidelines for getting the most out of careers and personal lives.

Taste, Talent and Tenacity. ARIEL HOLLINSHEAD (The George Washington University Medical Center).

The title of this abstract represents the three things that Lillian Gish, famous actress in silent and modern movies, said were needed to sustain an outstanding career. As a research oncologist, with a Ph.D. in Pharmacology and Professorship in a Dept. Medicine, I spent long hours in innovative, difficult, multidisciplinary basic research, and always with care that the research was meaningful to medical science. An important further step was in taking discoveries from the laboratory to the clinic. If the clinical research warranted a further step, I had to learn how to work with government requirements and with properly chosen associates for reliable conducting of clinical trials. These three areas intermingled for much of my life as a scientist, but then came the surprise. It wasn't enough to perform reliable work, to publish carefully written papers, to obtain grants and contracts, to work cooperatively with physicians for many years.

No. For one's work to count, to be incorporated as an acceptable medical approach, it was important to be interactive in male-dominated organizations, with politics, with business, with the press and with industry.

The Environmental Challenge
SUZANNE L. PHINNEY, D.Env. (Aerojet)

Overseeing a corporation's response to the exponential growth in environmental regulations is a daunting challenge, particularly in a downturned economy. Perhaps the only greater challenge is reaching such a level of responsibility in a corporation where upper management is exclusively male with decades of aerospace experience behind them. While acknowledging the importance of being in the right field at the right time, the other important considerations in reaching this level included:

- a strong academic background (Doctorate in Environmental Science) in a field where most professionals stop at the B.S. degree;
- strong professional ties, including serving on the editorial board of *The Environmental Professional* and the publication of numerous articles relevant to professionals in the field;
- understanding of the political climate of the organization, and how to best serve it while retaining a strong environmental ethic;
- demonstrated capability and recognition of technical expertise within the corporation and with regulatory agencies.
- community involvement such as serving on city and county commissions, League of Women Voters, numerous local environmental groups;

Achieving Success Despite the Barriers. ELIZABETH RODRIGUEZ (Office of the Secretary of Defense/Director of Research & Engineering, Pentagon)

Achieving success in a technical field can be hindered by barriers. In some cases, these barriers are compounded if you are female. This discussion will deal with barriers the author faced while competing in a male-dominated profession. The author will describe her early school years as well as her post-secondary education. She will speak to her experience as: a mathematician at the Pacific Missile Test Center, Point Mugu, CA; Program Manager with the Strategic Defense Initiative Organization, Pentagon, Washington, D.C.; and Operations Research Analyst with the Director of Operational Test & Evaluation, Pentagon, Washington, D.C. The author will also discuss some key elements which she believes have contributed to her success in her present career, that of Special Assistant to the Director of Research and Engineering at the Pentagon.

Women in the Health and Environmental Sciences: Building Effective Organizations in the Federal Government and Structuring an Effective Corporation in the Public Sector.
ELIZABETH L. ANDERSON (Clement International Corporation)

Women in the health and environmental sciences have a unique opportunity to participate in building, in essence, a new field of science. This emerging field of science is a composite of many disciplines woven together to present a coherent response to the compelling problems associated with an increasingly complex environment. The applications of this composite science are broad indeed encompassing state and local issues, nation specific issues, and issues of international and global importance accompanied by important social and economic impacts in virtually every case. This paper will focus on three aspects from a personal point of view: (1)

The elements of success for women scientists in a rapidly evolving, relatively new field of the sciences. Undoubtedly, this experience for women differs considerably from that of entering a field dominated by decade old networks where relationships and practices have largely been dominated by men. (2) Given the essential role of the health and environmental sciences in the federal regulatory framework, the ingredients of success for women building and directing a group with significant responsibilities within the federal bureaucracy; and (3) Essential ingredients for building and directing a corporation specializing in the health and environmental sciences with primary business objectives.

33. Sociology

33-1. Drugs, Crime, and Violence: What Do We Know?

Organized by: Paul J. Goldstein *(Deputy Director, Narcotic and Drug Research, Inc., New York, NY)*

8:30 am / Sun / 17 Feb — Sheraton/Warren

Experimental Studies of Drugs and Aggression. STUART P. TAYLOR (Kent State University).

The major purpose of this presentation is to describe some of the research my students and I have been conducting on the effects of commonly abused psychoactive drugs on aggressive behavior. We have studied the effects of a variety of stimulants and depressants. Relative to depressants, one of the most consistent findings in our laboratory is that ethanol enhances aggressive responding. This alcohol-instigating effect appears to vary as a function the dose of alcohol, the degree of instigation in the situation, and the presence of inhibitory cues. Another sedative hypnotic, diazepam, has also been observed to facilitate aggressive behavior in our laboratory. In contrast to these results, we found that neither secobarbital nor pentobarbital increased aggression. We have conducted a number of studies on the effects of stimulants on aggressive responding. While increasing cardiovascular activity, amphetamines have not facilitated aggressive behavior in our laboratory. Another commonly abused stimulant, cocaine, was found to increase aggressive behavior. We have also explored the effects of marihuana on aggressive responding. In two studies, THC appeared to inhibit aggression. A number of studies recently conducted in our laboratory have explored the interactive effects of drugs on aggressive altercations.

Human Laboratory Studies of Drugs and Aggressive Behavior. DON R. CHEREK (Univ. Texas Hlth. Sci. Ctr. at Houston) and RALPH SPIGA.*

Research employing the methods of behavioral pharmacology to determine the effects of drugs on human aggressive responding under controlled laboratory conditions will be presented. Subjects served as their own control and repeated measures of aggressive responding were taken under placebo and different drug dose conditions. Aggressive responding was operationally defined as the delivery of an aversive stimulus to another person. Subjects were provided with both aggressive and non-aggresive response options. The major focus of the presentation will be to emphasize the importance of the behavioral history of the subject in determining the effects of a given drug on aggression. This point will be supported by: (1) animal data indicating the importance of dominance hierarchy in determining the effects of alcohol on aggression, (2) our own data relating to paper-and-pencil measures of hostility and the effects of diazepam and triazolam on human aggressive responding, and (3) comparisons of the effects of marijuana on aggressive responding of college students versus urban males with substance use histories. These studies suggest that differences in behavioral history can alter the effects of drugs on aggressive behavior, and one cannot predict the effects of drugs on aggressive behavior when going across different subject populations.

*This research was supported by NIDA grant DA 03166-07.

Context and Contingency in Drug-Related Violence. Jeffrey Fagan (Rutgers University).

There are fundamental differences between substances in their association with aggression. Various substances affect mind and body differently. Aggression is mediated by personality and expectancy factors, situational factors in the social context, and sociocultural factors that channel the arousal effects of substances into behaviors that may or may not involve interpersonal aggression. Regardless of how substances are used, cultural meanings and practices contribute to the circumstances of how people use intoxicants and how they behave afterward. Thus, for example, a social group may use the same drugs at different times for contradictory purposes. This ritualization provides participants a set of rules governing the boundaries of aggression: locations, participants, and severity. Research is reviewed from four seemingly diverse social contexts (families, youth gangs, barrooms, and street drug scenes) to show the influence on aggression of interactions of personality, social network, situation or setting, and cultural norms. These factors are integrated in an explanatory model to suggest specific hypotheses about the development of social rituals that control drug-related aggression.

Drug Use: Its Role in Predatory and Violent Offending. JACQUELINE COHEN (Carnegie Mellon University)

While cumulating evidence of links between drug use and crime has spurred a variety of efforts to increase sanctions for drug offenses, such policies ignore the potential role of drug use as an aggravating factor in predatory crimes like robbery and burglary. The research reported here examines longitudinal data on individual histories of arrests and urine tests for drug use. When compared to drug offenders (i.e., persons charged with possession, manufacture, distribution, or sale of illicit drugs), drug-using predatory offenders (i.e., persons charged with robbery or burglary who test positive for drug use) are expected to display higher rates of detected criminal activity in both predatory and drug offenses, and thus to represent better candidates for enhanced incarceration sentences than do drug offenders. The research also probes more deeply into the relationship between drug use and violent offending, particularly differences between users and non-users in *participation* in violence by offenders, *frequency* of violence, and *termination* rates of ending involvement in violent offending. We expect these different aspects of violent offending to vary with drug types: for example, the pharmacological effects of many drugs in depressing central nervous system response (e.g., heroin or barbiturates) are expected to contribute to lower participation in violence (i.e., fewer violent offenders) among drug-users than non-users, but use of hallucinogenic or stimulant drugs (e.g., PCP or crack cocaine) are expected to be associated with higher frequencies of violence by violent drug users.

Drugs and Violence: Clinical and Epidemiological Studies KENNETH TARDIFF (Cornell Medical College), PETER MARZUK (Cornell Medical College)

The authors will present findings from two different data bases: patients admitted to a university psychiatric hospital and cases coming to attention of the Chief Medical Examiner of New York City. In the first study, 270 consecutive patients 19 to 55 years of age admitted to the Payne Whitney Clinic were assessed using a structured interview to assess the frequency and severity of violence toward other persons and suicidal ideation and behaviors. There were an additional 89 patients who refused to be interviewed or who were discharged before an interview could be done and their records were used to obtain data. Their overall history of drug and alcohol use was quantified as was use of drugs and/or alcohol prior to specific violent and/or suicidal episodes. The authors will describe patterns of violence and suicide in relation to the type and extent of drug use and to underlying psychopathology.

Rates of specific drug use will be compared to rates of drug and alcohol positive toxicologies in the authors' studies of persons coming to the medical examiner's office because of deaths from homicide, suicide and auto accidents.

33-2. Violence and Youth: Research and Prevention Programs

Organized by: **Felton J. Earls** *(Professor of Human Behavior and Development, Harvard School of Public Health, Boston, MA)*

8:30 am / Sat / 16 Feb **Sheraton/Warren**

Predicting Teen's Violence Risk: A Developmental Taxonomy. TERRIE E. MOFFITT (University of Wisconsin at Madison).

Discriminating among children who are at low and high risk for serious offending when they reach young adulthood is an unsolved puzzle. When should parents and professionals worry about children's antisocial behaviors? Which teen's delinquency is harmless experimentation, and which teen is at the threshold of a life of predatory crime? Who will need intervention? Who will benefit from it? How early should we intervene? What to do? Data will be presented from one 18-year program of research into these questions, the Dunedin Multidisciplinary Health and Development Study. This study of an unselected contemporary birth cohort of 1037 New Zealanders has suggested that understanding the heterogeneity of antisocial behavior in adolescence is a crucial first step. We have identified subtypes of delinquent children on the basis of the distinct developmental courses of their antisocial behavior and neuro-cognitive deficits. The subtypes in the NZ sample have hypothetically different etiologies, different courses, different outcomes, and different treatment responses. This new developmental taxonomy may help to answer important applied questions.

The Development of Violent and Assaultive Youth
ROBERT B. CAIRNS (University of North Carolina), and BEVERLEY D. CAIRNS (University of North Carolina)

Arrests for crimes of violence in the U.S. reach an asymptote in 17-18 year olds. Preventative efforts would be facilitated is (a) children who were most likely to become assaultive adolescents could be identified by mid-childhood, and (b) factors that promote violence in development could be clearly specified. Recent European longitudinal research implicates measures of aggression in 10 year-old boys in the prediction of adolescent violence. To determine whether parallel outcomes obtain in the U.S. for boys as and well as for girls, a decade-long longitudinal study of 695 males and females has been conducted. Subjects were originally selected from representative public schools in suburban and rural areas, and they were seen each year from the 4th grade through post-high school (i.e., 10 to 21 years of age). A low rate of attrition -- 99% of the living subjects were individually tracked throughout the U.S. in the last year of high school -- permitted us to identify all serious violent offenders. A configuration of deviant, aggressive behavior in childhood proved closely linked to arrests for violence in adolescence and young adulthood. This configuration was also strongly associated with early school dropout and teenage parenthood. From childhood through adolescence, aggressive-assaultive youth affiliated with others like themselves, leading over time to an escalation in levels of violence. Almost 50% of the adolescent males claimed firearm ownership, accounting in part for the incidence of serious injuries and death in males. Fewer girls than boys were identified as extremely aggressive in childhood, but when the configuration did occur, it was closely linked to subsequent problems of living in both women and men.

Developmental Epidemiology, Vulnerability, and Prevention Research on Early Risk Behaviors. SHEPPARD G. KELLAM (Johns Hopkins University), LARRY DOLAN (Johns Hopkins University), LISA WERTHAMER-LARSSON (Johns Hopkins University), and GEORGE REBOK (Johns Hopkins University)

Over 2,000 first graders from 19 public elementary schools in Baltimore have participated in two preventive intervention trials during first and second grade, with annual follow-up. The targets of one intervention, the Good Behavior Game, were aggressive and shy behaviors. Prior research suggested that early aggressive behavior and particularly its combination with shy behaving predict heavy drug use, delinquency, and school dropout later.
The second intervention, Mastery Learning, was directed at raising school achievement test scores, found to be an important antecedent of depressive symptoms and possibly depressive disorder. The design involved random assignment of control and intervention schools and of children to intervention and control classrooom.
The short-term results of each intervention indicated meaningful impact specific to its target through first grade. Studies of the evolving relationships among the target behaviors suggests that concentration problems are an important antecedent for both aggressive and shy behaving, achievement, and depression. The theoretical and practical implications are discussed.

Community-based Skills Development Program as a Preventive Strategy
OFFORD, D.R. (McMaster University, Hamilton, Ontario), JONES, M.B. (Pennsylvania State University College of Medicine, Hershey, Pennsylvania)

PALS (for "participate and learn skills") was a nonschool skill-development program offered to all children 5-15 years of age living in a publicly supported housing complex in Ottawa, Ontario. Both sport (eg., hockey and swimming) and nonsport (eg., music lessons and dance) activities were offered to all children, 5 to 15 years of age in the housing complex. Participation was excellent. For instance in the first year, 70.8% of the children participated in at least one PALS activity. Further, the children gained skills in the various activities, and these gains were much greater than those in children living in the control complex. While none but marginal and possibly nonexistent spill over effects on school performance or behavior in the home were observed, there were, however, clear and significant changes in unobtrusive measures of antisocial behavior outside home and school. A cost-benefit analysis indicated that potential savings, primarily in reduced vandalism but also in reduced police and fire costs, greatly exceeded the cost of mounting the program.

33-3. Family Violence: Etiology, Impact, and Prevention of Child Abuse

Organized by: **Cathy Spatz Widom** *(Professor and Director, Hindelang Research Center, Univ. at Albany, Albany, NY)*

2:30 pm / Sat / 16 Feb **Sheraton/Warren**

Risk Factors Associated with Child Abuse.
ROY C. HERRENKOHL, (Lehigh University), ELLEN C. HERRENKOHL, (Lehigh University).

The literature on child abuse suggests a variety of factors presumed to increase the risk of child abuse. There are also a few authors who have proposed perspectives for integrating these factors into a strategy for risk assessment. An integrated risk model has not been tested, however. This presentation will suggest that there are two types of risk - the risk for the occurrence of abuse and the risk for negative outcomes for the child due to abuse. It will further be proposed that risk factors which predict the two types of risk, while overlapping, are not the same. Statistical and individual case examples are given and the implications of the two types of risk for service provision and for prevention are considered.

The Effects of Physical Abuse on the Development of Young Children. BYRON EGELAND (University of Minnesota).

As part of a longitudinal study of high risk children, a sample of 24 physically abused children were identified and compared to nonabused children from the same sample. Comparisons of the two groups on assessments of child adaptation, which were based on the salient developmental issues of a particular age, indicated that abused children had significant social, emotional and behavioral problems beyond the problems related to low SES. Abused children were more

likely to show an anxious avoidant pattern of attachment during infancy. The expectations about self and relationships that the abused child develops during this period may play a major role in accounting for abuse across generations. During the toddler and preschool period they were angry, noncompliant, and lacking in enthusiasm and positive affect. As they entered school they were hyperactive, distractible, lacked self-control, and were not well liked by peers. The abused child's pattern of interaction with peers often resembled the abusive rejecting pattern they experienced with their parents. They were submissive or aggressive in their interactions with others, depending on their perception of the power of the interactant. All of the abused children suffered negative consequences, and there was a range of developmental outcomes. The more competent of the abused children lived in more stable, organized and predictable home environments, and they had alternative caregivers such as a grandparent, who provided nurturance.

Long-term Consequences of Early Child Abuse and Neglect
CATHY SPATZ WIDOM (University at Albany)

What are the longterm effects of child abuse on the physical, neurological, cognitive, social and emotional development of the child? Almost twenty years ago, Martin et al. (1974) wrote that answers to such questions were only partially and tenuously provided by the existing literature. This presentation will describe the current state of our knowledge about the longterm consequences of physical child abuse. Then, using data from a prospective cohorts design study, criminal consequences of child abuse and neglect will be reported as well as preliminary findings from an ongoing follow-up study of cases of physical and sexual abuse and negelct and a control group. In addition to a description of the extent of adjustment or maladjustment for these groups, across a wide domain of outcome variables, an attempt will be made to describe factors which appear to differentiate those who succeed from those who succumb. Implications for prevention and possible intervention strategies will be discussed.

The Prevention of Child Maltreatment.
DAVID L. OLDS (University of Rochester)

The U.S. Advisory Board on Child Abuse and Neglect has identified home-visitation as the best documented strategy for preventing child maltreatment. Randomized trials of home-visitation programs, however, show that they vary widely in their objectives, structures, and effectiveness. Our own randomized trial of home-visitation has produced convincing preventive effects, but did so in the context of a broad-based program aimed at promoting the health of at-risk women and their children during pregnancy and the first two years of the child's life. During pregnancy, the program produced improvements in women's health-related behaviors (smoking and diet), informal social support, use of community services, and the birthweight and length of gestation of babies born to young adolescents and smokers. A reduction in verified cases of child abuse and neglect was produced for women at greatest risk for caregiving dysfunction (poor unmarried teenagers). This reduction was corroborated by parents' reports of their children's temperaments, observations of their caregiving, the children's developmental status, and the children's emergency-room contacts. Moreover, during the first four years after delivery, nurse-visited poor, unmarried women had fewer subsequent unintended pregnancies and increased participation in the labor force. Other programs that produced preventive effects also were based on comprehensive, broad-based health-promotion models. We infer from these findings that home-visiting programs aimed at child abuse prevention are most likely to succeed if they simultaneously address the multiple contextual and personal factors that interfere with parents' efforts to care for their children. Preventive intervention research will be further strengthened if investigators pay closer attention to statistical power considerations and if they use standard definitions of child maltreatment that are validated with corroborating evidence from other sources.

33-4. The Social Pathology of Large Cities

Organized by: **Keith Harries** *(Professor and Chair, Dept. of Geography, Univ. of Maryland — Baltimore County, Baltimore, MD)*

2:30 pm / Fri / 15 Feb **Sheraton/Warren**

Black Philadelphia Then and Now: The "Underclass" of the Late 20th Century Compared with the Poorer African-Americans of the Late 19th.
ROGER LANE (Haverford College).

The modern black underclass is defined above all by its inability to participate fully in the modern service economy, with its unprecedented and growing educational demands. It is also marked, in practice, by values that differ from those of other blacks, by crime and drug abuse, by the virtual absence not only of stable two-parent households but of marriage itself, and by geographic and social isolation from middle and working class blacks. During the late 19th century in contrast poor blacks, although plagued by crime, poverty, and other handicaps, generally shared the dominant value system, tried to make marriage work, were less prone to drug abuse than immigrant whites, and were connected with other blacks through a rich network of associations. Their problem was not then their own inability to work but the open prejudice that kept them from using their skills. Philadelphia once had the biggest of northern black communities; it now has a typical one. And so it is a good place to examine the two situations, a century apart, and to find what happened in between to make the difference.

Emerging Settlement Patterns: Implications for the Inner City Poor. MARK ALAN HUGHES (Princeton University).

The changing functions of the central-city and outer-city economies have implications for public policy. I review these changing functions in the emerging settlement patterns of the 1990s. I argue that emerging metropolitan structure, which has had severe consequences for the inner city, is imposing costs on the outer city as well. This affords an opportunity to re-examine policy strategies regarding the inner-city poor.

Does A Growing Underclass Threaten to Undermine Black Progress? IRWIN GARFINKEL (Columbia University), JAN HOEM (University of Stockholm), SARA MCLANAHAN (Princeton University), DAN MEYER (University of Wisconsin).

This paper defines the underclass and provides empirical estimates of the extent to which it is growing. The underclass is defined as a group of individuals who are weakly attached to the labor force, whose parents were also weakly attached to the labor force, and who are isolated from mainstream society. The empirical analysis uses long-term welfare dependence as a proxy for weak labor force attachment. It asks whether estimates of the magnitude of intergenerational welfare dependence coupled with estimates of differential fertility between welfare dependent black mothers and all other black mothers indicate that the proportion of black children growing up in an underclass is increasing. Results indicate that this is unlikely. Yet the proportion of black mothers dependent on welfare may be growing. According to Myrdal's theory of cumulation, the latter may feed racial prejudice and undermine black progress.

Why Homelessness Won't Go Away. MICHAEL DEAR (University of Southern California)

The present crisis of U.S. homelessness is qualitatively and quantitatively different from past episodes and from the experiences of other advanced industrial nations, including those of Western Europe, Australia and Canada. The intensity and intransigence of American homelessness is particularly associated with: deindustrialization and economic recession; the restructuring of the welfare state; and the collapse of federal affordable housing programs. Demographic analysis suggests that a "culture of chronicity" is taking hold amongst the new homeless. This encompasses drug and alcohol abuse, mental disability, and excessive reliance on the shelter system and other forms of institutional living (e.g., prisons). The current crisis of homelessness was three decades in the making, so it is unlikely that there will be a "quick fix" solution to the crisis.

Crimes in the Capital City: Case Study of Washington, D.C.
DEWITT DAVIS, JR. (University of the District of Columbia).

The purpose of this paper is to determine where the crimes more frequently occur within the central city of Washington, D.C. and to determine if spatial relocation and expansion diffusion are occurring more during the last few years. This may help to discover if the total city is safe or dangerous or are there concentrated areas. Crimes in this study are homicides, rapes, and assaults. Many of these crimes should be classified as street crimes because many of them transpire outside the dwellings. This certainly concerns the residents of the city as well as visitors who are pedestrians. It is believed that many of the crimes in recent years are drug related, especially the street crimes. The research time period ranges from 1980 to 1990, and the study concentrates on the crimes that have taken place at the census tract level during several year periods. A comparative analysis is conducted to ascertain the annual increases and decreases in the census tracts. The majo r conclusion is that crimes are consistently occurring in the same census tracts each year with some exceptions. Spatial relocation and expansion diffusion are not particularly widespread, and there are clusters of census tracts or neighborhoods that are crime prone. It is suggested that Washington, D.C., with some exceptions, is relatively safe and free from these street crimes.

33-5. Mental Health and Violence

Organized by: **Cathy Spatz Widom** *(Professor and Director, Hindelang Research Center, Univ. at Albany, Albany, NY)*

2:30 pm / Sun / 17 Feb **Sheraton/Warren**

Major Mental Disorder and Violence
SHEILAGH HODGINS (Université de Montréal)

Evidence is now accumulating which indicates that persons suffering from major mental disorders (schizophrenia, major depression, bipolar disorder) are at increased risk for criminal behaviour, particularly violence. Even though families, mental health professionals and the police often fail to report the aggressive behaviour of the mental disordered, official statistics demonstrate that persons suffering from these disorders are more often responsible for criminal acts than are non-disordered persons. The rates and types of convictions of mentally disordered persons will be compared to those of non-disordered persons. Studies of the antisocial behaviour of mentally disordered persons, of their self reported aggressive behaviour, and of illegal acts within hospitals will be briefly presented. Studies of the prevalence of mental disorder among inmates of correctional facilities in comparison to the prevalence in the general population will be synthesized. Drawing from knowledge of the determinants of the major mental disorders and of the determinants of aggressive behaviour, hypotheses will be proposed to explain why those who suffer from major mental disorders are at increased risk for violence.

Crime and Mental Disorders Among Male Jail Detainees.
LINDA A. TEPLIN (Northwestern University Medical School)

Persons with severe mental disorders (schizophrenia and the major affective disorders) are stereotyped as being particularly dangerous and violent. This paper presents data bearing on this issue: we examine the effect of diagnostic profile on the criminal careers of 728 randomly selected male jail detainees. Psychopathology was assessed by clinical psychologists using the National Institute of Mental Health Diagnostic Interview Schedule, a state of the art structured diagnostic interview. Criminal career data were collected using a multi-indicator/cross-validational approach using both self report and archival data. Severe mental disorder was not predictive of violent crime. Implications of these findings are discussed.

Situational Aspects Of Violent Behavior.
EDWARD P. MULVEY, PH.D. (Western Psychiatric Institute and Clinic).

The purposes of this presentation will be 1) to provide an overview of what is known about the social and situational correlates of violence and 2) to propose several strategies and foci for further investigation of these factors. A brief overview of the existing knowledge base on this topic will be provided. This overview will focus on general trends in findings from several disciplines rather than particular research studies. Also, a case will be made that the existing research design and analytic approaches may be masking effects of considerable clinical and public policy importance. Strategies for defining and examining subgroups of interest and alternative conceptualizations regarding the role of social and situational factors for future investigation will be provided.

The Role Of Serotonergic Activity In The Modulation Of Violent Behavior
J. JOHN MANN (University of Pittsburgh)

A role has been proposed for the neurotransmitter serotonin in the modulation of violent behavior. Studies in rodents have shown that impaired serotonin availability can lead to increased aggressive behavior and that restoring serotonin availability can reverse this behavioral change. Studies in primates are more complex because of measurement problems both with regard to the behavior and the serotonin system. Aggressive behavior can be socially adaptive or appropriate versus destructive or pathological. Measurement of serotonin indices in cerebrospinal fluid, peripheral blood or by neuroendocrine challenge tests assesses different aspects of the serotonin system and generates results whose interpretation depends on the determination as to whether they reflect pre or postsynaptic effects as well as the brain region involved. Findings will be presented that suggest that impaired or reduced serotonin responsivity is associated with impulsive violence in patients without an affective disorder. The theoretical, forensic and treatment implications are substantial if these findings are confirmed.

Clinical Treatment Approaches to Violence
KENNETH TARDIFF (Cornell Medical College)

The author will present biological, psychological and social treatment approaches in the management of violent psychiatric patients. He will begin with the assessment of patients and the potential for actual violent behavior. He will describe various types of violent patients and the treatment modalities most appropriate for each type. Treatments include medications, such as neuroleptics, anxiolytics, anticonvulsants, lithium beta-blockers and psychostimulants. He will discuss other treatments such as psychotherapy and behavior therapy. For emergencies, he will discuss the use of seclusion and physical restraint in hospitals and the legal issues surrounding their implementation.

Technical Session

33T-1. Rural Development Aspects of Recreation Enterprises

Organized by: **Dale Colyer** *(Professor of Agricultural Economics, West Virginia Univ., Morgantown, WV)*, **Dennis K. Smith** *(Professor of Agricultural Economics, West Virginia Univ., Morgantown, WV)*, and **Anthony Ferrise** *(Professor and Extension Specialist, West Virginia Univ., Morgantown, WV)*

8:30 am / Tue / 19 Feb **Sheraton/Warren**

The Future of Access to Private Lands
LAURENCE R. JAHN (Wildlife Management Institute) and
ERIC W. SCHENCK (Wildlife Management Institute)

The majority (59 percent) of the land resource base in the U.S. is privately owned. Management of private lands is essential for maintaining and enhancing fish and wildlife resources enjoyed by growing numbers of outdoor recreationists. Development of alternative or supplemental income opportunities for private landowners through management of natural resources and recreational access has the potential to influence access to some private lands. Such enterprises may be most attractive to family farmers and nonindustrial, private forest owners. Some innovative cooperative programs have developed that offer landowners economic or other incentives to allow recreational access. Public and private wildlife and fish constituency organizations must take more affirmative actions to provide landowners with information and guidelines to develop recreational access programs for their lands and waters.

A Typology of Outdoor Recreation Activities on Private Lands. JAMES E. MILLER (Extension Service, USDA)

A growing demand for outdoor recreation has created opportunities for private landowners, businesses and rural communities to develop recreational enterprises. While there are many prospects for traditional enterprises such as hunting and fishing, non-traditional activities are becoming more important. These include risk recreation adventures, non-consumptive enjoyment of wildlife, educational and environmental encounters, and outdoor living or working experiences. Most of these activities can be conducted in forested, partially forested, agricultural and other open space areas. They can be grouped into three broad categories: wildlife consumptive, wildlife non-consumptive, and non-wildlife associated outdoor recreation. Interest in such activities by entrepreneurs, public users, legislators, state and federal resource agencies, conservation organizations and academic institutions vary geographically and are affected somewhat by traditional mores and customs. While opportunities for rural landowners to enhance incomes exist, to be effective the enterprises must be conducted through sustained management of their renewable natural resources and recreational access. Sound stewardship is the basis of a successful operation. However, there are tradeoffs between recreational and more traditional land uses. Incentives, disincentives, and environmental concerns also are important factors in managing recreational enterprises.

Economic Issues in Outdoor Recreation E. JANE LUZAR (Louisiana State University) and CHRISTOPHER GAN (Louisiana State University)

The rural development potential of outdoor recreation can vary regionally due to localized economic characteristics of the demand for and supply of outdoor recreation enterprises, as well as other institutionally determined factors. Economic issues underlying the rural development potential of recreation enterprises addressed in this paper include measurement issues common to non-consumptive recreation, measurement issues related to consumptive recreation enterprises, and measurement issues related to fiscal impact analysis of the contribution of outdoor recreation enterprises to local and state economies. In addition, some institutional constraints and facilitating factors common to the development of rural recreation enterprises are identified.

The Demand for Outdoor Recreation. LINDA L. LANGNER (USDA Forest Service).

The majority of Americans participate in some type of outdoor recreation. The demand for outdoor recreation is expected to increase in the future. Patterns of recreation will change in response to demographic changes, new technology, and economic conditions. A growing population will fuel demand growth. An aging population will result in a change in preferred recreation activities. The changing ethnic composition of the U.S. population will also affect participation patterns. Recent decreases in leisure time are already affecting recreation trip patterns: people are choosing to take shorter, close to home trips rather than extended vacations. Another major factor in meeting future demand is the availability of recreation opportunities. The rural private land base has the potential to provide recreation opportunities. This land base will be important in meeting future demand, and also offers opportunities for private landowners to derive income.

The Efficacy of Enhancing Rural Economies Through Public Recreation on Private Lands. BRETT A. WRIGHT (George Mason University).

The supply of land which serves as a base for outdoor recreation in America is no longer sufficient to meet demand. The public estate, which grew rapidly during the 1960's and 1970's, virtually stopped expanding in the 1980's. The President's Commission on Americans Outdoors (1987) recommended governmental agencies make efforts to enlist the support of private landowners in accommodating a still growing demand for recreation opportunities. Supplies of private lands for public recreation, however, are decreasing due to conversion and closure. Increasing demand and diminishing supplies should be sufficient to allow private, rural landowners to develop recreation enterprises that supplement flagging agrarian economies. However, increased benefits from recreation management have been largely unrealized by landowners due to a myriad of constraints, such as increased legal liability, loss of control, and various behavior-related disincentives. This paper discusses the supply, determinants, and limiting factors associated with public recreation on the nation's private lands.

Legal Considerations in Making Private Land Available for Public Recreation. JOHN C. BECKER (The Pennsylvania State University).

Opening private land to public recreation involves several important considerations, including interference with a neighbor's use and enjoyment of property, land use restrictions in zoning regulations, contracts, real estate, inheritance, or estate taxes, public access and civil rights, and tort liability to those injured by a condition on the land. Owners also fear opening land will result in loss of control over those who enter and abuse the right to be there. For more than 25 years legislatures have encouraged owners to open their land by offering some protection in return. Such programs vary considerably in express terms and in the interpretation given them. To improve such programs policy and decision makers should evaluate the benefits of greater uniformity, clearer meaning for crucial terms, and broader participation in forging solutions to the dilemma of recreational users who cannot find land on which to recreate because landowners are fearful of making their land available.

Research Issues and Needs for Recreational Development. Eric M. Thunberg (University of Florida) and Lawrence W. Libby (University of Florida)

A great deal of attention in recreation development research has focused on identification of economic opportunities for public use of private lands. With this attention has come a growing awareness of the economic possibilities for recreation development as a community development strategy. Thus, there would appear to be considerable public interest beyond the returns to landowners or entrepreneurs in recreation development. This paper focuses on the public and private interests in recreation and the research issues affecting the success of public and private partnerships in recreation development. From the public perspective, the principle research need may be identification of the tradeoffs between the increased economic activity and the increased demands on public services. Both the individual and broader public gain from recreation demand analysis. Identification of the seasonality of demand, the sensitivity of demand to regional and national conditions, the effects of site specific characteristics, and the effect on recreation demand of off-site facilities may be particularly fruitful research topics. Contributions of case studies also should be studied.

Educational Issues and Needs for Outdoor Recreation. ANTHONY FERRISE (West Virginia University)

The charging of fees by private landowners for access to their land for hunting, fishing and other renewable

natural-resource based outdoor recreational activities has recently emerged as an important and timely educational issue for rural development. There are many opportunities for rural landowners, businesses and communities to increase their incomes by meeting demands of consumers for quality outdoor recreational experiences while simultaneously contributing to the conservation of the nation's natural resource base. Education is a vital element in the success of any rural development activity. It may be even more important for the majority of individuals and groups contemplating recreational enterprises, since these involve new activities that are different from agricultural and forestry enterprises commonly pursued by rural residents. They must provide a service instead of producing a product. The marketing of a service is very different since the provider must attract customers. There also are differences in management, taxes, and the legal issues and problems faced by recreational enterprises. Landowners must have an objective understanding of the characteristics, merits and pitfalls of these enterprises so that they can judge where the opportunity for this income fits their land management strategy and goals. These new skills from the extension service and other providers of adult education and new technology.

The Public Policy Issues of Outdoor Recreational Development. DENNIS K. SMITH (West Virginia University)

The development and provision of outdoor recreational services by private landowners has a strong pubic policy context. To increase the supply of outdoor recreational opportunities, especially by the small landowner, state and/or federal governments need to remove hindrances and establish incentives and market and institutional frameworks for the provision of such services. Laws relating to trespass, liability, property access and wildlife ownership need to clarified and modified if fee access is to be encouraged. The policy linkages between outdoor recreational development and conservation, agriculture, forestry, the environment, animal rights and rural economic development need to be identified and addressed to establish positive interfaces. The distributional consequences, non-market effects, and community impacts of recreational enterprise developments need to be determined for appropriate public policies to address these issues. It appears that outdoor recreational development by private landowners is dependent upon public policy modifications. These public policy modifications need the establishment of a strong research knowledge base.

34. Economics; Competitiveness

34-1. Systematic Economic Analysis: Policy on Monopoly and Competition

Organized by: **Allen R. Ferguson** *(President, Allen Ferguson Economics, Inc., Washington, DC)*

8:30 am / Fri / 15 Feb **Sheraton/Wisconsin**

Economic Analysis of Predatory Pricing Allegations
ALLEN R. FERGUSON (AFE, Inc., Washington D.C.)

The Federal Court in the Eastern District of Louisiana found, in February 1990, for a plaintiff which had alleged conspiracy, monopolization, predation. This paper is based on the Court record, largely on the author's expert testimony for the plaintiff and the defendant's response. The basic objective evidence consisted of a large body of tariffs and financial, traffic and trade records. Preliminary findings from those sources were tested against statements of officials of the major carriers. The paper describes the techniques used and the conclusions deduced. The tariffs showed a classic predatory pricing pattern. To test the predatory pricing hypothesis, a two-tiered approach was used. First, it was determined that the incumbents had and had used monopolistic power, that the market was ripe for collusion and predation. This analysis involved testing several sub-hypotheses: on market definition, barriers, concentration and unusual avenues for communicating. Second, the predation issue was addressed directly, whether: the alleged predators did not maximize short-run profits, recovered the cost of their action, rates were below cost. This required an index of ocean liner costs. Finally, alternative explanations of the observed rate changes were explored.

The Trade-off Between Dynamic and Allocative Efficiency: The Case of Exclusive Licensing of Innovations
SHARON M. OSTER (Yale University School of Organization and Management)

This article focuses on the economic trade-offs associated with the granting of exclusive license on innovations. Innovating firms often choose to license their product and process ideas to other firms rather than to exploit those ideas themselves. In a general case such licensing can provide for a more socially efficient rate of product development since it allows firms to exploit differential advantage in the discovery versus development of products. Under some circumstances, exclusivity provisions within licenses may further promote new product development. On the other hand, particularly in cases of preexisting market power, exclusive licenses may adversely affect the rate of diffusion of innovations through their effect on competition.

The Causes and Cost of Thrift Institution Failures: A Structure-Behavior-Outcome Approach
REBEL A. COLE (Federal Reserve Bank of Dallas), JOSEPH A. MCKENZIE (Federal Housing Finance Board), and LAWRENCE J. WHITE (New York University)

This paper will use a structure-behavior-outcome approach to explore econometrically the causes and costs of the insolvencies of hundreds of thrift institutions in the late 1980s. An understanding of these causes and costs should be useful in the ongoing policy debate concerning the regulation and insurance of all depositories (i.e., banks and credit unions as well as thrifts), including portfolio restrictions.

Methodologies for Economic Analysis of Mergers.
ROBERT WILLIG (Antitrust Division, U.S. Department of Justice).

This paper covers, in an integrated fashion, theoretical, forensic, and econometric methodologies for the analysis of the effects of mergers on social and consumer welfare. First, the impacts of mergers are studied in the context of several theoretical models of industries characterized by homogeneous products, heterogeneous products, and bidding institutions. Second, the forensic methodologies in the latest Department of Justice Merger Guidelines are summarized and related to the results of the theoretical studies. It is shown that there is consistency between the lessons of theory and the major provisions of the Guidelines, focusing on defining the relevant market, measuring concentration, accounting for supply substitution and entry, and assessing other identified significant factors. Examples are discussed of several econometric techniques that have proven to be useful in determining in particular industries the answers to questions posed by the Guidelines--especially in regard to market definition. Finally, a review is provided of an econometric study of the impacts of two actual mergers among airlines. It is seen that the impacts are qualitatively consistent with the results that are predicted by both the theoretical models and the forensic methodologies.

34-2. Frontiers of Research in Experimental Economics

Organized by: **Vernon L. Smith** *(Regents' Professor of Economics, Univ. of Arizona, Tucson, AZ)*

8:30 am / Sun / 17 Feb **Sheraton/Wisconsin**

Introduction to Frontier Research in Experimental Economics. VERNON L. SMITH (University of Arizona).

Laboratory studies of experimental markets extend back 30 years, but in the last decade this research has accelerated, partly due to the computerization of laboratories. Experimental economics uses real people, earning real money, who interact through the rules of a wide variety of exchange institutions to study individual and market behavior. Laboratory data are used to test hypotheses derived from economic and game theory, problems in industrial organization and regulation, public policy, and in the design of new markets. A simple example of an experimental market is used to demonstrate how we induce controlled conditions of demand (supply) in the laboratory, how subjects are motivated, the kind of questions investigated and some results.

These techniques underpin all of the papers in this session. Although it is common for subjects to interact in an experimental market through computer terminals, there are two fundamentally different kinds of computer assisted experiments: in the first the computer has a purely recording, monitoring, and message exchange function--all the experimental outcomes are determined directly by the subjects decision; in the second the computer collects the dispersed bids (offers) from buyers (sellers or transporters) and processes this information with optimization algorithms to determine all prices and allocations. The latter are called "smart" computer assisted markets, and have been used to study the performance properties of new market design for the privatization and deregulation of complex interdependent technologies where allocations have traditionally been made by political command or regulatory systems.

Market Engineering: Using the Laboratory as a Test-Bed for Designing Computer Assisted Markets. STEPHEN J. RASSENTI (Economic Science Laboratory)

Various private and public good domains exist in which agents face serious coordination problems if the extant form of market institution pays no attention to related values. For example, in the GASNET environment we have a composite good (delivered natural gas) whose value is dependent on the costs of producers, transporters and distributors. The structure of the pipeline network limits the possible allocations. In the PBS (Public Broadcasting System) case we have discrete public goods (television programs) which may or may not be produced depending on the joint value of the program to all stations who share broadcast rights. The limited budgets of the stations do not allow them to jointly produce all programs available. In the SLOT problem we have discrete private goods, takeoff and landing rights at various airports, which only have values in flight paths for airlines who share airport use. The limited number of slots available does not allow all valuable paths to be flown.

There are countless scenarios in which resources have related values. In all cases "smart" markets can be constructed which require a computer to solve a mathematical program and feed the solution back to participating agents. Market engineering uses the information gathered through laboratory experimentation to design, test, and optimize the efficiency of such markets. Results from smart markets programmed and tested at the ESL suggest that "optimal" central coordination of bid information can lead to highly efficient allocations of valuable resources.

Designing Trading Institutions Which Reduce Price Volatility. KEVIN A. MCCABE (University of Minnesota).

Recent comments on stock market performance express concern about price volatility. Such volatility could be the result of endogenous speculative expectations or of efficient adjustment to exogenous information.

We present the results of an ongoing research program to design hybrid trading institutions which combine both the advantages of uniform pricing and continuous trading. After designing a new auction we use laboratory experiments to study the behavioral properties of our proposed institutions. We will describe several auctions including English Clock, Double Dutch, and Uniform Price Double Auction which perform well in laboratory studies.

When we compare our successful designs with unsuccessful designs, a number of important regularities emerge. These regularities suggest that private value information, feedback of market information, anonymity, endogenous closing rules, and unidirectional improvement in messages create the most favorable environment for economic efficiency in the environments studied.

Incentives and the Regulation of Public Utilities. PAULA-ANN CECH (Northwestern University).

First, a general overview of the current experimental work being done for and/or about regulated public utilities (e.g., telecommunications, electric power, natural gas, etc.) will be given. Results of experimental work on telecommunications markets will be addressed in more detail.

This research addresses the consequences of deregulating rate-of-return regulated (RORR) public utility firms allowing them to enter ancillary, competitive markets. A stylized model of the telecommunications industry is tested experimentally to determine if anti-competitive firm behavior results when entry restrictions are lifted. The results offer no support for arguments that regulated firms will use monopoly market earnings to underwrite ancillary market operations ("deep pocket"), engage in predatory pricing, or unfair competition. Economic arguments for removing entry barriers to improve market performance (increased output and lower prices) are substantiated.

It further looks at the diversification incentives for a firm under a similar "cost based" regulatory scheme which combines elements of RORR with fully distributed cost pricing. Experiments are conducted to test firm behavior under different cost allocation regulations. Comparison of these rules will give insight to the necessary conditions which provide different diversification levels, output and price allocation between core and non-core businesses, choice of technology, and cost-reduction.

In closing, a discussion of future work and the potential for using laboratory experiments to test public utility regulation schemes and deregulation consequences is offered.

Horizontal Mergers: Concentration and Performance. CHARISSA P. WELLFORD (Federal Trade Commission).

The Department of Justice Merger Guidelines specify critical levels of concentration to screen for mergers to be challenged. This study uses laboratory experiments to investigate whether the guidelines can effectively identify anticompetitive mergers using the guideline's concentration criterion. Focus lies on predicted, as well as market performance effects associated with merger in a product market context. Laboratory analysis allows for direct control of variables such as market definition, scale economies, barriers to entry and concentration, thus permitting the tradeoff of cost efficiencies and anticompetitive effects due to merger to be considered for the industries investigated. The experimental design takes both the merger guidelines and the economic theory of merger into account.

When the merged firm enjoys economies of scale, the data indicate that merger leads to significantly more competitive market performance. The data suggest that if the antitrust authorities rely on the Herfindahl-Hirshman Index (HHI) as measured by sales as opposed to capacity they inappropriately increase the number of cases to be challenged. It remains to be seen whether or not a more useful predictor of the anticompetitive effects of merger exists. The data indicate that the HHI based on capacity accompanied by an alteration of the policy demarcation line would improve measurement of the effect.

34-3. Sustainable Economic Development: Substance or Rhetoric?

Organized by: **Gardner M. Brown, Jr.** *(Professor, Dept. of Economics, Univ. of Washington, Seattle, WA)*

2:30 pm / Fri / 15 Feb **Sheraton/Wisconsin**

Sustainable Growth: An Impossibility Theorem. HERMAN E. DALY (World Bank).

The economy is an open subsystem of the Earth ecosystem which is finite, nongrowing and materially closed. A growing economic subsystem incorporates an ever greater proportion of the total ecosystem system into itself and must reach a limit at 100%, if not before. Therefore its growth is not sustainable. The term "sustainable growth" when applied to the economy is a bad oxymoron--self-contradictory as prose.

Economists have a point that growth in GNP is a mixture of quantitative and qualitative increase and therefore not strictly subject to physical laws. Precisely because quantitative and qualitative change are very different it is best to call them by the different names. When something grows it gets bigger. When something develops it gets different. The economy, must eventually stop growing, but can continue to develop. "Sustainable development" therefore makes sense for the economy, but only if it is understood as "development without growth"--qualitative improvement of a physical economic base maintained in a steady state by a throughput of matter-energy that is within the regenerative and assimilative capacities of the ecosystem. Currently "sustainable development" is used as a synonym for the oxymoronic "sustainable growth." It must be saved from this perdition.

Sustainable Development: Implications for U.S. Policy.
ROBERT REPETTO (World Resources Institute).

Sustainable development, achieving continuing improvements in living standards without more serious environmental damage, is a policy concern in the U.S. as well as in the developing world, because environmental threats are now global and because U.S. economic policies affect the prospects for sustainable development at home and abroad. Among the most important steps the U.S. can take are to (1) adopt energy policies that promote efficiency and renewable energy sources; (2) employ economic and regulatory instruments that encourage waste minimization and cleaner industrial technologies; (3) revise agricultural policies in concert with other countries to eliminate distorted incentives toward monocultures and excessive chemical use; (4) liberalize international trade to allow labor-intensive exports from developing countries greater access to U.S. markets; (5) promote international agreements to deal with stratospheric ozone, climate change, loss of biological diversity, the marine environmental and other international or global environmental threats.

Energy and Sustainable Development.
ADAM ROSE (The Pennsylvania State University)

For many years, analysts have considered the adequacy of conventional energy resources to fuel long-term economic growth. More recently, the focus has shifted to the deleterious effects of energy use on the environment, to the extent that effects on the latter may render the planet incapable of sustaining life. This paper will analyze factors that have affected energy use in major regions of the world over the past thirty years, and will combine the lessons of the past with technology assessments and policy restrictions to project future prospects for sustainable development. The methodology is that of structural decomposition analysis of interindustry models, which is capable of evaluating "sources" of change in energy use in terms of economic production theory at a highly detailed level. The goal is to evaluate the relative contributions on energy use of economic growth, changes in the composition of GNP, interfuel competition, energy conservation, other forms of technological change, and changes in major factor aggregates in the absence of major energy policy changes. An evaluation of the sensitivity of each source to energy and environmental regulations will then be offered as a guide to future policymaking.

Ecosystems and Carrying Capacity.
GARDNER BROWN, JR. (University of Washington)

Renewable resources have an infinite number of steady states, each of which has a sustainable yield. The root question is which level of sustainable development? Nonrenewable resources cannot both be used and sustained. "Sustainable development" is the modern rhetorical replacement for "conservation," and faces the same intellectual hurdles in its search for legitimacy and durability as did the multifarious and nefarious old definitions of conservation.

34-4. Technology Transfer from the University or National Laboratory to the Market Place

Organized by: **David Hsi** *(Professor, Agricultural Science Center, New Mexico State Univ., Las Lunas, NM),* **Edward H. Blum** *(President and CEO, Blum & Co., Reston, VA),* and **Gerold Yonas** *(Director, Laboratory Development, Sandia National Laboratories, Albuquerque, NM)*

8:30 am & 2:30 pm / Mon / 18 Feb **Sheraton/Wisconsin**

Transfer of Bio/Medical Technology
NORMAN FRIEDLAND (Friedland & Assoc.)

Assuring and improving the health of the U.S. and the world's population has become one of the largest international industries. Recent major advances in fundamental bio-science emphasize the huge and important gains that lie ahead as this science is transformed into marketplace technology and practice. This session explores the potential, recent successes, and legal, institutional, and financial considerations of transferring bio/medical technology from the university, institute, hospital, or national laboratory to the marketplace. Four distinguished speakers representing perspectives of industry, finance, non-profits, and government will present their experience and views in a panel format. Audience questions and discussion will follow the presentations.

Transfer of Bio/Medical Technology: Recent Successes
THEODORE A. BRUINSMA (University Technology Transfer, Inc.)

Over the past five years, UTTI has worked closely with several universities to identify commercially promising technologies and transfer them profitably to the marketplace. Recent successes to be discussed include: (1) A cryogenic probe for freezing and killing tumors in the liver and prostate; (2) a fluoroscopic enhancement imaging device; and (3) a protein crystallization process. These have already returned, respectively, 40, 2.5, and 3.5 times the initial investments to develop them.

Transfer of Bio/Medical Technology: Recent Successes
NORMAN FRIEDLAND (Friedland & Assoc.)

Despite the many difficulties associated with transforming university, hospital or medical institute research into commercial technologies and businesses, there have been many successes. Selected examples from direct experience are discussed of the institutional and financial structures, and personal relationships, that have led and are likely to continue to lead to marketplace success for inventors, institutions, and financial backers.

Transfer of Bio/Medical Technology: A University Perspective
EDWARD MCCORDY (Washington University School of Medicine)

Washington University's School of Medicine has tried several different approaches to achieve commercial benefits from research and technology developed by its faculty and staff. Potentially generalizable lessons have begun to emerge from this experience, which includes some successes, some failures, and many in-betweens.

Transfer of Bio/Medical Technology: A Federal Government Perspective
ROBERT CHARROW (Crowell & Moring)

Recent experience as a senior official in HHS General Counsel overseeing, among other areas, NIH and HHS intellectual property provides insights into the Government's balancing of (1) the need to maximize benefits from publicly funded research, recognizing that the private sector is the principal means of achieving these benefits, with (2) the need to ensure the quality and objectivity of Federally sponsored research and the "fair and equitable" distribution of the benefits thereof.

Transfer of Energy/Environment Technology
GEROLD YONAS (Sandia National Laboratories)

Two of the most critical issues facing the U.S. today are national energy security and achieving economic progress while protecting our fragile environment. These topics are receiving significant attention in research institutions across the country. This session will explore the relationship and involvement of industry, the financial community, academe, and the government in moving technology in the energy and environmental areas from the research mode into practical applications. It will present some success stories, summarize the view of the financial and academic communities, and discuss recent government policy in these areas. Barriers to effective technology transfer will be discussed. Four distinguished speakers will present their views in a panel format. These presentations will be followed by an audience discussion of the issues raised by the presenters.

Transfer of Energy/Environment Technology: An Industry Perspective
WILLIAM S. BRADLEY (ARCO Oil and Gas Company)

Technology transfer, as practiced by ARCO, relies heavily upon licensing whenever the technology is to be transferred to or from another company or institution. Examples of business arrangements employed by ARCO for such transfers are described in general terms.

Transfer of Energy/Environment Technology: A Financial Perspective
EDWARD H. BLUM (Blum & Co., Inc.)

Without the proper institutional and financial arrangements, even potentially outstanding energy and environmental science and technology may fail to gain commercial acceptance and use. A technology investment banker discusses arrangements and financial techniques that have led to success, and those that hold particular promise for the 1990's.

Transfer of Energy/Environment Technology: A Non-Profit Perspective
ROBERT MUIR (Research & Technology Institute of Western Michigan)

Not-for-profit institutes and Federal laboratories have developed commercially attractive technologies using public funds. Recent changes in Federal law have improved the climate for transforming these technologies into commercial products and accelerated their transfer into the marketplace. Experiences of MRI Ventures with commercializing technologies developed by MRI and the Solar Energy Research Institute are discussed.

Transfer of Energy/Environment Technology: A Government Perspective
PATRICK VON BARGEN (U.S. Senator Jeff Bingaman)

The Congress has approved legislation and Secretary Watkins has initiated many technology transfer projects from the Department of Energy Laboratories to the market place.

Transfer of Manufacturing Technology: An Industry Perspective
DON WALUKAS (National Center of Manufacturing Sciences)

An industry perspective of the transfer of manufacturing technology from the university or national laboratory to technical applications and commercialization.

Transfer of Manufacturing Technology: A Financial Perspective
Gerald A. Marxman (CommTech International)

CommTech International was formed in 1983 to develop and commercialize promising proprietary technologies originating from substantial research and development programs funded by the U.S. Government or through internal sponsorship at SRI International, major research universities and other comparable sources. To date, CommTech has raised approx. $38 million, reviewed over 400 technologies, and chosen 27 for commercialization, several of them advanced manufacturing technologies.

Government, Academia and Private Industry--Working Together
C. BYRON WINN (Colorado State University)

It is generally recognized that the United States is falling behind other areas of the world in various aspects of manufacturing. Competing in today's marketplace can often be like a never-ending game of corporate leapfrog. Just as companies vault over the obstacles blocking their progress, they are overrun by fast-breaking competitors. To successfully spring ahead and stay ahead of the competition, operations must be modern, dynamic, and highly open to change. Competitive companies must be astute consumers of advanced technology, equipment, systems, and philosophies. But many of our small and medium-sized companies lack in-house expertise to make fully informed selections from the list of available technologies. Colorado State University has created a unique consortium to help small and medium-sized companies effectively use new technologies to solve their manufacturing problems. The Manufacturing Excellence Center is comprised of twenty state-of-the-art campus laboratories in four different colleges. To tackle industry issues, MEC calls upon talented researchers in automation, energy conservation, hazardous waste management, production scheduling, computer integrated manufacturing, human relations, and many other areas. MEC helps companies embrace new technologies, improve manufacturing methods, implement automation, boost productivity and product quality--and accept that change is inevitable. Several case studies will be presented, along with recommendations regarding professional development of faculty involved in such a center.

Transfer of Manufacturing Technology
HARRY ROOK (National Institute of Standards and Technology)

Manufacturing is the backbone of U. S. economy, the richest and strongest in the world. In recent years, this country is encountering serious competition in manufacturing from industrialized nations in western Europe and eastern Asia. This session will explore the potential, success and legal considerations of transferring manufacturing technology from the university or national laboratory to the market place from the perspectives of industry, financial institutions, universities and government. Four distinguished speakers representing the communities mentioned will present their views in a panel format. Audience participation of the issues raised will follow the presentations.

Transfer of Information Technology
DAVID HSI (New Mexico State Univ. and Univ. of New Mexico)

Toward the end of the 20th century, we see an unprecedented acceleration of information, data and knowledge explosion. Information technology and computer capabilities developed in recent years are helpful in disseminating, storing, sorting and retrieving the massive accumulation of information. Advanced, intelligent systems not only transmit voice, high speed data, slow scan video images and other types of data over the wires or across space but also decipher, translate and make sensible decisions on the information received. This session will explore the potential, success and legal considerations of transferring information technology from the university or national laboratory to the market place from the perspectives of industry, financial institutions, universities and government. Four distinguished

speakers representing the communities mentioned will present their views in a panel format. Audience participation of the issues raised will follow the presentations.

Technology Transfer to the Marketplace: An Industry Perspective
G. W. ARNOLD (AT&T Bell Laboratories)

The transfer of technology out of the laboratory to the marketplace is a process involving people. Effective communication, teamwork and problem-solving across technical and business disciplines is required for success. This talk will discuss barriers to effective transfer within industry and what can be done to overcome them.

Transfer of Information Technology: A Financial Perspective
A. R. GALE (IBD Associates)

Various creative financial structures and arrangements have facilitated the transfer of university and other early-stage information technologies into the marketplace. Experience as top management of MCA Communications, a private investor, and long-time technology transfer consultant shows many ways commercially successful transfer can be accomplished.

Academic/Non-Profit Involvement of Information Technology Transfer
AVERETT S. TOMBES (New Mexico State University)

Considerable evidence is now available which supports the involvement of universities in the transfer of research/technology into commercial products. Successful examples are found in public and private, large and small research universities from all geographical sectors of the United States. One example from an urban university shows the transfer of knowledge of CAD/CAM informational systems from a mechanical engineering laboratory to small manufacturing companies, thus increasing their competitiveness. The second example from a land-grant university illustrates how a chemistry professor can move his intellectual property into a spinoff company now in its fourth year with an anticipated four million dollar gross revenue. From these two experiences, suggestions will be offered on obtaining administration and faculty support for a technology support program and resolving the inevitable problems.

Transfer of Information Technology: A Federal Government Perspective
CHARLES W. BERNARD (Columbia Bay Company)

The U.S. Department of Defense has been a major driver and catalyst for the development of a wide range of new technologies, notably in information and related areas. A long-time DDR&E insider's experience is presented concerning the means by which new missions are translated into technological needs, and needs are transformed into developments and then into DOD and commercial practice.

34-5. Manufacturing's Future: Policy, Strategy, and the New Global Challenge

Organized by: **Christopher T. Hill** *(Executive Director, Manufacturing Forum, National Academy of Engineering and National Academy of Sciences, Washington, DC)*

8:30 am & 2:30 pm / Sat / 16 Feb **Sheraton/Wisconsin**

Challenges to U.S. Manufacturing.
WILLIAM HOWARD (National Academy of Engineering).

American industry is at a critical crossroads. A successful manufacturing future depends on learning the new modes of manufacturing that are now being practiced so effectively in parts of Asia and Europe, borrowing the best of their features, adapting them to U.S. circumstances, and, ultimately, developing a new style of manufacturing as different from the traditional "American system of manufactures" as the American system was from the earlier craft system in the 19th century. Mass production of standardized products of adequate quality, employing workers with limited skills and under central direction must give way to new modes involving flexible manufacturing of diverse products of world-class quality, employing workers with highly developed, diverse skills under loose coordination. Successful examples of making this transition will be described, and strategies for overcoming the remaining intellectual, strategic, and public policy barriers will be examined.

An Assessment of U.S. Manufacturing: All Is Not Well.
JULIE FOX GORTE (Office of Technology Assessment).

U.S. manufacturing is in trouble, and the trouble is likely to get worse. Compared with our best competitors, American productivity growth is lackluster, capital investment low, education and training poor. Beyond overall indicators, massive anecdotal evidence supports the contention that American manufacturing has a long way to go to catch up to its Japanese competitors in many industries and areas. American firms have made progress, but they lag Japanese competitors in ensuring quality and efficiency in the manufacturing process in many parts of the electronics, computer and telecommunications industries, motor vehicles, machine tools and specialized industrial machinery. Moreover, U.S. firms are chasing a rapidly moving target. In several industries, including automobiles, consumer electronics and machine tools, Japanese companies have extended their superb manufacturing proficiency into the design process, designing manufacturable products in less time and at lower cost than American companies. Many U.S. companies (including motor vehicle producers) have narrowed the gaps in productivity and quality between them and their Japanese competitors. But much more effort will be needed to regain parity where it has been lost, and to keep up with the Japanese leaders in electronics and microelectronics. Many U.S. companies have difficulty mobilizing the financial and human resources needed to match the Japanese. Government participation in the effort is notably lacking in the U.S.

U.S. Productivity Performance: It's Better Than You Think
WILLIAM J. BAUMOL (C. V. Starr Center for Applied Economics, New York University) (at least so far)

Technological change and other developments that modify comparative advantage always leave some industries unable to compete. The justified complaints of labor and investors in those industries create the impression that the entire economy is in terrible trouble. But the data tell a very different story. U.S. productivity fell after 1973, but so did that of every industrial country. Japan's fell by the same percent as ours. The share of the U.S. labor force in service jobs is rising, but the share in almost every other industrial country is rising even faster. U.S. productivity growth in manufacturing has shown no downward trend since 1947. Our manufacturing productivity level is still ahead of everyone else's, and while Japan is catching up (with diminishing speed), Germany is falling further behind. We lead both Japan and Germany in 9 of the 13 subsectors into which Japanese data divide the manufacturing sector. Our share of the world's industrial employment continues to rise. These and other grounds for optimism will be reported, but prospective sources of trouble will be pointed out and their dangers emphasized.

Manufacturing's Health and the Standard of Living.
LAWRENCE MISHEL (Economic Policy Institute).

This paper reviews the evidence regarding the degree of decline of America's industrial base and its causes, the relative competitiveness of our manufacturing sector and the relationship of our trade and competitiveness problems to recent declines in real wages, especially among workers without a college degree.

The Manufacturing World of Tomorrow - New Technology, New Strategy and New Structure
Joel D. Goldhar (Illinois Institute of Technology) and Theodore Schlie (Lehigh University)

The application of Information Technology to all aspects of the engineering, design, manufacturing and distribution functions

has changed the economics of production from an emphasis on scale and specialization for cost minimization to scope and integration for low cost variety. The combination of flexible manufacturing (FMS) and electronic links (CIM) to design and to customers results in an organization with a very high level of responsiveness to change and opportunity. Leading edge users of these new technologies are learning how to develop aggressive strategies and organize their business units to take full advantage of the speed and variety capabilities of FMS and CIM. This logic leads to a "service business" strategy for manufacturing firms.

Educating Leaders for Tomorrow's Manufacturing Enterprises. H. KENT BOWEN (Massachusetts Institute of Technology), and WILLIAM C. HANSON (Digital Equipment Corporation).

The principles for designing and making products are changing more quickly than many organizations are able to change their structures, systems, and human factors. Major transitions that are occurring require fundamental changes in the skill, knowledge base, and mindset of those who will lead the required changes at all levels of the manufacturing enterprise. This paper discusses the results of an industry-university partnership to educate tomorrow's leaders through the development of a manufacturing curriculum; experimental learning; company-based, team projects; and the use of industry experts as teachers.

International Cooperative Research in Manufacturing. HIROYUKI YOSHIKAWA (University of Tokyo).

The future of manufacturing industry is gloomy in the industrialized countries. In face of difficult problems: environmental pollution, excessive competition in market share, trade friction, increase of investment for manufacturing research, less participation of youth in manufacturing, reliability decay and increase of accidents, etc.; we cannot depict any consistent programme about the future of manufacturing industry to cope with those problems. We propose a necessary paradigm shift of manufacturing: from competition to collaboration. We take a standpoint that those problems have been caused mainly by insufficient flow of manufacturing knowledge through the world, creating uneven distributions of knowledge and, thereby, of wealth. An excess unevenness generates the said problems. We live in a liberal economy, where any product manufactured somewhere can be sold anywhere in the world without control. But we should not forget that there is another important rule that the secrecy of manufacturing knowledge is legitimated in our society. This is a product-liberalism with knowledge secretivism. A new paradigm: product-liberalism with knowledge liberalism must be established, where the optimum dissemination of manufacturing knowledge will be realized. Systemizing manufacturing knowledge and establishing a liberal market for it are necessary for this purpose. International collaboration is crucial, and thus a project called IMS (Intelligent Manufacturing Systems) has been proposed.

Federal Support for Manufacturing R & D
JOHN A. SIMPSON (National Institute for Standards and Technology)

There are difficulties in determining the scope of Federal Support for Manufacturing R&D. Of the title only the words "Federal" and "Support" have generally accepted definitions. Increasingly, manufacturing is considered either a component of "product realization" or the term is expanded to encompass all of product realization and includes all that is taught in our great Business Schools. There has always been a question in manufacturing where R&D leaves off and production begins. With the modern emphasis on continuing improvement, the boundary is still less defined. For the purposes of this paper, we will take a somewhat restricted view. Manufacturing will be defined as the transformation of material. Research and Development will be construed to include product development, as well as process development. Federal Support for Manufacturing R&D is a relatively uncoordinated complex of many different agencies pursuing several goals by various means. The programs divide into two general classes, one supporting broad goals, the other narrower mission directed efforts. The size, scope and organization of both types of programs will be considered.

34-6. Mineral Resources and the Changing International Economy of the '90s

Organized by: **Carroll Ann Hodges** *(Geologist, Branch of Resource Analysis, U.S. Geological Survey, Menlo Park, CA)* and **John J. Schanz, Jr.** *(Adjunct Professor, Dept. of Mineral Economics, Colorado School of Mines, Golden, CO)*

2:30 pm / Sun / 17 Feb **Sheraton/Wisconsin**

The Global Shift from Strategic Priorities to Economic Competitiveness. BRUCE C. NETSCHERT (National Economic Research Associates, Inc., Washington, D.C.)

The stunning realignment of the world economy over the past 18 months calls for a new look at the place and role of mineral commodities in economic activity and national affairs. The traditional role of mineral resources was geopolitical: national strength was viewed in terms of possession or at least guaranteed access. Now possession is less significant, since economic strength is based less on heavy industry (with its strong dependence on mineral supply) and more on industries and service activities not based on the structural metals. Due to its vital role in economic activity and resource concentration in one region, only oil retains its geopolitical significance. These circumstances affect all aspects of mineral industries and government mineral policy. Thus it seems likely that worldwide mineral exploration will be affected by the opening up of Eastern Europe and the USSR to foreign participation, with greater application of new technology such as satellite remote sensing. New patterns of mineral trade will emerge as uneconomic subsidization declines and competitive market forces prevail. The U.S. mineral industry will be affected both adversely and beneficially. National security will play a greatly diminished role in the determination of mineral policy. Marginal mining activities will further decline in the face of competition. At the same time, mineral processing should benefit from the more open access to foreign resources. The new realignment may result in the establishment of new trading blocs and restriction of commerce rather than economically rational trade. In any event, there will be great changes.

Technological, Financial, and Political Pressures on World mineral Endowment. EUGENE A. THIERS (SRI International)

Mineral endowment is a dynamic condition and a function of both time and technology. Such dynamism stems from demand and supply fundamentals and their evolution in various human societies, and from technoeconomic factors that determine mineral availability and utility.

What is demand and the difference between demand and consumption? The elements of demand include industrial habits, consumer attitudes, price, comparative performance, and their evolution in industrial societies, all of which are influenced by technological factors. Examples of common materials, such as iron, industrial diamond, and cement, show that the intrinsic value of materials tends to decrease over time. Some of the factors that can project such past trends in both industrially advanced and developing nations are technological innovations in product design as well as in component materials.

Technological, financial, and political factors that influence mineral supply will be affected by the changes that are occurring in Eastern Europe and that could occur in Asia. Adopting Western industrial values in these countries could significantly expand the mineral supply potential of the planet, as waste and inefficient practices are curbed. The possible options for economic development of newly industrialized countries must be examined in terms of the role mineral exploration and development could play in meeting future capital needs and societal values. The fundamental mineral endowment of Eastern countries indicates the supply potential of such regions in the future.

Perestroika and the End of the Cold War: Possible Mineral Trade Implications for the USSR and Eastern Europe. ISTVAN DOBOZI (Dept. of Mineral Economics, Colorado School of Mines)

The sweeping political and economic reforms currently occurring in the Soviet bloc have long-term implications for Soviet and East European trade

in minerals, including those considered strategic. Several policy issues now emerge. Will diminished security concerns, increased cost-consciousness, and shifting priorities under perestroika divert Soviet attention from developing high-cost mineral deposits? Will the USSR open up its vast mineral resources (including those termed "critical" or "strategic") to direct investments and joint ventures by its former adversaries? Who will be interested? Drastic structural changes in the Japanese economy (resulting in sharply reduced demand for specific resources) have apparently lessened Japan's interest in joint development projects in Siberia. An absence of Soviet "imperial responsibility" to supply East Europe's mineral needs and a collapse of traditional intra-COMECON mineral supply arrangements may drive eastern Europe into competition with the West for mineral resources.

The prospective cuts in Warsaw Pact military forces may result in reduced defense-industry consumption of mineral commodities. Military-civilian conversion may free some resources for export or reduce imports. Market-oriented economic reforms in these countries could eliminate some of the systemic waste generated by old-fashioned central planning. What are projected international export and import implications of this shift toward demand-side economic thinking?

The Minerals Industry in an Interdependent World: Can Industry Deliver the Goods? SIMON D. STRAUSS (Magma Copper Company)

Forty years ago the Truman Administration was concerned over the adequacy of world resources. A detailed study made by a five-man commission was published in 1951 estimating that increasing use of minerals over the next 25 years would put severe strains on reserves and shortages might ensue. In fact demand for minerals increased far more sharply than had been anticipated and yet no real shortages developed. This was primarily due to the extraordinary success in finding resources not previously identified. Private industry was largely responsible for financing and constructing new facilities throughout the world. Public sector companies have been formed in developing countries to operate some of these facilities but have as yet launched relatively few new ventures. Though volatility of mineral prices creates some problems, private industry has demonstrated its capacity to find and equip mineral deposits adequate to meet world demand. There is little reason to doubt that this record can be maintained during the nineties since a substantial inventory exists of identified but as yet undeveloped deposits of most major minerals. Some examples will be cited.

Federal Minerals and Materials Policy in a Changing World. DAVID S. BROWN (Bureau of Mines, Washington, D.C.)

Recent international political changes assure that private enterprise and market principles will impact world affairs in the '90s. U.S. industry faces a unique period of competitive challenge coupled with new opportunities, requiring technologies that better use skilled labor, apply specifically to geologic and geographic characteristics of domestic resources, and minimize regulatory cost without loss of environmental protection. Private and government research must be directed toward automation, robotics, process computerization, and new materials, followed by accelerated commercialization. New families of materials containing "exotic" components, many being by-products of primary metal production, are joining or replacing those items critical and strategic to industry and defense. The Federal establishment must reshape minerals policy and requires expanded data bases, increased analytical capability, and intensive research. For example, more flexible, market-sensitive environmental regulations may be needed rather than the current command-and-control approach. The U.S. Bureau of Mines Information and Analysis group is engaged in a multimillion, multiyear effort to modernize its information infrastructure; new data on advanced materials markets, waste generation, recycling, and emerging technologies are being acquired, foreign coverage is being expanded. But data alone are inert. The Bureau joins other agencies in actively promoting minerals policy that will ensure a strong U.S. industrial and defense base.

34-7. Systems Perspective for the Quality of Health Care

Organized by: **R. Clifton Bailey** *(Statistical Advisor, Health Standards and Quality Bureau, Health Care Financing Administration, Baltimore, MD)* and **W. Edwards Deming** *(Consultant in Statistical Studies, Washington, DC)*

8:30 am / Sat / 16 Feb **Sheraton/Arlington**

Optimizing a System; Profound Knowledge. W. EDWARDS DEMING PH.D. (Consultant in Statistical Studies).

The job of management in education, industry, and government, is optimization of a system. The broader the system, the greater be the possible gains for everybody, provided the system be managed. Without an aim, there is no system. Without management of the system, aims will not be achieved. It can be shown mathematically that it is only necessary to reach approximate optimization.

The prevailing system of management in industry, education, and government, has destroyed our people. Life begins, life ends. People are born with intrinsic motivation, self-esteem, dignity, curiosity to learn, joy in learning. Forces of destruction begin with toddlers -- a prize for the best Halloween costume, grades in school, gold stars, and continue through the university. On the job, people, teams, divisions are ranked -- reward at the top, punishment at the bottom.

The transformation to new principles of management requires knowledge and leadership.

Epidemiologic Oversight of of the Effectiveness of Medical Care.
HENRY KRAKAUER (Health Care Financing Admin.)

The Health Care Financing Administration is responsible for the assurance of the quality of the medical services provided to Medicare beneficiaries, preponderantly persons over 65 years of age. Until now, its principal tool has been a process of inspection carried out by contractors, the Peer Review Organizations. A new approach, based on epidemiologic oversight and evaluation of medical practices, is in the initial stages of implementation. It focuses on patterns of care and the associated patterns of outcomes. Its components are: (1) the monitoring of trends over time in the use of treatments and services, in rates mortality, of morbidity, of disability, and of expenditures for health care services; (2) the assessment of the variation of these rates among geographic locales and among the providers of care such as hospitals; (3) in order to account for secular trends and geographic variations, the evaluation of the relative merits of competing medical interventions. The objective of this program is the continuous improvement of medical services and, therethrough, of the health of Medicare beneficiaries.

Hospitalwide Quality Improvement: Beginning the Journey. PAUL B. BATALDEN, M.D. (Hospital Corporation of America)

A description of the underlying theory, road may for change, examples and lessons learned will be discussed.

Quality Management for Health Care Delivery. BRENT C. JAMES, MD, MSTAT (Institute for Health Care Delivery Research, Intermountain Health Care, Inc., Salt Lake City, Utah).

Since the introduction of the Diagnosis Related Group (DRG) Prospective Pricing System (PPS) for hospitals in 1983, hospital-based health care management has become heavily focused on costs. Many health care providers and researchers have raised serious questions regarding the impact of these hospital-based cost controls on the quality of care delivered within the entire health care ***system*** (including those components beyond hospitals), and have demonstrated specific instances in which health outcomes may have been compromised. We applied Continuous Quality Improvement (CQI) theory to the health care quality-cost question and identified three ways in which quality relates to cost: 1) quality waste, 2) productivity, and 3) optimalism versus maximalism (cost-benefit). Both quality waste reduction and productivity enhancement offer opportunities to significantly decrease health care costs by increasing quality. They may be addressed by health care providers acting independently, but also serve to frame societal questions regarding the cost-benefit of specific health care technologies. The concepts of quality waste and productivity illustrate the potential

damage that a singular cost-focus can have on a complicated health care system, and suggest that appropriate cost-containment goals can best be met through medical quality improvement systems similar to those found in some industries. At the same time, compared to traditional medical quality assurance, medical CQI may offer significantly more capacity to involve all health care providers, improve health care quality, and generate important clinical knowledge.

Learning from Others: The Application of Total Quality Management to Health Care Organizations. DONALD M. BERWICK, M.D. (Harvard Medical School).

While the crises of cost and confidence in health care continue in full force, new technologies for total quality management (TQM) have achieved breakthroughs in quality and productivity in other industries. Early evidence, based on the work of a number of pioneering health care organizations, suggests that TQM can have success in health care, as well. Special issues do arise: how to involve physicians in the TQM process, how to link TQM with traditional forms of quality assurance, and how to apply TQM to processes of work in which physicians' decisions appear to be pivotal, for example. However, on the whole, the complex work processes and interdependencies in medical care are not as far from those in other industries as may have first appeared to be the case.

Technical Sessions

34T-1. Economic Microsimulation for Public Policy Analysis

Organized by: **Daniel H. Weinberg** *(Chief, Housing and Household Economic Statistics, U.S. Bureau of the Census, Washington, DC)*

2:30 pm / Sat / 16 Feb **Sheraton/Vermont**

National Research Council Report on Microsimulation
ERIC HANUSHEK (University of Rochester)

The National Academy of Sciences National Research Council established a panel to evaluate the usefulness of microsimulation models for federal agency evaluation of changes to welfare programs. This paper summarizes the results of that panel study.

Labor Supply Response in Microsimulation Models.
GARY BURTLESS (The Brookings Institution).

Microeconomic simulation models are important tools for analyzing the costs and distributional consequences of U.S. social welfare policies. They have played a significant role in forecasting the impact of reforming tax and transfer programs, including welfare and the income tax, and they contributed to the debate over the distributional effects of tax and transfer reforms enacted during the Reagan Administration. This paper considers the current status and future prospects of labor supply models that have been embodied in the major microsimulation models. It describes the specific models of labor supply response that have been included in recent simulation models, and it considers the conditions under which simulated labor supply responses can improve the predictions of program costs and benefits that emerge from simulation exercises. The paper concludes with an outline of an ideal research program to improve predictions of labor supply response in microsimulation models. A major conclusion is that simulation exercises would be greatly improved through a careful and systematic validation of past predictions from a given model. That is, previous predictions from a model should be routinely compared to actual historical outcomes observable in the population under study. While such validation is common in macroeconomic forecasting models, it is unknown in the case of micosimulation models.

Future Computing Environments for Socioeconomic Microsimulation.
PAUL COTTON (Fulcrum Technologies, Inc.), GEORGE SADOWSKY (New York University).

This paper presents the results of a study undertaken in 1989 for the National Academy of Sciences Panel to Evaluate Microsimulation Models for Welfare Programs. The paper addresses the impact that computing technology has had and will have in the future upon the conceptualization, design, implementation, and use of microanalytic simulation modelling in the medium term. Two areas are studied in detail: (1) the current state of computer systems that support static microsimulation models, with specific reference to TRIM2 (HHS/ASPE) and SPSD/M (Statistics Canada): and (2) advances in computing technology anticipated in the medium term (1990-1995) and their implications for additional investment in microanalytic simulation models and the computer systems that support them. The paper includes (1): a detailed comparison of the TRIM2 and SPSD/M systems from modelling and implementation perspectives; and (2) a review of earlier studies regarding rates of technological progress in the computing industry and medium and longer term price/performance projections for computing equipment. The paper concludes that: (1) TRIM2 should not be ported to a microcomputer environment; (2) desktop computing is the appropriate future technology for further investment in microsimulation models; (3) future computing systems for microanalytic modelling can and should be oriented to objects used in the modelling and simulation processes and should concentrate upon making the user interface powerful for both modelling and execution: (4) an assessment should be made of how to transfer TRIM2's intellectual capital into such a new environment in a verifiably functionally equivalent form; and (5) a new conceptual framework for the aging process would allow the same computing environment to serve both static and dynamic modelling activities.

34T-2. Ecological Economics

Organized by: **Herman E. Daly** *(Senior Economist, Environment Dept., World Bank, Washington, DC)*

2:30 pm / Sun / 17 Feb **Sheraton/Vermont**

Ecological Economics: Creating a New Transdisciplinary Science
ROBERT COSTANZA (Coastal and Environmental Policy Program, Center for Environmental and Estuarine Studies, University of Maryland, Solomons, MD 20688)

Ecological Economics is a new transdisciplinary science that looks at the full range of interrelationships between ecological and economic systems. This breadth is essential if we are to understand and manage our planet wisely in the face of mounting, interdependent global environmental, population, and economic development problems.

This paper: (1) summarizes the state and goals of this emerging transdisciplinary field, particularly as regards issues of sustainability; (2) provides a working agenda for research, education, and policy for the coming decade to ensure sustainability; and (3) provides a set of policy guidelines and recommendations for achieving these goals.

Assuring sustainability of ecological economic systems depends on our ability to make local and short term goals and incentives (like local economic growth and private interests) consistent with global and long term goals (like sustainability and global welfare). This requires: (1) establishing a hierarchy of goals for local, national, and global ecological economic planning and management; (2) developing better regional and global ecological economic modeling capabilities to allow us to see the range of possible outcomes of our current activities; (3) adjusting current prices to reflect long run, global ecological costs, *including uncertainty* ; and (4) developing policies that lead to no further decline in the stock of *natural capital.*

Environmental Management in Development: The Evolution of Paradigms. MICHAEL E. COLBY ((The World Bank)).

Environmental management and its relationship to human development are in a period of dramatic change. Conceptions of what is economically and technologically practical, ecologically necessary, and politically feasible are rapidly shifting. Implicit in changing strategies are differing philosophies of human-nature relationships. For centuries, an often implicit debate has prevailed between what have come to be called "economics" and "development" on one side, and "ecology" and the "preservation of nature" on the other. In the past quarter century, this dichotomy has begun to break down. Societies are now beginning to have serious discussions about "sustainable development." The resolution of this debate must incorporate different approaches to the organization of social and production systems, new orientations toward the past and the future, and diversity in philosophies of science and

epistemology. Five fundamental paradigms of environmental management in development, of human-nature relationships, are described. From the primordial dichotomy of "frontier economics" versus "deep ecology," paradigms of "environmental protection," "resource management," and "eco-development" are evolving, in a progression which involves increasing integration of economic, ecological, and social systems into the definition of development and the organization of human societies. Each perceives different evidence, imperatives, and problems, and prescribes different solutions, strategies, technologies, roles for economic sectors, culture, governments, and ethics, etc. Each actually encompasses several schools of thought, not always in complete agreement, and there are also areas of overlap. The paper explores the distinctions, connections, and implications of these five paradigms for the future of environmental management in development.

Intergenerational Resource Rights: Implications for Neoclassical Economics. RICHARD B. NORGAARD (Energy and Resources Program, University of California at Berkeley).

Neoclassical economists, in an effort to provide definitive answers to complex social choices, have sought rationales to avoid having to address the fact that alternative assignments of property rights yield alternative efficient allocations of resources. These different efficient solutions have different equilibrium prices including rates of interest. Neoclassical economists now address questions of the future in terms of their efficiency under the implicit assumption that this generation has the right to all resources. This approach results in several contradictions with respect to sustainable development, specifically the problems of valuing and discounting benefits and costs to future generations. These contradictions are resolved by treating sustainability as a matter of reassigning resource rights to future generations. Such an approach is perfectly consistent with neoclassical theory, but it contradicts long established conventions in neoclassical resource and environmental economics that were adopted to fulfill a technocratic role in public decision-making processes. Treating sustainability as an equity issue, rather than as a constraint on this generation's implicit right to efficiently use all resources, would reduce the power of the econocracy and seriously challenge democratic institutions. The relationships between theory, the disciplinary and professional culture of neoclassical economists, the opportunities for that culture to change, the course of democracy, and the nature of ecological economics are explored.

On The Economics Of Sustainable Tropical Forestry. ROBERT GOODLAND (World Bank).

Sustainability of tropical forest use can be vastly promoted by standard economics, which is not consistently applied in forestry. Five elements are outlined. First, repeal perverse incentives, such as negative interest rates and subsidized credit. Second, use "full costs" which means internalizing all costs, such as of highway construction. Third, tax what the owners of the forest want less of, such as low-output extensive land use (eg: cattle ranches)--to the fullest extent politically feasible. Fourth, regulate or impose limits flexibly, such as no destruction of centers of endemism. Fifth, promote value-added and demote export of crude logs. This increases the income the forest owners receive from less extraction. Although vigorous implementation of these five economic devices would go far towards attaining sustainability, it will only be fully achieved by addition of a few non-economic precautions, such as those concerning vulnerable ethnic minorities.

"An Historical Turning Point in Economic Development: From Empty-World to Full-World Economics" - HERMAN E. DALY, Environment Department, World

The evolution of the human economy has passed from an era in which manmade capital was the limiting factor in economic development to an era in which remaining natural capital is the limiting factor. Economic logic tells us that we should maximize the productivity of the scarcest factor, as well as try to increase its supply. This means that economic policy should be designed to increase the productivity of natural capital and its total amount, rather than to increase the productivity of manmade capital and its accumulation, as was appropriate when it was the limiting factor. Two reasons why this fundamental change in the pattern of scarcity has not been generally recognized are that the speed of "filling" has been exponential, and that neoclassical economic theory has considered manmade and natural capital as substitutes rather than complements. If factors are highly substitutable then neither can be limiting. The Far-reaching consequences of this turning point for investment policy are considered

35. Science and International Security

35-1. Defense Technology and Policy After the Cold War

Organized by: **Amy Crumpton** *(Program Assistant, Directorate for Science Policy and Programs, AAAS, Washington, DC)*, **Ashton B. Carter** *(Director, Center for Science & International Affairs, Harvard Univ., Cambridge, MA)*, **Elizabeth Kirk** *(Directorate for International Programs, AAAS, Washington, DC)*, **James L. Hecht** *(Director, Project for the Study of the American Future, Univ. of Delaware, Newark, DE)*, and **John R. Kort** *(Chief, Analysis Branch, Regional Economic Analysis Division, U.S. Dept. of Commerce, Washington, DC)*

8:30 am & 2:30 pm / Sat / 16 Feb — **Sheraton/Dover**

8:30 am & 2:30 pm / Sun / 17 Feb — **Sheraton/Dover**

National Security and Economic Competitiveness. JAMES L. HECHT (University of Delaware).

Security in today's world depends as much on matching the capital investments of economic adversaries as the military expenditures of political adversaries. Capital investment is even more the key to improved competitiveness than is generally recognized. When productivity growth over a 20-year period is correlated with investment for the major industrial countries, there is a linear relationship which indicates zero growth in productivity when a nation invests about 8 per cent of GNP. This occurs because sizeable investments must be made to replace manufacturing facilities which can no longer compete because of technological change. The importance of capital formation with respect to competitiveness is further demonstrated by the fact that American companies, on average, are two times as profitable as foreign competitors -- even though the American companies are losing market share. This is because the U.S. companies have less money to invest, and therefore invest it more selectively. If the U.S. used West Germany as a model, the defense budget would be cut from 300 to 150 billion dollars a year and capital formation would be increased by 100 billion a year. Americans overwhelmingly approve increasing capital formation even though very few are aware that the U.S. invests a lower percentage of GNP than its major competitors.

The Shrinking Defense Budget: Economic Impact and Industry Response. GORDON ADAMS (Defense Budget Project), and CONRAD PETER SCHMIDT (Defense Budget Project).

The defense budget is expected to decline significantly over the next five years, perhaps as much as 25 percent in constant dollars. The paper discusses the macroeconomic consequences of this decline and examines the microeconomic impacts, disaggregated by state and sub-state jurisdictions. In particular, the paper

examines the responses of the firms in the defense market to this decline, describing the different characteristics of those firms, their involvement in the defense market and the strategies they employ in coping with a declining market. These strategies include internal diversification, acquisition, downsizing, and sale of assets. Finally, the paper contains some recommendations for the role of federal policy in easing transitions of firms from defense to commercial markets.

Using DoD Data on Prime Contract Awards to Assess Cutbacks in U. S. Defense Contractor Employment. JOSEPH V. CARTWRIGHT (Office of Economic Adjustment, Office of the Secretary of Defense).

The paper presents estimates of the size of the work force vulnerable to cutbacks from the declining value of prime contracts awarded by the Department of Defense to private-sector defense contractors. Despite the continuing uncertainty surrounding future DoD budgets, the estimates illustrate (1) the general size of the defense-related civilian work force vulnerable to cutbacks at the national and regional levels, and (2) the specific techniques for using data on DoD prime contracts to estimate contractor employment. In this latter regard, other researchers should find the discussion of the database in the paper useful. Directions for future research to identify more precisely how cutbacks in specific contracts will affect specific local-area labor markets are outlined. The preliminary results of several local-area case studies on the extent of defense-related contracting and subcontracting are discussed.

The Impact of Defense Spending Reductions on the U.S. and Selected Regional Economies. G. WAYNE GLASS (Congressional Budget Office) and R. WILLIAM THOMAS (Congressional Budget Office).

The study examines the potential impact of reducing defense spending at various rates on the U.S. economy and on selected regional economies. Using the INFORUM model of the U.S. economy, the analysis predicts results under three budget scenarios for various macroeconomic indicators such as GNP and its components of final demand and national income. The scenarios include the President's budget request and the House and Senate budget resolutions. The analysis also predicts output and employment under the alternative scenarios for 76 major industrial sectors and includes an asse-sment of their impact on states' economies. In addition, the study examines three local economies -- St. Louis, Bath, Maine, and Monterey, California -- to illustrate the potential impact of cutting certain weapons programs and closing military bases on specific locales.

Where Values Collide: Public Interest and Nuclear Weapons Facilities. BEATRICE BRAILSFORD (Snake River Alliance).

The Snake River Alliance is an Idaho citizens organization working for peace, the reversal of the nuclear arms race, and responsible solutions to nuclear waste. There is a core contrast between the values of the Energy Department and its contractors and the citizens which environmental peace groups represent. The Energy Department makes decisions about nuclear weapon desires in total secrecy. Citizens believe that informed consent is the only source of legitimacy for the U.S. government and that it is harmful to democracy to have any element of the government set its own mission. The Energy Department sees itself as the prime, if not quite only, decisionmaker in its "cleanup." For forty years, our nation has paid a high price because the Energy Department's perspective has prevailed. Unfortunately, the end of the Cold War has not yet led to a fundamental reorientation in the way decisions about our defense initiatives (including cleanup and waste management at defense facilities) are made. But some changes are desperately needed and, by now, politically possible.

35-4. Implications of Proliferating Advanced Weaponry: Nuclear, Chemical, Missile, and Naval Forces

Organized by: **Janne E. Nolan** *(Senior Fellow, Brookings Institution, Washington, DC)*

8:30 am / Tue / 19 Feb **Sheraton/Annapolis**

Economic and Socio-Political Implications of Hi-Tech Arms Race in the Middle East, ANDREI SHOUMIKHIN (U.S. and Canada Studies Institute, USSR Academy of Sciences)

The role of superpowers as well as regional powers is analyzed in initiating and expanding the race in technologically advanced weapons in the Middle East are discussed. Various implications of this race are analyzed both from the point of view of the economic and political situation in the region and the general balance of forces in East-West, North-South relations. Particular attention is being paid to the Arab-Israeli and Persian Gulf crises. A case is being made to internationalizing efforts in curbing the race of advanced weapons in the Middle East and the world.

Implications of Proliferating Advanced Weaponry: Nuclear, Chemical, Missile and Naval Forces. Dr. Ravinder Pal Singh, Institute for Defence Analysis.

What are the motivations in Third World countries to develop ballistic missiles, chemical and nuclear weapons? Is it only a question of developing strategic deterrence, or are these countries trying to develop options out of escalating costs of conventional weapons acquisitions and North-South arms transfer dependency? If East-West relations are moving from confrontation to cooperation leading to cutbacks in their military postures, would these changes contribute to multipolarity emerging in the shape of regional powers? Any attempt by the superpowers to maintain status quo could find their conflict resolution initiatives restrained by counter value deterrence capabilities in the shape of ballistic missiles, chemical and nuclear weapons. This paper examines the implications of all these questions, as well as the question of proliferation of naval power in the Third World.

Preventing Regional Nuclear Weapon Proliferation: The Case for the Establishment of a Nuclear Weapon Free Zone (NWFZ) in the Middle East. Dr. MAHMOUD KAREM (Permanent Mission of Egypt to the United Nations, Geneva),

The Middle East is undoubtedly one of the most sensitive regions witnessing continuous military conflict and political upheaval. The integration of nuclear weapons into the overall military capabilities and national security policies of the countries within this region could lead to devastating regional as well as international repercussions. It is therefore, argued that the establishment of a (NWFZ) could help the region safeguard against escalated tensions and enhance the prospects of peace. This proposal could also function as a confidence building measure that may, if succesfully implemented, spill over positively into other areas of the Arab-Israeli conflict. In so doing it is important to outline the practicable steps in order to bridge gaps between the parties. Security preoccupations and requirements need to be addressed and action oriented proposals will be presented. A brief summary on the negotiating status of a draft convention on the prohibition of Chemical Weapons will be presented taking into account the latest developments and positions of the parties in the Conference on Disarmament in Geneva insofar as they relate to the establishment of a region free from weapons of mass destruction in the Middle East.

The Implications of and Responses to Chemical Weapons Proliferation. ELISA D. HARRIS (Brookings Institution)

Concern over the spread of chemical weapons has mounted steadily since the early 1980s, when Iraq began to use

poison gas against Iranian military forces. The potential dangers inherent in the proliferation of these weapons became even more apparent in the late 1980s, following revelations of Libya's efforts to acquire a chemical weapons production capability. This paper examines the implications of chemical weapons proliferation for regional as well as international security. It also discusses policy options for mitigating the threat posed by the spread of these weapons.

Regional Security and Weapons Proliferation: the Middle East Crisis. GEOFFREY KEMP (Carnegie Endowment for International Peace).

The proliferation of advanced weapons and high technology to conflict regions in the third world has been a troublesome item on the international agenda for many years. However, the Middle East crisis has vividly demonstrated the urgency of the problem and need to formulate more effective arms control mechanisms to reduce the risks that weapons of mass destruction will be used in conflict. The political difficulties of structuring regional arms limitations are formidable in view of the long-standing hostilities between the local actors, the large amounts of money available to fund military programs and the ambiguous and often contradictory policies of the external powers who provide most of the weaponry and technology. There is little hope that external constraints on technology transfers to all regional players are either feasible or desirable unless they are either focused on one maverick country--such as Iraq -- or unless they are part of a broader political settlement that is supported by the key regional antagonists.

35-7. Scientific Approaches to the Study of International Conflict Resolution

Organized by: **Eric H. Arnett** *(Program Associate, Program on Science, Arms Control, and National Security, AAAS, Washington, DC)* and **Richard Cottam** *(Professor, Dept. of Political Science, Univ. of Pittsburgh, Pittsburgh, PA)*

2:30 pm / Mon / 18 Feb **Sheraton/Vermont**

Nationalism as a Primary Source of Conflict in the Post Cold War World. **Richard W. Cottam (University of Pittsburgh).**

With the end of the Soviet-American cold war, the primary focus of interstate conflict is likely to be at a regional level and to involve competing claims of nationalistic identity communities. This is a reflection of the explosion in political participation in third world areas and an accompanying attraction to populist movements. The identity communities are ethnic, religious and/or territorial in composition and their conflicting demands are expressed both within and between states. With the decline in superpower involvement in internal affairs, the sense of efficacy of emerging communites is enhanced. They now tend to see the following objectives as achievable: 1) independence from imperial control expressed primarily in terms of removal of leaders seen as luckeys of the imperial powers, 2) national unification believed to have been held up by superpower machinations, 3) irredentist claims, 4) rectification of discriminatory treatment and demeaning of national dignity, 5) advancing nationalist grandeur interests. Most large identity communities will be conglomerations of discreet identity groups, especially ethnic, religious and racial, with difficult to reconcile interests. This leads to difficulties in mobilizing support for strategic objectives, produces vulnerabilities to external forces and leads easily to perceptions of treason on the part of component leadership. External competitors are likely to adopt tactical plans to strengthen or weaken community components and to involve themselves intimately in intra-community affairs. Conflict resolution efforts by international organizations will be complicated by the need to have a sophisticated understanding of the conflict environment. The above points are illustrated by an application to the Iraqi policy in the Gulf conflict.

Patterns of Conflictful and Cooperative Interaction Between Nations MARTIN PATCHEN (Purdue University)

This paper briefly reviews research concerning the circumstances under which national leaders take coercive or cooperative actions toward other nations and the circumstances under which such actions are effective in securing compliance or cooperation from the target. Special attention is focused on research concerning the occurrence or non-occurence of reciprocity in inter-nation relations, especially in United States-Soviet Union relations. Unresolved issues and useful directions for further research are discussed.

Technical Sessions

35T-2. Fissile Materials from Nuclear Arms Reductions: A Question of Disposition

Organized by: **William G. Sutcliffe** *(Staff Member, Center for Technical Studies of Security, Energy, and Arms Control, Lawrence Livermore National Laboratory, Livermore, CA)* and **Milo D. Nordyke** *(Director, Center for Technical Studies of Security, Energy, and Arms Control, Lawrence Livermore National Laboratory, Livermore, CA)*

8:30 am / Mon / 18 Feb **Sheraton/Vermont**

Limiting and Reducing Inventories of Fissionable Weapon Materials. L. CHARLES HEBEL (Xerox Palo Alto Research Center, Palo Alto, CA 94304)

As the United States and the Soviet Union agree on reductions in nuclear weapon delivery systems, they may also wish to make restraints and reductions in the total amount of fissionable materials available for weapons. Many tonnes of such materials would be made surplus by the START reductions in strategic weapons and the prospective reductions in theater weapons following the anticipated CEF agreement.

We review several reasons why a production cut-off and reduction in the stockpiles of fissionable weapon materials is a timely subject for the US-USSR agenda: 1) the opportunity to buttress cuts in weapon systems by eliminating surplus fissionable weapon materials; 2) the crucial need to bolster non-proliferation and sustain the Nuclear Non-Proliferation Treaty, which must undergo critical review in 1995; 3) the risks, liabilities, and costs of maintaining the defense nuclear materials facilities and perpetually protecting the large stockpiles of fissionable weapon materials; 4) the ongoing advances in the technologies for producing fissionable materials.

We survey the verification issues and problems of a "four-step" control framework to cease the production of fissionable material for weapons and systematically reduce the stockpiles. An effective control framework is feasible, provided the two nations address certain key issues. We conclude that the time is ripe for the U.S. and USSR to prepare to negotiate controls on their fissionable weapon materials.

Options and Regulatory Issues Related to the Disposition of Fissile Materials from Arms Reductions. CLARANCE H. BLOOMSTER, MARK H. KILLINGER, PAUL L. HENDRICKSON (Battelle, Pacific Northwest Laboratory)

This study identifies and evaluates potential options for dealing with large quantities of fissile materials in response to possible nuclear arms reduction treaties. Four broad categories of options for retiring the fissile material are evaluated: Monitored storage, nuclear fuel, disposal, and detonation.

The retirement options are evaluated according to seven criteria 1) verifiability, 2) proliferation-resistance, 3) cost, 4) irreversibility, 5) technical difficulty, 6) safety and environmental risk, and 7) political and public acceptance.

Overall, the best option for retired enriched uranium from warheads is use as fuel for commercial power reactors and naval reactors. Use of the retired plutonium as nuclear fuel is an attractive option because of the economic benefit, which could reach $800 million. The other options entail costs ranging from $50 million to more than $2 billion.

Another preferred option for the plutonium is to store it in a secured facility as a strategic fuel reserve for later use when low-cost fuels become scarce and breeding becomes competitive.

This study also analyzes the regulatory issues associated with the retirement options. Included are assessments of impacts from the following federal regulations and statutes: NEPA, Clean Air Act, NRC and DOT RCRA, as well as DOE regulations and directives. Impacts of state and local transportation laws are also analyzed.

Disposal of Fissionable Material from Dismantled Nuclear Weapons. JOHN J. TAYLOR (Electric Power Research Institute)

The START discussion between the U.S. and USSR on significant reductions in nuclear weapon delivery systems have elevated the issue of disposal of the fissionable material contained in the warheads of these systems. It is, therefore, appropriate to develop specific plans for such disposal.

As an aid to such planning, this paper examines the use of power reactors to "burn up" weapons fissionable materials, the process which has emerged from previous studies as an effective and economical disposal methods. The handling of both highly enriched uranium and plutonium is considered. Evaluations are made of the relative merits of using reactors dedicated solely for this purpose as against using power reactors in essentially their present form. These evaluations include the levels of depletion of fissionable isotopes, the degree of fissionable material control, and economics, both capital investment and operating costs.

The impact on the nuclear power generation industry of the disposal option of using existing power reactors is assessed. Potential changes in the safeguards systems for civilian reactors are examined as influenced by the various disposal options. The compatibility of the options with the International Atomic Energy Agency Safeguards Systems is also reviewed.

The storage of the residual material in the form of spent fuel is evaluated for its compatibility with, and impact on, the development of the permanent national repository for spent civilian reactor fuel.

Controlling Military Nuclear Materials. DAVID ALBRIGHT (Federation of American Scientists, Washington, DC)

Verifiable dismantlement of nuclear arsenals will require the safeguarded disposal or non-weapons uses of the nuclear materials from these arsenals. Although the bulk of U.S. weapons materials is currently in deployed nuclear weapons, a significant fraction is in irradiated fuel or manufacturing scrap, and a growing fraction is in retired weapons in storage or scheduled for disassembly. This paper discusses the various forms and estimated inventories of these materials in the U.S. and it suggests actions that can be taken to safely store or dispose of these materials without inhibiting arrangements for verifiable warhead dismantlement.

What to do with Fissile Stuff from Dismantled Warheads?. WARREN H. DONNELLY (Congressional Research Service, The Library of Congress, Washington, DC)

The new era in U.S. Soviet relations is quickening the pace of negotiations for the superpower nuclear arms reduction, which brings into question what to do with the warheads from dismantled nuclear weapons, and what to do with the fissile materials they contain. Academics and analysts outside of government are beginning to give some consideration to these questions, but there still are few signs of attention within the executive branch or the Congress. This analysis looks at part of the overall questions: what could be done with the fissile materials recovered from such warheads. It considers the range of possible options, discards implausible one, and discusses those that seem sensible. Indefinite storage ultimately followed by dilution of highly enriched uranium down to fuel grade; and either fissioning of plutonium for energy or mixing it with radioactive materials and burying it as nuclear waste. Notable statements of these ideas are identified and compared.

36. Science and Technology Policy

36-5. Making Witnesses Out of Wizards: Bringing Oz into the Courtroom

Organized by: **Ruth C. Burg** *(Administrative Judge, Armed Services Board of Contract Appeals, Falls Church, VA)* and **Mark Frankel** *(Program Director, AAAS, Washington, DC)*

8:30 am / Mon / 18 Feb Sheraton/Colorado

Science Experts in Civil Lawsuits. MAURICE ROSENBERG (Columbia University School of Law).

Evidence from experts in the form of information and opinions is the chief source of the judge's and jury's appreciation of the S & T materials that are crucial to informed decision in many lawsuits. Today problems and defects abound in the process of obtaining experts' evidence, both before and during trial. Differences in legal and scientific perspectives on truth, causation and other important matters contribute to these problems.

One reform proposal would mandate a full exchange of views of party-hired experts in the pretrial stage. Another would facilitate and encourage the federal courts to appoint impartial experts in specified circumstances. To overcome many experts' distaste for the treatment they receive from opposing counsel, consideration is being given to modifying the cross-examination process. The possibilities of reciprocal educational programs for judges and scientists will be outlined, along with ideas for making judicial notice of non-record S & T materials a better and fairer process.

Taming the Expert Witness. RUBIN BRESSLER, M.D. (Arizona Health Sciences Center).

The frequency of medical malpractice suits (MMS) and the amounts of individual awards have risen markedly. Expert witnesses (EW) are extensively used in MMS. Qualification as an EW is highly discretionary and can be based on education, training, experience in the area at issue or a distally related one. The EW is unique in that he can testify giving his opinion on complex technical issues. The EW frequently is an advocate for the lawyer who solicited his help, rather than an impartial witness. Highly paid EW have played important roles in MMS. The testimony of the EW is rarely challenged in regard to the accuracy, specificity, reliability and applicability of the presentation. Testimony is not considered in light of its acceptability to a majority of active professionals in the field. Several major faults derive from use of opinions of EW: (1) the EW are not true experts, but fit the loose legal definition, (2) the information presented by the EW may not be accurate or applicable, (3) the opinions of the EW may not be consonant with the majority of scientific opinion, (4) the EW derives financial gain for his opinion, which may engender zeal for the position he presents beyond its scientific merit. Some suggested remedies include: (1) stricter qualifications for defining an EW, (2) obligatory court appointed EW to assess the technical material for judge and jury prior to judge's instructions to the jury, (3) use of judges with technical-scientific backgrounds or special training for MMS and allied type litigation, (4) use of an independent, impartial panel of qualified experts suggested by medical specialty boards and/or scientific societies.

The Engineer as Expert Witness
NEAL FITZSIMONS (Engineering Counsel)

It was only in 1989 that there was any specific professional guidance for engineers acting as experts in the court room. Even today the majority of engineer experts are 'seat of the pants' witnesses unlearned in the ways of law who need much guidance from the case attorney. Unfortunately, many of the attorneys involved are unlearned in the ways of engineering and are less than 'ept' in dealing with their own engineer expert. The result can be a muddled case wherein justice may be the first casualty. What is being done to constrain this problem? How can engineers and lawyers better work together to serve justice? These and related questions are addressed after an historical background is presented.

Tapping the Right Expert
MARSHALL J. DOKE, JR. (Doke & Riley)

The selection of persons to serve as expert witnesses is one of the trial lawyer's most difficult decisions. The selection process begins with evaluation of whether an expert is needed at all, the purposes of the need, and consideration of the offensive or defensive nature of the purpose. Selection of the "right" expert includes evaluation of knowledge, ability, experience, and communicative skills. The "chemistry" between the expert and the client (or the lawyer) can be a determinative factor. The best known or most knowledgeable expert may not be the best witness, and this session will deal with a trial lawyer's evaluation.

Technical Sessions

36T-1. Improving the Functioning of Government Agencies

Organized by: **Stephen D. Nelson** *(Program Director, Science, Technology, and Government, AAAS, Washington, DC)*

8:30 am / Tue / 19 Feb **Omni/Caucus**

Policy Issues in Improving the Functioning of Government Agencies. BRUCE L.R. SMITH (Brookings Institution)

A decade and more has passed since the Civil Service Reform Act was adopted during the Carter Administration. The basic issues raised, but not resolved, in that legislation are in need of urgent re-examination -- decentralization, political-career interactions, merit pay tied to performance appraisal, and others. This opening paper puts the issues in a broad perspective and provides a framework for the session.

Total Quality Management in the Federal Government. ERIC E. ANSCHUTZ (Eric Anschutz Associates).

Total Quality Management is a set of management methods used widely and with extraordinary success in Japan since the early 1950's. Though based on the work of an American, W. Edwards Deming, TQM was not applied in the United States until the early 1980's when a number of our private-sector firms adopted it. The first known public-sector application took place in the mid-80's, and federal government applications of TQM have become widespread in the last several years. TQM, as practiced in the public-sector, has in recent years been shaped by the Federal Quality Institute with their issuance of eight criteria for the annual President's Award for Quality and Productivity Improvement: (1) top management leadership and support, (2) strategic planning, (3) focus on the customer, (4) employee recognition and training, (5) employee empowerment and teamwork, (6) measurement and analysis, (7) quality assurance, and (8) quality and productivity improvement results. These eight public sector TQM criteria parallel closely those set forth for the Baldrige National Quality Award and the Deming Prize which guide US and Japanese private sector TQM strategies, respectively. TQM, though nothing more than a coherent set of management fundamentals, has repeatedly led to major improvements.

Overview of Issues and Recent Government Initiatives. Marilyn K. Gowing (U.S. Office of Personnel Management).

This presentation will highlight the contributions of psychological research to several Federal government-wide programs including: Flexiplace or telecommuting; and engineers in the Federal government workforce.

The presenter will also present an overview of some issues pertaining to the role of behavioral research in improving the functioning of government agencies.

36T-2. Risk Perception and Public Policy

Organized by: **Michael A. Kamrin** *(Professor, Institute for Environmental Toxicology, Michigan State Univ., East Lansing, MI)* and **Daniel A. Bronstein** *(Professor, Dept. of Resource Development, Michigan State Univ., East Lansing, MI)*

2:30 pm / Sun / 17 Feb **Omni/Cabinet**

Risk Perception, Trust, and Public Policy. PAUL SLOVIC (Decision Research and University of Oregon).

Historians of technology will surely be fascinated by these last decades of the 20th century--a period in which citizens of the United States are waging war against the powerful nuclear and chemical technologies created to satisfy their myriad needs and desires. The battle lines have been drawn over strong and conflicting perceptions about risk. Never has so much money and effort been spent to make life healthier and safer, yet--at the same time--a great many members of the public have become more--rather than less--concerned about risk, and believe themselves and their environment to be increasingly vulnerable to the hazards of technology. I shall argue that perceptions of risk are a product of the society in which we live. Our brand of Jeffersonian democracy, our intrusive media, our powerful special-interest groups, and our penchant for litigation combine to overpower the young science of risk assessment and obliterate trust in the ability of science, industry, and government to manage technological risks. This crisis of trust must be recognized, understood, and dealt with competently, if we are to make sound decisions about the use and regulation of technology.

Consumer Perception of Risks from Pesticide Residues in Foods. EILEEN VAN RAVENSWAAY (Michigan State University)

Results of a survey of consumers' perceptions of risks from pesticide residues in food are presented. Data includes consumers' perceptions of risks of exposure to pesticides in different types of food, their perceptions of the different types of health risks associated with pesticide residues, and their relative rankings of the seriousness of pesticide residues relative to other food safety problems. Consumer willingness to accept lower quality or to pay more for foods with reduced pesticide residues is assessed. Results are compared to other studies. Implications for risk communicators and food safety policies are developed.

Radon Denial: Deciphering the Causes
SHELDON KRIMSKY
(Tufts University)

Major campaigns have been initiated by state and federal agencies to communicate the risks of indoor radon and motivate homeowners to test and mitigate when high levels are present. Despite repeated warnings that radon is the second major cause of lung cancer, it has very little staying power on the public's risk agenda. Theoretical

contributions to the cultural theory of risk along with recent empirical findings on risk perception are helpful in explaining the high level of social denial or skepticism regarding health risks associated with indoor radon. Public reaction to radon more closely follows health/life style risks than traditional environmental risks despite the fact that exposure to radon is involuntary.

Impact of the Media on Risk Perception
CRISTINE RUSSELL (Washington Post)

Perrier contamination. Alar in apples. Radon. Cigarette smoke. Air pollution. All risks are not equal. But too often media coverage magnifies smaller risks, while downplaying or even ignoring risks of far greater magnitude. A risk is obviously not a matter of public concern until the public knows about it--and the news media are naturally attracted to new and dramatic risks. The challenge is not only to alert the public to a given health or environmental risk but to help individuals understand what it may mean to them. Despite all the discussion in recent years about improving risk communication, we still have a long way to go. The responsibility goes well beyond the media. Experts have to make a better effort to present risk information in terms that make sense to the public, to take outside concerns seriously and to avoid attempts to manipulate or massage a risk message on behalf of interested parties. The presentation will offer guidelines for working with, not against, the news media to improve risk communication.

Risk Perception and Public Policy: A Comparative Review.
ORTWIN RENN (CENTED, Clark University).

Risk perception studies have been performed in many countries and used to confirm or modify public policies on technologies or emergency planning. The paper will address several cases in which governments have provided grants to research institutions to explore public perception as a means to improve their policies or initiate a communication program. The cases will be drawn from the United States and Western Europe. The focus will be on two related subjects: (1) what elements of risk perception did appear to have an impact on the final policies chosen and (2) how much rationality was attributed to public perception compared to experts' risk assessments? In the conclusions the potential functions of perception research for policy making are discussed.

The Cultural Theory of Risk Perception and Global Environmental Policy.
STEVE RAYNER (Global Environmental Studies Center, Oak Ridge National Laboratory).

The cultural theory of risk perception is unique in that it takes the perceiver rather than the hazard as the starting point for analysis. The public policy implications of cultural theory focus on institutional design rather than technical fixes or packaging information. However, the cultural approach has been criticized persistently on several grounds. These include assertions that the theory ignores interests and power, is inherently conservative politically, deterministic theoretically, and impossible to apply in practice without doing violent damage to the complexity of real social institutions. This paper will respond to each of these criticisms and illustrate the utility of cultural analysis in analyzing global environmental policy.

36T-3. Allocating Public Funds for Science: Practice and Possibilities

Organized by: **Jack Sommer** *(President, Political Economic Research Institute, McLean, VA)*

8:30 am / Mon / 18 Feb **Omni/Cabinet**

And Now A Word From Our Sponsors.
ELIZABETH ROBINSON (OTA) and DARYL CHUBIN (OTA)

Central to OTA's study of *Basic Research for the 1990s* is an analysis of how six Federal R&D agencies -- DoD, DoE, USDA, NASA, NSF, and NIH -- set their research agendas and translate programmatic goals into reality. Over 120 interviews with agency personnel at various levels of decision-making provide a unique database for understanding the interplay of priority-setting, annual agency budgets, and the mechanisms used to select extramural and intramural research performers. This presentation compares agencies on a continuum of proposal review that extends from the use of external experts, or *peer review*, to reliance on the in-house judgments of program managers, or *manager discretion*. These "words from the sponsors" illustrate the cultures in which these mechanisms of proposal review operate, and the checks and balances which ensure their integrity.

NSF Examines Its Own Proposal Review System.
JAMES M. McCULLOUGH (Director, Program Evaluation, National Science Foundation).

In 1990 NSF made several changes to its proposal review system, including improvements in feedback to applicants, new rules for reconsideration of declined proposals, and a mechanism for making small grants without external peer review. These changes were based in part on surveys and statistical work by the Foundation's own Evaluation Staff. Mr. McCullough will describe past and continuing work of this type and make available copies of relevant public reports.

Gender and Allocation Issues:Insights from Sigma Xi Surveys
DEBORAH L. SELTZER (DLS Research Associates)

In 1988, Sigma Xi, The Scientific Research Society, conducted a demographic and attitudinal survey of its membership. In terms of field of science designation, membership of the Society corresponds, in large part, to the universe of natural scientists and engineers holding Ph.D.s; and, in terms of sector of employment, about half are in universities, a third in industry, and a sixth in government. The survey results provide insight into attitudes and perceptions within the scientific community relative to research, societal, and political issues. Differences of opinion, based on gender, were apparent in some areas of the survey but not in others; how much of these differences may be accounted for by age and field of science is considered.

Peer Review as Self-Regulation: A Public Choice Perspective.
PETER H. ARANSON (Emory University) and CHRISTOPHER C. CURRAN (Emory University)

We interpret peer review in the context of research grant-making as a form of self-regulation by the members of a particular profession or discipline. Peer review is then susceptible to two interpretations. In the economic theory of welfare, peer review is an attempt by the profession or discipline to increase the value of output (knowledge gained) per dollar invested, thereby increasing demand for research, price, and social surplus. In the economic theory of public choice, peer review is an attempt to cartelize the profession or discipline, thereby restricting entry and output while raising price. We explore the prior conditions under which one theory or the other is likely to apply and then examine related empirical findings with respect to the alternative predictions of the two theories.

Allocating Public Resources to Technology Development.
CHRISTOPHER T. HILL (Manufacturing Forum, National Academies of Engineering and Science).

Allocating public resources to technology development poses theoretical and practical issues that differ substantially from the allocation problem for science. Scientific inquiry by nature has profoundly unpredictable outcomes over which property rights are often not assertable and whose beneficiaries are usually not identifiable ex ante. Education is often an intended by-product. Technology is developed under definable uncertainties, for a purpose -- sometimes governmental, but often economic -- to benefit a known individual or

group. Allocation of resources to technology development for governmental purposes is complicated both theoretically (where exactly are the market failures?) and due to concerns for fairness. Allocation of resources to technology development for economic purposes is inherently political, most experts are not disinterested in the results, and non-market information dissemination is often a government objective. The challenge is to formulate allocation processes that take advantage of the interests at stake, rather than processes that attempt to eliminate them. Implications for programs that support civilian technology development and transfer will be discussed.

Centers and the Individual Scientist: Conflict or Compromise?
RITA COLWELL (University of Maryland, College Park, MD)

A proliferation of research centers has occured during the past decade. A perceived shifting of public funding toward centers has ignited controversy in the scientific community. Arguments can be made in favor of centers and, similarly for funding individual scientists. Is there a satisfactory middle ground in this allocation debate? Does the center concept threaten creativity and productivity in science?

Peer Review To Plateau
DAVID D. MORAN (David Taylor Research Center) &
LORI L. WALL (David Taylor Research Center)

Policy guiding the distribution of research grants in the United States has been based upon a philosophy of priority ranking through peer review of proposals. Peer review to plateau (PRP) is proposed as an equitable alternative selection process which engenders the highest quality research effort while rectifying one of the major deficiencies of the current system—the favoring of low risk productivity over high risk potential. With PRP, status, stature, influence, and politics are reduced through blind selection procedures, thereby elevating the importance of the appropriateness and the soundness of the science.

Self-Organization Through Prizes and Lots: A Radical Proposal
JACK SOMMER (PERI)

Current standard practice of public grants ex ante the conduct of fundamental scientific research based on proposal review by peers poses several moral hazards which may be avoided by switching to post hoc awards; prizes for accomplishment rather than the underwriting of promises may reduce these hazards. To effect a regime of public prizes rather than grants poses the question of inauguration of research careers. This question is addressed through a system of lotteries with self-organizing properties which, after an initial turbulent transition state, would yield a more diversified fundamental scientific research community endowed with greater organizational flexibility and, presumably, less vulnerable to "old boys" networks and attendant "peermarking."

36T-4. Knowledge Synthesis: An Ethical Imperative for Policy Development

Organized by: Keith Wilde *(Senior Policy Analyst, Canadian Dept. of Agriculture, Ottawa, Canada)*

2:30 pm / Mon / 18 Feb — Omni/Cabinet

Education for Creative Synthesis Against the Folly of Specialist Power.
RICHARD R. HARWOOD (Michigan State University)

Agricultural science has evolved during the past several decades with an overall imbalance in the application of scientific method. Norms for most scientific disciplinary groups require increasingly sophisticated and rigorous mathematical and statistical analyses to support conclusions on the behavior of complex populations of agricultural organisms which exist in highly variable environments. Such rigor is both commendable and desirable, but currently available experimental methods and analytical tools make it possible only where both complexity of interaction and environmental variability are highly restricted. The imbalance comes with dominance of analytical rigor over the growing need for analysis of complex biological, social and economic interactions. Analytical rigor may occasionally serve as veneer to flagrant violation of reason in basic assumption. There is growing frustration in much of the scientific community over inability to effectively model new and desirable interfaces between production systems and the environment. In today's scientific environment the hint of "softness" in data will prompt discard of findings or of concept. Examples are manifold. The implications of methodological imbalance are most serious in our educational system, where future generations of scientists must be trained to deal with the interactive complexities of tomorrow's world.

Environmental Preservation, Science, and Ideology.
JOHN M. CULBERTSON (University of Wisconsin).

While the scientific method brought great advances in the physical and biological sciences, subjects relating to human affairs and beliefs became dominated by an ideology that generates false knowledge and misstates the requirements of habitat preservation. Ancient man understood that disordered or habitat-destroying societies are, in time, extinguished--societal selection rules. Long-surviving societies are those whose members so behave as to maintain a functional order, limited population, and preserved habitat.
The take-over of the "social sciences" by millenarian beliefs in which an earthly heaven designed by "Nature" can be gained by some panacea--the anarchists' abolition of government, the Marxists' class revolution, the "freeing" of individuals by laissez faire economics and social permissiveness, Nature-guided "economic growth"--caused human affairs to be interpreted in terms of a misleading world-view of Nature-magic rather than material causes. An environmental crash, with all it implies, now can be avoided only through changed beliefs and policies that actually cause human actions that actually cause habitat-preservation. This will not occur under a false science that depicts individuals' actions as magically Nature-validated and thus not subject to societal guidance or constraint, and that depicts evolution as a providential "natural selection" among individuals rather than a performance-based selection among societies.

A GREEK HELL
Nicole MORGAN (University of Ottawa, Department of Philosophy)

In Western cultures, bureaucracies are regarded as rationale instruments. They themselves take pride in their scientific approaches to management, in thei r devotion to impartial research (social, economic, statistical, etc...) and in a neutrality guaranteed by a "merit principle".
This paper will question the pretence and examine the many ways "knowledge" (the Logos) is twisted so as to fit the desiderata of bureaucratic and/or political power while keeping the appearance of objectivity.
It will demonstrate how, over the decades, modern bureaucracies have become "politicized" in the sense that they are more and more obsessed by images than content, devoting increasing energy to keeping intellectual curiosity and its bearer from any field.
There will be a description of a Greek hell, that is a world where words do not carry any other meaning than protecting or enhancing territories

Ecology, Religion and Practical Reason. LANGDON GILKEY (The University of Chicago)

Problem is the failure of practical reason vis a vis ecology. This is an essay on the roots of this failure and its possible resolution. This is not merely a problem of materialistic philosophy nor of certain special interests.(1)Back of every philosophy lies interest, the drive to security and increased well-being, individual and social self-interest. This interest is often hidden, even unconscious; and usually it is accompanied by idealistic philosophical and moral justification (rationalization).(2)"Special interests" are those whose vital concerns are directly involved. This includes the general public as well if their own economic interests are threatened. The problem of deep ecology is that environmental concerns require material sacrifice by the entire public.(3) Reflection, and with it science, serves as much as it challenges these deep levels of social interest ;science is now 'established' in the social structure; like medieval religion, it is coopted by that structure. We have here reached a religious level both of problem and of resolution. Nature represents an ultimate value to our existence, and its preservation an ultimate concern for us. A change in fundamental attitude and valuation, a religious change, is thus necessary from our humanistic concentration on human creativity to a more objective concern for the whole as sacred.

Common Sense in Uncommon Times
TIMOTHY C. WEISKELL(Harvard Divinity School)

The division of labor and social organization of human groups has proceeded most rapidly in urban-based societies. But some of the most impressive societal achievements have been short-lived. Indeed, from a long-term perspective, the gradual rise and sudden fall of urban societies has provided a solemn and sadly steady drum beat throughout recorded history. In many cases the relatively rapid decline of urban civilizations can be traced to a syndrome of ecological deterioration that appears to be unleashed when ruling classes or policy-forming elites fail to respect, consult or implement age-old agricultural or ecological knowledge. It is not so much through ignorance but rather through a failure to act collectively upon available knowledge that many social groups have experienced decline or collapse. The paper examines what social scientists or historians might be able to say about the ability of social groups to perceive, process, synthesize and act upon readily available information in times of uncommon stress.

The Conscious Employment of Emotions as an Adjunct to Creativity. ARISTIDE H. ESSER (Association for the Study of Man-Environment Relations).

True creativity originates in feelings; reason is used only to justify the consequences. I will explore the implications of this premise in order to create a context for (economic) decision-making based on a biospheric ethic. In particular, I want to consider reasoned insights into the function of our brain and the evolution of its intelligence arising from conscious and unconscious functioning. Epistemics, implied in the Triune Brain theory of MacLean, appears to be a promising approach to a crucial reconsideration of epistemology, which has been heavily influenced by Western science and technology. Epistemics provides a contextual framework for examination of reasoned intentions (such as materialistic self-interest in Adam Smith's economics and empathy in Marx's theory), and the unconscious drives of aggression and sex. A global economics for the 21st century needs to re-channel the impact of these (four) motivations on our present public policies, incorporating the vital element of a conscious adaptation of the balanced perspective that pervades much of Eastern philosophy.

Workshops

36W-1. Government Hearings and Expert Witnesses: Giving Effective Testimony

Organized by: **Stephen D. Nelson** *(Program Director, Science, Technology, and Government, AAAS, Washington, DC)*

2:30 pm / Sat / 16 Feb **Omni/Cabinet**

The Structure of Congressional Hearings: Strategic Implications
GRACE L. OSTENSO (Committee on Science, Space, and Technology, U.S. House of Representatives).

Congressional hearings are structured to achieve a variety of goals: building political, scientific, and technical consensus; assessing the implementation and effectiveness of federal agency programs; influencing public policy direction and action; setting scientific, technical, and related budgetary priorities; obtaining expert knowledge on a narrow technical subject; and building public and Congressional support for policy initiatives. The development of public policy through the hearing and consensus building process invokes some of the most basic questions of American political philosophy: public control vs. self-regulation; federal vs. local jurisdiction; individual vs. societal responsibility; and deriving a balance among the conflicting rights and values of different social institutions and public interests. Following the identification of a public policy issue, the objectives and focus of a hearing are defined; witnesses are selected to represent a broad range of expertise and a balance between stakeholders with differing viewpoints; and a line-of-questioning is developed to ensure the objectives are achieved. The hearing record serves as guidance for action and a knowledge base for Congress and the public.

Legal Considerations for Witnesses.
JOHN C. GRABOW (Partner, Ginsburg, Feldman and Bress, Chartered).

This presentation will begin with a discussion of some recent examples of congressional inquiries involving scientific-technical matters. It will then give an overview of the legal tools available to congressional committees in conducting investigations, including the subpoena and contempt powers. Addressed next will be the constitutional limitations on Congress' exercise of these powers, as well as the internal procedural rules that have been adopted by the Senate and House which govern the conduct of congressional hearings. The presentation will conclude with a discussion of strategic considerations for a witness in a congressional hearing, including contacts with committee staff, the potential impact of hearing testimony on parallel criminal and civil proceedings, the problem of committee leaks, and the role of counsel.

37. History and Philosophy of Science

37-1. The Beginning and the End of the World: Historical Perspectives

Organized by: **Stephen G. Brush** *(Professor, Dept. of History and Institute for Physical Science and Technology, Univ. of Maryland, College Park, MD)*

8:30 am / Sun / 17 Feb **Sheraton/Kansas**

Impermanence Enters the Astronomical Universe - Comets Novae and Solar Radiation, 1400-1650.

PEGGY ALDRICH KIDWELL (Smithsonian Institution).

During the period 1400 to 1650, European astronomers came to see heavenly bodies as transient. They rejected Aristotle's view that the planets, sun and stars were eternal and unchanging. Speculations about the beginning and end of the universe, which had long been a concern of theology, entered the realm of astronomy. This transition was part and parcel of both a new concern for observation and of a revolution in ideas about the order of the universe. This paper examines changing views of comets, novae and solar radiation, as they suggest how impermanent phenomena entered the world of mathematical astronomy.

From Genesis to Apocalypse: Newton's God and Newton's Science. JAMES E. FORCE (Univ. of Kentucky).

In this paper, I argue that central to all of Newton's thought, including his scientific thought, is his conviction that in the "proper" interpretation of Genesis and of the crucial core of yet unfulfilled prophecies in Daniel and Revelation, God's plan for human and natural world history is revealed to the wise whose researches have added to our natural and revealed knowledge of God. First, I analyze Newton's critical Biblical theology. Second, I trace his metaphysical theology concerning the nature and attributes of the Lord God of total dominion. Third, I examine how what we know of the Lord God of dominion from scripture, nature, and the events of history leads Newton and his follower, William Whiston, to develop unique theories of the origin of the earth and of its prophesied destruction. Finally, I analyze the nature of the relationship between Newton's critical Biblical theology and his scientific methodology. Newton's Biblical theology--especially in his theories regarding the beginning and the end of human and natural world history--provides an important key for understanding how Newton unifies all the seemingly disparate elements of his thinking about God and science into a unified whole. Newton takes seriously God's revelation to the prophet Daniel that, at the end of time, "Many shall run to and fro and knowledge shall increase."

Nebular Birth and Heat Death, 1754-1905. STEPHEN G. BRUSH (University of Maryland at College Park).

At the beginning of the 19th century a simple astronomical-geological model for the beginning of the world was widely accepted: contraction of an incandescent gaseous nebula to a star (Herschel) surrounded by rings that collapse to planets (Laplace), which then condense and cool (Buffon). The model could explain a wide range of phenomena, from the regularity of planetary orbits to terrestrial mountain chains, and bolstered a progressive evolutionary worldview -- "from nebula to man." Then thermodynamics (Helmholtz, Clausius, Kelvin) entered the picture. Analysis of the processes of energy conversion and dissipation that powered the Sun and allowed life to emerge on Earth indicated that eventually all stars must stop shining and all planets must freeze. Would that be the end of the world, or would a new century find a way to revive it or at least postpone the inevitable Heat Death?

Redshifts, Galaxies, and General Relativity: Ideas on the Creation and End of the Universe in the Early Twentieth Century. ROBERT W. SMITH (Smithsonian Institution and the Johns Hopkins University).

In the first three decades of this century the modern science of cosmology was forged from general relativity theory and new observing methods and instruments, particularly large optical telescopes perched thousands of feet above sea level in California and Arizona. These radical changes in the theoretical and observational tools used by astronomers, physicists and mathematicians accompanied revolutionary changes in cosmology itself. The new cosmology of the early 1930's included two key cognitive features absent from the cosmology of the turn of the century: first, the existence of galaxies outside our own stellar systems that are visible in Earth-based telescopes, and second, that these galaxies evince the expansion of the universe. In this paper I shall examine the new cosmology with particular reference to ideas on the creation and end of the universe.

The End of the Universe. FRANK J. TIPLER (Tulane University).

Almost all work in cosmology is devoted to study of the past 20 billion years. But even if closed, the universe will last for another 100 billion years of proper time: most of spacetime lies in the far future. Because the Einstein equations have infinite phase space chaos, one can investigate most of reality — the future — only with the aid of a constraint. I shall present the picture of the ultimate universal future implied by the Dirac-Dyson postulate: physics allows life in some form to survive literally forever. I shall show that this postulate implies: (1) the universe must be closed; (2) the future c-boundary of the universe must consist of a single point (the Omega Point); (3) life eventually must completely engulf the entire universe and begin to control its dynamics on a global scale; (3) knowledge and energy resources possessed by life as a whole must diverge to infinity as the Omega Point is approached. I shall show that the known laws of physics are consistent with the postulate. Finally, I shall show that life will eventually possess sufficient computer power to simulate *exactly* the entire present day visible universe, and all of its previous states to date. Thus it will be physically possible, in principle, to resurrect to eternal life every human who has ever lived, or now lives. I shall give reasons for expecting this simulation of the past to be carried out by life in the far future. Resurrection of the dead to individual immortality is hence an implication of reductionist scientific materialism, a deduction from the fact that a human is nothing but a machine governed by the known laws of physics.

Brain Wars in England: Richard Owen's Lost Cause

C.U.M. SMITH (Aston University, England)

According to Freeman (1) "Richard Owen was probably the only man Darwin hated" and, after the publication of The Origin, Darwin wrote to Lyell that "he (Owen) was quite savage and crimson at me". Why the mutual loathing? Thereby hangs the tale of this contribution. And, central to this story, is the subject-matter of comparative neuroanatomy. This was, moreover, no mere squabble in the groves of academe. Deep forces were at work in England in the aftermath of the revolutionary wars of the beginning of the century. The tangle of personal professional, political and social passions which led to the bruising encounter between Owen and Huxley at the 1860 meeting of the British Association for the Advancement of Science will be examined. It will be shown how these passions influenced what Owen and others saw in the brain, and how the rough seas of the neuroanatomical controversy splashed over into the popular writings of the period.

1. Freeman, R.B., 1978, Charles Darwin: a Companion, Folkestone: Dawson.

37-2. Metaphors and Models in the Brain Sciences: Historical Perspectives

Organized by: **Edward Manier** *(Professor, Philosophy and Reilly Center for Science, Technology, and Values, Univ. of Notre Dame, Notre Dame, IN)*

2:30 pm / Sat / 16 Feb **Sheraton/Kansas**

'Opening the black box,' figurative uses of molecules and algorithms

EDWARD MANIER (Dept. of Philosophy, Univ. of Notre Dame)

Philosophers believe we have a compelling epistemic interest in a general theory of the brain. While learning theory alone will not suffice for this purpose, it will be central to any adequate account of brain function. Investigations of adaptive neural networks (parallel distributed processing models) are transforming links connecting molecular and cognitive studies of Pavlovian learning. Neural networks consist of layers of computational units, each with an activation state determined by the instantaneous sum of its weighted inputs, transformed by feedback sequences structured by algorithmic learning rules. These models facilitate communication between molecular neuroscience and cognitive psychology; standardize and facilitate comparison of the computational capacities of alternate paradigms of associative learning. Associative learning in animals can now be rigorously compared with human category learning. Reductionists talk about "opening the black box," baring rich mysteries to simple inspection but the tasks of identifying the molecular alphabet of learning cannot be separated from the codiscovery of the

basic algorithms structuring the experiential modification of brains and neural networks. Computational models are an essential part of the development and criticism of molecular models. The power of this integrated approach points to the necessity of reassessing wider cultural uses of the metaphor of the brain as a system of deterministic reflexes.

Evolutionary Assumptions in the Neurosciences
TERRENCE W. DEACON (Harvard University)

In recent decades there has been remarkably little interest or emphasis on evolutionary issues in the neurosciences. One side effect of this avoidance of evolutionary questions is the growth of a cottage industry of statistical studies of brain size, pursued almost exclusively by non-neuroscientists, apparently oblivious to the complex problems of brain structure and function. Another side effect is the unquestioned acceptance by neuroscientists of simplistic and fallacious assumptions about brain evolution and function including assumptions about evolutionary progress, recapitulation, terminal addition of new structures, hierarchic organization, complexity, the importance of brain size, and the comparative relation of human and other species' brains. Unfortunately, these fallacious evolutionary assumptions are often the basis for the underlying metaphors that guide structural and functional studies. Explanations of brain functions are inevitably couched in terms of higher vs lower functions carried out by newer vs older brain structures in later vs earlier stages of information processing involving more vs less complex information despite the absence of supportive research or even critical reflection on these assumptions. As more complex theoretical models of macroscopic brain functions begin to emerge -- including those explicitly modeled on "Darwinism" -- the evolutionary naivete of the field will prove to be a serious handicap.

Brain Science and the Cultural Uses of Metaphors
ANNE HARRINGTON (Harvard University)

The use of metaphors in the brain sciences can serve to enhance comprehension and dialogue, yet some metaphors prove so successful that they come for a time to define understanding of the human brain. When this is the case, one can almost be certain that more is going on than simple pedagogy. Such "super metaphors" catch on because they offer themselves as cultural resources. They provide societies with a language--sanctified with the authority and finality of biological truth--to talk about enduring dilemmas of the human condition. Here four such "super metaphors" in the brain sciences will be introduced: (1) the deterministic image of the brain as a system of reflexes; (2) the evolutionary image of the brain as a hierarchy of levels; (3) the machine image of the brain as a system of centers and tracts; and (4) the popular modern image of the brain as a divided system of left-sided verbal rationality and right-sided non-verbal intuition. It will be argued that the cultural functions of "super metaphors" do not necessarily detract from their scientific fruitfulness. Metaphors function simultaneously on a number of meaning levels which are more or less porous to each other, but each of which has its own logic and set of agendas. Science, in short, is a multi-level discourse.

37-3. Mathematics in Times of Social Upheaval

Organized by: **Sanford L. Segal** *(Professor of Mathematics, Univ. of Rochester, Rochester, NY)*

8:30 am / Mon / 18 Feb **Sheraton/Kansas**

Mathematicians vs. Humanists in the Göttingen Philosophical Faculty, 1900-1919 David E. Rowe (Pace University).

A series of disputes between the scientists and humanists on Göttingen's philosophical faculty took place between 1900 and 1919. The three fundamental issues at stake all had modernist overtones and the debates generally reflected two fundamentally different conceptions regarding educational reforms. The first conflict concerned the acceptance of graduates from schools other than the classical Gymnasien as candidates for doctoral degrees. The second issue was whether or not women could be allowed to habilitate at Göttingen, and thereby enter the ranks of the faculty's Dozenten. The third and final question, which ultimately led to the dissolution of the Philosophische Fakultät, involved a dispute over the controversial philosopher, Leonard Nelson. An outspoken pacifist, Nelson was backed by the influential mathematician, David Hilbert, who headed the "liberal coalition" within the faculty. To nearly all the humanists, on the other hand, his name was anathema, and the ferocious fight that ensued reveals much about growing tensions within the fabric of German academic life during this era.

The anti-religious campaign and Moscow mathematics.
CHARLES E. FORD (Saint Louis University).

An anti-religious campaign was one component of the 'cultural revolution' launched by Stalin in 1928. The leadership of the Moscow school of mathematics became a specific target of this campaign. This school had been strongly influenced by a religious-philosophical 'renaissance' within the Russian Orthodox Church in the years just before the revolution. The priest Pavel Florensky was a leading figure in the renaissance. He was a close friend of Dmitrii Egorov and Nikolai Luzin, the founders of the Moscow school of mathematics, and played a key role in its origins. After the revolution, Egorov was the leading figure in Moscow mathematics. He became an outspoken defender of the Church and was one of the first targets of the anti-religious campaign, in which some of the younger mathematicians were enlisted against him. He was arrested in 1930 and died in exile in 1931. After the revolution, Florensky entered into a very active career of scientific research. This continued even after his arrest in 1933, up until his execution in 1937. Nikolai Luzin was perhaps the most famous mathematician in Moscow. He was the target of a series of denunciations in 1936 in which some of his most famous former students took part. Although these denunciations made the front pages of *Pravda*, Luzin was not arrested. So effective was the anti-religious campaign that the religious-philosophical renaissance remains little known today, and its connections with the development of modern mathematics and science in Moscow have only recently been rediscovered.

The Case of Nikolai Luzin
Aleksey E. Levin (University of Maryland)

The report presents and interprets the so-called "Academician Luzin's Case" which took place in the summer of 1936. Nikolai N. Luzin, a most visible Soviet mathematician and educator, was made the object of blatant public campaign directed against him personally as well as against some other scientists of lesser rank. However, disregarding the very rough language and extremely aggressive tone of official accusations, the campaign quite unusually did not bring about any really tragic repercussions for Luzin himself whose career was not heavily damaged and whose personal safety was not endangered. The prehistory and development of the campaign are outlined, and its moving forces and causes are analyzed in the context of the Soviet political history of the 1930s. Some arguments in the support of the idea that Luzin's case may be regarded as an important albeit masked preparatory step towards the organization of the Zinoviev-Kamenev public trial of August 1936 are given and discussed.

Warren Weaver, Vannevar Bush, and the Applied Mathematics Panel in WWII.
LARRY OWENS (University of Massachusetts).

Through Warren Weaver and the Applied Mathematics Panel, Vannevar Bush and his colleagues in the Office of Scientific Research and Development hoped to coordinate the work of U.S. mathematicians in the Second World War. In many ways the effort was successful. The Panel employed nearly 300 people, among them mathematicians of the caliber of Richard Courant, Oswald Veblen, and John von Neumann, spent much money and wrote innumerable reports, and gave applied mathematics, especially, a boost at a time when, in many

accounts, it was paid little heed. But in other ways the Panel failed. And even its original mandate split the mathematical community into angry factions. This talk will focus on the Panel's failures, for while its accomplishments have been well memorialized, its trials and tribulations illuminate the uneven development of American mathematics at the time of the war as as well as the imperial ambitions of men like Bush and Weaver who sought to devise organizational means for the central management of American science.

Mathematics and Nazi Politics: Three Examples.
SANFORD L. SEGAL (Univ. of Rochester).

With respect to academic matters, at least for mathematics, the major concern of the Nazi state seems to have been ideological correctness as expressed in the Civil Service Law of April 7, 1933 and later regulations. Otherwise, even when war-related work was involved, mathematical matters often degenerated into conflictful disputes between individuals, each, of course, necessarily arguing on the side of ideological correctness. Even international politics might affect an academic appointment. No sufficiently highly placed bureaucrat seems to have cared enough about mathematics to enforce a direction in such disputes; at least not until they exhausted themselves. While, on the one hand, this provided opportunities for the numerous German mathematicians who were not ideologues and not Jewish, but only interested in preserving their discipline in a difficult time, it also provided many opportunities for opportunists who wished to use the political situation to advance their own careers--since correct politics and ideology were the major requirements for such advancement. There were also mathematicians who were convinced Nazi ideologues. The last two groups contained a surprising number of prominent as well as not-so-prominent mathematicians, although the majority of German mathematicians during the Nazi period seemed to have been in the first group, and wished to protect their discipline as best possible against ideological incursions. Three examples, each from a different period in the history of the Third Reich, of the sort of disputes mentioned are briefly described, two involving applied mathematics, and one pure mathematics.

37-4. Creative Couples and Gender Complementarity: Cross-disciplinary Perspectives

Organized by: **Helena M. Pycior** *(Associate Professor of History, Univ. of Wisconsin, Milwaukee, WI)*, **Nancy G. Slack** *(Visiting Research Scholar, Section of the History of Medicine, Yale Univ. School of Medicine, New Haven, CT)*, and **Pnina Geraldine Abir-Am** *(Visiting Research Associate, Northeastern Univ., Boston, MA)*

2:30 pm / Fri / 15 Feb **Sheraton/Kansas**

Dividing the Research and the Credit: Marie and Pierre Curie. HELENA PYCIOR (University of Wisconsin-Milwaukee).

Not the first woman to excel in mathematics or science, Marie Sklodowska Curie was probably the first woman to receive nearly full credit for her scientific work. This paper examines some of the factors that permitted Curie, a turn-of-the-century woman, to achieve scientific prominence. The paper focuses above all on her marriage to and scientific partnership with Pierre Curie. Together the Curies formed a research team and, perhaps together, developed a publication strategy that assured that Marie Curie received credit for her independent and joint discoveries in the field of radioactivity. The paper examines the publications of the Curies, with an eye towards refining historical accounts of how they divided their research and credit. The paper also comments on the historiography of the Curies as a scientific couple. Although their publication strategy forced their contemporaries to see the couple as a research team of equals, later accounts of their work reduced Marie Curie's role through subtle interpretations of the division of research within the Curie team, while other accounts minimized the achievements of both Curies.

Mary Putnam Jacobi and Abraham Jacobi: Mixing Medicine with Politics. JOY HARVEY (University of Oklahoma)

The ideal of partnership in science and marriage has been invoked by previous biographers of the Doctors Jacobi. This paper will explore gender options as perceived by both husband and wife in the last three decades of the nineteenth century. It will examine the degree to which the two physicians and scientists shared scientific, political and social beliefs but it will emphasize points of conflict as well as contact. Mary Putnam Jacobi's clinical training in France, her radicalization before and during the Paris Commune by the "gentle" French anarchists, and her views of scientific competition will be contrasted with her older husband's German background, his commitment to a more autocratic style of science and medicine, as well as his belief in State Socialism. Abraham Jacobi held an important place in the New York medical world both as a physician notable for his work on Infant Diseases and through his close relationship with William Osler and his circle. Her practice centered around the Women's Medical School of the New York Infirmary and its dispensary and the pediatric clinic of Mt. Sinai. In the 1890s she became a dedicated proponent of Women's Suffrage in New York in opposition to her husband's closest friend, Carl Schurz, a former Secretary of the Interior, which heightened their marital conflicts.

Contrasting Sex Roles in American Botanical/Ecological Couples. NANCY G. SLACK (Yale University).

The lives and work of five American married couples who did important research in botany or ecology from the mid-nineteenth to the mid-twentieth century are examined. They represent a continuum from the husband creator - wife executor mode to couples in which the wife did the more important work. Some couples collaborated; some did separate research. The Sullivants, Farrs, Brandegees, Brittons and Clements were all couples who produced new knowledge about plants. Yet the relative achievements of the male and female partners varied greatly. This paper explores factors that may account for these differences. These include age and status as scientists at the time of marriage, changing societal roles for women and the internalization of these expectations by both wives and husbands. All of these couples were white and were native born Americans, but social class was a factor. The external appearances/ internal reality of the couples' relationships and the question of "credit" for scientific results are also examined.

Most of the major achievers among botanical women during this time period were not married; they remained single or in several important cases were early widows. Yet several of these women were highly successful within marriages. What were the important interactions in these couples?

The Localization of Complementarity. MARY CATHERINE BATESON (George Mason University).

The most severe strains on two-career families arise when advancement for one member of a couple depends on a move to a different part of the country. In the traditional pattern of bread-winning husband/home-making wife such moves were stressful but provided occasions for reaffirming the existing roles as the husband's salary increased and the wife organized a new household. For couples symmetrically committed to comparable careers, such that each member makes an optimum career decision, the outcome may be commuting, dissolution, or (rather rarely) moving in tandem. In general, however, in two-career families such moves put one partner at a disadvantage and disrupt tenuous balances of equality and complementarity, creating a situation where a given balance can only be sustained with a decision not to move. Thus the mobility attributed to the nuclear family decreases with two working adults and marriages/ relationships become increasingly contingent on place of residence.

37-5. AAAS in Public Affairs, 1848-1975

Organized by: **Albert H. Teich** *(Director, Science and Policy Programs, AAAS, Washington, DC)* and **Michele Aldrich** *(Director of Information Services, AAAS, Washington, DC)*

2:30 pm / Sun / 17 Feb **Sheraton/Kansas**

Power Through Persuasion: The AAAS and National Science Initiatives in the 19th Century
SALLY GREGORY KOHLSTEDT (University of Minnesota)

When scientists organized the AAAS in 1848 they had in mind an organization that could present and represent national scientific activity. Although the annual meetings were held in major cities around the country, much of the planning occurred in Washington where prestigious leaders like Joseph Henry and Alexander Dallas Bache held positions in government related offices. They were often shrewdly political and intent on establishing support for science within and through the federal government. The development of new professional organizations and unprecedented government expansion during and after the Civil War moderated the direct political influence of the AAAS, but it remained a central forum for discussion of key issues in national science and an agency for new initiatives.

The AAAS and the "Science and Society" Movement in 1930s America.
PETER J. KUZNICK (The American University)

Following a period of relative conservatism in the 1920s, during which scientists fortified their ties to business and philanthropic foundations, the Great Depression, in combination with other domestic and international developments, impelled scientists to reconsider their social and political responsibilities. These newly aroused scientists spawned the "science and society" movement, which directly addressed the social impact of the application of scientific discoveries. AAAS leaders helped catalyze the fledgling movement by encouraging debate among scientists and initiating a series of semiannual "Science and Society" symposia at AAAS meetings beginning in 1937. Fueled by the deteriorating international situation, the movement became increasingly politicized and, in some measure, radicalized, as growing numbers of scientists became involved in antifascist activities at home and abroad and began promoting reform of the American socioeconomic system. The movement peaked in December 1938 with the election of the nation's most prominent left-wing scientist, Harvard physiologist Walter B. Cannon, to the AAAS presidency and the formation that month of two new organizations of left and liberal scientists--the American Association of Scientific Workers and the Lincoln's Birthday Committee for Democracy and Intellectual Freedom.

AAAS and Establishment of the National Science Foundation
DAEL WOLFLE (University of Washington)

In 1945 two rival bills were introduced into Congress calling for the establishment of a National Science Foundation. Each was supported by a self-created committee of scientists. Congress held hearings in 1945 and 1946 but failed to agree on some of the controversial points and did not adopt either bill or a compromise one. Expecting legislation to be brought up again when Congress reconvened, James P. Conant and Kirtley F Mather, members of the AAAS Board of Directors, recommended that Council create an intersociety committee to represent the whole scientific community. Council approved and some 75 scientific and technical societies joined the Intersociety Committee for a National Science Foundation. For the next four years, until NSF legislation was adopted in 1950 that committee worked closely with the cognizant Congressional committees and helped resolve the differences that prevented earlier adoption of NSF legislation. Science kept the scientific community informed of the disagreements and of the progress, or lack of progress, of NSF legislation.

AAAS and the Public Understanding of Science, 1945-1975. BRUCE V. LEWENSTEIN (Cornell University).

Although the AAAS had long been active in promoting public understanding of science, it only added "public understanding" to its charter in the 1940s. And not until the Arden House conference of 1951 did the association fully commit itself to "increase public understanding and appreciation of the importance and promise of methods of science in human progress." Although leaders of the association first envisioned massive programs devoted to public understanding, internal politics and budgetary realities led to more modest activities through the 1950s. The Committee on the Public Understanding of Science drew in members from many scientific, publishing, and journalistic organizations, thus providing an effective body for coordinating disparate activities. Leaders of the AAAS quickly learned to "leverage" their efforts into influence in the mass media, book publishing, museum, and public information fields. By the 1960s, the AAAS was receiving major grants from both private and public foundations to help science writers, educators, and other professionals pursue their interests in public understanding of science. In the 1970s, the association sponsored major studies of science in newspapers and science on television. Throughout these activities, the AAAS was one of the leaders in defining the "public understanding" of science to be equivalent to the "public appreciation" of the benefits provided by science to society.

Science Magazine and Public Policy, 1900-1945.
Michael M. Sokal (Worcester Polytechnic Institute)

Although Science became the AAAS's official journal in 1900, it remained privately owned and edited by James McKeen Cattell (who took control of the journal in 1894) through 1944. Throughout his 50-year editorship, Cattell used his position to publicize his views on public issues of importance to the American scientific community and, at times, embarrassed his AAAS colleagues by his vociferous support of idiosyncratic positions. This paper reviews several of these episodes: Cattell's 1897 campaign to have a scientist appointed head of the Bureau of Fisheries; his 1902 efforts to "reform" the Smithsonian Institution and to "advise" those creating the Carnegie Institution of Washington; attempts (through the 1930s) to ignore the social relations of science movement; and his 1942 campaign limit wartime censorship of scientific periodicals. It concludes that as Science (through Cattell) lost interest in such public affairs, it became a duller journal, even as its continued publication of important research results made it required reading for most American scientists.

Technical Sessions

37T-1. Beyond Historical Impressionism: Testing Theories of Scientific Change

Organized by: **Frank J. Sulloway** *(Visiting Scholar, Program in Science, Technology, and Society, MIT, Cambridge, MA)*

2:30 pm / Mon / 18 Feb **Sheraton/Kansas**

Testing Theories of Science. DAVID L. HULL (Northwestern University).

Instead of philosophers interpreting the claims that they make about science to be a priori, they should try to make as many of them as possible as empirical as possible. Philosophers frequently justify their disdain for data by arguing that as philosophers they are interested in meaning, not truth. But one of the best ways of discovering what we mean by the terms that we use is to attempt to test claims that utilize these terms. The two extremes of testing are broad sampling and deep,

detailed historical studies. Broad sampling tends to force us to deal with relatively easy questions at a fairly superificial level. More substantive questions require detailed historical analyses. Unfortunately, such analyses take so much time that a single person can perform only a limited number of them during the course of a single career. Because each investigator has his or her own interests and techniques, the results tend not to be comparable. If case studies are to be lend themselves to answering some of the broader questions about science, those of us who study science must engage in cooperative research. Even normative claims can be tested, albeit indirectly. One way of testing a prescription is to convince scientists in a particular area that they should behave this way and see what happens. If progress in this area of science becomes even more marked, then possibly there is something to be said for this prescription. If not, not.

Scrutinizing Science: A Review of Empirical Studies of Scientific Change.
ARTHUR DONOVAN (United States Merchant Marine Academy)

Historian of science, like historians of art, music and other modes of culture, ought to play a prominent role in defining the periods and styles of the subjects they study and in explaining how they have changed over time. But since no single discipline can be itself provide an adequate general account of scientific change, this undertaking should be pursued in the multidisciplinary context of Science Studies. To help construct better grounded theories of science, historians must be willing to recast their findings in ways that make them accessible and meaningful to theorists trained in other disciplines. If they do this, then the history of science can provide powerful empirical evidence for the appraisal of specific theoretical claims concerning the dynamics of scientific change.

A report will be given of one attempt to adapt specific case studies in the history of science to the evaluation of certain current theoretical claims about scientific change. The specific claims tested are drawn primarily from theories of scientific change proposed by Kuhn, Feyerabend, Lakatos and Laudan. The results of this effort, summarized in a long introduction and supported by 16 historical case studies, are available in Arthur Donovan, Larry Laudan and Rachel Laudan, eds., Scrutinizing Science: Empirical Studies of Scientific Change (Kluwer, 1988).

Orthodoxy and Innovation in Science: A Multivariate Analysis. FRANK J. SULLOWAY (Massachusetts Institute of Technology)

Can historical models of scientific change really be subjected to scientific testing? This presentation will argue that theories of scientific change can indeed be tested in a rigorous manner, and it will present the results of several such "tests." Drawing upon a massive data base of biographical and historical information collected on more than twenty major scientific revolutions in the history of science, this paper will show that epistemological, sociological, and psychological factors all contribute in important ways to the outcome of scientific debates. With the assistance of this data base, it is also possible to determine the relative importance of such factors as age, marginality, political and religious attitudes, psychological influences such as birth order, and various epistemological criteria in the acceptance and rejection of scientific innovations.

Using large and standardized data bases accumulated with the help of the international history of science community, many other questions about conceptual change in science may now be settled in a straightforward empirical manner. Such questions include the role of anomalous evidence in the overthrow of scientific theories, how epistemological properties of a new theory influence its acceptance, and the effect that the prestige and authority of a prevailing theory has upon the likelihood of its overthrow.

The Limits of Scientific Reasoning: Implications for the Practice and Study of Science
DAVID FAUST (University of Rhode Island)

Cognitive studies demonstrate surprising limits in human judgment and reasoning. These limits are not exclusive to laypersons but rather are shared by scientists and those who study the scientific process. Based on a description of cognitive limitations and the plausible conjecture that scientific advance and processes are mainly probabilistic versus categorical phenomena, two predictions will be presented and discussed: (1) Over the next 2 to 4 decades, if undertaken, systematic, representative sampling of scientific episodes will contribute at least as much to the history and philosophy of science as any other methodological development or area of study within these disciplines, and (2) During this same period, the accelerating development of decision aids which provide help where it has been least available -- in the generation and evaluation of hypotheses and theories -- will transform, if not revolutionize, the scientific enterprise.

37T-2. Neurobiology and Narrative: The Novels and Essays of Walker Percy, M.D.

Organized by: **Edward Manier** *(Professor, Philosophy and Reilly Center for Science, Technology, and Values, Univ. of Notre Dame, Notre Dame, IN)*

8:30 am / Tue / 19 Feb **Sheraton/Kansas**

Walker Percy, Neuroscience, and Common Sense
JAMES H. SCHWARTZ (Howard Hughes Medical Institute at Columbia Univ.)

Three distinct aspects of Percy's writings and thought bear on neuroscience in particular and science in general. The first is his often repeated philosophical postulate that personal or societal values and an understanding of consciousness cannot be obtained through science, either experimental or theoretical. The second is that a different discourse (either completely new or traditional) must be used to arrive at moral reasons for living. The third is an unusual formal feature of his books, which, although they are called "novels" and "non-fiction", in fact belong to a genre that has no adequate modern name: while old comedy (like that of Aristophanes) might be appropriate, the terms allegory, morality play, parody, and burlesque have often been used. This structure has become increasingly familiar in twentieth century popular culture (where movies like Blue Velvet and The Freshman are examples). All three of these aspects reveal Percy's veiled and limited optimism: that values, the meaning of life, and the nature of the conscious self all can be known, and that morality can be implemented in human life. Twentieth century neuroscience, philosophy and history do not provide much cause for such optimism. Nevertheless, the simple notion that we must understand the facts before finding solutions to the problem is not only philosophically pragmatic, but also practical common sense.

Walker Percy's Symbol: Objects Claimed/Object Lost
LEWIS LAWSON (University of Maryland)

From 1954, in "Symbol as Need," until his death, in 1990, Walker Percy revealed in his writing that one idea transcended all others in his thinking. In his view neither idealist nor empiricist explained the symbolic function of language, the "Helen Keller phenomenon" or the "Delta Factor," as he came to call it. He thus devoted himself to essays that assert his own theory of language as symbol and to novels which subject his theory to existential field testing. Both types of discourse must then be studied, using analysis appropriate to each, before the full range of his idea can be appreciated. His essays assert that when mind occurs in the infant through the introduction of language by the caring Other, that event recapitulates the experience of the human race over an, as yet, immeasurable

period of time. His novels assert that in gaining the capacity to conceive of objects through language, mind inevitably loses its sense of communion with the original object. Thus Percy's protagonists (individually) yearn for the lost mother, even as they (racially) yearn for the lost paradise. The subject is inevitably alienated as it uses symbols as intermediaries for objects, but the subject can overcome alienation by realizing that symbols also enable it to commune with Another.

Walker Percy and 'Existential' Narrative
STEPHEN H. WATSON (University of Notre Dame)

Thomas Nagel criticized Percy for lack of acquaintance with the philosophy of language since Wittgenstein and for neurobiological naivete. Both criticisms are partially well taken. Appeals to classical accounts of the self and broader metaphysical considerations will not construct an empirically adequate account of language -- and the discursive practices which underwrote these accounts cannot be neurologically grounded. Still, it would be equally naive to think the resources to which Percy appeals (metaphorical, symbolic, etc.) were simply reducible, or that their irreducibility marked them as irrational. It would be as naive to think that empirical methods would be the only methods of rational warrant as it would be to think that other methods might simply replace them. The ancient quarrel between the humanities and the sciences, one which underwrites both Percy's arguments and the foundations of classical hermeneutics, turns out to be rigorously undecidable. Percy's naivete turns less into a search for a "new form of explanation" or even the romantic's quest for the lost origin which underwrites a good deal of the existentialist discourse upon which he relies, than the explication of conceptual resources which are neither rigorously reducible, nor rigorously groundable, nor readily surpassable.

Walker Percy's Challenge to Science
PATRICK SAMWAY, S.J. (America Magazine)

"The Fateful Rift: the San Andreas Fault in the Modern Mind," delivered as the 18th annual Jefferson Lecture in the Humanities for the National Endowment for the Humanities on May 3, 1989, served as the final attempt of Walker Percy, M.D., to call attention to his belief that the view of human nature and its place in the world we obtain from modern science is radically incoherent. The source of such incoherency lies within science itself as it is presently practiced; the solution is not to be found in something extra-scientific, like New Age religion, but within science. In this talk, Dr. Percy is doing more than raising the standard humanistic objection to science, that it is too impersonal, detached, and that it does not meet human needs by taking into account such human experiences as emotions, art, and faith. Dr. Percy's purpose is to challenge science in the name of science. My paper will discuss the approach Dr. Percy takes in challenging science not only in this talk, but in other talks such as the 1977 Hopwood Lecture at the University of Michigan entitled "The State of the Novel: Dying Art or New Science?", the 1988 T.S. Eliot Award Lecture of the Rockford Foundation in Illinois entitled "Physician as Novelist," and the essay published in 1985 entitled "Diagnosing the Modern Malaise." For validation of Dr. Percy's argument, certain sections from Love in the Ruins and The Thanatos Syndrome dealing with science and medicine will be analyzed.

37T-4. Technical Change and the State in the 20th Century: Case Studies

Organized by: Eric Schatzberg *(Postdoctoral Fellow, Center for the History of Electrical Engineering, Rutgers Univ., New Brunswick, NJ)*

8:30 am / Fri / 15 Feb **Sheraton/Vermont**

The Origins of the French Nuclear Power Program.
GABRIELLE HECHT (University of Pennsylvania).

France derives a larger portion of its electricity from nuclear power than any other nation in the world: over 75 percent. In order to understand how France came to have such a large nuclear program, this paper examines the choices that French politicians and engineers made about nuclear energy between 1945 and 1969. Decisions concerning reactor technology were guided not just by scientific knowledge and industrial constraints, but also by economic, political, and cultural concerns. The resulting nuclear program, in terms of its organization, its management, and its technology, was distinctly French.

The Indian Space Program: High Technology in a Developing Country.
RAMAN SRINIVASAN (University of Pennsylvania).

The Indian space program was designed to creatively use technological backwardness and political neutrality in the process of acquiring new technologies. It was argued that the very backwardness of India demanded the application of artificial satellites for education, meteorology, resource management and defence. The architect of the Indian space program, Vikram Sarabhai, felt that the application of advanced space technologies would enable India to "leap-frog" into the twentieth century. Thus an ambitious space effort was seen as an appropriate technology for a poor nation. In order to appropriate space technology, Sarabhai exploited India's policy of non-alignment by approaching all of the space powers and securing their cooperation. Thus satellites built in India borrow creatively from American, French, German, and Soviet designs. My paper will analyse this new Indian strategy for acquiring and assimilating a novel technology.

The U.S. Army, Strategic Materials, and the Development of All-Metal Airplanes
ERIC SCHATZBERG (Center for the History of Electrical Engineering).

This paper examines the role of the U.S. Army in the shift from wood to metal airplanes in the 1920s and early 1930s. Beginning in 1920, the Army actively promoted metal construction through its research and development programs, and through contracts for experimental metal airplanes. Governments often invoke military requirements to justify state involvement in technical change, and the Army's metal airplane program was no exception. Until the early 1930s, most Army airplanes used wood as the main structural material in wings. Officers in the Army's Air Corps feared a shortage of aircraft timber in the event of war. These officers supported the rapid development of metal aircraft as an alternative to creating a stockpile of aircraft spruce. However, these officers ignored potential problems in the supply of aircraft metals, aluminum in particular. The Army's decision to develop metal airplane was not simply a response to objective military requirements, but also reflected the strong prejudice of the engineering community against wood.

Workshop

37W-1. Science in National Life: A Videohistory Workshop

Organized by: David H. DeVorkin *(Curator of Astronomy, National Air and Space Museum, Smithsonian Institution, Washington, DC)*

8:30 am / Tue / 19 Feb **Sheraton/Colorado**

The Early Space Sciences: A Study of Laboratory Technique. DAVID H. DEVORKIN (Department of Space History, National Air and Space Museum, Smithsonian Institution).

We will discuss two broad issues: (1) how video documentation aids in the understanding of contemporary issues in the history of science and technology; and (2) how early groups in the space sciences formed and applied their talents to making instruments work on rockets. In the early years of the space sciences in the immediate post World War II era, scientists formed groups mainly in military laboratories to take advantage of captured German V-2 missiles, using the warhead space to carry instruments to study the high atmosphere and the solar spectrum. We will examine one specific group that formed to use geiger counters to study the x-ray spectrum of the sun, and to analyze it as a possible source of the maintenance and destruction of the earth's ionosphere.

Exploring the Manhattan Project: Using Video as a Technique in artifact preservation. STANLEY GOLDBERG (Unaffiliated Scholar).

Forty five years after the event there is still new primary data to be added to the historical database underpinning the histories of the Manhattan Project. In this talk we will present video footage that explores how video techniques allow for the fuller documentation and preservation of artifacts which have been heretofore unavailable for inspection.

Preserving the Scientist's Environment: Video Documentation of Laboratory Life. PAMELA M. HENSON (Smithsonian Institution Archives).

A scientist's laboratory can provide a wealth of information for the historian of science. Video-history is one method for capturing visual information about scientists, their research, their environments, and the techniques and processes used in their research. Henson will address the types of visual information which can be recorded --environments, artifacts, processes, and group interactions. She will also explain how video-history differs from traditional audiotaped interviews. Excerpts will be shown and discussed from her videotaped interviews of Smithsonian paleontologists and tropical biologists in their work environments.

Video Documentation of 20th Century Biomedical Instrumentation. RAMUNAS KONDRATAS (Medical Sciences Division, National Museum of American History, Smithsonian Institution).

This presentation will explore through video clips various ways in which video technology can be used to document important developments in the history of the biomedical sciences and technology -- especially, how it might supplement the more traditional means of infommation gathering. Examples will be taken from the fields of medical imaging, particularly the history of CT-scanning, and DNA sequencing, including the use of sequencers and robotics in the Human Genome Project. Discussion will focus on the use of video technology as a research tool, as a means of extending archival databases, and as an educational resource.

38. Science and Technology Education

38-2. Animals in the K-12 Classroom

Organized by: **Deborah C. Runkle** *(Senior Program Associate, AAAS, Washington, DC)*, **Jerod M. Loeb** *(Director, Division of Biomedical Science, American Medical Association, Chicago, IL)*, and **J. Fredrick Cornhill** *(Professor, Ohio State Univ., Columbus, OH)*

8:30 am / Mon / 18 Feb **Sheraton/Warren**

Animals or Alternatives: The Current Status
JULIANA TEXLEY (Anchor Bay Schools, New Baltimore Mi)

Recent challenges from animal rights groups have occurred at a time when science educators have been reexamining the objectives of their curricula at every level. Traditional laboratory experiences with sacrificed and preserved animals have been challenged not only for their impact on the animal species involved, but for their cognitive and affective affects on students in classrooms kindergarten through grade 12.

At the same time, teachers have analyzed their own background and ability to teach current material in the life sciences. The result has been a demand for more laboratory training in animal behavior and care, and new emphases in texts and teacher training.

A variety of professional associations have been challenged to develop policies which reflected sound curricular practices with respect to use of animals, and to defend these policies in the face of strong opposition from both animal rights groups and traditionalists in life science education. The results have proved valuable, as life science has become more scientific and more lively.

Perceptions of the Students
LINDA J. LaSCOLA, M.S.W. (LaScola Qualitative Research)

A combined qualitative and quantitative study was conducted nationwide to determine adults' and children's attitudes towards the use of animals in biomedical research. The children's study is presented here. The qualitative component (conducted 4/89), involved 6 children's focus groups (49 respondents). Spontaneous responses were elicited using open discussion of issues, posters, and video clips. Hypotheses developed were tested in a telephone survey of 400 children (Mellman & Lazarus Research, 7/89). Findings: Animal research was not an important or familiar issue to children; 46% in the survey had not heard or read about it. In the focus groups, children generally put priority on people over animals, but some children, identifying with animals as underdogs, felt using animals in research was unfair. In the survey, attitudes were inconsistent: only 26% favored using animals in research, but most favored it for finding cures (65%) or for understanding body function (57%). Many children felt that too many animals were used in research, and that some research was unnecessary and/or cruel. Children were matter-of-fact about the death of animals, including pets, and were more concerned about pain and "torture" (e.g., injections). Scientists were trusted as much as parents and family doctors. Children did not understand that the animal rights movement's objective is to eliminate use of animals in research. Suggestions: Emphasize the benefits of animal research and reinforce the concepts that the use of animals in research is regulated and that scientists are humane and caring. Because children's attitudes are not deeply held, children are likely to outgrow their hostility about the use of animals in research.

The Price of Ignorance. JEROD M. LOEB (American Medical Association)

Public science illiteracy and a lack of familiarity with the basic tenets of scientific method has permitted organizations espousing antiscience messages to prosper. This is particularly true with respect to animal activism. While animal activists have had some success arguing that research using animals is duplicative, unnecessary and cruel, they have had significant impact in convincing the public (and legislators) that animal use in the classroom is immoral, outdated and should be prohibited. This includes the dissection of dead frogs in the K-12 curriculum and the use of anesthetized animals in professional schools. Complex considerations often determine whether, and to what extent, animals are used in teaching programs. Where student interest may be high, faculty interest may not; where faculty interest and expertise may be high, student interest may not; parental, student, administrative and societal pressures have precluded the use of animals in some classrooms. While the short-term implications of this may be relatively insignificant, the long-term effects are problematic. They include a steady decline in science interest among US students and a lack of public appreciation for the mechanisms of basic scientific progress, particularly in biomedical research.

Sound scientific attitudes are fostered by focusing on activities that utilize a "hands-on" learning approach. The understanding of core scientific concepts and science process requires investigative opportunities. To do otherwise perpetuates scientific mediocrity. This is the price of ignorance.

Science Research-Science Fair-Vertebrate Animals
DR. WILLIAM R.M. RITTER (Upper Dublin School District, Fort Washington, PA 19034

Science research at the pre-college level is a challenging alternative for gifted students and students with inquiry behavior. Science Fairs and Science Research should not be considered the same activity. Science research, regardless of who is doing the research, or the age of the individual, has a specific series of activities that are all subject to verification. Science Fairs are competitive events that take place after the research is complete. The Fair process itself is an opportunity to communicate a student's research efforts similar to a scientific conference or paper presentation. Vertebrate animals in most cases are not necessary for pre-college research. However, the opportunity to use vertebrates when required should be strongly defended and upheld. The ISEF Science Teacher Association, Biology Teachers Association and other groups have developed procedures and rules for vertebrate research. This approach assures both legal and humane procedures for vertebrate research. The advisers of student research have the responsibility to guide young scientists in the proper choice of research topics, research models, and adherence to all regulations that are intended to preserve the right to use vertebrates as research subjects.

Teaching the Teachers.
MARGARET D. SNYDER (The Ohio State University)

An educational process is necessary in enlightening teachers regarding the many aspects of the use of animals in the classroom and student research. The Ohio State University and the Ohio Academy of Science entered into a partnership in 1988-89 and 1989-90 to present regional workshops on the "Humane Care and Use of Animals in the Classroom." The program goal was: To offer a program of instruction for teacher K-12 that will impart understanding and knowledge of societal and leagal concerns on issues of animal use, the principles of animal biology, and the principles of humane care and effective use of live vertebrates as well as the responsibilities incumbent on the teacher in caring for and using these animals in instruction and student research. The program was very successful and achieved its goal.

38-3. Science for the Nonscience Major

Organized by: Cesare Emiliani *(Professor of Marine Geology, Univ. of Miami, Coral Gables, FL)*

2:30 pm / Sun / 17 Feb — Sheraton/Holmes

Two Cheers for the Higher (and Lower) Vulgarization of Science. DEREK A. DAVENPORT (Purdue University).

Michael Faraday and Karl Marx are among the eminent Victorians buried in London's Highgate Cemetery. Marx's headstone bears the exhortation:

The Philosophers Have Only Interpreted
The World in Various Ways
The Point However Is To Change It

Faraday's stone carries no message for posterity. As we approach the 21st century it is not hard to predict that the legacy of the natural philosopher will outlast that of the political one. Science, perhaps alone, is asymtotically for the ages. Even so liberal arts innocents are being sent naked into that brave new world. They and, more culpably, their mentors are not listening to the hissing of the scientific serpents. We must learn to hiss more seductively or else slither off into cultural irrelevancy. When, where and how do we start? The K-8 years, when minds are open and senses yet unsated, are beginning to be imaginatively addressed. Chemistry in the Community and related efforts are tackling the next stage. As far as the college level is concerned we should abandon watered down freshman/sophomore level run-throughs and save our efforts for a junior/senior seminar where we can meet with the maturing liberal arts majors on more equal, if differently biased, terms. In short we should sponsor a separately informed but mutually informing bull-session.

Just About Life
WILLIAM F. LOOMIS (University of California San Diego, La Jolla, CA)

Every year brings new insights into the biological processes that function in cells and organisms. The excitement of participating in this intellectual voyage of discovery can be brought to non-science majors as easily as to biology majors. Many non-science majors actively avoid exact quantitative analyses as the result of unpleasant experiences earlier in their education. These can be overcome by addressing the universal interest in reproduction, health and evolution in a manner that gradually introduces molecules, genes, and selection processes. I will argue that biology for non-majors should focus on the attributes specific to life that include catalysis and integration and that the physical and chemical details are not essential at the start for a good understanding. A person who understands enzymology, embryology and evolution is better able to make societal decisions and will lead a fuller life than those who shrug off such long words as being beyond them and of no significance to their professional goals. The challenge for college biology teachers is to go beyond the text books and bring the adventure to the students. The dry names of structures and species take on new life and biology will be a course of choice for non-majors. If successful, non-science majors will want to understand the physical and chemical basis of life and go on to more exacting courses.

Quantum Physics for Poets. LEON M. LEDERMAN (University of Chicago).

One need not belabor the importance of science literacy in the United States. Increasingly, our population is ignorant of science and, increasingly, life-and-death issues have science-technology sides. Our decision-makers and those who control what is seen, heard, and read, all of whom are college graduates, are increasingly ignorant and uncomfortable with science. Quantum Physics is part of a 3-quarters course at the University of Chicago, one of two such sequences required of nonscience majors. In my view this is only a start for a

four-year requirement in science, science-history, science-culture, science-economics, which will produce graduates, at the least, comfortable with science issues. Since quantum mechanics was one of the greatest intellectual revolutions of the 20th century and since it is at once a major basis of our economic well-being and a profound philosophical arena, it is ideal as a vehicle for involvement of liberal art students. The talk will deal with mathematics and how to reduce eye-glaze, with the dichotomy of labs, problem sets, exams, prerequisites, etc., in contrast to the Einstein-Podolsky-Rosen criticism of the Copenhagen viewpoint.

Cosmology: The Science of the Universe.
EDWARD HARRISON (University of Massachusetts and Five College Astronomy Department).

Cosmology attracts and fascinates us all. In one sense, it is the science of the large-scale structure of the universe: the cosmic expansion; the background radiation; and the origin, evolution, and fate of the universe and its planetary, stellar, and galactic systems. In another sense, ancient and modern, it is the grand science that seeks to assemble all accepted knowledge into a rational scheme. Most sciences tear things apart into smaller and smaller constituents, seeking to examine the world in progressively greater detail. Cosmology is the only science devoted to assembling all the pieces into a "mighty frame." In yet another and broader sense, cosmology is the study of many universes; the study not only of the contemporary physical universe but also of the universes of other societies in different periods of history. Wherever we find a society of human beings, we find there a universe that unifies the knowledge and beliefs of that society. From cosmology we learn the nature of the scientific method and we see how science has shaped our view of the world. Finally, the study of cosmology cautions us against the arrogance of all human beliefs and we become agnostic; the belief-systems of our ancestors concerning the nature of the universe have proved wrong with the advance of knowledge, might therefore our present beliefs also be in error and inadequate in the eyes of our descendents?

Planet at Risk. CESARE EMILIANI (University of Miami).

The next generation will be burdened with the awesome task of stabilizing Planet Earth. A basic understanding of this extraordinarily complex system is therefore essential for all students, including the nonscience majors who will provide the legislators and the managers. Such understanding is best achieved by starting at cosmological time t = 0 and developing a model that traces the evolution of the entire natural system. The model is conveniently presented in a sequence of four courses. The first course (*Physics/Chemistry*) should provide the foundation for the other three courses, emphasizing the structure of matter and energy, the principles of quantum mechanics and relativity, and chemical and molecular bondings and interactions. The second course (*Cosmology*) should trace element formation and evolution and the evolution of the universe from the Big Bang to 4.5 billion years ago when the solar system formed. The third course (*Geology*) should discuss the formation of the earth, its subsequernt geophysical and geochemical evolution, and its workings. The fourth course (*Evolution of Life and Environment*) should study the origin of life on Earth and should closely examine the parallel evolution of life and environment. In a more modest program, Physics/Chemistry, Cosmology, and Geology could be grouped into a single course while the Evolution of Life and Environment would form a second course. In either case, the courses should be accompanied by a development of the pertinent math and by laboratory and field experiences as appropriate.

Science for College Students. It's Up to Us.
DAVID S. SAXON (Mass. Institute of Technology)

That an educated citizenry critically needs to understand enough of science and technology to be able to distinguish sense from nonsense is manifest. Such understanding ought to begin in the schools, but we can't hold our breath waiting for that to happen and the pipeline is long. At the college level the ability to make a difference is in our own hands, in the hands of the faculty in physics, math, chemistry, engineering, etc. I offer the radical suggestion that each of us assume, as a new and fundamental professional obligation, responsibility for presenting our subjects to the general student. I urge that each of us do so at least every other year even if it means an increase in our teaching loads. I urge our professional societies to endorse this new obligation and to vigorously further its acceptance. In meeting this obligation, each of us could, and in my judgement should, take an individualistic approach, an approach centered, that is, on our own individual interests, views and values. I intend such efforts to be an addition to, and not a replacement for, the highly structured, departmentally defined courses that science and engineering departments traditionally offer and that they do so well.

Technical Sessions

38T-1. Advocacy Journalism: Reporting on Sustainable Development

Organized by: **James Cornell** *(President, International Science Writers Association, and Smithsonian Institution Astrophysical Observatory, Cambridge, MA)* and **Tensie Whelan** *(Vice President for Conservation Information, National Audubon Society, New York, NY)*

2:30 pm / Mon / 18 Feb **Sheraton/Woodley**

The Role of the Reporter in Environmental Issues. JAMES DETJEN (The Philadelphia Inquirer).

A new surge in reporting about the environment and sustainable development occurred in the United States in the late 1980s and early 1990s, reflecting growing interest in these topics among the nation's public. By early 1990, journalists had even established a new national organization, known as the Society of Environmental Journalists. Most journalists with major print newspapers and broadcast media, radio stations, and television stations still believe in "objective" rather than "advocacy" reporting. While they generally support efforts to improve the environment, they believe it is vital to report opposing viewpoints on environmental controversies. Most oppose any reporting that presents only one side of an issue, or openly advocates a course of action. Nevertheless, environmental journalists play an important role in investigating pollution and other environmental controversies, in educating the public and in helping to set the agenda for governmental officials. A minority of United States journalists--principally in smaller, alternative newspapers and magazines--openly endorse advocacy journalism.

Environmental Issues in the Caribbean Basin. JOY RUDDER (Caribbean Week).

Environmental consciousness in the Caribbean is still generally restricted to small specialist groups of hobby naturalists or professional organizations. However, at a meeting of the Caribbean Community (CARICOM) in June 1989, environmental awareness and education were set as priorities for regional concern and action. Media professionals are urgently needed to further the cause of public education in environmental matters. Unfortunately, environmental reporting is still in a nascent stage in the Caribbean. Journalists need access to pertinent information since scientists or government officials are often inaccessible, suspicious, or even antagonistic to reporters. At the same time, reporters have been guilty of superficiality, sensationalism, and a failure to understand the interrelated issues surrounding each environmental topic. Some commendable efforts have been made, however. 1990 was the first year in which official training in environmental reporting was available through the help of the Caribbean Institute

of Mass Communications, the Caribbean Conservation Association, and the Panos Institute. Also, the Caribbean Broadcasting Union and the Caribbean News Agency have increased sustained coverage of environmental issues, as have several privately owned print and broadcast media. While Caribbean people need urgently to be sensitized on environmental matters, and goaded to take pro-environmental action, the journalists who share the task of shaping this consciousness must teach themselves to see in new ways.

Hazardous Waste Dumping in Africa. BUNMI MAKINWA (Pan African News Agency).

Environmental journalism has not yet become a clearly-defined beat in African media. However, environmental reporting got committed attention between 1987 and 1989 when it was "whispered" that African countries had become cheap dumping sites for rejected hazardous wastes from Europe and North America. Some of the reporters, especially in Nigeria, found the wastes in their backyards, as it were, and, for a short period, there was an unprecedented media-government cooperation to get to the root of the matter. As journalists kept up the vigil to prevent additional dumping and to advocate removal of whatever wastes were already in some countries, the African governments, aided by environmental groups in Europe, passed tough laws and set up environmental monitoring bodies. The spill-over effects are still being seen in the attention being paid to the environment by the media and governments of many African countries.

Conservation and Development in Costa Rica. YANINA ROVINSKI (International Union for Conservation of Nature and Natural Resources).

Costa Rica is a land of contradictions. While its conservation record is often praised and its National Parks are known, its deforestation rates are dismal, its capital reeks of exhaust fumes, and its rivers are polluted with agro-chemicals. The national press also reflects these contradictions. Claiming to be objective, free from political pressures, and highly professional, the Costa Rican press still lives in a world of one-source journalism; and generalist reporters are spread thin, writing about science, health, culture, economics, and politics all at the same time. Within this context, environmental reporting stands out for the growing interest it has attracted. The number of articles and broadcasting time devoted to environmental issues has increased immeasurably recently. Yet, for most media, environmental issues garner more space than depth of reporting. Rarely are sources questioned. Causes for environmental crisis are often ignored. Emphasis is on disasters rather than policies. Investigative reporting, with rare exceptions, is unknown. While this romantic advocacy of conservation has clearly helped shape public opinion and create a positive attitude towards environmentalists, the lack of serious reporting underlines media ignorance of deeper social problems. Ironically, the press may advocate conservation, but it still has a long way to go before it either understands--or reports on--"sustainable development."

Temples or Tombs: Industry versus Environment. DARRYL D'MONTE (Resident Editor, The Times of India, Bombay).

The dilemma posed by the choice between preserving the environment and promoting development is all the more acute in poor countries. The tendency has been to view development as an overriding imperative. Three cases in India illustrate the problem. These are the Silent Valley hydroelectric project in Kerala, which was scrapped on environmental grounds; the threat to the Taj Mahal from an oil refinery 40 km away; and a massive fertilizer plant near Bombay. All three projects concerned the provision of energy, directly or indirectly; and each raised an environmental controversy. The media has a vital role to play in all such conflicts: first, by informing people about threats to the environment, and second, by helping in the resolution of the conflict. However, journalists must always be aware that playing the role of activists can blur these roles. Ideally, reporters must play the role of informants rather than activists, and remain even-handed in all such controversies.

Eastern European Perspectives on Sustainable Development. HELENE KNORRE (Moscow Science Writers Association).

When I began working as a science writer nearly 25 years ago, it was a somewhat political choice. In those years of diktat and arbitrary rule, science writing was a sphere in which one could be really honest and write frankly about what one considered important and useful to people. Like many of my colleagues in those severe days, I tried to make people realize that we share a common home--our earth--and common interests that cannot be divided. In those years, also, interest in science was great enough so that our profession was considered prestigious, even elitist. The situation has now changed drastically. Science writing has lost its prestige and become a third-rate, even risky, profession. People are concerned about the economic problems, crisis phenomena, and critical ecological situation in the country, but stories about science, either its achievements or recommendations, cause irritation and enmity. Science, and scientists, are blamed for all troubles and disasters, all catastrophes and failures. Since Chernobyl, it has become popular to revile technical progress. Indeed, it may even be dangerous to offer scientific solutions, for your good name can be defamed and you can be charged with almost anything. Our country now has a lot of shortages, but the main shortage is knowledge and education.

Environmental Journalism: Profession or Mission? MANUEL SATORRE (President, Philippine Environmental Journalists)

Asian journalists, especially members of the Asian Forum of Environmental Journalists (AFEJ), have opted for activism in the reportage of the environment in their respective countries. Although this violates Western notions of so-called objectivity, it is a choice that had been taken by journalists in many countries because of the serious environmental degradation that is now affecting economic growth. In the Philippines, for instance, satellite images show only 19 percent of the original forest cover is left. Thus, every Filipino environmental journalist has taken stand of all-out protection and is urging the complete stop in logging and exports. Because they feel activism is necessary to protect the environment and to sustain economic growth, many journalists have forged ties with Non-Government Organizations (NGOs) in the hope that together they may stop environmental degradation not only of the region's forests and wetlands, including the oceans and seas, but also urban areas. Most Asian journalists feel they are fighting against time, and unless action is taken, the region may lose all its natural resources.

38T-2. Minority Mathematics and Science: Successful Programs at Community Colleges

Organized by: **Estrella M. Triana** *(Senior Program Associate, Directorate for Education and Human Resources Programs, AAAS, Washington, DC)* and **Eugenio Barrios** *(Acting Dean of Academic Affairs, Hostos Community College, Bronx, NY)*

2:30 pm / Sat / 16 Feb **Sheraton/Woodley**

The Minority Honors Training and Industrial Assistance Program
Isiah O. Sewell (U.S. Department of Energy)

The Office of Minority Economic Impact, U.S. Department of Energy has established a nationwide program in energy-related technologies at two-year colleges. Each of the programs provides student financial assistance, general and specialized counselling to include role models where appropriate, individual and group tutoring. The program also requires that linkages be established with industry, federal and private laboratories to provide enhanced job placement, advice on curriculum and in some cases actual

class instruction. More recently, emphasis has been placed on assisting and encouraging program graduates to continue their education by transferring to four-year institutions. Eight institutions are currently participating in the program. More than 600 students have graduated, with approximately two-thirds having been placed directly into full time jobs. Approximately 100 have continued their education to include degrees at the baccalaureate level and beyond. The presentation covers the history of the program, outlines features that make the program effective and presents statistical records for the institutions and students in the program.

Minority Honors Program at Greenville Technical College. Judith H. Williams (Greenville Technical College, Greenville, South Carolina).

To insure retention which will directly indicate success of the program, emphasis is placed on frequent interview sessions. This correlation establishes a mentorship relationship between student and counselor. Issues addressed pinpoint all student related situations i.e. class scheduling, conflicts with instructors, progress, educational and career goals, and employment outlook. The minority students are praised and encouraged. It is of little consequence to offer a financial award without personal monoriting.

Increasing Career Access Opportunities for Hispanics in Science and Technology.
HENRY ESTRADA (Evergreen Valley College, San Jose CA).

Hispanics have been underrepresented in higher education, particularly in science and technology. In California, most Hispanics use the community college system as a cost-effective entry into higher education. The ENLACE (pronounced en-LAH-say) program was developed at Evergreen Valley College to enroll and retain at-risk Hispanic students and to increase the number of Hispanic students who transfer to four-year colleges and universities. ENLACE employs a nontraditional instructional/counseling/mentoring model that has been highly successful. The program received the national Noel/Levitz Excellence in Student Retention Award in 1989. The National Science Foundation awarded a grant to the program in August, 1990. The project supported by this grant will select students who show potential and strong interest in mathematics, but lack prerequisite math skills, and, employing the ENLACE methodology, successfully prepare them for courses in calculus, science and engineering. Participating students will complete accelerated math courses from beginning algebra through precalculus mathematics in two semesters.

38T-3. Satellite Delivery of Education: From Elementary School to the Working World

Organized by: **Patricia S. Curlin** *(Project Director, Public Understanding of Science and Technology, AAAS, Washington, DC)* and **Peter Lykos** *(Professor of Chemistry, Illinois Institute of Technology, Chicago, IL, and Science Consultant, National Technological Univ., Fort Collins, CO)*

2:30 pm / Mon / 18 Feb **Omni/Embassy**

Satellite Delivered Education to the High School: The North Carolina Experience. LINDA K. DE GRAND (North Carolina Department of Public Instruction)

Using as illustration experiences based upon the three million dollar implementation of North Carolina's statewide Distance Learning by Satellite network, this presentation will consider issues involved in such an undertaking at the state level:

- planning, including the role of educational equity
- funding mechanisms (state and federal resources; local requirements for project participation)
- establishment of educational policies (certification)
- training, particularly for the classroom facilitator
- on-going operations -- challenges and solutions
- evaluation
- future directions, including network interconnection and program areas.

Potential Barriers to Satellite Delivered Distance Education. SMITH L. HOLT (Oklahoma State University at Stillwater)

There are many barriers to the effective and successful utilization of television for the delivery of Distance Learning. Among these are both on-campus and off-campus attitudinal barriers, fiscal barriers, as well as some important quality issues. On-campus attitudinal barriers include: the historic placement of educational outreach programs in divisions of continuing education, and lack of an appropriate reward system for faculty who participate. Off-campus attitudinal barriers center on turf issues. Colleges and universities do not want other institutions invading their service areas. State departments of education express concern over direct instruction of high school students by college faculty, particularly if they are uncertified. Fiscal barriers involve: the market, the venture capital for course development, the day-to-day costs of program delivery, marketing the courses, deciding who pays for the courses and how much, the break-even point of receipts vs. expenditures, and whether there should be a "profit?" The quality issues include format of the courses, the use of computer-generated graphics, amount of pre-production effort needed and available. To insure a successful Distance Learning effort, all these issues must be addressed and difficulties resolved prior to any on-air time.

Extra-Terrestrial Education: Not Science Fiction at All. C. LOUIS NEVINS (California State University at Chico), CHARLES F. URBANOWICZ (California State University at Chico).

Sputnik I was the forerunner of numerous satellites orbiting the earth, providing individuals not only with scientific data, but also with various commercial applications from satellites at various altitudes. Communications satellites, weather satellites, space stations, and trips to the moon all resulted from the successful launch of mankind's first artificial satellite, Echo, which was also a communications satellite. Sputnik I's impact and the space race brought on massively increased government involvement in research and development -- not just in military, but even in civilian technology. Government influence was felt in education (particularly science education) and other areas. However, there has been little real utilization of post-Sputnik satellites by educational institutions, with the exception of the National Technological University (NTU) Consortium, the independent work of California State University, and a few other single institutions. This session will address distance education in a general sense and then focus in on the successes of a terrestrial educational delivery system in Northern California (ITFS) and an extra-terrestrial system (C-Band and Ku-Band satellite-delivered) educational program.

The National Technological University in the Service of the Engineering Community. PETER LYKOS (National Technological University)

By 1976 the number of engineering schools using video to share their regular courses for credit with neighboring high tech industries had grown to the point where the Association of Media-based Continuing Education for Engineers (AMCEE) was formed by them for the purpose of sharing experiences and to share their courses beyond their respective local audiences via video cassettes. Lionel Baldwin, then Dean of Engineering at Colorado State University, played a leadership role in the formation and growth of AMCEE. A natural outgrowth of AMCEE was for the participating engineering schools to be retrofitted with satellite uplinks so they could share their courses, live and audio interactively, with remotely sited students located at sites in the "foot print" of a satellite signal. Accordingly, the National Technological University (NTU) was formed in January of 1984 with Lionel Baldwin as President. Today some 30 engineering schools are supplying courses to engineers at over 300 receiving sites. During the 89-90 academic year NTU delivered over 11,000 broadcast hours of credit courses and 1,700 hours of non-credit courses. The North Central Association of Colleges and Schools has accredited NTU to offer masters degrees and almost 1,000

students have been admitted to those programs. Given the robust and highly successful NTU program for engineers, a natural extension to consider is how a similar service might be provided to the scientific community.

ACS Satellite TV Seminars: Continuing Education in Chemistry. CYRELLE K. GERSON (American Chemical Society)

Satellite television communications give us the opportunity to distribute live, technical seminars to a large and widely dispersed audience. Scientific associations can reach more individuals with state-of-the-science information delivered directly by the experts than ever before. The audience can easily expand beyond members of the association to include professionals in other disciplines as well as students. And television can convey the speakers' personalities in a way that gives the audience the feeling of getting to know the speakers personally. The major challenge to successfully conducting satellite TV seminars is to identify significant technical subjects that have large audiences, who also possess the downlink technology to receive the programs.

Workshop

38W-2. Progress in Public Understanding of Science

Organized by: **Sheila Grinell** *(Consultant for Science Exhibits and Museums, Teaneck, NJ)* and **Pat Curlin** *(Project Director, Public Understanding of Science and Technology, AAAS, Washington, DC)*

8:30 am / Sun / 17 Feb — **Sheraton/Woodley**

2:30 pm / Sun / 17 Feb — **Sheraton/Woodley**

Setting a Gold Standard for Evaluating Public Health Social Marketing Campaigns. JANINE JASON (The National AIDS Information and Education Program [NAIEP], Centers for Disease Control [CDC], Atlanta, GA 30333)

The NAIEP was established at CDC in 1987 to assure a comprehensive, consistent Federal media-based effort to inform the public about HIV/AIDS, to support beliefs, attitudes, and social norms consistent with low risk behaviors, and to promote positive attitudes toward HIV-infected people through coordinated social marketing activities centered around the national "America Responds to AIDS" (ARTA) campaign. In 1989, CDC commissioned the National Academy of Sciences (NAS)'s recommendations for evaluation of its AIDS prevention programs. The NAS published "Evaluating AIDS Prevention Programs," which recommends that the ARTA campaign evaluations be "formative" - occurring prior to and during production, "efficacy" - using nearly completed materials and done in experimental or quasi-experimental settings, "process" - whether materials reach the targeted audiences, and "effectiveness" - whether the campaign has its intended effect. With the latest phase of ARTA, NAIEP piloted quantitative and qualitative formative, efficacy, process, and effectiveness evaluations which constitute an innovative and pragmatic response to NAS's academic recommendations. In this presentation, I review the results of these pilot evaluations, share the lessons they provide, discuss how they will be extended, and consider their applicability to other local and national public health campaigns.

Not knowing, needing to know, and wanting to know. JOHN ZIMAN (Science Policy Support Group, London).

According to the "deficiency" model, nobody understands much science. According to the "rational choice" model, everybody needs to understand a great deal more. The hard questions for action and evaluation come from the "context" model: what do particular people want to know in their particular circumstances? They often understand their own business better than the scientific experts. They reject bad news about unavoidable risks. They suspect the motives of knowledgeable institutions. They construct their own meanings from the diverse representations in the media, and combine science, ethical views and life experience to arrive at personal positions on controversial issues. Theory and practice on PUOS should not underrate the incoherence, practical inadequacy, incredibility and inconsistency of formal scientific knowledge as received and used by the public.

The Effects of SQUARE ONE TV upon Children's Problem-Solving Behavior. EVE R. HALL (Children's Television Workshop), EDWARD T. ESTY (Children's Television Workshop), SHALOM M. FISCH (Children's Television Workshop).

Children's Television Workshop has conducted a study of the effects of programs from the first two seasons of a television series about mathematics, entitled SQUARE ONE TV, aimed at 8- to 12-year-old children. One of the goals of the series is to encourage the use and application of problem-solving processes. The study was organized in a pre/post experimental/control design, with a treatment consisting of watching 30 half-hour programs of SQUARE ONE TV. Subjects (N=48) were individually interviewed and videotaped using a set of nonroutine mathematical problems, and their performance was measured by two scores: one involving the number and variety of problem-solving actions and heuristics used, and the other the mathematical completeness and sophistication of their solutions. Gains from pretest to posttest in both scores were significant for the experimental group, and significantly greater for the experimental group than the control group, indicating that persistent viewing of SQUARE ONE TV can increase problem-solving performance in its target audience.

39. Science and Technology Curricula

39-4. Fulfilling the Promise: Biology Education in the Nation's Schools

Organized by: **Donna M. Gerardi** *(Commission on Life Science, National Research Council, Washington, DC)*

8:30 am / Sat / 16 Feb — **Sheraton/Wilmington**

Fulfilling the Promise: Biology Education in the Nation's Schools TIMOTHY H. GOLDSMITH (Yale University), JANE BUTLER KAHLE (Miami University, Ohio).

The National Research Council's Committee on High-School Biology Education recently completed a study on biology education at the K-12 level entitled Fulfulling the Promise: Biology Education in the Nation's Schools. Supported by the Howard Hughes Medical Institute, the study was conducted by a committee of biologists, teachers, and science educators. Among issues considered by the Committee were the continuum of science education from grades K-12; leadership in science education; textbooks; laboratories; tests and testing; teacher preparation and inservice; the role of the scientific community in K-12 science education, and the recruitment of students into careers in science. Dr. Goldsmith, chairman of the committee, and other committee members will describe the major conclusions and recommendations of the study. Other panel members from the state and federal level will offer comments on how the scientific and education communities can best follow through on the recommendations of the report.

39-5. Mathematics and Mathematics Education: Beyond Reports

Organized by: **Ronald G. Douglas** *(Vice Provost for Undergraduate Studies, State Univ. of New York, Stony Brook, NY)*, **James A. Voytuk** *(Senior Staff Officer, National Research Council, Washington, DC)*, and **Lawrence H. Cox** *(Director, Board on Mathematical Sciences, National Research Council, Washington, DC)*

8:30 am & 2:30 pm / Fri / 15 Feb **Sheraton/Wilmington**

Leading Curriculum Reform in Mathematics: Changes in Practice and Content
IRIS M. CARL (Houston Independent School District)

Students are capable of learning more mathematics than we require of them. The lack of fit between what students are taught and what they need to learn limits opportunities to fulfill their potential. The mathematics community has reached consensus on new goals for a quality mathematical education for all students. The guidelines of the National Council of Teachers of Mathematics as envisioned in the Curriculum and Evaluation Standards for School Mathematics lead national efforts toward development of needed change. This presentation will describe new emphases, new techniques, and new approaches as possible actions to implement curriculum reform.

Minority Successes in Mathematics
ASA G. HILLIARD III (Georgia State University)

Far too many students from minority cultural groups, especially African, Hispanic, and Indian, have failed to reach their potential in mathematics. Educators seem to be perplexed. Many speculative solutions have been offered. However, there are powerful lessons to be learned about this problem from educators who are successful, routinely, with this very student population. Staff development and school structures must be designed to fit what we know about school success with minority cultural groups.

Mathematics Matters for All Students
JACKIE B. GOLDBERG (Los Angeles Unified School District)

Problem-solving is a skill everyone uses. It is more than a skill that only college bound students need. Problem-solving is not beyond the capacity of any individual in our public schools. When mathematics instruction has as its goals the expansion of the mind of the student, and the expansion of the number, type, and sophistication of the strategies the student can employ in solving problems, more students will be successful. The sweeping changes in mathematics instruction will accomplish much more than just increasing the number of Ph.D. candidates at the university level. It will empower all young people with tools that will increase their ability to overcome obstacles that currently impede their attainment of personal goals. Parents, students, business people and even school board members will embrace these new approaches to mathematics instruction with great enthusiasm as they learn more about them.

Revitalizing Undergraduate Mathematics
WILLIAM E. KIRWAN (University of Maryland, College Park)

The strength of U.S. science and technology is largely responsible for the nation's prosperity and its prominence as a world leader. However, there is mounting evidence to suggest that the health of the U.S. science and technology enterprise is threatened. At the core of the problem are deficiencies at all levels in mathematics education. In response to this situation, the National Research Council appointed the Committee on the Mathematical Sciences in the Year 2000 (MS 2000) to study the fundamental problems in mathematics education at the collegiate level and to propose corrective actions. The committee has formulated a plan that addresses many issues, including: the training of a mathematically literate workforce, the participation of women and minorities in scientific careers, and the philosophy of undergraduate education. An overview of this plan will be given and the role of the mathematics community, the colleges and universities, and the federal agencies in carrying out this plan will be outlined.

Opening the Pipeline via Innovative Programs
PHILLIP URI TREISMAN (Swarthmore College)

Freshman mathematics courses have been burial grounds for the aspirations of too many students who enter college with an interest in pursuing a mathematics-dependent profession. At many large institutions, failure rates in calculus and precalculus hover around 50 percent; failure rates of minority students are even higher. Few students who enroll in remedial courses as freshmen ever go on to successfully complete even one year of calculus.
In the last three years, several dozen college and university mathematics departments have begun developing adaptations of a program created at the University of California at Berkeley, which has dramatically increased the number of ethnic minority students excelling in calculus and continuing on to major in mathematics or one of the sciences. These programs share in common a rejection of traditional remedial approaches to aiding minority students, i.e., individual and group tutoring, as well as orientation, time management, and study skills courses. They provide instead a rich community life based on students' shared intellectual and professional interests, strengthened courses, and connection to departmental and disciplinary life. Several of these programs and their results will be discussed.

The Changing Role of the Professor
JOHN TOLL (Universities Research Association, University of Maryland)

The professor's basic responsibility remains the extension of human understanding through teaching and research. But both our disciplines and the context in which faculty work are continually changing. The demands of research require universities to be flexible in teaching arrangements. The ferment for reform of undergraduate education, the growth of interdisciplinary programs, and the improvements in educational technology have broadened the opportunities for new approaches to teaching. The Socratic approach, long favored in some institutions and some subjects, is becoming increasingly common. The growing emphasis on "accountability" has both positive and negative aspects; properly used, it reinforces good teaching, yet it also may encourage inflexability. The professor should aim to get the students to develop their own learning skills and powers of analysis, and to excite them so that they continue to explore ideas on their own. New curricula in mathematics and sciences are being developed with this goal, for the general student as well as the science major.

Moving Forward with the Recommendations of "Renewing U.S. Mathematics: A Plan for the 1990s"
PHILLIP A. GRIFFITHS (Duke University)

The 1984 National Research Council report "Renewing U.S. Mathematics: Critical Resource for the Future" documented serious problems in research support in the mathematical sciences. Because of mathematics' importance for all of science education, the NRC Board on Mathematical Sciences issued a second report last spring--updating the first report but going beyond it, into the attracting and training of Ph.D.'s. This new report found improved funding and continuing research advances. However, severe problems remain, especially in support for principal investigators and in attracting new talent, particularly women and minorities. An overview will be given of this report and the actions being taken to implement its recommendations. A key component is establishing a partnership between the mathematical sciences community, colleges and universities, and the federal agencies that support the field.

A Reaction and Response from the Community
MICHAEL ARTIN (Massachusetts Institute of Technology)

The 1990 National Research Council report "Renewing U.S. Mathematics: A Plan for the 1990s" has identified some critical issues, in particular the need for additional

funding to support graduate education and research in the mathematical sciences, and to address the problem of attracting people to careers in mathematics. In this report, the recommended actions are directed at the mathematics community, as well as to federal agencies and university administrations. Is this appropriate and necessary? Will the recommended actions solve the basic problems? What can individual faculty members and their departments do to implement the recommendations? Can the mathematics community be of assistance in developing an action plan? Are the goals of the report attainable? These are just some of the questions on the minds of the community and the answers will shape their plan of action.

The View from Washington
ERICH BLOCH (former director, National Science Foundation)

There is much talk in academia, industry and the Government about the state of the country's education and human resources, especially as it relates to the sciences, engineering and technology endeavors of the Nation. There is no discipline that touches both the education process and the development process of our technical workforce from beginning to end like mathematics. To its credit, the mathematical sciences community has performed a comprehensive study of the status of its research and education enterprise. The breadth of this examination of a discipline's sphere of activity is unprecedented, ranging from elementary education through cutting-edge research. The first steps have been taken in charting a path for the future intended to renew student interest in the mathematical sciences and propel the research endeavor to even greater heights.
How to position the entire community to develop a coherent program in the context of an evolving academic and educational environment that encompasses all of science and engineering, in light of the environment the mathematics community and their colleagues will face is the subject of this talk.

39-6. NSF-supported Innovations in Undergraduate Education

Organized by: **Robert F. Watson** *(Director, Division of Undergraduate Science, Engineering, Mathematics Education, National Science Foundation, Washington, DC)*

2:30 pm / Mon / 18 Feb **Sheraton/Rockville**

Calculus&Mathematica. H. PORTA and J.J. UHL (University of Illinois at Urbana-Champaign).

Calculus&Mathematica is a new calculus course that places calculus on a firm calculational base as the introduction to measurements -- both exact and approximate.
The method of delivery is *Mathematica* Notebooks which are used not only to solve problems at the end but also to help set up the theory at the beginning. The basic principle of *Calculus&Mathematica* is that calculations and plots set up ideas that set up further calculations and plots that set up further ideas.... In this sense, the course is in harmony with Richard Hamming's aphorism: "Computing is for insight, not numbers."
The goal of *Calculus&Mathematica* is to produce students who are experienced enough with calculation to have the right calculus reaction to a given situation. For this reason, pathology and formality are absent, but the spirit of good mathematics permeates the course.
This presentation will look at some actual student work and will try to give the flavor of the individual lessons. Finally it will give some speculations about the role of *Calculus&Mathematica* in calculus reform.

Teaching A Mass-Market Dinosaur Course. KEVIN PADIAN (University of California, Berkeley).

For ten years we have run a lower-division lecture course on 'The Age of the Dinosaurs,' incorporating for 500 to 750+ majors and non-majors a wide range of exposure to current topics in earth science, paleontology, evolutionary biology, and the methods and philosophy of science. This well received course is complemented by other courses in The Age of Mammals, The History of Life, Evolution and Extinction, and The Oceans. With NSF's help, we offered *gratis* at the 1989 Geological Society of America Annual Meeting a 'Short Course on the Age of Dinosaurs' sponsored by the Society for Vertebrate Paleontology, the Paleontological Society, and the National Association of Geology Teachers. A dozen experts on the Age of Dinosaurs spoke with an audience of 500 college and high school teachers, museum curators, publishers, authors, and artists in a day-long course. A book of 'Short Course Notes' (still in print) treated not only the up-to-date scientific information, but also offered suggestions on how to organize, teach, and administer such a course. These courses are useful to introduce students to other topics and courses in earth and life science departments, and to motivate them to learn more and even major in these fields.

An Integrated, First Year Curriculum in Science, Engineering, and Mathematics: One Year's Experience. JERRY FINE, JEFFREY FROYD, MICHAEL MOLONEY, EDWARD MOTTEL, BRIAN WINKEL (Rose-Hulman Institute of Technology).

Rose-Hulman Institute of Technology is offering an integrated, first year curriculum in science, engineering, and mathematics to sixty students in the 1990-91 academic year. Students in the curriculum are studying traditional topics in calculus, chemistry, physics, computer science, engineering graphics, and engineering design in a three course, 12-credits-per-quarter, sequence. Two ideas form the foundation for the new curriculum. First, students learn more effectively and more efficiently when concepts from different disciplines are related to one another. Second, emphasis must be shifted from rote symbolic and numeric manipulation to conceptualization, visualization, problem formulation, and solution interpretation. From these two ideas an integrated curriculum emerges which emphasizes multi-disciplinary concepts and problem-solving. Topics in the new curriculum have been reorganized into three categories: 1) basic building blocks, 2) thematic concepts, and 3) problem solving strategies.

From Feasibility to a Focus on Laser Physics. JOHN R. BRANDENBERGER (Lawrence University)

The Instrumentation and Faculty Enhancement programs of the National Science Foundation have played pivotal roles in a recent investigation into the teaching of laser physics in undergraduate institutions. Lawrence University has conducted a three-year feasibility study and pilot program with the expectation that it would have impact beyond Lawrence. The project addressed questions regarding equipment, the suitability of various experiments, the appropriateness of laser and light courses, space requirements, and the level of faculty expertise needed to offer meaningful instruction in laser physics. With NSF support, supplemented by grants from corporations and private foundations, the Department of Physics equipped an extensive teaching laboratory with researchgrade laser equipment that supports undergraduate instruction and research. The value of pilot programs of this sort, both to the host institution and to other colleges and universities, will be discussed. In particular, we

look at how these NSF programs and the feasibility study impacted physics at Lawrence, leaving it with a collection of first-rate laser laboratories that give the Department a special identity, unique focus, and increased capacity to attract strong science students.

Comprehensive Regional Access Centers for Minorities. JAMES M. ROSSER (California State University, Los Angeles)

The NSF ACCESS program addresses both the underrepresentation of minorities and the country's growing need for trained scientists and engineers. This requires attention to the entire educational pipeline. Currently 12 full and 6 prospective centers are supported. Centers have a regional leadership role involving a systemic network of universities, schools, community and professional organizations, and the corporate sector. Besides direct support of students and teachers, ACCESS centers coordinate and enhance the many individual programs already in place in the region. Each ACCESS center has a national committee to advise it and to inform NSF of its progress. Programs and approaches vary among the centers. As one example, The Southern California ACCESS Center has six parallel pipelines, each coordinated by a California State University campus and strengthened across pipelines by similar programs at each level. All centers must monitor the continuing progress of each student via a computer tracking system. Each full ACCESS center receives a five year commitment from NSF, but such funds are only seed money: ACCESS centers must receive support from a wide spectrum of sources throughout its region.

39-7. Science and Mathematics Curriculum Reform: How Do They Relate?

Organized by: **Robert L. Russell** *(Program Director, Informal Science Education Program, National Science Foundation, Washington, DC)*

8:30 am / Mon / 18 Feb **Sheraton/Rockville**

Science Curriculum Reform as Related to Mathematics
F. James Rutherford (American Association for the Advancement of Science)

Major curriculum reforms in science and mathematics education (K-12) have been in progress throughout the 1980's and are continuing. These reforms have suggested major departures from past practices. The relationship of science curriculum to mathematics will be discussed. The major philosophical foundations, approaches, and content of major reform efforts of science will be compared and contrasted with those in mathematics. The relationship of science instruction to mathematics instruction at different levels will also be discussed.

Mathematics Curriculum Reform as Related to Science
JOHN A. DOSSEY (Illinois State University)

Major curriculum in science and mathematics mathematics education (K-12) have been in progress throughout the 1980's and are continuing. These reforms have suggested major departures from past practices. The relationship of mathematics curriculum to science will be discussed. The major philosophical foundations, approaches, and content of major reform efforts of mathematics will be compared and contrasted with those in science. The relationship of mathematics instruction to science instruction at different levels will also be discussed.

39-8. The Progress and Impact of Project 2061

Organized by: **F. James Rutherford** *(Chief Education Officer and Director, Project 2061, AAAS, Washington, DC)*

2:30 pm / Mon / 18 Feb **Sheraton/Wilmington**

The Response to Science For All Americans
F. JAMES RUTHERFORD (AAAS)

A description of how Science for All Americans was received by scientists and educators and of the use being made of it. Plans for reaching the general public will be announced.

The Impact of Project 2061 in California.
THOMAS SACHSE (California Department of Education)

Even before the publication of Science for All Americans, California was looking to Project 2061 for direction as the new California Science Framework was under development. Jim Rutherford and other AAAS staff met with the framework committee and the primary authors to shape the framework in the image of Project 2061. As Phase 2 began, it became essential for California to participate in the shaping of curriculum models. Now, science educators and others in California are anxious to use the work of phases one and two to expand the Project 2061 efforts into a strategic plan for the long-term implementation that lies ahead.

This presentation will retrace the events that have shaped the science education reform in California with specific reference to Project 2061 and its impact on systemic change. In addition, it will forecast the next round of changes in making Science for All Americans a reality for California students.

The Design of Phase II of Project 2061
F. JAMES RUTHERFORD (AAAS)

The purposes, organization, and current status of the second phase of the project will be described.

The Process of Creating the Curriculum of the Future
CLARA TOLBERT (Pennsylvania School District)

Teachers are key to school reform. Although creative ideas for reforming education come from many sources, only teachers can provide the insights that emerge from intensive, direct experience in the classroom itself. They bring to the task of reform a knowledge of students, craft, and school culture that others cannot.

Working with Teachers in Phase II
STEVEN KORNGUTH (University of Wisconsin)

This presentation will describe the experiences and perceptions of a scientist at the University of Wisconsin who served as consultant to the six development teams at a summer institute and with one of the teams throughout the year with regard to their thinking about what is involved in understanding biological ideas and, more generally, understanding science as an enterprise. The presentation will consider mechanisms by which the scientific and technical community may participate in and assist school districts in developing and evaluating novel curricula.

Technical Session

39T-1. Calculus Reform: Some Examples

Organized by: Thomas W. Tucker *(Professor, Dept. of Mathematics, Colage Univ., Hamilton, NY)*

8:30 am / Sat / 16 Feb **Sheraton/Woodley**

Calculus in Context--The Five College Project
JAMES CALLAHAN (Smith College)

Calculus in Context is a fundamental restructuring of the three-semester calculus sequence, in which the major mathematical concepts grow out of substantial problems from the sciences. Computers are used to explore ideas and to answer questions that would otherwise be inaccessible. For example, systems of differential equations are introduced at the outset, because they are frequently met in scientific work, and because a beginning student can understand how to solve them numerically. Furthermore, since solutions are only approximate, and errors are reduced by successive approximation, students see limit processes introduced in a compelling way. The course is intended for all students of calculus, and its ultimate aim is to make them able to use calculus as a language and as a tool in their own work. This talk summarizes the principles that have guided the formation of the new curriculum, and it describes how those principles have been implemented in practice. Special attention is given to the opening weeks of the first course, Calculus I.

Student Research Projects in the Calculus Curriculum. MARCUS S. COHEN, EDWARD D. GAUGHAN, ARTHUR KNOEBEL, DOUGLAS S. KURTZ & DAVID J. PENGELLEY (New Mexico State University)

Our program of instruction centers around the use of student research projects, the aim being to have students discover the excitement, intrigue, and beauty of mathematics, as well as becoming independent learners. A "project" is a meaningful and substantial problem, harder, more open-ended, and more involved than the usual homework exercises found in textbooks. Projects may be used to enhance learning of material that students find difficult. Projects may also be used to cover important material that is not included in the course. To ease the demand on faculty time, we have designed a student-help laboratory where students go to seek assistance on the projects. Writing is also an important part of the process of completing the projects; students are expected to turn in a well written report explaining their solution. In the course of a semester, students will work both individually and in groups. We believe that students who are using projects are learning both critical thinking and scientific writing, using calculus as their laboratory.

Calculus as a Laboratory Course.
DAVID A. SMITH (Duke University), LAWRENCE C. MOORE (Duke University).

Project CALC is an NSF-funded joint project of Duke University and the North Carolina School of Science and Mathematics; the acronym is spelled out in our title. The thrust of the project is to redesign the calculus curriculum in the style of a laboratory science, with the computer functioning as the principal item of laboratory equipment. Two-student teams discover the principles and concepts of calculus by doing experiments in prepared learning environments. These discoveries in turn drive the content of classroom sessions, which also require active student involvement, teamwork, and interaction between students and instructor. Laboratory and classroom projects are based on real-world applications, for which the computer enables the processing and analysis of real data. Both types of projects require written reports; a technical word processor facilitates both writing and revision of mathematical exposition.

Calculus&*Mathematica* H. PORTA and J.J. UHL,(University of Illinois)

Calculus&*Mathematica* is a new calculus course that places calculus on a firm calculational base as the introduction to measurements-both exact and approximate.
The method of delivery is *Mathematica* Notebooks which are used not only to solve problems at the end but also to help set up the theory at the beginning. The basic principle of Calculus&*Mathematica* is that calculations and plots set up ideas that set up further calculations and plots that set up further ideas..... In this sense, the course is in harmony with Richard Hamming's position that computing is for insight, not numbers.

The goal of Calculus&*Mathematica* is to produce students who are experienced enough with calculation to have the right calculus reaction to a given situation. For this reason, pathology and formality are absent, but the spirit of good mathematics permeates the course.

This presentation will look at some actual student work and will try to give the flavor of the individual lessons. Finally it will give some speculations about the role of Calculus&*Mathematica* in calculus reform.

IV. Contributed Papers

101-139 American Junior Academy of Science

(Sat., 16 Feb., 9:45-11:45 am)

101
UTILIZING 5-FU FOR MAXIMIZING TNT-1 MAb UPTAKE IN HT-29 MULTICELLULAR TUMOR SPHEROIDS. LAWRENCE WANG, Alan L. Epstein, Feng-Ming Chen, Department of Pathology, University of Southern California, School of Medicine, Los Angeles, California 90033

TNT-1* (IgG2a) monoclonal antibody (MAb), with specificity to nuclear histones, has been shown to be effective in treating and imaging different types of cancer tumors in nude mouse models. This approach is based upon the evidence that many malignant tumors contain a substantial number of degenerating or necrotic cells, allowing the entry and binding of TNT-1 to nuclear antigens. Multicellular tumor spheorids represent a tumor model with an intermediate level of complexity between cells growing as monolayers in vitro and solid tumors in experimental animals. These tumor spheroids have been shown to be a convenient model for TNT therapy of micrometastases. Based upon the hypothesis that increasing cell death in tumors may increase TNT-1 uptake, we studied the use of the chemotherapeutic drug, 5-Fluorouracil as sequential therapy to increase TNT-1 uptake in multicellular tumor spheroids. Human tumor spheroids of HT-29 colon adenocarcinoma were incubated in various concentrations of 5-FU for 24 hours: 10 mg/ml, 5 mg/ml, 2.5 mg/ml, 1.25 mg/ml, and 0 mg/ml. The last group served as control. After each group was incubated at its respective drug concentration for 24 hours at 37°C 95% air: 5% CO_2 mixture, spheroids in each group were briefly washed with 1 ml of media and re-incubated for 24 hours in 1 ml of complete media containing 10 uci/ml of ^{125}I labeled TNT-1 F(ab')2. Upon completion of 24 hr incubation in the radioactive medium, individual spheroids were briefly washed in 10 ml of media, and counted in a gamma counter. Uptake studies revealed some increase in uptake of TNT-1 F(ab')2 by spheroids treated with 5-FU compared to control. H&E stains of 5-FU treated spheroids showed increased necrotic areas in the outer periphery region of the spheroid compared to untreated spheroids. Autoradiography studies are still pending and should confirm increased uptake of TNT-1 in the outer viable region of the spheroid. These data encourage us to expand our study of sequential chemotherapy with TNT-1 radioimmunotherapy to pre-clinical animal trials.

*TNT=Tumor Necrosis Treatment

102 The role of Calcium and Other Agents in Melanophore Cells. MICHAEL SHEN (Cherry Creek High School, Englewood, Colorado)

Melanocytes are pigment cells found in amphibians. The objective of these experiments was to study the effect of calcium, and other agents that might change calcium levels, on the dispersal of pigment in melanophore cells. The two types of animals used in this research were Rana catesbeiana and Ambystoma tigrinum. It was found that calcium is very crucial if pigment expansion is to occur. EGTA binds up extracellular calcium which deprives the melanophore cell of calcium. This in turn causes the pigment to contract and/or keeps the pigment from expanding. This lack of calcium administered to the melanophore cells causes no damage to it. Other inhibitors of pigment expansion are still being researched, but the data obtained has been equivocal due to the design of the experiments and treatments being used.

103 The Effects of Selenium on the Growth of Bacteria and Its Incorporation into the Amino Acids of Rhizobium leguminosarum. JONATHAN ALDEN DYER Central High School

Selenium's importance as a micronutrient for humans and animals has become well known in recent years. The possibility that selenium could be beneficial to an organism if it were administered at levels below toxicity and above those that are normally present was the purpose of this experiment. Four bacteria were grown in selenium containing media and their growth was measured. After comparison to controls and concentration adjustment three of the four strains grew better. Phase II: Bacteria grown in selenium containing media should utilize the selenium in their growth environment and incorporate it into their amino acids. Although this has been noted for E. coli, work on nitrogen fixing bacteria has not been found. Rhizobium leguminosarum was used in this research. The bacteria were grown in selenium containing media, centrifuged out, their protein extracted and hydrolyzed, and the amino acids chromatographed using high performance liquid chromatography. The experimental chromatographs were compared to those of a control selenoamino acid. Due to the coelution of the selenoamino acid with another amino acid, alternative solvent systems were investigated. A lithium column system has been used by other researchers and was incorporated into the HPLC system used in this research. Due to the amount of time required to carry this out the selenoamino acid had broken down before chromatography was completed.

104 Effect of Ultrasound and Electrical Current on Competence of E. coli Cells. SARAH CHO (Notre Dame Academy).

Bacterial transformation is the uptake of a fragment of DNA, which replaces or adds a particular nucleotide sequence to a recipient's genome. The occurrence of transformation in nature is exceedingly rare. Heat shock is the usual method of inducing transformation in bacterial cells. However, this technique favors small molecules of DNA and the efficiency rate is a low 0.01%. The present experiment investigates ultrasound and electricity as alternative methods for producing bacterial transformation. Frequencies from 60 to 80 kHz were found to produce competence in E. coli cells with 80 kHz producing the highest rate of transformation. Alternating pulses of 50 and 100 V DC for durations of 5 s every 10 s for specified time spans resulted in transformation. However, a time span as large as 360 s seemed to be lethal. Pulses of 50 V of electricity alone produced a significant number of transformants with the 90 s time span producing greater number of transformants than that of the alternating 50 and 100 V. Pulses of 100 V were incapable of inducing competence.

105 Comparison of Two Transformation Procedures Using Purified, Unpurified, and Recombinant Plamids JENNIFER STEVENS (Yorktown High School, Arlington, Virginia)

The objective of this project was to compare two transformation procedures, the transformation and storage solution (TSS) procedure and the calcium chloride ($CaCl_2$) procedure, using purified, unpurified, and recombinant plasmids. The hypothesis was that the TSS procedure would yield a higher transformation efficiency. Competent cells for transformation were prepared from E. coli strains HB101 and DH5α using each of the procedures, which were then transformed using purified pUC19 plasmid or unpurified pUC19 isolated from JM109 bacteria. The transformation efficiency for each procedure was calculated. Because the transformation efficiency of the TSS-prepared cells was consistantly low, only $CaCl_2$ treated DH5α cells were transformed with the recombinant plasmid prepared from pUC19 and pPBBP-D plasmids. DH5α cells were used because they produce B-galactosidase in conjuction with the pUC19 plasmid. The average transformation efficiency for both the purified and unpurified plasmids was up to ten times lower for the TSS procedure than the $CaCl_2$ procedure, so it was concluded that the $CaCl_2$ procedure yields a higher transformation efficiency than the TSS procedure.

106 An Observation of the Differences Between the Inhibition Efficacy of Liposome-Encapsulated and Non-Encapsulated Tetracycline on the Growth of Escherichia coli. STAN LU. Bridgewater-Raritan High School West.

The main objective of this study is to determine if a liposomal preparation of tetracycline is feasible and effective as a bacterial growth inhibitor. The manufacture of the liposome was performed by the dry-film method. Briefly, the tetracycline was incorporated in the organic phase and the manufacture was done at a temperature above the trasition temperature of the phospholipid (NIKKOL Lecinol S-10EX). The E. coli was cultured in nutrient broth and the bacterial counts were done from cultured plates of agar. The independent parameters are tetracycline concentration, phos-

pholipid concentration, and pH of the medium. The data were analyzed by the X-STAT statistical software on a personal computer. It was observed that the narrow range of pH had little effect on growth inhibition, even though a pH of 7 seemed like the optimum on the linear graph. On the three-parameter contour plot, however, the tetracyline and liposome concentrations had the greatest effects. The antibiotic activity of the tetracycline base was significantly improved by, as expected, the increase in tetracycline concentration,and the liposome encapsulation. It was concluded that liposome-encapsulated tetracycline is more efficacious than non-encapsulated tetracyline.

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Cloning, Expression, and Transport Studies of Proteins From the Wild Type and Mutant F- Sendai Virus ,
Anna Kim, Alhambra High School, California State University at Los Angeles

The localization of certain glycoproteins in the envelopes of such viruses as Sendai virus, at the onset of viral budding, seems to indicate some relationship between these proteins and the budding viruses' peculiar polarity, that is, their respective buddings from the apical and basolateral domains. In the Sendai virus, these glycoproteins are the F and M genes, which we are attempting to clone at present. Preliminary procedural experimentation has been done, and has basically entailed a PCR run and an interesting experiment on CaCl2. The CaCl2 test seems to indicate that transformation is more efficient at 75 mM with 30 seconds of heat shock, or at 50 mM with 180 seconds of heat shock instead of at the accepted norm of 50mM at 120 seconds of heat shock.

108 Genetic Engineering of Lactic Acid Bacteria
Purbita Ray (Laramie, WY)

The objectives of this project were to study the plasmid encoded traits in Pediococcus acidilactici and to investigate the use of electroporation as an effective technique to introduce plasmids in Pediococcus acidilactici and Lactococcus lactis strains. To determine the plasmid encoded traits in P. acidilactici F curing studies were conducted with the parental strain. Variants were isolated, and phenotypic and genotypic (plasmid profiles) studies were conducted. In P. acidilactici F a 11 Md plasmid encodes for bacteriocin production and a 41 Md plasmid encodes for sucrose hydrolysis. To determine the effectiveness of electroporation to introduce plasmids in Pediococcus and in Lactococcus strains the lac-plasmid from L. lactis Prl and the suc-plasmid from P. acidilactici (Bac$^-$ Suc$^+$ variant) were isolated and purified by Cesium chloride-Ethidium bromide density gradient centrifugation. The purified plasmids were used to introduce into Lac$^-$ Lactococcus lactis 2301 and Suc$^-$ P. acidilactici F$^{-/-}$ by electroporation. The lac-plasmid was introduced into L. lactis 2301 and the suc-plasmid was introduced into P. acidilactici F$^{-/-}$ as demonstrated by phenotypic and genotypic analysis of the electrotransformants. However, no Lac$^+$ P. acidilactici and Suc$^+$ L. lactis electrotransformants were isolated. Membrane filter conjugation between selected strains also did not produce any Lac$^+$ P. acidilactici or Suc$^+$ L. lactis. The electrotransformation method to introduce lac-plasmid in P. acidilactici and suc-plasmid in L. lactis is currently being studied.

109 Structural Organization and Expression of Tyrosine Kinase Proto-Oncogenes in Hydra. TIMOTHY CHAN, University High, Irvine, CA 92720.

This project explores oncogenes, genes that have the potential to be transformed into a cancerous state. The first oncogene discovered, called src, has now been identified in similar, conserved forms throughout the evolutionary chain. It has been shown that the simple metazoan Hydra contains a src-type-kinase, called STK, which is related to the src oncogene of vertebrates. Moreover, Hydra contains a family of tyrosine kinase proto-oncogenes which includes STK. Hydra is the simplest organism in the evolutionary chain in which this gene family has been identified. The src gene and its relatives have vital but currently unknown roles, and their functions are of considerable interest because of the genes' capacity to be converted into oncogenic forms. This project investigates the structural organization of the STK proto-oncogene, notably the intron/exon structure, in Hydra, via Southern DNA blot hybridizations and direct dideoxy sequencing. Secondly, by using these data to help determine conserved regions in the tyrosine kinase family, it identifies novel members of the family in Hydra and explores the expression of these genes. This analysis centers on a Northern RNA hybridization and a digoxygenin in situ hybridization. Hydra DNA library screening and sequencing off deletions are used to characterize the full messages of the genes. This may aid our understanding of src-type genes' roles.

110 The Effects of Varying the Amount of Indole-3-Acetic Acid, in a Basic Plant Tissue Culture, on Boston Fern (Nephrolepis exaltate bostoniensis).
EREZ LIEBERMANN (Ocean Township High School, Oakhurst, New Jersey)

This study examines the effect of varying the hormone amounts in plant tissue culture on the callus growth using Boston Fern cutlets. It was hypothesized that if the hormone was increased in a plant tissue culture medium then the amount of callus growth would increase. The research involved making a basic "home made" agar-solidified plant tissue culture medium and changing the amounts of indole-3-acetic acid (IAA) in the medium. A sterile transfer environment was maintained with a transfer cabinet and an ultraviolet light. For growth purposes artificial lighting was used to insure that the cutlets received the desired amount of light. The callus growth was affected by changing the amount of growth hormones (auxins). Results indicated that increased amount of IAA in the medium promoted callus growth.

111 Polyhydroxybutyrate: A Polymer Produced and Degraded by Bacteria YUEH Z. LEE Shawnee Mission South H.S.

The methods currently used to make plastic packaging biodegradable are not effective at reducing the degradation time. Polyhydroxybutyrate (PHB) is a polymer that is produced by bacteria to store energy. Since PHB is produced intracellularly, it needs to be extracted. Many patents describe this process, but most seem to have a problem preventing the complete extraction of PHB. The goal of this project was to find an extraction process to extract as much PHB as possible from inside the cell walls of the bacteria.

The bacteria was grown in a nitrogen-free medium, so that it would produce PHB. Various ideas from patents and other sources were combined to make different extraction procedures. Each procedure was tested, and the amount of PHB extracted by each procedure was compared, to determine the one that was the most effective at extracting PHB.

This research will hopefully help reduce the solid waste problem that the United States has. Possible applications include diapers, trash bags, or other situations where recycling is not feasible.

112 Does Presoaking and/or Hyperthermia Cause Stimulation in Bean Seed Germination and Growth? DAVID STOFFEL (Bettendorf High School, Bettendorf, IA).

This research was an attempt to determine if hyperthermia and/or presoaking were stimulatory to bean germination and growth. In one experiment, bean seeds were soaked in water for set periods of time (0,4,8,12,16, 20,24,28,32,36 hours), placed in petri dishes (on filter paper), and observed for radical emergence in five days. In a second experiment, the same soaking schedule was followed but the seeds were planted in potting soil and germination rate, height and yield were observed. Another set of experiments involved (experiment 3) dry heating seeds to 100

or 120 F for 20, 40 or 60 minutes; soaking the seeds for 20, 40 or 60 minutes at room temperature or treating them with Captan; and then planting them in soil. Germination rate, height and yield were observed. A fourth experiment involved heating seeds to 100 or 120 F and soaking for 20, 40 or 60 minutes and then planting, to serve as controls.

The results for the first experiment showed that all groups except the 4 and 16 hour seeds had faster radical emergence than the controls. For experiment 2, the controls had larger numbers of germinating seeds but germinated at a slower rate. The plant height of the controls was greater than that of the experimentals at the end of 17 days. In the heating and soaking experiments, soaking for 40 or 60 minutes at 100 F or for 20 minutes at 120 F stimulated germination rate and increased average plant height.

It was concluded that presoaking is only useful if early emergence is important and 4 hours soaking time is sufficient. Soaking and heating were effective in stimulating germination and growth if 60 minutes and 100 F were used.

113 The Effects of Decreased Watering on Plant Growth, Production, and Nutrition. DAN WOODARD (Kenton High School) Kenton OH.

In a greenhouse, 4 rows each of carrots, sweet corn, lima beans, and green beans were grown, each receiving 0.3, 0.5, 0.7, or 0.9 inch of simulated rainfall weekly. It was thought that plant growth and yield would decrease significantly between 0.3 and 0.5 inch, as would plant uptake of nutrients. Although this drop off point was not found, plants did produce less when less water was applied. Corn watered the most produced twice as much as corn watered the least, carrots 1.24 times, lima beans 1.66 times, and green beans, 1.14 times respectively. Plant analysis showed only calcium, magnesium, and iron levels reacted as expected, with amounts being directly proportional to the amount of water supplied. Copper and zinc levels were invariant. Nitrogen, potassium, and magnesium levels were erratic. Phosphorus and boron levels were unexpectedly higher with reduced watering. Since the drop off point had not yet been found, 10 rows of kohlrabi were planted and watered at 0, 0.05, 0.1, 0.2, 0.3, 0.5, 1, and 2 inch increments. The greatest drop off was discovered between 0 and 0.05 inch according to average plant tissue weights. Kohlrabi leaf analysis showed consistently high macronutrient levels between 0.1 and 1 inch. Nitrogen levels were highest in plants receiving no water, yet since these plants were stunted, levels could be lower if plants were of normal size. If plants receiving no water were omitted from the study, the row watered 0.3 inch had plants containing the highest nitrogen levels.

114 The Effects of Different Culture Media on the Growth of a Lichen Synthesized from Separate Alga and Fungus Symbionts. AMY M. ELFNER (Hayes High School) Delaware, OH.

A lichen is a symbiotic partnership between an alga and a fungus. According to Lynn Margulis (1988) there are some 25,000 different species of lichens based on the fungal partners. Usually the individual species of algae and fungi are morphologically and physiologically different when growing as a symbiotic partnership than when they grow as separate species. When lichens develop, certain chemicals such as acids and pigments are produced. Lichen acids, many of which have been identified, affect the substrate such as soil, rocks or tree bark. As a photosynthetic organism the algal partner produces sugars which may be used by the fungus. The objective of this project is to determine which culture media will produce the best growth of a lichen species. Growth trials were conducted using the commercially available alga Trebouxia ericia and fungi isolated from the lichen species Cladonia cristatella collected in Delaware County, Ohio. The hypothesis was that when the alga and fungus are combined they would grow together as symbionts most effectively on agar with no aiding nutrients. Analysis was conducted using a compound light microscope with results recorded by color and black and white photographs. Results from initial growth trials show that the fungal hyphae were closer together to the algal cells on pure agar than on nutrient aided agar.

115 Rhododendron Propagation Part III. JOHN L. HARRINGTON (Menchville High School, Newport News, Virginia)

The purpose of this project was to determine the effects of indole-3-acetic acid, indole-3 butyric acid, naphthalene acetic acid, and RooTone rooting hormones on the propagation of the R. Euchaites, R. Catawbiense Album, and R. Roseum Elegans rhododendron varieties. A four-factor factorial design procedure was used to determine the main effects and the two-factor interaction effects of the four rooting hormones upon the three rhododendron varieties. The effects on each variety, as well as the average for all varieties were determined. On July 22, 1989, after a soaking rain, 80 cuttings were taken from each of the three varieties. Hardened new growth was taken that had no bloom buds. All but two leaves were removed and the remaining leaves were trimmed. The rooting bed was watered once every week. The condition of the cuttings was observed every week, and the number of living cuttings of each variety in each data set was recorded. By September 23, 1989 very few additional cuttings were dying, and the experiment was concluded on October 14, 1989. The survival rates for the R. Euchaites, R. Catabiense Album, and R. Roseum Elegans varieties were 90.0%, 86.3%, and 78.8% respectively. The main effects of indole-3-acetic acid, indole-3-butyric acid, naphthalene acetic acid, and RooTone were -18.3%, -13.3%, +11.7%, and -10% respectively. No two-factor interaction effect was of significance. The beneficial effect of naphthalene acetic acid was highly significant.

116 Parenchymal Cell Proliferation Activity in Adult Male Mouse Submandibular Gland. YAOFAY LIN (Rowland Heights High School, Rowland Heights, CA); P. C. Denny, Yang Chai (School of Dentistry, University of Southern California, Los Angeles, CA)

There is active turnover of secretory cells in adult mouse submandibular gland (SMG). Two proposed mechanisms for parenchymal cell proliferation in adult salivary gland are stem or progenitor cell-mediated proliferation, and self-proliferation. To understand the mechanism of cell-proliferation in SMG, cells synthesizing DNA have been studied within secretory complex. Eight male mice were given a single pulse injection of ^{3}H-thymidine. Following a thymidine chase, they were sacrificed at 90 min, 24h, 48h, 1wk, 2wk, 3wk, 4wk, and 6wk. For 90 min, 24h, and 48h samples, the labeling indices (LI) were obtained by randomly selecting 60 sections, which contain about 10,000 cells, from each sample group. Side by side labeled nuclei were counted as one labeled site. The LI revealed that striated granular duct cells (SGD) consistently had its LI of approximately 3 times higher than any other cell type. Within the time period ID had the next highest LI, followed by AC with GD being lowest. In conclusion, self-proliferation is at least a part of the mechanism of gland maintenance. High LI of SGD might be the indication of SGD being intermediates between stem ID and GD.
Supported by NIH DE-04960.

117 Cholesterol in Children. NISHA KUTTOTHARA (Loudonville Jr. High School) Loudonville, OH.

Twenty students were studied by a seventh grader for total cholesterol, high density, low density lipoproteins, triglycerides as well as dietary habits and physical activities. The group was divided into ten Amish and ten non-Amish children of equal gender. The results revealed that the non-Amish children had more total cholesterol level as well as low density lipoproteins. The Amish children not only had more high density lipoproteins but also amazingly low triglyceride levels. The author attributes the difference in the findings to a difference in dietary habits and lifestyles of the two groups. The results suggest the need for further and larger studies to explain this dramatic difference seen in this very first study comparing the Amish and non-Amish children.

118 Does Psychological Stress affect the Antibody Level for the Epstein-Barr Virus? JENNIE EVENSON (Linden-McKinley High School) Columbus OH.

The purpose of this project is to determine if psychological stress can reactivate the Epstein-Barr virus from a

remission period. This can be determined by measuring the amount of antibody in the subject's blood, because the more antibody there is in the blood, the more antigen (produced by the virus) there must be in the body. The more virus antigen there is in the body, the more likely it is that the subject is going through a reactivation period. The experiment used seventeen medical students who were proven to have the Epstein-Barr virus antibodies. Blood was drawn four weeks prior to final exams, during final exams, and four weeks after the final exams. This was done to demonstrate the onset of psychological stress. The blood was then tested with the Enzyme Linked Immunosorbent Assay. This assay uses the Epstein-Barr virus antigens, which bond with the antibodies in the subject's blood which are specifically made for that virus. The results showed that the overall antibody level increased minimally during the exams, and four weeks after the exams.

119 Role of Endothelium in Nitroglycerin Induced Desensitization to Nitrovasodilators. JOANN BECK (Hamilton High School) Hamilton, OH.

Nitroglycerin is used to treat a variety of cardiovascular pathophysiologies including angina pectoris. The purpose of this study was to investigate the role of the endothelium in nitroglycerin-induced desensitization to the relaxant effects of nitroglycerin and other vasodilators in blood vessels using porcine coronary artery rings. Nitroglycerin induced desensitization to nitroglycerin to the same magnitude in tissues with or without endothelium. In contrast, prior exposure to nitroglycerin was essentially without effect on relaxations to sodium nitroprusside. Tissues were also desensitized to substance P, although to a smaller magnitude than to nitroglycerin. In contrast, calcium ionophore A23187 appears not be affected. These results demonstrate that 1) nitroglycerin-induced desensitization does not occur to all agents which elevate cyclic GMP levels in the smooth muscle; 2) the relaxant effects due to agents which act through receptors located on the endothelium are also desensitized and 3) the desensitization of the endothelium-dependent vasodilators may be due to an action on the endothelium, since the calcium ionophore-induced relaxations were unaffected. The mechanism of nitroglycerin-induced desensitization of the endothelium-dependent vasodilators remains to be investigated.

120 Do Some Common Foods Have Mutagenic Effects on Three Different Strains of Salmonella typhimurium? MARILYN KOCH (San Antonio, TX)

The purpose of this research project was to determine if some common foods had mutagenic effects on three different strains of Salmonella typhimurium, indicator baceteria used for measuring mutagenicity. Seven foods were evaluated by preparing test samples in water and dimethyl sulfoxide(DMSO) and incubating these samples with each of the three strains(TA97a, TA98, and TA100) prior to plating on minimal glucose agar. The seven samples were fajita seasoning, chili mix, chili powder, masa A(Quaker), masaB(Mexican), pico de gallo, and cooked fajita drippings. Of all seven samples, one provided dramatic evidence for possessing mutagenic activity, and that sample was the cooked fajita drippings. These drippings resulted in increased levels of bacterial reversion in the Ames' Salmonella Mutagenicity Test at 3.1 to 5.7 times greater than background, far exceeding the acceptable values that indicate mutagenesis.

121 A One-Year Study of the Coliform Bacteria Population of Green River in Casey County. DONNA HOLDER (Casey County High School).

In this investigation, water at two sites on Green River in Casey County, one above and one below Liberty, was sampled using Millipore Samplers and EMB agar plates. Sampling was done once each month for one year. An analysis of the data showed that there was a significant difference in the number of coliform colonies obtained above Liberty and the number obtained below on both the Millipore Samplers and the EMB agar plates. More colonies appeared on the samples taken from the site located above Liberty. Runoff appears to be the main source of these bacteria. The number of colonies was then compared to pH of the water, temperature of the water, average daytime high and nighttime low temperatures, approximate amounts of rainfall, chloride content, dissolved oxygen content, and volume and velocity of flow. No direct relationships were found; however, the following factors seem to be affected by or to directly affect the number of colonies: chloride content, dissolved oxygen content, temperature, and amount of rainfall. The bacteria seem to be entering the river above Liberty, but their affect on the chemistry of the water is not noticeable until the water reaches Rubarts-Ford, the site below Liberty. This was supported by data obtained from testing that was done on eleven sites along Green River. Financial support for this investigation was provided by Casey County High School and the Kentucky Junior Academy of Science.

122 More Damage, More Satisfaction? Nicotine Concentration in Relation to Oral Mucosal Damage. ALAN ADAMS (Regis High School, Cedar Rapids, IA).

It is estimated that 12 million Americans use smokeless tobacco (ST) - chewing tobacco and snuff. One of the results of this habit is a change in the lining of the mouth where the tobacco is placed, a white patch, or leukoplakia develops; 6% of oral leukoplakias develop into oral cancer. Smokeless tobacco is known to contain higher levels (2-8%) of nicotine than cigarette tobacco. My hypothesis is that nicotine may act directly on the surface of the mouth lining so as to damage it and cause the development of leukoplakia. Eighteen biopsies of porcine-attached gingiva and buccal mucosa were trimmed, nicotine (2 and 6%) in phosphate buffered saline (PBS) was placed within a gasket cemented to the epithelial surface, and tissues were incubated at 37 degrees Celsius for two hours to simulate body conditions. Controls were incubated with PBS. Tissues were processed for examination in a light microscope. Damage was estimated by measuring the area of the intercellular spaces at two epithelial levels using a Bioquant computerized image analysis system. Results were expressed as a percentage of total area showing damage. Treatment with nicotine caused more damage in both tissues as compared to controls. The extent of this damage tended to be greater with 6% than with 2% nicotine. These results support the hypothesis and also indicate that higher concentrations of nicotine may cause more damage. As this may lead to leukoplakia and ultimately oral cancer, it would be desirable to develop tobacco with less nicotine that would still provide satisfaction for the user.

123 Analysis of Gap Junction-Mediated Communication Using Freeze-Fracturing Technique. KURT HONG, DR. JEAN PAUL REVEL, California Institute of Technology, CA 91106

The basic structural unit of gap junctions is the connexon. Connexons in one cell membrane associate with similar structures in the membranes of a neighboring cell to form an aqueous path between the cytoplasms, thus coupling them both electrically and metabolically. Connexons are hexameric, formed by the association of six protein molecules that form a central pore. Gap junction - mediated communication are known to be vital in many cellular and physiological funtions, which include distribution of nutrients during embryogenesis and electrical synapses between neurons. Intercellular movement of molecules via gap junctions has been shown to exist in vivo in almost all cells with nearly no exception. With cells in vitro, however, there are instances where inter- cellular communication is absent. Possissibilities have risen theorizing that this absence of communication may be due to cancer or malignant cells that either have defective gap junction or apparently lacked such permeable junctions. Using freeze-fracturing technique, replicas of these single cells are analyzed and examined for presence of gap junctions. If the junctions exist but intercellular communication is not present, possibility of closed channels is also prominent. Different cells lines have been tested and at present, no gap junctions have been detected among the single cells where communcation did not exist. The results thus enable us to study the regulation of the junction permeability. While the pricipal factors involved in controling channel permeability have been found, molecular mechanisms of channel gating are still poorly understood and thus needed to be explored.

124 Cryoprotectants: A Protective Means of Acclimation. ESTELLE H. CLINE. (The North Carolina School of Science and Mathematics and Wake Forest University).

I performed a study of cold-hardiness due to the presence of cyroprotectants in the hemolymph of the Popilius disjunctus. I determined the capacity of several chemicals to preserve cardiac tissue viability. The functioning of the tissue was prolonged by the 2-component solutions of serotonin-mannitol and serotonin-glycerol. The Lowry Assay was used to measure changes in the

hemolymph protein levels after refrigeration. The beetle at -6.6°C rendered the highest protein level. An SDS-Electrophoresis assay indicated the presence of a "new" protein at -6.6°C with a molecular weight of 43,000 daltons and characteristics similar to those of thermal hysteresis proteins that protect tissue against chilling damage within a specific temperature range.

125 Effects of Olfactory Imprinting in Rattus norvegicus. AMY JO ROY (Ashland High School) Ashland, OH.

Newborn Sprague-Dawley rats were exposed to Mr. Clean liquid lemon detergent, men's British Sterling cologne, or pine shavings to see if they showed a preference to one of the scents. Odors were mixed with the bedding in each of the rearing cages for the first 16 days of life and then the rats were tested between the age of 29-31 days old. Four males and four females were tested alone from each of the three rearing cages for 30 minutes. Most rats spent the majority of the time in the pine shavings test chamber and the least amount of time in the cologne chamber. The subjects showed no preference for the odor they were raised with in their cages. Some factors that might have influenced the results are: length of time spent in test chamber, amount of odor present in test chamber, the length of time exposed to scent in rearing cages, and the strength of the odors in the rearing cage and test chambers.

126 Asthma and Weather. GRIFFIN WEBER (Dozier Middle School, Newport News, Virginia)

A statistical study was conducted in Southeastern Virginia, a known trouble spot for asthmatics, to determine if weather conditions could be used to predict the severity of an asthmatic's asthma symptoms for a given day, and to discover which weather factors were most influential. Daily weather measurements and counts of the number of people who received asthma treatment from clinics were obtained, and daily surveys were completed by asthmatics who rated the severity of their asthma symptoms each day and indicated which weather factor most affected his or her asthma symptoms. Correlation and regression analyses were performed on the collected data using the statistical computer package called MINITAB. The accuracy of the surveys was ensured due to the negative correlation between the daily average survey ratings and the number of people who received asthma treatment at the medical clinics. It was found that low barometric pressure and range in barametric pressure were the most significantly correlated influences of asthma. Surprisingly, wind, humidity, and temperature had very little correlation with asthma and only less than half of those surveyed correctly guessed their most influential weather factor. A multiple regression formula, which combined all the weather conditions for a given day, was constructed which could enable an asthmatic to predict the severity of his or her asthma symptoms for a given day. The asthmatic could thus control the level of medication taken. It could also be used by hospitals to estimate the number of people who need asthma treatment for a given day.

127 Incidence and Types of Bulk Tank Mastitis Bacteria in Herds with High and Low Bulk Tank Sematic Cell Count. REBECCA A. SPORE (Ashland High School) Ashland, OH.

Fourteen dairy herds were evaluated to determine a correlation between bacterial colony forming units (ml) and bulk tank SCC. Incidence and types of mastitis causing organisms in the bulk tank of these herds were identified by standard milk culturing techniques. Each herd's mastitis milking hygiene and mastitis control program was evaluated by observation of milking techniques and completion of a survey by the farmer. A recommendation was then submitted to the farmer to encourage maintenance of LSCC.

128 MCF-7 or not MCF-7?: The Use of Isozyme Analysis and DNA Fingerprinting to Determine the Origins and Genetic Fingerprints of Various MCF-7 Breast Carcinoma Cell Cultures. ILEA A. MATHIS (Westerville North High School) Westerville, OH.

Through the years, cell culturists who have grown cells for experimental purpose have been plagued with problems. Contamination and growth difficulties are only two of many problems that stunt the growth and quality of cell lines. One of the latest problem cell lines is MCF-7, a human breast carcinoma line started in 1973 by Soule, Vazquez, Long Albert, and Brennan from a pleural effusion derived from a breast carcinoma. In the past few years, demand for those cells has become selective. Several isolated MCF-7 cultures from across the nation have demonstrated differences in (a) morphology, (b) growth characteristics, (c) hormone receptor combination, and (d) antibiotic resistance. In this project, four cultures will be analyzed to determine the origin and genetic fingerprint of each: (1) MCF-7/ATCC (American Type Culture Collection), (2) MCF-7/NCI (National Cancer Institute), (3) MCF-7/ADR (Adriamycin Resistant), and (4) MCF-7/MCF (Michigan Cancer Foundation). I believe the cultures are, indeed, different genetically, and possibly, in origin. If this is proven true, the future and the past of the MCF-7 line should be seriously questioned by the scientific world.

129 How Safe is Your Food When the Power Goes Off? CLAIRE M. COMPTON (Lexington High School, Lexington, South Carolina).

This research was designed to determine the length of time food products would stay fresh under different circumstances and environments after losing a constant source of refrigeration. This will help people determine what precautions may be necessary with their food after the electricity has been off. The researcher designed a number of experiments involving refrigerators, ice chests, and freezers. Thermometers with remote sensors were arranged in different positions inside the units, with temperature variations being recorded when there was no electricity. The researcher discovered that the quality and design of a refrigeration unit greatly determines its ability to protect food without electricity, and the location of the food in a freezer or refrigerator is also important.

130 Factors Affecting The Reading Of Geometrically Inverted Text DAWN LAM (Notre Dame Academy, Covington, Kentucky)

This experiment studied factors that may influence the speed of reading geometrically inverted text - i.e., text that has been rotated around its horizontal axis. Such factors included academic aptitude, eye dominance, handedness, age, position in family, and English proficiency. High school students from America and Hong Kong were asked to read a page of inverted text into a tape recorder. Time to read 75-word sections, number of mistakes, and letters most often misidentified were monitored. It was found that academic aptitude, practice, and level of English proficiency had an effect on reading speed but eye dominance, handedness, age and position in family did not.

131 How Do You Communicate with a Deaf-Blind Person from a Distance? SCOTT YANO (Evergreen Middle School) Fayette, OH.

A thorough literature search was conducted and revealed that deaf-blindness is one of the most disabling of all handicaps. Despite their deficiencies, there are many methods and devices that help the deaf-blind communicate. Through studying these methods, however, I have found one serious problem with them: they do not let someone communicate with a deaf-blind person from a distance. The goal of this project was to build a unique device that would solve this problem. This device was called the deaf-blind wrist communicator. The question addressed by this project was, "How Do You Communicate With a Deaf-Blind Person From a Distance?" The basic function of this device was to detect a signal (e.g. Morse code) emitted by a transmitter (e.g. whistle), and relay this signal to a deaf-blind person by activating a motor that would turn on the person's skin in response to the signal code. The basic design for the deaf-blind wrist communicator came from a hearing device which I had designed and built previously. Many modifications were made to the hearing device's circuit, such as a feature that

controls the sensitivity of the device. Furthermore, considerable development work was done to make the wrist communicator small enough to be worn on a person's wrist - like a watch. Actual testing has shown that the new deaf-blind wrist communicator can help deaf-blind people lead more productive lives by giving them a method of communicating with other people from a distance.

132
Greenhouse Earth: A Rising Threat. JEROME HENSON (Leesville High School, Leesville, La.)

The purpose of this research was to investigate the theory of Greenhouse Earth with respect to (1) what is causing it, (2) what effects it has on the environment of the United States-especially agriculture, and (3) how man can best adjust to the climate change. Scientific method guided the study. Related literature was reviewed. Interviews were conducted with experts for information and opinions of the interactions of the environment and economy in their chosen vocations. Greenhouse Earth occurs when clearing of forests, urban and industrial growth, and usage of oil and other fossil fuels cause carbon dioxide and other gases to accumulate in the atmosphere. Much like the panes of a greenhouse, these gases are transparent to solar energy but hinder the escape of infrared heat into space, adversely affecting our environment. To test present effects of Greenhouse Earth on food and pasture plants simple controlled experiments were conducted. The experimental groups were plants exposed to increased CO_2 trace gases, sunlight, and heat, which are conditions caused by the Greenhouse Effect. The control groups were exposed to present conditions on Earth. Another experiment involved gathering air samples from the experimenter's house, having the air analyzed for CO_2 ppm, and using the data yielded in controlled hydroponic experiments on food and house plants. Observable health and life span was the data yielded in all experiments. Measurements of stem growth in centimeters was recorded, charted, and statistically analyzed. Plant experiments show that increased carbon dioxide and heat cause to grow better in a controlled environment.

133 Goose Creek Limestone Discovered in Horry County, SC
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126 Greengate Lane, Spartanburg, SC, 29302

Chemical and biostratigraphic analyses of a new locality near Conway, Horry County SC, demonstrate equivalency with the Goose Creek Limestone, a formation not previously recognized outside the area of Charleston, SC. The new site yielded 64 larger species of mollusks and echinoids and an additional 36 species identifiable from latex peels. Previous studies (M. Campbell, 1989, 40th ISEF Abstracts, p. 122) increased the known Goose Creek fauna from 64 to 117 taxa and demonstrated that Goose Creek Limestone actually underlies the Duplin Formation, but had been misplaced in the traditional stratigraphic section. The 117 taxa made a regional statistical analysis possible, but conclusions were limited by a species count still low by Pliocene standards. In the present study, I document 167 Goose Creek taxa, based on new collections from Cross and Conway, and the use of latex peels. Goose Creek strata less than 4 km from the Waccamaw River suggest that some of its moldic limestone beds traditionally assigned to a post-Duplin age actually belong to the older Goose Creek Limestone. Especially suspect are limestone beds at the type section of the Bear Bluff Formation. Expanded statistical and chemical analyses support this new interpretation of the Bear Bluff and Goose Creek and suggest the equivalency of the Horry County and Charleston Pliocene sections. Field studies are in progress to resolve this question.

134
EXPERIMENTAL TURBULENCE AND THE k-EPSILON TRANSPORT EQUATIONS

CAMERON R. HAIGHT
Santa Fe High School/ Los Alamos National Laboratory

Experimental turbulence was modeled at low Reynold's Number flows using the k-Epsilon turbulence transport equations. A water tunnel and FORTRAN code were designed to examine the turbulence with the purpose of investigating and understanding the hierarchy of order inherent to what many consider a chaotic flow.

The water tunnel was designed with structures to minimize pre-obstacle turbulence, and the turbulent flow resulting from flow over the square obstacle was illuminated with a rheoscopic fluid. Using the Eulerian method in two dimensions, the code was written based on the Navier-Stokes equations for conservation of mass and momentum, and the k-Epsilon equations. In this respect the code was unique. The transport equations have never before been applied to the low speed instabilities. Vortex shedding frequency and eddy size results from the experiment confirmed the equations, code methods, and code results.

In conclusion, first, the Karman Vortex Street was identified to be the dominant structure of the turbulence. Second, the vortices, and the resultant vortex shear of the Street were identified to be the primary contributors to the high turbulence energy values. Last, the transport equations were confirmed in an area of questioned validity, that of vortex street energy and scale detection in theoretical situations.

These determined characteristics and causes of turbulence provide for applications such as designing artificial hearts, submarine detection, aerodynamic and combustion efficiency, and nuclear fusion.

135 **Turbulent Drag Reduction in Fluid Flow Through Linear and Non-Linear Pipe Configurations.** **Daniel A. Lane (Robert E. Lee High School)**

Turbulent drag is a major source of energy loss in flow systems of all types. It has been proven that the addition of high molecular weight linear polymers to a fluid in newtonian flow will reduce the turbulence in the system by as much as 80%[1]. This reduction of drag directly correlates to a reduction in the amount of energy required to maintain a constant system performance level. For years, researchers have tested different polymers, but only in straight pipes. This study was done to compare not the effects of different drag reducing polymers on a flow system, but the effect of a bend in a flow system on the drag reducing effects of the polymer. Different polymers were tested at different concentrations in both straight and bent pipe systems of different composition. Data was compiled and plotted to allow for a qualitative analysis of the results. The bent pipe system was designed to contain the same length of pipe as the straight pipe system, and had a 90° bend located in the center of the test section. Significant drag reduction occured in both systems, but only in the linear portions of the pipe configurations. Drag actually increased around the bend in the pipe system.

1. Mysels, Karol A. "Early Experiences with Viscous Drag Reduction." Chemical Engineering Progress Symposium Series, no. 111, 67, 45-47 (1971).

136
Sound Velocity Measurements and Estimation of Upper Limit of Hydrogen Penetration in Titanium by Ultrasonics Techniques
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The objective of this project was to measure sound velocity changes in a titanium rod immersed in an electrolytic cell as well as estimating the upper limit of hydrogen penetration in titanium. A Ti chamber was built and a Ti rod was placed inside it. On the two ends of the rod, a brass fixture held 6 MHz transducers against the Ti rod and included BNC connectors. A data acquisition board was installed in a computer to take data, which were imported to a spreadsheet.

After several weeks of hours run, the data suggested that there were no significant changes in the sound velocity. Mathematical calculations estimated that the maximum change in length was 5.3×10^{-3} cm and that the maximum number of hydrogen per titanium atom was approximately 8, basing on the fact that the titanium has now become titanium hydride.

137 The Propagation of Sound in Gasses. KURT A. FRANKE (John Marshall High School, San Antonio, Texas)

The purpose of this investigation was to determine the nature of a sound wave through a gas. This experimenter hypothesized that the motion of a sound wave can be predicted using Boyle's law and the density of the gas. Furthermore, it was hypothesized that the speed of a sound wave is independent of amplitude. To discover this, the experimenter set up a tube with a condenser microphone on each end and a Panasonic miniature speaker on one end. This system also included a dual trace oscilloscope to measure the time between each microphone picking up the sound. Knowing the time and the distance between microphones, the speed of sound could be calculated. The tube was also filled with gases of different densities. The results of this experimental data were then compared with the results of a computer simulation based on Boyle's law. Also, the results were compared with solutions to the wave equation. The computer simulation was closer to the experimental data than the solutions to the wave equation were (the simulated speed was off an average of 0.5%). For different amplitudes, the speeds differed by 0.5% due to random error. These results verified the hypothesis.

138 The Chaos Game: Infinite Possibilities--A Fractal Study. CLINT S. WILKINS. Spartanburg High School's Summer Science Research Program.

Fractals are pictures or formations which show the results of the merging of variables. These variables can be controlled, random, or a combination of the two. The system which merges the variables can range from very simple to highly complex. In this case, a **controlled** variable is merged with a **random** variable in a simple context. However, even the simplest examples require such a large volume of calculations and repetitions that it was impossible to study them until the advent of high speed computers. Some fractal situations which are presently being studied require entire days for even the fastest computers to construct their images. This research focuses upon the effects of altering the parameter of one controlled variable which has been set into a very simple algorithm. Background literature on fractals is limited, due to the embryonic status of the phenomenon. As a result, this study began with hours of systematic observation through playing "what if" games with the computer. The variable investigated was altered and the results recorded. Particular interest developed in the radical changes which were caused by NON-radical, systematic changes made in the variable. The focus of this study, then, centered around explaining these radical changes in mathematical terms.

139 Arithmetic Sequences and Fibonacci Quadratics. MAHESH MAHANTHAPPA (Fairview Senior High School).

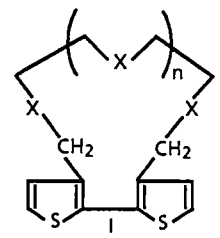
Rational solutions of quadratic equations, $ax^2+bx-c = 0$, whose coefficients a, b, and c are in an arithmetic sequence are considered. In particular we consider the following equations: A) $nx^2+(n+r)x-(n+2r) = 0$, B) $nx^2+(n+2r)x-(n+r) = 0$, C) $nx^2+(n-r)x-(n+r) = 0$ (which is equivalent to $(n+r)x^2+nx-(n+2r) = 0$ where n and r are positive integers. It is proved that, for r=1, rational solutions exist if and only if the n-values are given by f_{2m+1} $^{-1}$, $f_{2m+3}f_{2m}$, $f_{2m+1}f_{2m}$ for cases A, B, and C respectively, f_m being a Fibonacci number. The proofs make use of the properties of Pythagorean triplets, Pell equations, and related Diophantine equations. The case of r > 1 has also been considered. The author has surveyed Mathematical Reviews, The American Mathematical Monthly, and The Fibonacci Quarterly, and has found that this problem has not been considered before. A paper which contains the results of this investigation has been accepted for publication in The Fibonacci Quarterly.

201-243 Biomedical Sciences

(Sat., 16 Feb., 12:15–2:15 pm)

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Synthesis and Extracting Ability of Novel Thiophene Based Crown Ethers. HANS ZIMMER, A. AMER, H. B. MARK, JR., R. SHABANA AND C. A. F. STRILEY, Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221.

Since the recognition of the unusual alkali and alkaline earth ion complexing properties of crown ethers by C. F. Pedersen (J. Am. Chem. Soc. 1967, 89, 7017) considerable work on this class of compounds has been done. However, only a few reports containing crown ethers derived of thiophene appeared.



n = 0, 1, 2, 3, 4; X = O,S

Here we present some of our work dealing with such ethers derived of 2,2'-bis-thienylene of the general structure I. Their synthesis as well as some of their spectroscopic data will be discussed. Their ability to extract $Li^{\oplus}$, $Na^{\oplus}$, $K^{\oplus}$, and $Cs^{\oplus}$ cations from aqueous picrate solution will be presented.

202 Lipid Peroxidation in the Pancreas of the Copper-Deficient Rat. A.A. Mylroie and J. Kyle. Chicago State University, Chicago, IL.

Dietary copper deficiency in rats has been shown to result in considerable pancreatic atrophy. The present study was designed to investigate the effect of copper deficiency on lipid peroxidation, glutathione status and antioxidant enzyme activities in rat pancreas. Groups of male weanling Sprague-Dawley rats were fed a Cu-sufficient (6ppm) or Cu-deficient (<0.5ppm) purified AIN-'76 diet for 3, 5, and 7 weeks. At the end of each experimental period, 4-6 animals from each group were sacrificed; copper levels in blood and selected organs were determined to assess Cu status. Pancreas aliquots were assayed for glutathione peroxidase (GSH-PX) and glutathione and malondialdehyde (as a measure of lipid peroxidation). Pancreatic weights decreased progressively during the experimental period, whereas GSH-PX increased during the same time periods. Malondialdehyde levels increased significantly while glutathione levels in the Cu-deficient group increased at 3 and 5 weeks and decreased at 7 weeks, when compared to controls. The results suggest that in the rat increased lipid peroxidation may play a major role in pancreatic atrophy during dietary Cu-deficiency. (Supported by NIH grant RR-08043).

203 Factors in the Short Range Solvation of Secondary Amines by Cyclic Diethers. RONALD M. SCOTT (Eastern Michigan University), MINGHAO ZHOU (Eastern Michigan University).

Short range solvation involves the direct interaction of solute and solvent molecules, usually by formation of hydrogen bonds. We have extensively studied the solvation of secondary amines by electron donating solvents, using the equilibrium constant for the formation of the proton transfer complex between the amine and 2,4-dinitrophenol as a probe of the occurrence of short range solvation. Equilibrium constants have been determined for the formation of the solvent amine hydrogen bond. These constants indicate the tendency for both 5- and 6-membered ring diethers to form the hydrogen bond to be 10-20 fold greater than for a noncyclic or cyclic monoether or a noncyclic diether, although once formed the effect

of the hydrogen bond on the formation of the proton complex is moderate. It is proposed that the cyclic diether is forming a bifurcated hydrogen bond involving both oxygens of the diether. The formation of the short range solvation structure is affected by substitutions on dioxalane rings in a fashion consistent with the bifurcated bonding model.

204 **Huge Components in the Scattering Kinetics During the Photocycle of Triton Treated Purple Membrane.** JÓZSEF CZÉGÉ and LOU REINISCH, *Laser Biophysics Center, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, Bethesda, MD 20814.*

The solubilization of bacteriorhodopsin using TRITON X-100 was followed by measuring the scattering and the absorbance kinetics during the photocycle of purple membrane fragments at pH 7.9. At triton concentrations well below complete solubilization a new, very large scattering transient indicates that both the mechanical properties of the membrane and the protein conformational kinetics are modified. The new transient scattering component shows nearly no excitation polarization dependence. This suggest that the membrane fragments are more curved (the bending angle $\gtrsim 180°$) during the triton treatment. With the extreme bending the environment of the protein becomes more hydrophilic, which alters the absorbance kinetics. This model is supported by dynamic light scattering measurements, which show a slight increase in the mobility of the fragments after triton is added. A similar change in the purple membrane occurs without triton at pH > 11.0 as confirmed by parallel scattering and 400 nm absorbance kinetics measurements. As the concentration of triton increases, the protein molecules separates from the membrane forming particles of molecular size while the remaining white membranes retain their original size range.

205 Spin-lattice(T1) Relaxation Times of the Water Protons in Human Plasma Samples Were Related To Their "Hydration Water" and Paramagnetic Metal Ion Concentrations. BINAY KUMAR GHOSH(Beth Israel Medical Center, New York City, New York, 10003)

T1s of water protons - in experimental samples - were determined at 29° C and ≃ 13.2 MHz. It's about 3,000 milliseconds(msec) for deionized water. Those of ten plasma samples - from heparinized blood specimens - were between 1539 and 1408 msecs. Iron and total protein contents of the serums from the corresponding clotted(not heparinized) blood samples were determined. T1s of comparative samples - at pH≃1.5 - included 0.9 % sodium chloride solution,≃7 %(w/v) bovine albumin in 0.9 %(w/v) saline, 130 micrograms(μg) of ferric iron per deciliter(dl) in 0.9 %(w/v) saline, and a solution containing both ≃7 %(w/v) bovine albumin and 130 μg/dl of ferric iron in such saline. Comparisons of the T1s of these experimental samples distinguished the specific contribution of paramagnetic relaxation in the one incorporating both bovine albumin and ferric iron. It was rationalized that the observed T1 of a plasma sample related primarily to its "Hydration water". The relaxivity due to its content of paramagnetic metal ions had minor role.

206 Sex Linked Mental Retardation Which Correlates with a Restriction Fragment Length Polymorphism (RFLP) Proximal to Fragile X by BERT GOLD, ALICE LAZZARINI and MICHAEL K. McCORMACK (Division of Genetics; University of Medicine and Dentistry of New Jersey-School of Osteopathic Medicine; Camden, New Jersey 08103)

Several studies have suggested linkage of genes for X-linked mental retardation (XLMR) at sites other than the Fragile X region (FRAXA) Xq27.3. Cytogenetic studies, using both 5-FUdR and folate deficient medium, on a male member of a family with nine affected individuals, showed no evidence of Fragile X marker. RFLP analysis of 18 individuals constituting potentially 20 informative meioses using five DNA probes from the Fragile X region showed no evidence of linkage. Other studies eliminate three other areas of the X chromosome as likely linked sites (DXS9 at Xp22.2, DXS7 at Xp11.4-Xp11.3, and DXS1 at Xq11.2-Xq12). Taq I digests of this family's DNA probed with DXYS1X (Xq21.31) of pDP34 reveals a correlation between the mobility of the fast running allele and the XLMR. More studies are underway using oligonucleotides demarcating variable numbers of tandem repeat (VNTR) sequences and other RFLP's to precisely locate the FRAXA proximal XLMR locus and to verify the possible linkage with DXYS1X.

207 Evidence That Eukaryotic mRNA Translation can be Modified to "Prokaryotic Translation Mode": Role of High and Normal Mg++ Levels to Differentiate "Prokaryotic" from "Eukaryotic" Mode. HARVEY N. RUBIN and MOSTAFA N. HALIM, Structural RNA, San Diego, CA 92121.

The main differences between eukaryotic and prokaryotic mRNAs is that the former has a cap structure at the 5'-end, as well as poly(A) sequence at the 3'-end, while the latter lacks the cap structure and poly(A) sequence. The first step in translation of eukaryotic mRNA is the shortening of poly(A) sequence. Modification of either the cap structure or the poly(A) sequence on eukaryotic mRNA leads to a shift of its translation mode to "prokaryotic." (i) When a radiopolyadenylated decapped rabbit globin mRNA was translated in rabbit reticulocyte lysate, globin synthesized without shortening of poly(A) sequence; when the decapped mRNA was recapped, both globin synthesis and poly(A) shortening again took place. (ii) Eukaryotic mRNA translation is inhibited in the presence of 3.5-5 mM of Mg++, while E. coli mRNA translation tolerated up to 20 mM Mg++. Thus when decapped globin mRNA translated in the presence of either 2 or 10 mM of Mg++, its translation efficiency remained unchanged. (iii) Translation of globin mRNA poly(A) in depleted poly(A) binding protein rabbit reticulocyte lysate, and in the presence of either 3 or 10 mM of Mg++, equally resulted in globin synthesis without shortening of poly(A) sequence. These results reveal that decapping or altering the translation environment will switch mRNA translation from eukaryotic to "prokaryotic" mode. Thus a high Mg++ concentration (10-20 mM Mg++) permits decapped mRNA or mRNA without PABP to continue to translate "procaryotically," while mRNA fully equipped with cap and PABP is strongly inhibited from translation.

208 Evidence That mRNA Anionic Trypsinogen 5' Noncoding Sequence Hybridizes to its 3'-poly(A) but mRNA Cationic Trypsinogen Does Not. HARVEY N. RUBIN and MOSTAFA N. HALIM, Structural RNA, San Diego, CA 92121.

Based on the following reported findings: 1) A units are cleaved from poly(A) tail of mRNA during translation; 2) 5' noncoding sequence is hybridized to 3' poly(A) sequence; 3) dog anionic trypsinogen mRNA synthesizes more trypsinogen than cationic mRNA. We found by inspection that anionic trypsinogen RNA 5' noncoding sequence has CUUCU complexing with 5 A's from poly(A); there is only a trinucleotide at 5' noncoding sequence of cationic mRNA, one A/U and two A/C bonds. Based on the above finding we expect loss of A units during translation of anionic mRNA, but not of cationic. In translation, both mRNAs supported protein synthesis; anionic mRNA cut A units from its poly(A) tail, but the cationic lost only a small amount of A units. The results from this experiment fit in with the findings from our previous paper in which we showed that when PABP was not present, protein synthesis continued without loss of A units, compared to loss of A units when PABP was present. We call the usual mode of translation with PABP present the "eukaryotic mode" of translation; we designate the mode of translation without PABP as "prokaryotic mode." It has also been shown that decapped mRNA does not lose A units, and, in accordance with our nomenclature, we refer to it as translating in the "prokaryotic mode." Since cationic mRNA does not lose A units, we say that it is operating in a "prokaryotic mode." Conversely, anionic mRNA does lose A units in translation, and we say that it is translating in a "eukaryotic mode."

209 Shortening of Poly(A) Tail During Protein Synthesis is Neither Random nor Caused by RNases. HARVEY N. RUBIN and MOSTAFA N. HALIM, Structural RNA, San Diego, CA 92121.

We demonstrate that translation of rabbit globin mRNA with long poly(A) tail in rabbit reticulocyte lysate resulted in globin synthesis with concomitant shortening of poly(A) tail. The shortening of poly(A) tail is not affected by either RNasin (200 units) or

pancreatic RNase (0.1 ug). To further investigate that shortening of poly(A) tail during mRNA translation does not involve RNases, two cDNA probes were synthesized with the following sequences:

5' d[TTG TCA GCG GGA GAC AGC AC]-3' alpha 20 mers

5' d[TCC TCA CTG GAC AGA TGC AC]-3' beta 20 mers

When either the alpha or beta globin mRNA was hybridized with the alpha or beta cDNA respectively and translated in rabbit reticulocyte lysate, poly(A) shortening occurred to a much lesser extent as compared to non-hybridized mRNA. Furthermore, when alpha globin mRNA [^{14}C]poly(A) - alpha cDNA hybrid was translated in the presence of beta globin mRNA [^{3}H]poly(A) (or conversely, i.e. beta mRNA - beta cDNA hybrid in the presence of alpha globin mRNA), a 10% and 40% shortening of poly(A) was determined respectively. In the meantime, the hybridized mRNA resulted in no globin synthesis, while the non-hybridized mRNA synthesized globin at a rate similar to that obtained in a translation reaction mixture but in absence of the mRNA hybrid. Thus if exogenous or endogenous RNases are involved in poly(A) shortening during mRNA translation, both translated and non-translated mRNAs exist in the same micro-environment, and must be affected equally. Hence the present data reveal that shortening of poly(A) during mRNA translation does not occur randomly and is caused by at least other agent(s) than RNases.

210 An Eleven Amino Acid Sequence May Play an Important Role in Protein Synthesis and Cell Vitality. HARVEY N. RUBIN and MOSTAFA N. HALIM, Structural RNA, San Diego, CA 92121.

A report [Sachs et al. (1987) Mol. Cell Biol. 7, 3268-3276] indicated that poly(A) binding protein (576 amino acid residues) is essential for yeast cell survivability. A 66-amino acid sequence out of the 576 was found to induce the same effect. By inspection of the 66 amino acid sequence domain in yeast, xenopus and human PABP, we found a nine amino acid sequence in common:

yeast	$_{357}$gly lys ser lys gly phe gly phe val$_{365}$
xenopus	$_{228}$gly lys ser lys gly phe gly phe val$_{236}$
human	$_{225}$gly lys ser lys gly phe gly phe val$_{233}$

We felt that the 9 amino acid sequence may even play the role of the total PABP sequence. To investigate this hypothesis, a synthetic peptide which includes this sequence was synthesized, i.e. NH_2 gly lys ser lys gly phe gly phe val trp phe CO_2H. (i) Two experiments were performed to test its binding to poly(A): in the first, when it was applied to a poly(A) sepharose 4B affinity column, it bound to the resin, while in the second, after attaching [^{3}H] poly(A) to a column packed with oligo(dt)cellulose, the 11 mers were passed through it and washed several times with the binding buffer. When poly(A) was released both radioactivity and 11 mers (as revealed by absorbance at 280nm) were retained in the eluate, which suggests the binding of 11 mers to poly(A). (ii) In another experiment, when the 11 mers were tested for ATP binding domain on ATP-Agarose column chromatography, it bound to the resin and eluted with about 1mM ATP. These results indicate that the 11 mers contain a common binding domain for poly(A) on ATP. Further studies on its hydrolytic and polymeric activities during mRNA translation are being investigated.

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Effects of Dexamethasone on the mRNA Levels of Human Glucocorticoid Receptor, Chicken Ovalbumin Upstream Promoter Transcription Factor and Heat Shock Protein 90α and β, in Primary Leukocytes and an Epstein Barr Virus-Transformed Human Lymphocyte Cell Line. NIKOS C. VAMVAKOPOULOS, VANESSA MAYOL, ANDREW N. MARGIORIS, TERESA GOMEZ and GEORGE P. CHROUSOS.Pediatric Endocrinology Section, National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, MD.

Glucocorticoids, their receptors (GR), the chicken ovalbumin upstream promoter transcription factor (COUP-TF) and the heat shock protein 90s (hsp90α and β), constitute essential (GR), or putative (COUP-TF, hsp90s), and potentially interrelated elements of the hypothalamic-pituitary-adrenal (HPA) axis dependent mammalian stress response. The aim of this study was to further elucidate the effect of glucocorticoids on the GR, the hsp90s, and COUP-TF. The steady state level of the mRNAs of these proteins was evaluated by quantitative Northern blot analysis in primary leukocytes (P-L) and Epstein-Barr Virus-transformed human lymphocytes (EBV-THL) basally, and after 24 hour exposure to 50 nM dexamethasone. At the basal state, the EBV-THL had a nearly 5 fold elevation in the levels of GR and the hsp90s over those of P-L, while no change in the COUP-TF mRNA level was observed. Treatment of P-L or normally growing EBV-THL with dexamethasone, had no effect on the mRNA level of GR, hsp90α, hsp90β, or COUP-TF. Similar treatment of EBV-THL grown in glucocorticoid-deprived media, however, resulted in a 1.3 fold increase in the level of GR mRNA, and a 1.5 to 1.6 fold increase of the hsp90s mRNAs, while it had no effect on the COUP-TF mRNA. Our studies extend previous findings of GR upregulation by glucocorticoids in EBV-THL and establish a potential interdependence between GR and hsp90s. They also demonstrate that hsp90 mRNAs respond to dexamethasone and viral transformation while COUP-TF mRNA does not. The glucocorticoid-induced concordant rise of GR and hsp90s mRNAs, may indicate a degree of interdepedence between the stress cascade and the biosynthesis of the hsp90s. The proteins of the mRNAs studied, may be involved in the coordination of the hormonal and cellular responses to stress in the mammalian organism.

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Preliminary Chromosomal Assignments of Human Heat Shock Protein 90 alpha and beta Genes. NIKOS C. VAMVAKOPOULOS, COSTAS CONSTANTINE, ANDREW N. MARGIORIS, GEORGE P. CHROUSOS. Pediatric Endocrinology Section, National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, MD.

Heat shock protein 90s (hsp90s) are highly conserved intracellular proteins, believed to play a major role in basal and stress-related cellular homeostasis and survival. Their involvement in human physiology and pathophysiology is largely unknown, although it appears that these proteins may be related to primal properties of life, such as growth, disease, immune function and aging. Two subfamilies of such proteins were recently identified in man, hsp90α and hsp90β. Using the human complementary hsp90α and β DNA sequences as hybridization probes on a BamHI restricted DNA panel of human-hamster somatic cell hybrids, we mapped a human hsp90α specific BamHI DNA fragment to chromosome 4 and human hsp90β specific BamHI DNA fragments to chromosomes 4 and 6. The hsp90α probe reacted to a minimum of four distinct human BamHI fragments , while the hsp90β probed pattern of BamHI digested human DNA was more complex. The majority of the BamHI generated human bands recognized by these probes, were indistinguisable from the hamster background. These data suggest that the human hsp90 genes reside in different chromosomes, and that, perhaps by analogy to their mouse homologs (Moore et al., 1989,J Biol Chem,264, 5343-5351), the human hsp90 alpha gene family will be found localized in relatively fewer chromosomal loci than the beta family. The presence of hsp90α and β genes on human chromosome 4, colocalizes them to the same chromosome with those of alcohol dehydrogenase and glucocorticoid receptor type I (mineralocorticoid receptor), two proteins also known to be involved in maintenance of homeostasis.

213 Developmental regulation of ecmA, a pre-stalk and stalk-specific gene in the slime mold *Dictyostelium discoideum*. MICHAEL J. GASKELL (Imperial Cancer Research Fund), DONALD J. WATTS (University of Sheffield), TIMOTHY TREFREY (University of Sheffield) and JEFFREY G. WILLIAMS (Imperial Cancer Research Fund).

We have been investigating the regions in the promoter of the ecmA gene which confer developmental regulation by coupling promoter fragments to reporter genes. We have shown that the promoter can be divided into several regions each with different functions (vegetative repression, efficiency of expreesion etc.) and that there seems to be a built in redundancy within the promoter of developmentally important regions. We have also shown, both by immunoflourescent double antibody staining and reporter gene enzyme assays that it is possible to separate by counter current distribution pre-stalk cells expressing ecmA from cells expressing ecmB, a related pre-stalk specific gene.

214 Immunochemical Evidence for B-endorphin, B-Lipotropic and ACTH-like Compounds in Tissues of the Earthworm Lumbricus terrestris. KENNETH V. KALOUSTIAN, Quinnipiac College, Hamden, CT 06518

Peptides initially thought to be present only in vertebrates have also been shown to be present in invertebrates. Using radioimmunoassay techniques, we present evidence for the presence of B-endorphin, B-lipotropic and ACTH-like peptides in tissues of the earthworm L. terrestris. The greatest concentration of B-endorphin and B-lipotropic-like immunoreactivity was observed in seminal vesicles followed by the supra- and subpharyngeal ganglia, ventral nerve fiber and the gastrointestinal tract. The greatest ACTH-like immunoreactivity was measured in ventral nerve fiber followed by supra- and subpharyngeal ganglia and intestines. The high concentration of these peptides in neuronal tissues may indicate neuromodular functions controlling reproductive and digestive activities. In a previous study we have reported inhibitory actions of B-endorphin on earthworm intestinal contractions. Since ACTH, B-endorphin and B-lipotropic hormones share the same common precursor molecule, proopiomelanocortin, it would not be surprising if proopiomelanocortin is also found in earthworm tissues.

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The In Vivo effect of a Polyclonal anti-TNFα Antibody on Cell Mediated Immunity. KENNETH CHAVIN, Medical University of South Carolina/Graduate Hospital, STEVE KUNKEL, University of Michigan, ALI NAJI, CLYDE BARKER, University of Pennsylvania, JONATHAN BROMBERG,Medical University of South Carolina

Tumor necrosis factor has pleiotropic effects and is involved in sepsis, tumor responses and immune regulation. The present experiments explore the effects of a polyclonal rabbit anti-murine TNFα antibody on cell mediated immunity in vivo. BALB/c mice were immunized to the hapten trinitrophenyl (TNP) by abdominal skin painting. Antibody was administered intravenously on the day of immunization and the following day. Animals were challenged with TNP on day 5 and contact sensitivity quantitated 24 hours later. Animals were sacrificed on day 7, ears removed for histology, spleens harvested and placed in culture for MLR, 1^0 anti-alloantigen CTL, 2^0 anti-TNP CTL, or examined by FACS. The CS response was reduced 70-80% and the 2^0 TNP-CTL was reduced 60-95%. Neither 1^0 alloantigen specific CTL nor MLR were affected by in vivo antibody treatment. FACS analysis demonstrated no alteration in the distribution of CD2, CD3, CD4, or CD8 T cell surface antigens. Administration of rmTNFα at the time of antibody reversed the immunosuppressive effects of the antiserum. Normal rabbit serum had no effect. These results demonstrate that anti-TNFα antibody can interfere with primary cell mediated immune responses in vivo and that TNFα is required for the initiation of both CS and CTL to a defined hapten.

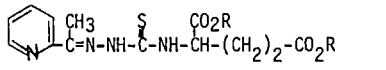
216

DNA Binding Properties of the Antitumor Antibiotic Carzinophilin. MARK E. SALVATI (University of California, at Los Angeles), ROBERT W. ARMSTRONG (University of California, at Los Angeles)

Carzinophilin (CZ) / Azinomycin B is an antitumor antibiotic first discovered in 1954. Initial studies have indicated that CZ is capable of forming inter-strand cross-links in duplexed DNA as shown by ethidium bromide binding assays and heat denaturation experiments. Utilizing polyacrylamide gel electrophoresis, we have established that CZ is an effective alkylator of G residues in both single- and double-stranded DNA. In addition, this bifunctional drug is capable of forming inter-strand cross-links between G and A residues in the sequence $\overset{5'\text{-GAT-}3'}{3'\text{-CTA-}5'}$. Sodium hydroxide stabilization of the CZ/DNA cross-link allows the determination of the exact location of this cross-link via piperdine decomposition and 1,10-phenanthroline-copper footprinting. Hydrolysis of the [3.1.0]-azabicyclic system of CZ yields an intermediate which is unable to alkylate or cross-link DNA, suggesting that the [3.1.0] system is responsible for the initial alkylation. Synthesis of DNA probes in which the key G residue is replaced by 2'-deoxy-7-deazaguanosine or 2'-deoxyinosine, provides information on the alkylation site on G.

217 Inhibition of Bovine Dihydrofolate Reductase by a Series of N^1-Heteroaromatic Thiosemicarbazone N^4-Glutamates. WILLIAM O. FOYE, and SUNIL DABADE, Massachusetts College of Pharmacy and Allied Health Sciences, Boston, MA., EVELYNE LEBRUN and ROLAND VAN RAPENBUSCH, Department of Organic Chemistry, University of Haute Normandie, Mont Saint-Aignan, France.

N^4-(2-Acetoxyethoxymethyl) -2-acetylpyridine thiosemicarbazone (AATSC) has been found to have significant inhibitory activity against dihydrofolate reductase (DHFR) from several sources. It also enhances methotrexate sensitivity of the DHFR's. To ascertain whether a closer analogy to the methotrexate structure of a thiosemicarbazone might give a better fit to the enzyme and greater inhibitory activity, the acetoxyethoxymethyl chain of this compound has been replaced by N^4-glutamate moieties, both the dimethyl ester and free acid(I). Other heterocyclic rings have also been incorporated in place of the pyridyl. ID_{50} values against bovine DHFR of these compounds were somewhat lower than that for AATSC, suggesting that AATSC binds at a different site on the enzyme than does methotrexate.



I

218 The Effects of Inhalation Anesthetics on the Secondary Structure of Poly-L-Lysine. J. S. CHIOU, H. KAMAYA, I. UEDA, Department of Anesthesia, University of Utah School of Medicine, and Anesthesia Service, VA Medical Center, Salt Lake City, UT 84148

The interactions between inhalation anesthetics and the secondary structure of poly-L-lysine (PLL) were analyzed by FTIR. Adding anesthetics in 2% PLL/D_2O solution, the difference spectrum of α-helix amide I band at 1638 cm^{-1} (strong band) decreased, and two new bands occurred at 1680 cm^{-1} (weak band) and 1610 cm^{-1} (strong band). The two bands have the same frequencies of the β-sheet instead of the random-coil conformation (strong band at 1644 cm^{-1}). This phenomenon is dose-dependent with increasing anesthetic concentration. One PLL molecule bind two halothane, isoflurane, and enflurane molecules and three chloroform molecules. The binding constants, K's, are 300 M^{-3}, 110 M^{-2}, 60 M^{-2}, 40 M^{-2} for chloroform, halothane, isoflurane, and enflurane, respectively. The potency of anesthetics agree with the clinical anesthetic potency. The disruption of PLL by anesthetics is caused by the exchange in intramolecular H-bonding, which partially changes α-helix into β-sheet. Hydrophobic interactions of methylene side groups stabilize the β-sheet of PLL. Anesthetics provoke H-bonding rearrangement and cause structural transformation of PLL.

Supported by the VA Medical Research, and NIH grants GM26950 & 27670.

219 Histaminergic Receptors in Canine Paw Pad Microcirculation. S.K. MUKHOPADHYAY (University of Michigan), S.M. LINDENAUER (Veteran's Administration Medical Center).

Rapid and efficient wound healing/or tissue repair requires a competent microcirculatory system. In course of our study of the control mechanism of microcirculation vasodilatory action of histamine on canine paw pad was examined. Infusion of histamine, in presence of a-adrenergic blockade, caused redistribution of blood flow resulting in an increase in capillary and a decrease in AVA flow when compared to the basal flow pattern. Infusion of atropine sulfate, to block the cholinergic receptors, had no effect on this redistributed pattern. The increase in capillary flow was antagonized by H-2 receptor blocker cimetidine and ranitidine and marginally by benadryl an H-1 receptor antagonist. However, cimetidine, and to a lesser extent, ranitidine caused a highly significant increase in AVA flow without affecting the total femoral flow.

We conclude that histamine induces vasodilatation in the canine paw pad microvasculature through H-2 like receptors which are mainly present in the capillary system. H-1 like receptors may also be present in the capillary system but much less predominant as compared to that of H-2 receptors. On the other hand the AVA system of the paw pad contains H-1 like receptors which can be activated to vasodilate only when an H-2 antagonist and histamine are simultaneously present in the preparation.

220 Immune System Components Altered by a Food Supplement. EUGENE S. WAGNER and RAMAN MOCHARLA, Muncie Center for Medical Education, Indiana University School of Medicine, Ball State University, Muncie, IN 47306.

Vitamins such as A, B_1, B_2, B_6, C, folic acid, pantothenic acid and the minerals copper, iron, magnesium, manganese, and zinc have been reported to have specific effects on immune functioning. A nutritional supplement containing all of these nutrients which consists of barley/brown rice/kelp was given to a group of 16 subjects for 71 days. Following completion of this regimen, these subjects exhibited statistically significant increases in the percentage of their circulating leukocytes that were neutrophils and in total complement levels while the percentages of lymphocytes and monocytes each decreased. No statistically significant differences in any components of the immune systems were observed in a placebo group. This suggests that dietary supplementation for 71 days appears to have had an effect on certain components of the human immune system.

221 Tea Consumption and Cancer of the Esophagus: Exploratory Analysis of International Data. RICHARD H. FRANKE, JERRY A. CARDARELLI, CRAIG A. CLARKE, DENNIS J. CORBITT, ELIZABETH I. NORICO, CHRISTOPHER G. VOXAKIS, Loyola College, Baltimore.

Quantitative analysis of relationships between tea consumption and esophageal cancer death rates in twenty nations shows explanation of over two thirds of the variance in death rates among

females. National figures for per capita tea consumption over 1962 to 1976 correlated r = .83 (rho = .63) with esophageal cancer death rates about 1985. Age group segmented correlations for females were strongest for death rates in ages 65-74 (r = .75, rho = .84). The sample, composed of all nations with statistics from United Nations Statistical Yearbooks on tea consumption and from World Health Statistics: 1987 on esophageal cancer death rates, includes nations in North and South America, Eastern and Western Europe, Asia, and Oceania. Our results support earlier epidemiological research suggesting tannins in tea as a cause of esophageal cancer.

222 Association of Early Settlers in West Virginia and the Mortality Rates in the Counties of West Virginia. FRANCES J. SMITH and E. C. KELLER, JR., Department of Biology, West Virginia University, Morgantown, West Virginia

The purpose of the study was to examine whether ethnic geographical distribution may relate to patterns of mortality that could be due to: (1) cultural dietary uniqueness and (2) the genetic predisposition of certain ethnic backgrounds to human mortality. The different time frames studied were: frontier-early settlers; pre-Civil War - 1800's through 1926 and the later immigrations. Information was gathered through census data from the West Virginia University, University of Virginia, and Marshall University libraries and faculty, National Archives, Washington, D. C., local historical societies and Dorothy Davis, author of the "History of Harrison County." The sources from the libraries and archives gave overviews of immigrants settling in West Virginia including resident populations, age, race and sex but did not break down the information into counties. Data collected from Dorothy Davis provided insight into the ethnic groups which settled in Harrison County. Data are now being obtained from the 1900 US Census records. Different distributions of the frequency of occurrance of various cancers and cardiovascular mortalities are found between the northern and southern part of the state, which were settled by different ethnic groups at different times.

223 The Environmental and Genetic Examination of *Bdellovibrio* in the Upper Monongahela River Basin. S. CRAIG STAMM and E. C. KELLER, JR., Department of Biology, West Virginia University, Morgantown, West Virginia 26505.

This study investigated three general aspects concerning the bacterial predator *Bdellovibrio* : 1) an environmental aspect which involved the enumeration and isolation of this microbe in the river waters of the upper Monongahela river basin of north-central West Virginia; 2) an association aspect which examined the physical, chemical, and biological water quality variables associated with the detection of high or low densities of this predator; and 3) a genetic aspect which detailed the genetic variability of surviving isolates through heritability and host range analyses. The findings of this investigation indicated that some of the previous criteria and methodologies cited in the literature for the enumeration of *Bdellovibrio* result in inconsistent population estimates, hence a more accurate protocol for enumeration is described. Also, this study showed that the river water quality variables which were significantly correlated with the higher *Bdellovibrio* densities are: conductivity, pH, calcium, zinc, magnesium, iron, manganese, sulfates and phosphates. Furthermore, the *Bdellovibrio* densities were found to increase as the river water quality decreased. The heritability studies of two presumed polygenic traits (lytic expression time and survivability) illustrated substantial genetic variation for surviving isolates as did the host range analysis.

224 Associations of Human Genetic Traits with County Characteristics in West Virginia.TRACY WITT and E.C. KELLER, JR., Department of Biology, West Virginia University, Morgantown, WV.

Correlations were determined for 10 genetically inherited traits (freckles, pigmented iris, bent little finger, Darwin's ear point, widows peak, free ear lobe, long palmar muscle, tongue rolling, mid-digit hair, and hair type) with selected county socio/economic, environmental, and mortality variables. The genetic data were gathered throughout the state from 1983 to 1989 by students from Marshall and West Virginia Universities and date. In order to examine the most significant associations, only those relationships showing a probability of .001 or less were utilized. Of the 10 traits tested, only hair type, tongue rolling, and Darwin's ear point had probabilities in this range. Ten of the socio/economic, environmental, and mortality variables were found to be correlated with these three traits. Further, correlations were also computed to determine any relationships among the non-genetic variables. The gene frequency for tongue tolling and the amount of aid to exceptional children in the public school system resulted in the highest positive correlation observed (.57). The largest negative correlation (-.47) was found between the gene frequency of hair type and the proportion of mentally impaired individuals in the county. The number of individuals with mental disorders served by the Department of Vocational Rehabilitation was another variable correlated to the gene frequency of hair type. Other correlations of gene frequencies to other county variables ranged from r =-.47 to .47. Among the three gene frequencies listed above, correlation values ranged from r =.47 to .67.

225 Trends of Genetic Traits in West Virginia.WENDY KADY and E. C. KELLER, JR., Department of Biology, West Virginia University, Morgantown, West Virginia.

Trends were determined for each West Virginia county for ten genetic traits: bent little fingers, Darwin's ear point, free ear lobe, freckles, widow's peak, hair type, tongue rolling, mid-digit hair, pigmented iris, and long palmar muscle. The data were collected from 1983 - 1989 by students from West Virginia and Marshall Universities. High and low incidences of the traits were examined by county. There were groupings of high frequencies in the lower Northern Panhandle (Marshall, Wetzel, and Tyler counties) for mid-digit hair, free ear lobe, and bent little fingers traits. For the freckles trait, there was a grouping of high gene frequencies in the southern part of the state. The genetic traits, Darwin's ear point, hair type, and tongue rolling had high gene frequencies of occurrence in the northern part of the state and low gene frequencies along the lower part of the Ohio River. For the genetic trait, widow's peak, there was a clustering of high gene frequency in the south east region of the state including Pendleton, Randolph, Webster, and Pocohontas counties. The genetic traits, long palmar muscle and pigmented iris showed no general groupings at all.

226 Distribution of the Frequency of Occurrence of Spina Bifida in West Virginia. E.C. KELLER, JR., Department of Biology, West Virginia University, Morgantown, WV.

County-by-county examinations of the frequencies of occurrence of spina bifida were determined from information gathered from regional hospitals and clinics by Dr. Douglas Tolar. The spacial distribution of high frequencies of the occurrence of spina bifida is localized in the north central area of the state. Some of these West Virginia counties with high frequencies of spina bifida occur in coal producing counties and some in non-coal producing counties. Low frequencies of spina bifida occur in the southern coal fields, the northern panhandle, and the eastern panhandle of the state. Possible explanations and correlation data will be presented regarding various hypotheses as to the nature of these distributions.

227 Major Relationships Among Types of Human Mortality in West Virginia. BETH CHOBY and E.C. KELLER, JR. Department of Biology, West Virginia University, Morgantown, West Virginia.

Correlations among 38 classes of human mortality in the 55 counties of West Virginia were examined. The data were compiled from mortality records on computer tapes obtained from the WV Health Department and covered a 24 year period between 1959 and 1982. The 38 classes of mortality were those used by the WV Health Department in their annual reports. The 38 mortality variables examined were averages for each county over the 24 year period. Correlations among the variables were grouped at the r=0.90, r=0.80, r=0.70, and r=0.60 levels. Three distinct subgroups emerged. Group I included those neonatal related mortality classes; mortality group II included death due to pneumonia and influenza; and group III represented major cardiovascular and cancer mortalities. Groups II and III were related at the r=0.70 level, but group I variables remained separate at all correlation levels examined. In addition, the six highest and six lowest counties for each of the 18 mortality variables in groups I through III were determined. For these mortality classes, Mason, Marshall, Ohio, Webster, Ritchie, Doddridge, Lewis, and Taylor counties showed high group I through group III mortality rates. Conversly, Putnam, McDowell, Logan, Wyoming, Boone, Wayne, Grant, and Hardy counties showed low mortality levels. Overall, Southern West Virginia was low in the major cardiovascular and pneumonia/influenza categories but high in neonatal mortalities. A band of counties which runs through Central West Virginia was high in all three categories.

228 Preliminary Results on TMJ Syndrome Symptom Removal by Occlusal Splint Treatment of 109 Patients. KEVIN LEWIS and E. C. KELLER, JR. Biology Department, West Virginia University, ELIAS COSTIANES, Morgantown, WV.

One hundred and nine patients (about 25% of of the patients were male) were treated for TMJ Syndrome. All patients were checked for spastic pterygoid muscles by a neural stimulation device to assure the relaxation of these muscles prior to evaluation with a Kinesiograph. The Kinesiograph enables the three-dimensional positioning of the Mandible in space. From the Kinesiograph information on positioning, physiological occlusal splints were constructed. Data were obtained on 187 symptoms before and after treatment. The findings indicated that there was a declining profile of the frequency of occurrence of symptoms after treatment. This frequency profile ranged from 0 to 71%. However, most of the symptoms occurred less than 60% of the time. In regard to the distribution of symptom removal, three general groups were observed viz., 1) those symptoms for

which TMJ treatment had little effect, (about 40% of the symptoms), 2) those symptoms with a moderate amount of removal (about 5% of the symptoms), and 3) those symptoms with a high degree of removal to complete removal (about 55% of the symptoms). Different frequency of occurrance profiles of symptoms and different distributions of symptom removal were found between males and females as a result of TMJ treatment.

229 A Comparative Study of Induction of Micronuclei by Selected AIDS Treatment Drugs in Mouse Bone Marrow Cells. ASH MOTIMAYA, PATRICK CURRY, AND ROBERT KITCHIN. University of Wyoming.

In mammalian red blood cells, the nucleus is ejected during the normal maturation. Lagging chromosomes which fail to undergo normal division and chromosomal fragments which are induced by drugs or radiation persist as readily visible micronuclei. Five drugs currently used in the treatment of acquired immunodeficiency syndrome (AIDS) are being assessed for in vivo chromosomal mutagenicity and potential carcinogenicity using the mouse bone marrow micronucleus assay. The five drugs, 3'-azido-2',3'-dideoxythymidine (AZT), 2',3'-dideoxyadenosine (DDA), 2',3'-dideoxyinosine (DDI), doxorubicin hydrochloride, and D-penicillamine (DPA) were tested at doses ranging from 25% to 400% of the normal human clinical dose. Preliminary studies indicate that AZT and DPA are not mutagenic. However, doxorubin hydrochloride, DDA and DDI are mutagenic and induce micronuclei in mouse bone marrow cells at doses within the clinical range used for AIDS patients.

230 Trends and Methods in Identification of Human Immunodeficiency Virus (HIV) Seropositive Personnel in Active-Duty U.S. Navy Enlisted Personnel: 1986-1989. FRANK C. GARLAND (Naval Health Research Center, San Diego, California (NHRC), EDWARD D. GORHAM (NHRC), STEVE O. CUNNION (Uniformed Services University, Bethesda, Maryland (USUS), MILAN R. MILLER, (NHRC), LOUIS L. BALAZS (NHRC), AND THE NAVY HIV WORKING GROUP.

Time-trends in the occurrence of HIV seropositivity are the basis for projecting the future course of the epidemic. This study presents quarterly rates of HIV infection during 1986 to 1989. During this period, 1,795,578 enzyme-linked immunosorbent assay (ELISA) tests were given to 848,632 active-duty enlisted personnel. Of the 2,438 seropositive personnel identified, 778 had a previous negative test. Mean rates determined by three different methods declined between 1986 and 1989. The mean seropositive rate per 1,000 tested showed a steady decline from 2.9 in 1986 to 0.5 in 1989 ($p < 0.05$). The mean age-adjusted seroconversion rate per 1,000 tested (with a previous negative test) declined from 3.4 in 1986 to 0.5 in 1989 ($p < 0.05$). The mean seroconversion rate per 1,000 person-years declined from 0.9 in 1986 to 0.4 in 1989 ($p < 0.05$). The observed decline was primarily due to declining rates in groups initially at high risk. The race ratio (black/white) declined from 3.9 to 2.7 over the same time-period. The overall decline in HIV rates could not be explained by changes in the population tested according to age, race, sex, occupational risk group, or geographic location of home port during the study period. The decline is encouraging, although the trend may reflect a pattern imposed on the Navy population by rigorous testing and exclusion of HIV seropositive individuals from entrance into service. Despite the decline in seroconversion, the majority of AIDS cases in the Navy may yet occur.

231 Diabetes Incidence in U.S Navy Active-Duty Enlisted Personnel, 1974-1988. EDWARD D. GORHAM (Naval Health Research Center San Diego, California, USA (NHRC), FRANK C. GARLAND (NHRC), ELIZABETH BARRETT-CONNOR University Of California, San Diego, La Jolla, California, USA (UCSD), WILLIAM PUGH (NHRC). CEDRIC F. GARLAND (UCSD).

Incidence studies of diabetes are rare in populations of young adults. Computerized career history records maintained at the Naval Health Research Center were used to determine person-years at risk (N = 7,245,026) by demographic characteristics and occupation for active-duty enlisted Navy personnel during 1974-1988. Computerized inpatient medical records were searched for first hospitalizations for diabetes in this population and 2,408 incident cases were identified during the 15-year study-period. For comparisons, age-adjusted incidence rates and Standardized Incidence Ratios (SIRs) were calculated. The overall incidence rate of diabetes in active-duty Navy personnel was 3.3 per 10,000 person-years. Diabetes incidence was higher among blacks (4.8 per 10,000 person-years) than whites (2.9 per 10,000 person-years)($p < 0.05$), and among men (3.4 per 10,000 person-years) than women (2.7 per 10,000 person-years) ($p < 0.05$). The incidence of diabetes increased with age in blacks and whites but the increase was 3 times greater among blacks. Incidence among 17-24 year-olds was 1.7 per 10,000 person-years in both blacks and whites. At ages 40 years and greater, incidence increased approximately 10-fold among whites to 15.3 per 10,000 person-years, and nearly 30-fold among blacks to 46.3 per 10,000 person-years (B/W race-ratio = 3.0). The pronounced increase in risk of hospitalization for diabetes at older ages and among black personnel suggests that these groups should be the focus of screening efforts.

232 Do Sunscreens Prevent Melanoma?
CEDRIC F. GARLAND, FRANK C. GARLAND, EDWARD D. GORHAM (University of California, San Diego, La Jolla, California).

There were approximately 27,600 new cases and 6,300 deaths from melanoma in the United States in 1990. Sunscreens prevent sunburn and are widely recommended for use in the prevention of skin cancer, although the epidemiological, animal, and laboratory evidence that sunscreens prevent melanoma is scant. Incidence rates of cutaneous malignant melanoma in the U.S., Britain, Canada, and the Scandinavian countries have risen more rapidly than those of any cancer except lung cancer. In New York there was a fivefold increase in annual incidence rates from 1.5 per 100,000 in 1950 to approximately 8 per 100,000 in 1985. Even in areas with longstanding campaigns promoting sunscreen use such as Queensland, Australia, incidence and death rates of malignant melanoma have risen steeply since the 1960s. Most sunscreens are efficient blockers of ultraviolet B radiation (UV-B), but are nearly transparent to UV-A (particularly the near UV-A). The UV-B portion of the spectrum is primarily responsible for sunburn and is thought to be responsible for damage to melanocytes and possible carcinogenesis. However, only 5 to 10 percent of all ultraviolet radiation is UV-B (295-319 nm), while 90 to 95 percent is UV-A. UV-A penetrates the skin more deeply than UV-B. About half the UV-A incident on the skin reaches the melanocyte, while only about 15 percent of UV-B striking the skin reaches this depth. Sunscreens suppress the warning signal of redness in people most susceptable to skin cancer, and allow intense UV-A exposure in people who could normally not tolerate it. The increase in sunscreen sales in the US over the last 25 years has roughly paralleled the increase in melanoma incidence and mortality. A fresh evaluation of the efficacy of sunscreens in preventing melanoma may be needed.

233 Sunlight, Sulfur Dioxide, and Breast and Colon Cancer in Italy
FRANK C. GARLAND, CEDRIC F. GARLAND, EDWARD D. GORHAM (University of California, San Diego, La Jolla, California).

Epidemiologic and laboratory evidence suggest that vitamin D plays a role in reducing colon and breast cancer risk. Vitamin D was first proposed as a protective factor based on the observation that mortality for colon and breast cancer is highest in areas of the United States and the world receiving the least sunlight. Dietary vitamin D intake of 150 IU per day or more was shown to reduce risk of colon cancer by one-half in a prospective epidemiologic study. Vitamin D receptors have been described for human breast and colon cancer cell lines and inhibition of *in vitro* growth by vitamin D metabolites has been reported. Sulfur dioxide absorbs ultraviolet light in the region of the spectrum which is most active in forming vitamin D on the skin. High levels of sulfur dioxide and sulfate air pollution (acid haze) are associated with increased colon and breast cancer mortality in Canada, and can lead to vitamin D deficiencies in exposed populations. Age-adjusted breast and colon cancer mortality rates increased by approximately 40 percent between 1955 and 1980 in Italy, during a period of increasing sulfur dioxide pollution. As in most areas of the world, as sunlight levels increase in Italy, there is a significant ($p < 0.05$) decline in age-adjusted mortality rates from breast and colon cancers. Annual mortality rates per 100,000 for breast cancer at ages 35-64 years in northern, central, and southern Italy decreased from 42 to 34 to 30, respectively. Corresponding rates of colon cancer in women were 17, 16, and 10; and in men were 23, 19, and 12. The mortality differences were paralleled by differences in incidence rates. The north-south decline and the positive association with sulfur dioxide was absent for other cancers, and is consistent with a protective effect of vitamin D for colon and breast cancer.

234 Negative Schizophrenia as a Variant of Parkinsonism.
REUVEN SANDYK, M.D., M.Sc., STANLEY R. KAY, and ABRAHAM FISZBEIN, M.D. (Albert Einstein College of Medicine/Montefiore Medical Center and Bronx Psychiatric Center)

Based on clinical, neuroradiological, and pharmacological similarities, we have recently proposed that negative symptoms in schizophrenia may be a variant of parkinsonism, both sharing common pathophysiological mechanisms, and reflect the core pathology of the schizophrenic illness. To empirically investigate this association, we examined in 46 neuroleptic-stabilized chronic schizophrenic patients (42 men, 4 women; mean age = 33.1 years, SD = 8.3) the association of drug-induced parkinsonian symptoms with positive and negative features of schizophrenia. Parkinsonism was evaluated on Alpert's Extrapyramidal Rating Scale (ERS), which evaluates parkinsonian symptoms along seven dimensions that include gait, rigidity, tremor, abnormal movements, expression, restlessness, and bradykinesia. Positive and negative symptoms were blindly and independently rated according to the 4-item SAPS and 5-item SANS of Andreasen. The prediction that parkinsonism

would correlate with negative symptoms alone was tested with unidirectional Pearson product-moment analysis. The results indicated a significant association of ERS with global negative symptoms (r = .27, p <0.05) and, among individual items of the negative scale, with alogia (r = .31, p < 0.05) and avolition-apathy (r = .29, p < 0.05). By contrast, the ERS was unrelated to the global positive symptom rating and each of the constituent items. The findings were thus consistent with the hypothesis of a specific relationship between negative features of schizophrenia and parkinsonism. The significance of these findings for a broader conceptualization of the schizophrenic illness and Parkinson's disease, and the potential implications for the pharmacologic and neurosurgical treatment of schizophrenia, will be discussed.

235 Drug-Induced Parkinsonism: Relationship to Age at Onset of Schizophrenia.
REUVEN SANDYK, M.D., M.Sc., STANELY R. KAY, Ph.D., and ABRAHAM FISZBEIN, M.D. (Albert Einstein College of Medicine/Montefiore Medical Center and Bronx Psychiatric Center)

Several studies indicate that early age of onset of schizophrenia predicts an unfavorable prognosis and is associated with core negative symptoms. Since we have postulated that the latter shares a common pathophysiology with parkinsonism, we predicted that schizophrenic patients with parkinsonism would have an earlier age of onset. To test this prediction, we studied 40 female DSM-III diagnosed chronic institutionalized schizophrenic patients (mean age = 61 years, SD = 8.7), who were selected consecutively for the presence of drug-induced movement disorders and history of continuous neuroleptic therapy for at least one year prior to assessment. Patients with early onset schizophrenia were defined as those in whom the illness had begun during adolescence, i.e., between ages 14 and 19, in contrast to those with later onset. Parkinsonism was evaluated blindly with respect to age of onset by use of a modified version of the Simpson-Angus Scale for Extrapyramidal Effects. For comparative purposes, a diagnosis of persistent tardive dyskinesia (TD) was made according to the Research Diagnosis for TD (RDTD) criteria, and history of drug-induced dystonic reactions was obtained from reviews of the patients' charts. Of the 40 patients, 20% had an early onset of illness; 43% had parkinsonism; 53% had persistent TD; and 15% had a history of drug-induced dystonia. Parkisonism was unrelated to TD (X^2 = .68) and dystonia (X^2 = .30). We found that the prevalence of parkinsonism was significantly greater in patients with early onset of schizophrenia (75%) vs. those with later onset (34.3%; X^2 = 4.32, p < 0.05). By contrast, age of onset was not associated with the prevalence of persistent TD or drug-induced dystonia. Accordingly, the results supported the prediction of a specific association between age at onset of schizophrenia and the risk for parkinsonism. The significance of these findings for the pathophysiology of Parkinson's disease will be discussed.

236 Pineal Calcification as a Marker for Nonfamilial Schizophrenia.
STANLEY R. KAY, Ph.D., REUVEN SANDYK, M.D., M.Sc., J. DANIEL KANOFSKY, M.D., M.P.H., and ABRAHAM FISZBEIN, M.D. (Albert Einstein College of Medicine/Montefiore Medical Center)

Although disturbances in pineal melatonin functions have been implicated in the pathophysiology of schizophrenia and pineal extracts have been found efficacious for its treatment, structural abnormalities of the pineal gland in schizophrenia have received scant research attention. Specifically, to our knowledge there has been no comparison of pineal gland structure in schizophrenic vs. nonschizophrenic subjects or, particularly, in familial vs. nonfamilial schizophrenia. There is evidence, however, that structural brain abnormalities in nongenetic schizophrenia may in part be related to maternal obstetric complications. To investigate these issues, we evaluated pineal calcification (PC) size on computerized tomographic (CT) scan of 22 neuroleptic treated schizophrenic inpatients (20 men, 2 women; mean age 31.2 years (SD = 5.95) in relation to family history of schizophrenia and perinatal complications. The CT scan rater was kept blind to the identity of subjects, and patients' family and perinatal histories were ascertained by chart review plus direct family interview. PC size for the 12 patients without family history of major mental illness (mean = 11.33 mm, SD = 4.80) was significantly larger than for the 10 who had a family history of major mental illness (mean = 7.04 mm, SD = 3.93; t = 2.26, p 0.05). The two groups did not differ significantly with respect to age, age at onset, and duration of psychiatric illness. In addition, there was a significant association between PC size and history of maternal complications during delivery as derived from the scale of Parnas et al (e.g., bleeding, seizures), r_{pbi} = .46, p < 0.05, which itself was related with family history of major mental illness (C = -.23, n.s.). These findings may indicate disturbances of melatonin secretion in non-familial schizophrenia and suggest that the origins may be traced to perinatal injury. Our findings support the position that structural brain abnormalities in schizophrenia are at least partly due to nongenetic factors and provide evidence that perinatal insults may be among the nongenetic factors involved.

237 Pineal Calcification: Relationship to Age of Onset of Schizophrenia.
ABRAHAM FISZBEIN, M.D., REUVEN SANDYK, M.D., M.Sc., and STANLEY R. KAY, Ph.D. (Albert Einstein College of Medicine/Montefiore Medical Center and Bronx Psychiatric Center)

We have suggested a crucial role for the pineal gland in the onset and pathogenesis of schizophrenia, proposing that critical changes in melatonin secretion during puberty may in part be related to development of the illness. Since pineal calcification (PC) may reflect the metabolic and secretory activity of the gland, we investigated in 95 randomly selected chronic institutionalized schizophrenic patients (44 men, 51 women, mean age = 42.1 years, SD = 13.7) the association of PC from computerized tomographic (CT) scan with age of onset of the disease. The latter was judged independently and blindly with respect to CT scan data on the basis of patients' histories, and it was operationalized as the age at which the florid symptoms first emerged. Since schizophrenia typically begins during adolescence, early onset schizophrenics were defined as those in whom the illness had begun prior to age 20, in contrast to those with later onset. In our sample 14 patients (14.7%) were found to be early onset schizophrenics; on average their illness was first manifested at age 17.7 years, 14 years sooner than the later onset patients. The two groups did not differ with respect to current age, any of the historical and treatment variables, duration of hospitalization, and neuroleptic exposure. The prevalence of PC in patients with early onset, however, was significantly higher than that for the later onset schizophrenics (80.0% vs. 52.5%; X^2 = 3.89, df = 1, p < 0.05). These findings highlight the importance of the pineal gland for the timing of schizophrenia and, by implication, for its pathogenesis and prognosis. When considered within the context of basic research, our data suggest that the pineal gland may exert a protective effect against the onset of the disease.

238 Evidence for Chaos as a Normal Attribute of the Healthy Fetal Heart. Ronald E. Goans and Alfred L. Yergey, Laboratory of Theoretical and Physical Biology, NICHD, The National Institutes of Health, Bethesda, Maryland, and Department of Obstetrics and Gynecology, The University of Tennessee Medical Center at Knoxville, Knoxville, Tennessee.

Long electronic fetal heart rate time series taken from fetal monitoring during normal human labor and delivery have been analyzed using techniques derived from the theory of nonlinear dynamical systems. The largest Lyapunov exponent for each series has been calculated using the Wolf Fixed Time Evolution Algorithm and is positive for all clinically normal cases studied to date. This exponent averages 1.08 ± 0.3 for 225 normal fetal time series studied, but is parametrically dependent on the various variables of the phase space algorithm. The correlation integral for each series has been calculated by embedding the time series in successively higher dimensions using the Takens method. Correlation dimensions calculated using this technique average 2.7 ± 0.5 and the correlation integrals display a long scaling region. From these observations, fetal heart rate time series with clinically normal short and long-term variability appear to be chaotic under currently accepted criteria for chaotic systems. Pathological fetal heart rate series with decreased variability are seen to be nonchaotic with a negative Lyapunov exponent. A numerical simulation experiment illustrates the smooth transition from chaotic to nonchaotic behavior as the fetal short-term variability decreases. Our findings are in agreement with recent hypotheses by Goldberger and West in similar experiments on adult cardiac time series. Chaos is therefore apparently a normal finding in the healthy human heart.

239 Electromagnetic Fields and Evolution. IRVING SIMON (Unaffiliated)

The study of evolution has been enhanced with the major advances that has been made in the field of molecular biology. However, it may be necessary to learn more about what is going on at the atomic level if we expect to get a better understanding of the mechanisms that are involved which perpetuates the evolutionary process. The use of new technology (MRI, SQUID) to probe the electromagnetic fields emitted by organisms may further that research.

The study of the effects of electromagnetic fields (EMF) on organisms is rapidly becoming a major discipline. Concern that EMF may be contributing to cancer has led to epidemiological studies and laboratory research to determine if that is so.

It has also been noted that the communications between neurons in the brain, long thought to be due to a chemical process, is actually orchestrated by EMFs.

Mutations, as well as adaptations, must take place during the embryonic stages of organismic development. It is no coincidence that, at those stages, organisms are most vulnerable to EMF.

My paper explains just how EMF may affect the atoms of which organisms are composed in such a way as to direct their growth and development. It will also show how interacting, or commingling, electromagnetic fields, those associated with the environment as well as those associated with organisms, may influence one another to further their evolution as well as the evolutionary process in general.

240 Composition of Human Plaque Fluid of Patients Diagnosed as Having Mild to Moderate Periodontal Disease. LISA A. JOHNSON, D.D.S.

Previous studies have determined the composition of both the organic and the inorganic phases of resting pooled human plaque fluid in

average dental patients in absence of diagnosed periodontal disease. The purpose of this study is to determine the composition of human plaque fluid in a sampling of patients diagnosed as having mild to moderate periodontal disease. To this end 50 adult patients were randomly selected, all with non-contributory health histories, i.e., no genetic defects, systemic diseases, medicinal influences in a double blind study from a patient pool of a private practitioner the patient load of 2,000 were used as subjects of this study. 25 of the patients were diagnosed as having mild to moderate periodontal disease by one or more practioners working together or independently of each other in reaching this diagnosis. The subjects were treated routinely to reach a maintenance stage. At this point, plaque fluid samplings were taken and analyzed using the methods described by E. C. Morino and H. C. Margolis, et al. and P. Bnkatswarlu and A. Tatebossian with deviations and modifications to be described in subsequent publication along with results, which are still being analyzed.

241 Clinical Dental Information, A Necessary Part of Medical Education. M. LORBER, W. K. BOTTOMLEY, D. C. REYNOLDS. (Georgetown University School of Medicine, Washington DC 20007).

Medical education should afford basic knowledge of all common disorders. Therefore, dental information deserves to be an integral part of the curriculum. Knowledge of dental disease would help future physicians recognize major systemic complications of oral disorders and dental treatment and prevent deaths (NEJM 299:364, 1978). It would most benefit patients who avoid dentists. In our medical school each sophomore receives six hours of lectures in clinical dentistry. "Advanced Physical Examination of the Oral Region" (1 hr.) includes: 1) Seven questions for the medical history to alert the student to possible oral problems. 2) Relationships of teeth. 3) Use of a tongue blade to elicit pain or mobility and of the stethoscope to auscult the TMJ. 4) Abnormalities in color and contour of teeth. 5) Age changes. 6) Identification of fillings, crowns, bridges and dentures. "An Overview of Dentistry" (2 hrs.) encompasses: 1) Medical-dental consultations. 2) Dental aspects of 24 systemic conditions requiring delay or modification of dental care. 3) The appearance and complications of periodontal disease and dental caries. 4) The scope of each dental specialty, with emphasis on medical aspects. "Oral Surgery" (1 hr.) discusses: 1) Radiology. 2) Simple extraction and removal of impacted teeth. 3) Jaw fractures. 4) Orthognathic surgery. "Oral Diagnosis" (2 hrs.) includes the appearance, etiology, diagnosis and management of 44 disorders. These sessions are well accepted. The oral region is recognized as just another area to be mastered so competent medical care can be provided. Your hospital's dentists can staff a similar program. Please send for a packet of handouts and reprints.

242 Relationship of Hospitalizations to High Temperatures in Two Climatic Regions in the U.S. CAROL HAZARD (University of North Carolina at Chapel Hill).

An increase in the number of deaths, particularly cardiovascular deaths, has been shown to occur when temperatures remain at an elevated level for a period of days. The definition of "elevated temperature" has varied from study to study and usually covered a relatively short time period. At the same time, other studies have defined extremes in temperature, but have rarely used these definitions in applied situations over a whole year. This study used thirty-eight years, 1949-1986, of daily maximum temperatures in two cities in the United States to develop mean daily high temperature models. Hot days were defined as occurring when daily high temperatures were equal to or greater than one standard deviation above the model daily mean high temperature and could occur at any time of the year. Dates of hospitalizations of middle-aged white males were compared to the dates when temperatures equalled or exceeded the definition of a hot day. A relationship was found between all cause hospitalizations, as well as cardiovascular hospitalizations. Lags of one day were found to be significant and longer lags of two and three days served to reinforce the effect of heat on hospitalizations.

243 **The Federal Regulation of the Quality of Clinical Laboratory Testing: Technological and Regulatory Issues. Donald Levanty, J.D. (Marymount College) and Stanley Edinger, Ph.D. (U.S. Public Health Service)**

The Clinical Laboratory Improvement Act Amendments of 1988 (CLIA) was a landmark effort to extend federal regulation to all clinical laboratory testing sites including physician's offices. The legislation required the imposition of quality control, quality assurance, personnel, proficiency testing requirements on facilities as well as increased federal sanctions (civil and criminal), a fee-for-service payment system and exemptions of laboratories which perform "simple tests" with an insignificant risk of an erroneous test result. The regulations developed to implement the statutory provisions were supposed to include provision for the "complexity" of the methodology used in the testing.

The Health Care Financing Administration (HCFA) issued proposed regulations to implement most of the provisions and received over 50,000 comments on issues including access vs quality of care; personnel qualifications; responsiveness of the regulations to technological changes. The latter included the accuracy, precision, stability, simplicity and degree of "error-proofness" of modern instrumentation and testing protocols and the degree of evidence required to verify manufacturers claims. It has also raised issues concerning what is the medically relevant degree of accuracy and precision required of testing in various settings, how to measure the quality of the testing in the most cost effective manner and the importance of testing in patient care. The paper will explore these issues and possible options.

401-444 Physical Sciences; Environment; Ecology

(Mon., 18 Feb., 9:45–11:45 am)

401 **Application of Field Reshaping Theory In A Neural Network Controller For Active Attenuation.** RICHARD T. GORDON, WILLIAM D. VINING (Chubb & Son, Inc. & Central Missouri State University)

Experimental work in active attenuation has been limited by the state of the art in the electric circuitry utilized as the adaptive controller. Feedback and non-causality pose fundamental limitations to many active attenuation problems. Field Reshaping Theory (1) provides a formalism to develop a controller model in which these limitations are not inherent. This poster presents a model of an adaptive neural network employing field reshaping theory (FRT) as the controller for an active attenuation system. In this model a neural network based on a multi-layer perceptron is presented a vector representation of a primary noise field F, radiating from a primary source S, into a 3-D space EF. FRT shows that the radiation of F from S will be governed by the equation OP F = S, where OP is a physical operator. Then let F be reshaped to become F' = N F, where N is a reshaper. Next let OP N F = OP N F + (OP N F - OP N F). Then substituting we have OP F = N S + S', where S' is a secondary reshaping source. This shows that the desired controlling field F' can be radiated into EF by S' where S' = Q F, and Q is the Lie product of the operators OP and N. Choosing suitable expressions for OP and N, the relationship for S' is then implemented in the network by mapping F to S' utilizing Q. The three-layer perceptron architecture employing a back-propagation training algorithm was chosen for its ability to implement complex functions.

(1) M. Jessel, S. Yamada, J.Acoust.Soc.Jpn(E), 8, 4, p. 151-4, 1987

402 **High Performance Flexible Computing System for Real-Time Biomedical Signal Processing**

Elias S. Manolakos, Haris M. Stellakis
Communications and Digital Signal Processing Center (CDSP)
Electrical Eng. Dept., Northeastern University, Boston MA 02115

In the last few years and in response to the limitations of *power spectrum* analysis substantial research has been done towards developing *Higher Order Spectra (HOS)* techniques for a variety of application domains, including biomedical signal/image processing. HOS are defined as the Fourier transform of higher order auto-correlations (or, more exactly, of higher order *cumulants*), including the power spectrum as a special case. Moving to higher spectral dimensions exhibits a number of desired properties, such as insensitivity to Gaussianity and sensitivity to phase and to non-linearities. We applied HOS techniques with success to extract useful information from signals like ECG, EEG, EMG. The major drawback remains the extremely high computational complexity. Hence *parallel processing* is mandated to extend HOS applicability to *real-time* operating environments.

In this paper we present a unified VLSI array architecture that can accommodate real-time computation of many HOS based algorithms. Our design has been *systematically* derived allowing rigorous transformation of regular algorithms to processor array structures. The array functional correctness has been proved analytically and verified by simulations on a board of T-800 Transputers. We expect to fabricate the first family of processing elements (PEs) using 1.2μ MOSIS CMOS technology in the near future. Assuming that the incoming data are partitioned in successive blocks of M tokens/block the optimized mesh-type array enjoys the following characteristics: (a) Maximum uniform PE utilization; all PEs remain continuously busy. (b) Minimum completion time for a class of HOS based algorithms; at least two successive data blocks can be processed every $3M-1$ steps. (c) Maximum pipelinability; at least two successive data blocks can be fed in the array every $M+1$ steps. (d) One type of PEs with simple control programmable or hardwired.

403 Applications of Information Theory to Computer Security. IRA S. MOSKOWITZ (Center for Secure Information Technology, Naval Research Laboratory)

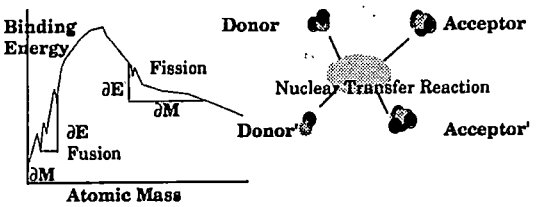
We will show how Shannon's information theory can be used to examine some important issues in computer security. Our interest is in quantifying how much information, in a supposedly secure computer system, can leak across a covert communication channel. We examine different types of covert channels. Of particular interest are timing channels where the response time of a request actually passes a message covertly. The "size" or capacity of these channels is a number looked at with great concern by computer manufacturers who wish to design secure computer systems. The audience for this presentation is all those who are interested in applying mathematical techniques to computer security. Background material will be presented to show how this research relates to other work in the field of computer security. Specifically, we will first discuss existing mathematical models that deal with access controls. Then we will look at the theories that deal with covert channels and examine certain security flaws in those models. The bulk of the investigations will be via information theory. Our work will also be related to the more publicized topic of hackers and viruses.

404 Neutron Transfer as an Alternative to Fission and Fusion for Nuclear Power. WILLIAM H. MOOK, JR. (Mobis, Corporation & JCM Enterprises).

Different nuclei are held together with different amounts of energy. Nuclei of middle atomic weights possess the most binding energy per nucleon. Thus processes which combine lightweight nuclei, or processes which break apart heavy nuclei are capable of releasing power from the nucleus. These processes are well known, they are called *Fusion* and *Fission* respectively.

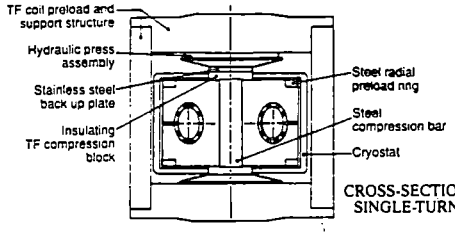
Another process can be contemplated which is capable of releasing nuclear energy. This process I call *neutron transfer*. Transferring neutrons, or parts of nuclei from a nucleus where they are loosely bound to nuclei where they are tightly bound may release nuclear energy. Such transfers may be capable of releasing nuclear energy without the creation of radioactive disintegration series products.

The viability of the proposed process is analyzed and potential fuel cycles are considered. Four well known nuclear processes are examined; neutron capture, photneutron emission, neutron doubling reactions, and photon doubling reactions.



405 Use of Advanced Electromechanics Engineering for the Scientific Study of Fusion Ignited Plasmas. R. CARRERA (The University of Texas at Austin).

A relatively simple and low cost fusion experiment, IGNITEX, is described. The experiment can be realized in a single-turn tokamak device as indicated below. This type of magnetic system can produce very high magnetic fields and induce very high plasma currents. The conditions in IGNITEX should be sufficient to ohmically start a self-sustained fusion reaction with deuterium/tritium fuel. To drive the IGNITEX magnet system, the use of homopolar generators is envisioned because of the demands for high current and low voltage. The original IGNITEX concept has been proposed by Profs. Marshall N. Rosenbluth, William F. Weldon, and Herbert H. Woodson at The University of Texas at Austin. The primary objective of the experiment is to produce and control ignited plasmas for scientific study in the simplest and least expensive way possible. The experiment is aimed to reproduce the crude and basic "pile of bricks" system that was utilized to produce a self-sustained fission reaction about fifty years ago. It is possible in the near term to advance the science of controlled thermonuclear fusion through the use of state-of-the-art engineering. The close interactions between science and engineering in the definition of the IGNITEX experiment are discussed.



CROSS-SECTION OF THE IGNITEX SINGLE-TURN-COIL TOKAMAK

406 The Laboratory of the Future. J. J. Eberhardt (U.S. DEPARTMENT OF ENERGY), J. K. Young (PACIFIC NORTHWEST LABORATORY)[a], P. M. Molton (PACIFIC NORTHWEST LABORATORY)[a]

Rising costs and the rapid pace of developments in instrumental analysis techniques will require more efficient allocation of programmatic research funds for experimental research programs. The authors show that scientific investigation is being transformed from a linear, isolated approach to a hierarchical, multidisciplinary methodology. The transformation began at the end of World War II with the development of electronic data processing equipment. The process has continued to today's sophisticated electromagnetic probes, which are becoming a mandatory part of most experimental analysis. Synergistic developments are leading to instruments with multiple probes and diverse data analysis capabilities, but their high costs and short lifetimes necessitate a coordinated, centralized research approach. The laboratory of the future will be a central "user facility" with highly automated instruments, specialized staff to operate and maintain equipment, and network access to both instruments and supercomputers.

(a) Pacific Northwest Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute under Contract DE-AC06-76RLO 1830.

407 Research in Science And Engineering: An Analysis of Energy Research Issues for the Department of Energy. BRAD ASHTON (Battelle - Northwest), TED HINDS (Battelle - Northwest) FREDERICK MARCH (Battelle-Northwest), and PHILIP STONE (Department Of Energy).

Specific strategies to improve the Department's and the nation's capabilities for energy-related scientific and technological research have been developed. Both institutional issues and funding mechanisms were analyzed. Strategies that could be implemented within current funding levels were identified: (1) establish national science priorities; (2) capitalize on international collaboration; (3) stimulate industrial basic research; and (4) focus ongoing strategic research (basic and applied) on energy technology needs. Two approaches that would require budgetary supplementation are (1) strengthen university science capabilities, and (2) maintain state-of-the-art research facilities. Underlying the analysis of these approaches are several questions regarding relative priorities, both within and among disciplines, which are presented here. A workshop held in October 1990 judged these six approaches to be both useful and feasible, from the Department's perspective, with the focus on university research and facilities being of central importance. Specific initiatives are being considered in the Department for the two approaches requiring funding increases.

408 Optical Remote Sensing Techniques Applied to a Study of Gray Whale Hydrodynamics. JOHN W. FOERSTER (United States Naval Academy).

The gray whale (*Eschrichtius robutus*) is a large marine mammal. It migrates annually from calving grounds in Mexico to the feeding grounds of the Bering Sea, a distance of 18000 kilometers. To be an efficient swimmer, the gray whale must overcome the energy consumptive influence of turbulence. I studied the efficiency of the animals' swimming hydrodynamics using computerized remote sensing techniques and an expert system. The hypothesis tested was that gray whales swimming at migration speeds (1-3 m/sec) achieve laminar flow. As a whale nears the surface to breathe, wakes are created and bubbles entrained. This change is measurable in digitized photographs by studying the picture element (pixel) values. Also, expelled air, and purged mud from the feeding process were used as simulated dye tracers. Laminar flow was the finding. The study continues to explore power output and propulsive efficiency.

409 On the Paleoweathering Crust-Enriched Iron Deposits
FANRENG ZENG (Northeast Univ. of Technology, Shenyang, Liaoning, PRC)
Weathering crust-enriched iron deposits take precambrian banded formations such as source beds formed under humid tropical climate. Silica leaches out and ferric oxides accumulate, thus gradually enriching the ferric oxides. However, formation of such iron deposits is governed by three factors: (1) precambrian banded iron formations, (2) humid tropical climate, and (3) the rate of weathering overtaking erosion, thus forming a weathering crust. Under the same climatic conditions, lateritic soils are formed from other rocks by a process of outleaching silica and enriching alumina and ferric oxides. Because there is little or no alumina in the precambrian banded iron formations, the remained materials are chiefly ferric oxides. Actually, weathering crust-enriched iron depoists are varieties of lateritic soils. In the presence of precambrian banded iron formations, lateritic soils are guides for exploring and assessing weathering crust-enriched iron deposits. Lateritic soils are composed chiefly of clay fractions. Chemically, they are distinguished by two ratios: $SiO_2:Al_2O_3=2$; $SiO_2:R_2O_3=1.6$. The lower the ratios, the more silica is outleached and the more ferric oxides are enriched. Mineralogically, they are characterized by Al2O3-hydrates in the form of gibbsite, boeminte, and/or diaspore. These criteria also can be applied to assess palaeolateritic soils and to guide exploration for palaeoweathering crust-enriched iron deposits such as those situated in the medium- to high-latitude regions of Kursk (54N) and Drivoi Rog (48N), USSR. But the co-existence of lateritic-type bauxite deposits proves that they were formed under humid tropical climate conditions.

410 **Military Geology for Engineers.** SALEH M. BILLO (King Saud University, Saudi Arabia).

Military geology involves terrain analysis for strategic and tactical operations. The erection of airfields, roads, tunnels, and water systems requires adaptations of military geology to meet the changing technical demands. Computer-and satellite-generated charts and maps currently deployed by U.S. troops in Saudi Arabia show vital battlefield tips, such as the strength of the bridges, and a survey of the geologic and hydrographic features of Saudi Arabia and Iraq. The new mapping technology pinpoints SAM 7 missile sites in Iraq, helps ground forces, and allow a pilot to follow land contours using terrain to hide the fighter from ground-based radar and other menaces. Geologic and topographic maps, and aerial photographs of remote or alien areas are also used to locate the best sites for airborne raids, missile launching, cratering and blast shielding by topographic features from atom bombs.

411 The Water Cycle in Climate Change: Some Potentials for Improved Information from Satellite Observations. A.K. McQUILLAN (Canada Centre for Remote Sensing, Ottawa, Canada)

The water cycle is of central importance in the climate system. In spite of extensive study, there is still much uncertainty associated with its detailed treatment in climate models. Projections of the response of the climate system to anthropogenic forcings, for example, effects of increases of atmospheric greenhouse gas concentrations, must include a realistic treatment of water cycle components. Topics of particular concern include measurement and representation in models of cloud processes and cloud feedback, water vapor distribution and feedback, distribution and intensity of convective activity, soil-vegetation-atmosphere exchanges of moisture and energy, interaction with major biogeochemical cycles, e.g., in atmospheric and terrestrial ecosystem processes, and others. Observational sampling deficiencies related to the high temporal and spatial variability of the water cycle are a major contributor to present uncertainties. Satellite programs beginning in this decade will address many of the current observational limitations. In particular, the sensitive response of many water cycle parameters to microwave remote sensing will be much more fully exploited. This paper will examine the applicability of satellite data to the monitoring of selected water cycle components, with emphasis on tropical and high latitude regions and on microwave sensing, including applications for which RADARSAT synthetic aperture radar data will be particularly valuable.

412 A General Method for Determining Impacts of Climatic Change: Northeastern United States Air Pollution Applications. Arthur N. Samel (University of North Carolina at Chapel Hill).

Researchers in a number of climate related fields are concerned about the potential effects of a greenhouse gas induced atmospheric warming. In an attempt to minimize future losses linked to climate change, specific impacts must be determined. The numerical tool used to project values of atmospheric variables is the general circulation model (GCM). Concentrations of carbon dioxide (CO_2) in the GCM atmosphere can be varied and decadal integrations allow for the development of climatologies. However, GCM output must be presented in a form that will be of use to the planner. A general method for the application of doubled CO_2 ($2xCO_2$) GCM output to problems in specific subdisciplines is presented. It will be shown that, beyond the development of general climatologies, the format of the GCM output must be refined to meet the specific data needs of the planner. To illustrate the method, 500 millibar $2xCO_2$ GCM output is used to imply changes in air pollution potential over the Northeastern United States.

413 An Automated Sensitivity Analysis Procedure Applied to an Atmospheric Disperion Model. R.J. RARIDON, J.E. HORWEDEL, AND R.Q. WRIGHT, Computing and Telecommunications Division, Oak Ridge National Laboratory*, Oak Ridge, TN 37831.

A method is described for performing a comprehensive sensitivity analysis by making use of computer calculus. The automated procedure employs a system called GRESS(1) to enhance a FORTRAN computer code by adding derivative-taking capabilities. From a single run of an enhanced model, GRESS calculates and reports normalized sensitivities of selected results with respect to all input data. The automated GRESS procedure is applied to the code AIRDOS-EPA(2), used to estimate radiation doses caused by atmospheric dispersion of radionuclides. Results demonstrate that an automated procedure can be used cheaply and efficiently to perform a comprehensive sensitivity analysis of existing computer models.

*Managed by Martin Marietta Energy Systems, Inc. for the U.S. Dept. of Energy under contract DE-AC05-84OR21400.
(1) Horwedel, J.E., Worley, B.A., Oblow, E.M., and Pin, E.M. "GRESS Version 0.0 Users Manual," ORNL/TM 10835, Oak Ridge National Laboratory, Oak Ridge, TN 37831, 1988.
(2) Moore, R.E., et al., "AIRDOS-EPA: A Computerized Methodology for Estimating Environmental Concentrations and Dose from Airborne Releases of Radionuclides," ORNL-5532, Oak Ridge National Laboratory, Oak Ridge, TN 37831, 1979.

414 A Mechanism for Ice Crystal Symmetry and for Processes of Ice Crystal Growth and Interaction. RICHARD L. PITTER (Desert Research Institute), and WILLIAM G. FINNEGAN (Desert Research Institute).

The high degree of symmetry in atmospheric ice crystals is postulated to be a result of electrical equipotential in the conducting liquid film on the growing edges of the crystal, due to selective ion incorporation into the ice phase, which leaves rejected ions in the liquid layer at the growing interface. Laboratory studies of freely-falling ice crystals growing by vapor diffusion at water saturation support this concept. Ice crystals grown from deionized water exhibit less symmetry due to insufficient charge density in the liquid layer.

Ice crystal shape is also affected by the solutes present: Ice crystals containing salts which produce higher freezing potentials (primarily ammonium salts) develop more elaborate morphological structures. The charge density in the liquid layer acts to extend the area of the growing ice interface, contrary to the surface tension force which tends to form a more compact crystal.

The magnitude of selective ion incorporation depends on the composition of included salts, and in turn influences ice crystal growth and interaction processes. Ice crystal aggregation, ice multiplication, and ice crystal scavenging of aerosol particles, are affected by included salts in the growing ice crystals.

415 Chemical Reactions in Growing Snowflakes. WILLIAM G. FINNEGAN (Desert Research Institute), and RICHARD L. PITTER (Desert Research Institute).

Sulfide and sulfite ions were found to oxidized to sulfate ion in rapidly growing snowflakes. In laboratory cloud chamber experiments, ice crystals, formed by nucleation of cloud droplets 10^{-4} N in ammonium sulfide, were found by ion chromatographic analysis to convert about 50 per cent of their sulfide ion to sulfate ion within the 1 to 3 minutes they have for growth and fallout. Similarly, ice crystals oxidize iodide and bromide ions (to currently unknown products) in 20 to 30 per cent conversions in selected chemical systems, and readily reduce both silver and nitrate ions in systems containing silver fluoride and sodium nitrate.

These various coupled oxidation-reduction reactions result from the selective incorporation of ammonium or halide ions into the ice phase during the rapid snowflake growth. Subsequent electron tansfer between the ice and aqueous phases then accomplishes the REDOX reactions. In situations where ions suitable for oxidizing or reducing are not present, water then participates in the reaction to give oxygen or hydrogen.

Continued research will identify the oxidation products of the halides and determine whether carbon dioxide (or carbonate ion) is reduced in, for example, snowflakes containing sodium chloride. The atmospheric implications of these reactions, either as a source for reactive halogens or as a sink for atmospheric carbon dioxide, are obvious.

416 Temperature Effects of Microwave Radiometer Calibration. TEDDY L. BARBER, U.S. Army Atmospheric Sciences Laboratory, EDWARD M. MEASURE, U.S. Army Atmospheric Sciences Laboratory, Randy Hulsey, Physical Science Laboratory, New Mexico State University.

A surface-based, microwave radiometric temperature profiling system is being developed and tested. The profiler measures atmospheric brightness temperatures at several elevation angles and at 4 frequencies between 50 and 60 GHz.

An important consideration for such a system is the ability to obtain reliable data in a wide variety of climatic conditions. One of the most important weather effects for such a system is temperature. Temperature effects on the profiling system were tested by performing measurements in a temperature controlled climate chamber. Chamber temperatures were systematically varied from -40 C to 52 C. During the measurement periods the system antenna was aimed at a temperature controlled (100 C) microwave absorbing surface. Results showed good performance of the system across the temperature range of the measurements.

417
Carbon Dioxide Information Analysis Center: Providing Information about Global Change. Frederick W. Stoss. (Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory).

The Carbon Dioxide Information Analysis Center (CDIAC), located in the Environmental Sciences Division of Oak Ridge National Laboratory, has been in operation since 1982. CDIAC is funded by the U.S. Department of Energy (DOE) to support the DOE Carbon Dioxide Research Program (CDRP). The goal of CDRP is to develop sound scientific information for policy formation and government action in responses to changes in concentrations of atmospheric carbon dioxide and other greenhouse gases. CDIAC provides information support to the international research, policy, education, and information communities. CDIAC activities include obtaining and evaluating data, articles, and reports. The center also produces digital numeric data packages (NDPs) and computer model packages. In addition, CDIAC distributes CO_2-related reports and produces special publications. Since 1985 CDIAC staff have responded to more than 20,000 requests for information. This poster presentation will summarize this unique information program, including a review of the production of NDPs and the availability of CDIAC reports and special information products.

418 Acid Rain Inhibits Ectomycorrhizae and Root Development in Southern Pine Forests. R. J. ESHER, Mississippi State University; D. H. MARX, S. J. URSIC, and R. L. BAKER, USDA Forest Service; L. R. BROWN, Mississippi State University; D. C. COLEMAN, University of Georgia.

A 2-year study evaluated the effects of acid precipitation on the forest floor community. Throughfall was collected at weekly intervals, acidified to pH 4.3 and 3.6, and applied to throughfall excluded m^2 plots in a stand of loblolly pine (*Pinus taeda* L.) in south Mississippi, and in a longleaf pine (*P. palustris* Mill.) plantation in east Texas. Control plots received ambient throughfall. Five plots of each treatment at each location were destructively sampled after one year and the five remaining plots were sampled after two years. Chemical analyses were conducted for all collections of throughfall and litter leachate, and for the fermentation layer, rhizosphere, and mineral soil. After two years, comparisons of the 3.6 pH plots with the controls indicated significant decreases in the number, length and biomass of lateral roots, and the percent and number of ectomycorrhizae. Most of these differences were also evident after one year of treatment. Decreases in root characteristics for plots subjected to applications of throughfall acidified to near-ambient pH 4.3 were also significant or bordered on significance. Numbers of herbivorous mites increased significantly with decreasing pH, but the predaceous mites appeared insensitive. Treated plots had fewer numbers of some groups of macroinvertebrates, especially earthworms, but variation was too great to show significance. The acid treatments had little effect on numbers of nematodes, saprophytic fungi or endomycorrhizal fungi.

419
Effects of Cadmium on Hepatic Microsomal Activities in Male Rats. JAMES GUILFORD, Edward Eugere, Alex Richard and Gouri Mitra, Texas Southern University, College of Pharmacy and Health Sciences, Houston, Texas 77004.

Male Sprague-Dawley rats were exposed to cadmium chloride at concentrations of 0.05, 0.58, 17 and 352 ppm in their drinking water for 29 weeks. The blood pressure, body weight, water intake, microsomal protein, cytochrome P-450, nitroanisole-O-demethylase, cytochrome P-450 reductase and heme oxygenase were recorded. At the end of the 29 week period all animals were sacrificed and the liver, kidney, abdominal fat, lung and heart were removed and weighed. Those rats drinking 352 ppm $CdCl_2$ showed a significant decrease in the rate of weight gain compared to the control and the other groups. Up to the 19th week, those rats receiving the highest level of cadmium showed a significantly higher blood pressure than the control and the other groups. Microsomal protein and cytochrome P-450 increased and enzymatic activity of nitroansole-O-demethylase and cytochrome P-450 reductase increased significantly. Heme oxygenase activity increased at 0,05 and 0.58 ppm cadmium chloride levels, but decreased at 17 and 352 ppm $CdCl_2$. (This research is supported in part by NIH Grant Number SRC-A(R)-1G12RR03045-01A1).

420 Localization of Cd in the Papillate Hindgut Region of Porcellio scaber. M. TOMITA, H. ROBERTSON, R. WITKUS, G.M.VERNON (Fordham Univ.).*

The hindgut of the isopod is a straight tube extending from the point of attachment of the hepatopancreas. It consists of the anterior hindgut identified by the presence of a typhlosole, a posterior hindgut or papillate region and a rectum which is separated from the papillate region by a muscular sphincter. Prosi and Back (1985) found Cd in posterior hindgut cells of isopods. In our light microscopic study of the hindgut of P. scaber collected from a Cd polluted site granules were noted in the epithelial cells of the papillate region. These granules were concentrated in the basal cytoplasm and were most extensive in the anterior papillate region. Elemental analysis of granules revealed Cd, S, Ca and Na. The Cd content of the granules was lowest in the posterior papillate region and highest in the anterior papillate region. As cadmium increased sulfur also increased which may indicate the presence of metallothionein, a sulfur containing protein, which is known to bind cadmium.

* This research was supported in part by a Cottrell College Science Grant (G-2580) from Research Corporation and by a CSTEP grant.

421 Localization of Cadmium in Hindgut Epithelial Cells of Oniscus asellus. M. TOMITA, C. BRAZER, R. WITKUS, G. M. VERNON (Fordham University).*

The hepatopancreas has long been studied as the primary site of heavy metal storage in the isopod. On the other hand, the hindgut's cuticle-lined

epithelium suggests that it is not a region of absorption. Ultrastructural analyses of the posterior hindgut and rectal epithelia indicate that these are regions of water reabsorption and ion transport (Witkus et al., 1969; Hames and Hopkin, 1989). Prosi and Back (1985) reported the presence of cadmium and lead in the papillate region of the hindgut. The purpose of this investigation was to locate regions of cadmium storage in the hindgut of the isopod O. asellus. Light microscopic study of glutaraldehyde fixed and Epon-Araldite embedded specimens revealed basally located intracellular granules similar to the cuprosomes found in the hepatopancreatic S cells. The granule containing cells were scattered in the ventral and dorsal surfaces of the papillate region of the hindgut. Elemental analysis revealed that the granules contain cadmium and sulfur. The presence of sulfur may reflect the presence of metallothionein, a heavy metal binding protein.

*Research supported in part by a Cottrell College Science Grant (G-2580) from Research Corporation.

422 Bioaccumulation of Cd and Its Relationship to Zn and Cu in Primary Consumers. A. BUSANI, R. HEISEY, R. WITKUS, G. M. VERNON (Fordham Univ.)*

This study was undertaken to ascertain whether species specific differences in Cd, Cu and Zn accumulation in field collected isopods could be duplicated in the laboratory. Adult specimens of Oniscus asellus and Porcellio scaber collected from uncontaminated sites were divided into two groups: a control group fed Cd-free Poplar leaves and an experimental group fed Cd-containing Poplar leaves. Hepatopancreatic tissue was processed for atomic absorption analysis. Results parallel those of field collected specimens (Vernon et al., 1990; Hopkin, 1990). O. asellus assimilated 3-7 times more Cd than P. scaber. Cd was accumulated within 7 days, and the level increased over the course of the experiment. Each species in the experimental group showed an initial increase in Cu which then decreased to levels below those of the controls. While Zn levels were up to 4 times greater in controls, there were no significant differences for Zn between the species in the experimental group. Biological bases for these differences are under investigation.

*Research supported by grants from Research Corp. (G-2580) and Clare Booth Luce Foundation.

423 Data Evaluation for Pesticide Regulation in California. M. SILVA, H. GREEN and J. GEE, California Department of Food and Agriculture.

The data evaluation process for pesticide regulation performed by the Medical Toxicology Branch of the California Department of Food and Agriculture (CDFA) is addressed. Sufficient concern was expressed by California citizens about potential dangers of exposure to pesticides (eg. birth defects, infertility and cancer) to implement the Birth Defects Prevention Act of 1984 and the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). The Acts involve identifying pesticide active ingredients according to three priorities: extent of use, exposure or suspected hazard to humans (or combinations of the three). A complete data base of Mandatory Health Effects Studies (reproduction, teratology, chronic toxicity, oncogenicity, mutagenicity and neurotoxicity), involving a data call-in to registrants, is required for assessment of health effects for each listed compound. Because of the enormous volume of information resulting from the data call-in, CDFA developed a new system for evaluating listed chemicals. On a mainframe computer, data can be accessed throughout the Branch. Each compound has standardized worksheets for all mandated study types with a review summary in "one-liner" format on the cover page. This method is effective in organizing, tracking and accessing the data for the purposes of data requirements, hazard identification and risk assessment.

424 State Water Quality Standards for Dioxin Adversely Impact Human Health and Living Resources. PETER L. deFUR (Environmental Defense Fund, 1108 E.Main St.,Richmond,VA.

Tetrachlorodibenzo-p-dioxin(TCDD or dioxin) is considered by some scientists to be the most toxic substance known. TCDD is an unintentional byproduct of some manufacturing processes and one of the identified contaminants in several superfund sites. TCDD is one of the priority pollutants requiring numeric water quality standards to be set by each state as a result of the 1987 ammendments to the Clean Water Act. The numeric standard is derived from an equation developed by EPA using bioaccumulation, cancer potency, cancer risk to the population and seafood consumption to estimate dose. The standard is then applied under certain assumed stream flow conditions. Presently, states have been given the discretion to use various factors to set the state standard, resulting in variation from < 0.013 to 1.2 pg/L among states. Current data in the literature and from EPA research labs indicate that bioaccumulation is at least 50,000, that toxic effects are observed at about 1 pg/L, and that seafood consumption in the U.S. has tripled in recent years. Moreover, annual variations in stream flow are often an order of magnitude or more, decreasing the dilution by a much. As a result, cancer risks to the population may vary by several orders of magnitude if states choose the most lenient factors to use in the calculation of the water quality standard for TCDD. The available data do not support interstate variation in standards or standards exceeding EPA criteria.

425 SALT IN WELL WATER, Is a Softener in the Background? JOSEPH E. KUNTZ, BS (City of Stamford Health Department, CT), Andrew McBride, MD, MPH (City of Stamford Health Department, CT)

Contamination of well water by salt has long been associated in the northeast United States with the use of salt to de-ice roads in the winter, but it may not be the main contributor. A statistical treatment of well analysis done in the Stamford area shows a significant difference in total chloride concentrations in wells not treated with a water softener and wells with a softener. Most softeners (greater than 85% in the homes surveyed) use an on-site regeneration system, requiring the discharging of the salt brine solution into either a septic system or a dry well. Of the 1,473 samples assayed for chlorides, 284 had softeners on the supply and 1,189 were not softened. Of the softened samples, 102 had levels of chloride greater than 150 mg/l compared to 278 of the non-softened samples having similar chloride levels(Chi-Square $p < 0.0001$.) The total samples are sorted to include only unique supplies and the p values of this group agree with the softener to non-softener comparison. Comparisons of chlorides in homes near softened supplies also showed significance. Chloride analysis of wells before the installation of a softener and after support this contention. Total chlorides represent a contamination of a non-toxic nature, but are a cumulative contaminant of the aquifer and can result in levels of an unpalatable nature.

426 The Economics of Recycling Post-Consumer Polystyrene Foam Products. JOHN STRASMA and ELIZABETH NEVERS (University of Wisconsin - Madison).

Reports research on the cost of manufacture, use, sorting, collection, processing and recycling of foam polystyrene consumer goods: sandwich boxes ("clamshells"), beverage cups, supermarket meat trays, etc. Includes empirical data from three on-going Wisconsin post-consumer polystyrene foam recycling experiments: fast food restaurants, residential households, and a rural county non-profit collection and processing program.

The study analyzes data on the costs and throughput of prototype technology for on-site sorting, cleaning and densifying, versus hauling and processing at a regional facility. The incremental costs of adding polystyrene to existing collection programs are small, but baling and shipping costs are high.

Also includes early findings on the economic feasibility of recycling quilted paper substitutes for fast food sandwich boxes. Analyzes public policy options: bans, taxes, mandatory buy-backs, industry subsidies, etc.



427
Mandated Community Decision Making In Siting Of Conventional Solid Waste Facilities: The Case Of Senate Bill 172 In Illinois. RABEL J. BURDGE Institute for Environmental Studies, University of Illinois at Urbana-Champaign, 1101 W. Peabody Drive, Urbana, IL 61801.

In 1981, the State of Illinois legislature passed Senate Bill, 172, which mandated that the local jurisdictional unit hold public hearings and approve all applications to site hazardous and solid waste facilities. The intent of the legislation was to provide (mandate) citizen participation in the hazardous and solid waste management and planning process. Over 150 persons involved in solid and hazardous waste management in six Illinois communities, completed and in-depth self-administered questionnaire on the degree to which mandated public participation influenced community efforts in implementing solid and hazardous waste management plans. The interviews were apportioned equally between: elected officials; members of the municipal and county planning staffs; representatives of voluntary organizations; the solid waste industry; citizen activists; and major generators of waste. Municipal and county professional employees along with representatives of the waste industry, were the least supportive of involving the public, while the elected officials and citizen activist groups were the most supportive. All respondents concurred that mandated public participation had enhanced public interest and participation in the hazardous and solid waste management planning process.

428 DOE Office of Technology Development Serves Environmental Restoration and Waste Management Needs. STEPHEN C. T. LIEN (U.S. Department of Energy), ARTHUR S. KUBO (BDM International, Inc.), and NORMAN H. CUTSHALL (Oak Ridge National Laboratory).

To support its major programs in environmental restoration (ER) and waste management operations (WM), the U.S. Department of Energy has organized the Office of Technology Development (OTD). The OTD mission is to direct an aggressive national program of applied research that will rapidly advance beyond current technologies.

The Office of Technology Development: 1) identifies research needs for ER and WM, 2) supports collaborative demonstrations, and 3) expedites technology generation. These activities are organized under integrated programs (IPs) and integrated demonstrations (IDs). An IP assembles related technologies which address specific ER/WM needs for the purpose of evaluating their relative merit and suitability to advance to the demonstration, testing and evaluation (DT&E) phase. An ID consolidates the technical activities of DT&E, assembling a comprehensive set of technologies that span all aspects of a remediation or waste management program, including characterization, permitting, implementation, and monitoring.

The principal measure of success for OTD will be the implementation of newly-generated technologies that enable ER and WM activities to be carried out more rapidly, with higher quality and improved safety, and at a lower overall cost.

429 Staffing Requirements for Environmental Compliance: Adopting a Methodology to Case Specific Situations[1] AMIT BANDO (Argonne National Laboratory, Buidling 308, 9700 S. Cass Ave., Argonne, IL. 60439; 708-972-7132); JONATHAN ELIAS (Argonne National Laboratory); CHARLOTTE YOUNG (Argonne National Laboratory)

Increasingly, industries and organizations must adopt environmentally sound operating procedures to solve current and anticipated environmental problems. Yet in order to implement these procedures, organizations must have appropriately trained staff who are housed in an effective organizational structure. To this end, Argonne National Laboratory has developc: a general methodology for determining the numbers and types of environmental staff needed to maintain and achieve environmental compliance at various types of industrial facilities. We are currently implementing this methodology at a ship repair industrial facility. This presentation consists of three sections: a brief description of the general methodology, a detailed analysis of the strengths and limitations of applying the general methodology to a specific case, and implications for applying the methodology to other types of facilities.

[1]Work supported by the U.S. Navy through interagency agreement under Contract W-31-109-Eng-38 with the U.S. Department of Energy.

430 Environmental Compliance at Industrial Facilities: A Prototype for Assessing Organizational Effectiveness[1] AMIT BANDO (Argonne National Laboratory, Building 308, 9700 S. Cass Ave., Argonne, IL. 60439; 708-972-7132); JONATHAN ELIAS (Argonne National Laboratory); CHARLOTTE YOUNG (Argonne National Laboratory)

Increasingly, industries and organizations must adopt environmentally sound operating procedures to solve current and anticipated environmental problems. Yet in order to implement these procedures, organizations must have appropriately trained staff who are housed in effective organizational structures. To this end, Argonne National Laboratory is implementing an approach for evaluating staffing and organizational parameters for achieving and maintaining environmental compliance at industrial facilities. Rather than analyzing the operating procedures in general terms, this analysis will emphasize specific issues involved in determining organizational requirements for environmental compliance under various circumstances. This presentation consists of three sections: a description of the methodology, refinements necessary for implementation, and implications for applying the methodology to various types of facilities.

[1]Work supported by the U.S. Navy through interagency agreement under Contract W-31-109-Eng-38 with the U.S. Department of Energy.

431 The National Institutes for the Environment: a proposal. HENRY F. HOWE, University of Illinois - Chicago, STEPHEN P. HUBBELL, Princeton University, DAVID E. BLOCKSTEIN, Committee for the National Institutes for the Environment.

No federal agency has a primary mission to explore the fundamental environmental processes that sustain life on earth and to understand human impacts on these processes. Of the $60 billion federal research and development budget, only 4% goes to environmental research. Environmental policy is based on inadequate science. We propose creation of a new mission-oriented extramural funding agency that will sponsor panel-reviewed investigator initiated research and multidisciplinary task forces for understanding, solving, and preventing environmental problems. The National Institutes for the Environment (NIE) would also increase production of U.S. scientists, develop a national environmental library, and promote environmental education. A model of problem-oriented institutes and intramural centers, analogous to the National Institutes of Health is proposed. The NIE would sponsor fundamental and applied research among the natural, engineering, social and policy sciences. Research would focus on isses such as sustainable resource use, climate change, habitat alteration, biodiversty, extinction and the human environment.

432 Sea Butterfly Abduction as a Chemical Defense in a Pelagic Antarctic Amphipod. JAMES B. McCLINTOCK (University of Alabama at Birmingham), JOHN JANSSEN (Loyola University, Chicago).

This study documents the first example of an invertebrate that cannot defend itself chemically (an amphipod) capturing and carrying a species that can (a sea butterfly or pteropod). *In situ* observations revealed that the amphipod *Hyperiella dilatata* frequently carried individual pteropods (*Clione limacina*) dorsally against their abdominal segments, grasping their captive with the 6th and 7th periopods. Amphipods (controls) and amphipod-pteropod pairs were presented to the antarctic fish *Pagothenia borchgrevinki*. Fish showed significant rejection for amphipods carrying a sea butterfly while always ingesting individual amphipods. Fish offered living pteropods or agar blocks containing pteropod homogenates and fish meal consistently spit them out with violent head shakes. This symbiotic relationship provides *H. dilatata* with defense but results in a significant decrease in maneuverability and swimming speed. The abducted pteropod appears to gain little from this relationship and is deprived of its normal feeding activities. Nonetheless, amphipods were never observed carrying dead pteropods, indicating that they must be periodically released and another sea butterfly captured in their place. Supported by NSF grants DPP-8815959 and DPP-8816775 to J.B.M. and J.J., respectively.

433

The Production of Mouse Embryos from Male and Female Gametes Cryopreserved in Liquid Nitrogen. ARTHUR K. CHAMPLIN (Colby College), DANIEL S. JOHNSTON (The Johns Hopkins University), AND LARRY E. MOBRAATEN (The Jackson Laboratory).

We have reported previously on a procedure to cryopreserve mouse oocytes (Schroeder, Champlin, Mobraaten and Eppig, 1990), and have recently developed a protocol which can be used to cryopreserve mouse sperm. When used for *in vitro* fertilization, this sperm is able to fertilize and cause normal preimplantation development of about 25% of oocytes freshly obtained from hormonally primed females. More recently, we have succeeded in producing viable two-celled embryos and then blastocysts from oocytes and sperm, both of which have been cryopreserved in liquid nitrogen. To our knowledge, this is the first reported production of mouse embryos from cryopreserved gametes.

Schroeder, A.C., A.K. Champlin, L.E. Mobraaten, and J.J. Eppig. 1990. Jour. Reprod. Fertil. 89: 43-50.

434 Response of a Mammalian Faunal Element to Climatic Changes. JENNIFER K. FREY*(University of New Mexico).

Faunal elements represent groups of species with similar contemporary distribution patterns. Members of a faunal element are hypothesized to have similar histories and usually to be adapted to similar environmental conditions. The influence of contemporary climatic changes on the distributions of four members of the Boreal faunal element at their distribution limits on the central plains were analyzed. Since the mid-1960's this region has experienced relatively cool, mesic conditions. The distributional limits of the Boreal fauna in this region--Sorex cinereus, Microtus pennsylvanicus, Zapus hudsonius, and Mustela nivalis--have expanded southward since onset of cryomesic conditions. Although members of the Boreal faunal element are known to have occurred farther south during glacial periods, this study demonstrates concordant contemporary changes in the distribution of this group of species related to relatively short-term climatic changes.

* Southwestern and Rocky Mountain Division, AAAS Larus Awardee, 1990.

435 Functional morphology and locomotion of the Arctic ctenophore *Mertensia ovum* Fabricius 1780 (Ctenophora: Cydippida); locomotion, drag, and natural history. G. I. MATSUMOTO.* (Department of Biology, University of California at Los Angeles, California. 90024-1606).

Mertensia ovum (Tentaculata: Cydippida) is an ambush predator abundant in the Arctic regions that reaches lengths of 8.9 cm and can swim at velocities up to 13.4 cm s^{-1}. Reynolds number for cilia (Re_c) average 96 while Reynolds number for the body (Re_b) average 1762. Based on laboratory investigations using a flow tank, models of *Mertensia ovum* (without cilia), and the principle of dynamic similarity, *M. ovum* may experience drag forces up to 848 dynes with drag coefficients (C_D) from 0.3 to 1.6. Comparison of flow patterns around *M. ovum* in situ and around models reveal the importance of the ctene plate and ctene row where individual edge vortices from single ctene plates are joined into larger aboral vortices that form beyond the posterior region of the ctenophore. The 8 characteristic ctene rows are on top of ridges that are separated by deep grooves. Flow stagnation behind the keels is a result of the body morphology while the narrowing of the wake (resulting in drag reduction) is a result of body morphology and differential ctene row propulsive forces.

* Pacific Division AAAS Larus Awardee, 1990.

436 Regeneration of Plants from Maize Callus Lines.
Y.C. TING (Dept. of Biology, Boston College, MA)

In the last spring, a study on the regeneration of plants form maize anther callus lines, 88-S5; 87-S4 and SAN was carried out. These lines were maintained by subculturing for several years. They all came from another culture in vitro. Lines 88-S5 and 87-S4 were from American commercial hybrids and SAN from a maize strain originally grown in the northwestern part of the People's Republic of China. To begin with the experiment, all of the above callus lines were grown on the N6 medium with 10 percent of sucrose and 0.5 mg/l 2,4-D. Six weeks later, they were transferred to the same medium with two percent sucrose, but without any 2, 4-D. After they had been on this medium for seven to eight weeks, many somatic embryos appeared on the calli of lines 88-S5 and SAN. However, for callus line 87-S4, only organogenesis was manifested. In about a week later, many of the embryos of line 88-S5 germinated and grew into plantlets. Of line SAN, none of the embryos germinated. It is concluded that the regeneration of plants from maize callus lines was perhaps controlled by genetic background.

437 Breeding Apomictic Brachiaria grasses for resistance to spittlebugs for Latin America. STEPHEN L. LAPOINTE (*Centro Internacional de Agricultura Tropical* - C.I.A.T.), JOHN W. MILES (C.I.A.T.)

Grasses of the genus Brachiaria are the most important forage grasses in the American tropics due to their excellent adaptation to acidic, aluminum-saturated soils, drought resistance, and high biomass production. The principal constraint to their utilization is susceptibility to spittlebugs (species of Cercopidae). High levels of resistance to spittlebugs have been identified in CIAT's Brachiaria germplasm collection and efforts are underway to develop mass infestation techniques using spittlebug eggs for rapid field evaluation of progeny. Until recently, hybridization of Brachiaria has not been possible due to apomixis. However, identification of sexual B. ruziziensis and induction by colchicine of tetraploid B. ruziziensis have made possible hybridization between B. ruziziensis and natural tetraploid apomicts (B. brizantha, B. decumbens, and others). Based on evaluation of open pollinated progenies of first generation hybrids, both apomictic and sexual reproductive modes are obtained in the F1 generation in approximately equal proportions. We are corroborating progeny test data with data on reproductive mode from analysis of embryo sacs. It appears possible to combine spittlebug resistance with other desirable agronomic traits in true breeding, apomictic cultivars.

438 *Maackia amurensis* Nodulates and Fixes Dinitrogen
JANET M. BATZLI and WILLIAM R. GRAVES (University of Maryland, Horticulture Dept., College Park, MD 20742) PETER VAN BERKUM (USDA-ARS, NF&SGL, BARC-W, Beltsville, MD 20705)

Maackia amurensis is a leguminous tree with the potential of increased use in urban landscapes. To our knowledge, evidence of nodulation and nitrogen fixation has not been reported. Our objectives were to examine *M. amurensis* for nodulation and nitrogen fixation and to characterize and compare the nitrogen-fixing bacteria associated with this host to known strains of *Bradyrhizobium* and *Rhizobium*. Soil samples were collected beneath legume trees throughout the United States, with additional samples from Canada and China. Seedlings were inoculated with soil samples and grown for six weeks. Upon harvest, small white nodules were found on the lateral and upper portions of the root systems. Bacteria were isolated from the larger nodules, subcultured, and used to inoculate seedlings. Inoculated plants nodulated and fixed nitrogen as determined by the acetylene reduction assay. Rhizobial isolates were characterized according to their intrinsic antibiotic resistance, pH reaction, NADP-linked 6-phosphogluconate dehydrogenase activity, ß-galactosidase activity, and mean generation times. We conclude that *M. amurensis* forms a nitrogen-fixing symbiotic relationship with slow-growing *Bradyrhizobium*.

439 Shrubs create a resource landscape on coastal sand dunes in California. PETER ALPERT (University of Massachusetts at Amherst).

Lupinus arboreus and Artemisia pycnocephala are common colonists on partly stabilized sand dunes along the coast of northern California. Both species reduce photon flux density by up to 95% at the soil surface. Only Lupinus significantly increases levels of nitrate and ammonium and rates of mineralization of nitrogen in the soil. As individuals grow and die, these shrub populations create a dynamic, small-scale, resource landscape for certain perennial herbs.

440 Measurements of Shrub Cover Using an Airborne Laser Profiler. JERRY C. RITCHIE, J.H. EVERITT, D.E. ESCOBAR, T.J. JACKSON and M.R. DAVIS. USDA ARS Hydrology Laboratory, Beltsville, MD 20708 USA and USDA ARS Remote Sensing Unit, Weslaco, TX 78596 USA

A study was made in a predominately shrub rangeland in South Texas to determine shrub canopy cover using an airborne laser profiler to measure the distance between the aircraft and the soil surface or plant canopy. Comparing the total number of laser pulses with pulses reflected by the canopy, canopy cover was highly correlated (r=0.94) with field measurements along a 30 meter transect. In another comparison, canopy cover was calculated to range between 17 and 42% for shrubs greater that 0.5 m tall on seven 940 m segments. Field measurements of shrub canopy made using the line intercept method along the same segments ranged between 19 to 43%. The laser measurements also provided data on the spatial distribution of cover along the 6.5 km flightline. This study shows that airborne laser measurements of land surface features can provide quick and accurate estimates of canopy cover and distribution for large areas of rangeland.

441
Multi Contributions of the Plant Growth Regulators with Multipurpose Schemes in Multicrop in Agriculture. BHIKHUBHAI N. PATEL (Principal, Gangadhra High School, Gangadhra, Dist. Surat, Gujarat State, India Pin 394310)

Scientist is an artist hence his scientific art should grow forever in the welfare of peoples. Test tube baby technology application will help in transplantation and transanimation for building up a white-green and red revolution in any country of the world. So the plant growth regulator and the peat moss application in multicrop system will serve as the soil conditioner and the strategy of birth growth and development. PGR are organic compounds which help in improving quality, yield and facility for harvesting. Historical evidences are the proof of this phenomena (e.g. castor oil trench in the Banana plant crop). PGR helps in enezymic process through genetic contents and the genetic programme having chemical influence on metabolic process. Self experimental results were obtained by using castor oil and zinc sulphate in the water logging crop and wasteland crop on banana, wheat, paddy and sugarcane which yielded a high result and a good profit. Natural, artificial and chemical compound were utilized for the acceleration of germination and rootment, photsynthesis, humidity, preservation, lustre, flowering, fruiting, weight and quality. PGRs were controlling in the falling of flowers, fruits, maturity, diseases and the sweetness and freshness of fruits and crops. Anti PGR are also applicable to check the vegetative growth in the high fertile soil. Zinc sulphate has played a vital role to check up the toxic salt and built up a super coiled root hair in the land. High order of thinking means results at all levels of multi productivity in various varied situations.

442
Sustained Yield of Timber and Non-Timber Forest Products: Management Alternatives in the Tropics. FRANCIS E. PUTZ (University of Florida), Joshua C. Dickinson III (Tropical Research & Development)

Sustainability of forest management systems is a reflection of underlying ecological, social/demographic and economic conditions. Using these conditions as axes of a three-dimensional matrix describing a site, we propose an approach whereby a forest manager can select an appropriate silvicultural system. These tropical forest management recommendations are drawn from the analysis of numerous silvicultural failures and a few noteworthy successes. The model has heuristic value insofar as it highlights the types of information needed to make valid management prescriptions. For example, controlled selective logging and/or extractive reserves for non-timber forest products may well be sustainable if managed by a forest dwelling population with secure tenure, soils and/or topography unsuitable for permanent agriculture, and access to market for relatively high value products. Along each axis of the matrix we examine relevant variables including topography, soils, successional stage of the forest, population characteristics and market access. At the outer limits it may be that plantations and agroforestry are the only sustainable uses of forested land competitive with annual crops and pasture. Our three-dimensional matrix approach can provide indicators in the evaluation of specific failed silvicultural systems as a step in the design of sustainable alternatives to the conversion of tropical forests to poor farms. The matrix can be useful in the design of socially and ecologically viable management systems for the buffer zones surrounding parks and reserves.

443 Iron Deficiency Stress Response of Epipremnum aureum and Philodendron scandens ssp. oxycardium. PAM MATTIS and DAVID R. HERSHEY (Department of Horticulture, University of Maryland, College Park, MD 20742-5611).

Common philodendron (P. s. ssp. oxycardium) and pothos (E. aureum), two widely-grown houseplants, were grown in Hoagland solution #1 with no Fe or Fe oxide or Fe-EDTA. For both species, Fe chlorosis appeared only in the no Fe treatments. For pothos with Fe-EDTA, solution pH rose from an initial 4.9 to >6.5. However, with no Fe and Fe oxide, solution pH declined to <3.5 , however, after 25 days, the pH began to rise again with the Fe oxide, exceeding 6.5 by day 35. Solution reductant concentration was about 10 times greater with no Fe than with Fe-EDTA. For philodendron, the solution pH initially increased slightly with Fe-EDTA, but eventually declined to <3.5 for all Fe treatments. Solution reductant levels with no Fe were not greater than with Fe-EDTA. Pothos exhibited a classic Type I Fe deficiency stress response. Philodendron did not respond to Fe deficiency stress since solution pH declined regardless of Fe availablility, and solution reductant levels did not increase with no Fe.

444 Temporal Dimensions in Biological Organization: Ecological Community Dynamics and Time. STEPHEN FREEDMAN (Loyola University of Chicago).

From the evolutionary perspective, time is a major limiting factor to a species, if seen as a window of opportunity for resource allocation. Species evolve the ability to utilize different components of time (daily, seasonal, yearly and multi-annual periods) to take advantage of pulses of resources. An important distinction can be made between the effect that fluctuating resources have on a species (which is well documented in the literature) and the time dimension of resource allocation,which may be more important in the evolution of species and the shaping of ecosystem dynamics. Part of the complexity that is evaluated in community structure is a temporal complexity,the use of time by organisms in a finite environment. Whether the time is used for immigration, colonization or persistence, organisms use their environments, both space and time, to obtain resources for survival. Most often, diversity is evaluated by measuring abiotic and biotic factors that influence spatial community organization. The use of time may be equally important as an influence on diversity. Diverse communities may be more likely to develop on landscapes where organisms efficiently parcel up the temporal environment. The succession of ecosystems can be seen as being influenced by the temporal relationships that exist between species.

501-544 Social and Behavioral Sciences

(Mon., 18 Feb., 12:15-2:15 pm)

501 Teamwork, Technology and Subways: Perspectives, Problems and Solutions of People Who Build, Manage and Operate Transit Systems in United States and Europe. DOTTIE J. EASTMAN (University of Massachusetts at Boston).

People responsible for public transportation identify myriad problems: financial difficulties; deteriorating infrastructures; outdated equipment; a need to develop new technologies; increased safety and security requirements;

negative public opinion and press; an aging work force; new management challenges; powerful political pressures; old work values of following orders and advancing by seniority, challenged by a new work culture of teamwork, employee decision-making, personal accountability, adaptation to computerized operations, flexibility and abstract skills.

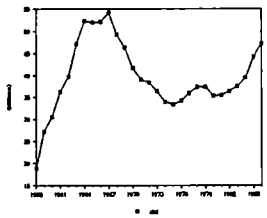
The first stage of this research incorporates interviews with personnel responsible for train operations (at all job levels from new hirees to managing directors), in eight transit systems in the United States and Europe. It focuses on managing the development and use of new train signaling and control technologies. Interviewees stressed people-issues as being critical. "Teamwork," widely promoted but difficult to achieve, requires a fundamental shift away from top-down control and towards employee participation. This research identifies critical issues and promotes interurban and international cross-organizational learning, presenting solutions developed by people in transit systems which have similar problems even though they differ in size, resources and organizational character based on the culture, history and politics of their host cities and countries.

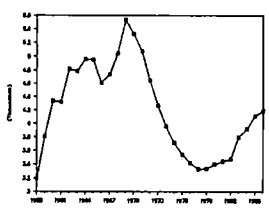
502 Vocal Affect Expression in Supreme Court Oral Argument. Steven Peterson, Alfred University, James Schubert, Alfred University: Glendon Schubert, University of Hawaii; Stephen Wasby, U.S. Naval Academy

Abstract: Vocal affect expression is explored as a mechanism of social control in the dominant-subordinate relationships that describe Justice-counsel interactions during oral argument. Changes in fundamental frequency, intensity, and variability in each, as acoustic properties of Justices' vocalizations, are independent variables and properties of compliance in counsel responses are analyzed as dependent variables. Observations are preliminary data drawn from the NSF supported study, "Oral Argument in Supreme Court Decision Making," that is developing a data base including relevant variables for 300 randomly selected cases argued over the period of the 1969 through 1980 terms.

503 The Decision to Study Physics: An Economic Analysis. CHRISTINA WISE MOHR (National Science Foundation and University of Maryland).

In recent years, the possibility of "shortfalls" of scientific and technical personnel during the upcoming decade has become the topic of considerable speculation and public policy discussion. However, the manpower projections that have generated the sense of urgency that fuels current concern often fail to account for the dynamics of labor market adjustments. This analysis of the supply and demand for newly graduated physicists attempts to redress that situation. Using data from 1958 to 1986, I explore the impact of changes in Federal research and development spending on the demand for new graduates, and I examine the reliability of Richard Freeman's "cobweb" model* to explain variations in the supply of new physicists.





* R.B. Freeman, *Supply and Salary Adjustments to the Changing Science Manpower Market: Physics, 1948-1973* (American Economics Review; March 1975)

504 Methods Used in the Ranking of American Doctorate Programs in Economics. EMILY SUN (Manhattan College)

Rankings of doctorate programs in American universities have been of considerable interest to students seeking admission to graduate schools, to new Ph.D.s looking for jobs in academia, to fund-granting agencies deciding on the allocation of scarce financial resources, and to educators in general. There are basically three methods used in the ratings: 1) Peer rankings by faculty members in their own fields. It is considered subjective, reflecting prestige and reputation rather than quality. It tends to favor large, well-established institutions over smaller, less well-known schools. 2) Scholarly productivity of the departmental faculty in terms of number of articles or pages published in professional journals, number of citations received, and number of journal editors and referees. Controversy involves the number and types of journals included in the counting and the omission of other types of scholarly work, such as books and interdisciplinary research. 3) Comprehensive measures, including size of faculty, per cent of faculty holding research grants, library facilities, availability of fellowships and job opportunities for graduate students, in addition to peer rating and faculty publications. Question centers on whether additional information yields better measures of quality. This paper compares all three types of rankings published for the economics major between 1925 and 1990 and concludes that there is no significant difference in the rankings, in spite of the methods used.

505 Accidental Deaths among Male Kansas Farmers, 1983-1989. R. SCOTT FREY (Kansas State University).

Farmers have been reported to be at high risk of death for various types of accidents. Age-standardized proportionate mortality ratios were computed for fourteen different types of accidental deaths that occurred among Kansas farmers during the period 1983-1989. Farmers were found to have a significantly inflated risk of death for six of the fourteen types of accidents: total accidents and accidents caused by motor vehicles, burns, environmental factors, machinery, and firearms. Policy implications of the findings are discussed.

506 Multivariate Pre-Processing for 2 x 2 Contingency Table Analyses. TURKAN K. GARDENIER (United States Equal Employment Opportunity Commission).

Many statistical tests originally designed for controlled clinical trials and epidemiological investigations are now being applied within the context of litigations for discrimination. These analyses involve comparing incidence rates for a "protected group" with an unprotected group at the same site or with availability estimates derived from external samples. This paper shows that maximum likelihood estimators derived from multivariate log-linear models form an essential component to the pre-processing necessary for estimation of expected cell values. An example is shown from a litigation case exploring the presence of a "chilling effect" caused by pre-admission requirements related to age and education factors. Nested contingency tables are generated to analyze main effects and interactive components which impact the availability estimates prior to submitting the observed rates or proportions to 2 x 2 analyses.

507 Charles Darwin and *Archaeopteryx*, a prediction confirmed. GENE KRITSKY (College of Mount St. Joseph and the Cincinnati Museum of Natural History).

At least two years before the true nature of *Archaeopteryx* was recognized, Charles Darwin wrote to Charles Lyell and predicted what a transitional bird might look like. *Archaeopteryx* was discovered in 1861 and was formally presented to the British scientific community on November 20, 1862 in a paper read by Sir Richard Owen to the Royal Society. In attendance was Hugh Falconer who recognized the fossil bird as a "grand Darwinian case." On January 3, 1863, Falconer wrote Darwin about the Solnhofen fossil bird, describing it as "a strange being a' la Darwin" and providing him with his first details about the fossil. Darwin responded on January 5, "I particularly wish to hear about the wondrous Bird; the case has delighted me, because no group is so isolated as Birds. I much wish to hear when we meet which digits are developed; when examining birds two or three years ago, I distinctly remember writing to Lyell that some day a fossil bird would be found with end of wing cloven, i.e. the bastard-wing and other part, both well developed." Falconer replied on January 9 about the wing and again wrote Darwin on

January 18 when John Evans discovered the fossil bird's jaw complete with teeth. While the evolutionary significance of *Archaeopteryx* has been debated for over a century, Darwin wrote to James D. Dana on January 7, 1863, "This is a grand case for me."

508 Mass Strandings of the Long-Finned Pilot Whale (Globicephala Melaena) on Cape Cod and Implications for Native American Subsistence and Social Organization. JAMES W. BRADLEY (R.S.Peabody Museum, Phillips Academy), WAYNE E. McFEE (Northeastern University).

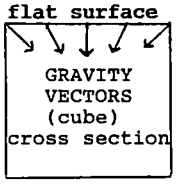
The long-finned pilot whale, or blackfish, is a medium sized, toothed, pelagic whale that frequents Cape Cod Bay during summer and fall months. A highly gregarious species, blackfish often become stranded with from 20 to 100 individuals involved. Analyses of 183 stranding events between 1800 and 1990 indicated that these were a patterned, non-random behavior and occurred with both locational and seasonal predictability. Archaeological evidence suggested that these patterns are of some antiquity. Ethnohistoric sources indicated that stranded blackfish were butchered for their blubber which was was then rendered and stored. Given the size of the average blackfish (700 kg), and stranding event, blackfish may have been the largest source of animal fat in the diet of native people on the outer Cape. Effective utilization of stranding opportunities may have been a factor in the formation of local corporate groups.

509 Religion and the Survival of the Fittest. ANDREJS BAIDINS (E. I. du Pont de Nemours & Co.)

The fact that just about every living culture on Earth has a religion means that, in the struggle for survival, cultures lacking a religion were eliminated by natural selection. Everything being equal, the law of survival of the fittest should have favored the atheists: the practice of religion consumes time and energy that could have been put to practical use. Yet it was not the religious, but the atheistic societies that failed to survive. Evidently there is something in religion that increases the fitness of humans. It may be something as simple as increasing the efficiency of group living, or it may be as exotic as an awareness of another continuum, a faculty that enables its possessors to make more correct decisions than people lacking it.

510 A Reexamination and Correction of the Ancient Flat Earth-Round Earth Controversy. DAVID THORNDILL, (Essex Community College).

Aristotle, Ptolemy, and Copernicus gave several proofs for a spherical earth. They were so convincing that almost every educated person since the time of Aristotle has accepted these proofs. Yet most of these proofs for a spherical earth also fit many flat earth models. This paper will show how the following ancient observations which have been described as spherical earth "proofs" also fit cuboid flat earth models:
1. The pole star and the zenith appear to move as one travels north or south. 2. Stars disappear from the southern horizon as one travels north. 3. Ships sailing away appear to sink over the horizon. 4. Lunar eclipses have been recorded at earlier local time in western locations.
The earlier flat earth models assume the zenith, "up", is perpendicular to the flat surface of the earth. Analysis of gravity vectors shows how "up" changes as one moves from the center to an edge of a flat earth (planetoid). A corrected flat earth model is presented.



511 Moral Rights: The Inescapable Hobgoblin of Technology. SANDRA ANDERSON SCHUH, Department of Philosophy, University of Tampa, FL.

Scientists are urged, in this paper, to recognize that a Copernican type revolution in ethical theory and application is long overdue. Ethical considerations have been divorced from scientific research and development, to be confronted when necessary only as an afterthought. But from its very inception, it is argued, the work of a scientist is infused with ethical factors.

The problem of human rights especially, but also animal rights, has come to the fore in the melee of recent scientific and technological growth. Solutions in this problem area of rights versus technology cry out for a wedding of science and ethics. Must the two continue to be distrustful and often adversarial marriage partners?

Philosophical/ethical arguments are advanced to suggest, if we are to survive and prosper, that science and ethics can and should become loving bedfellows. For technology without a generous commingling of moral values is at best trivial, and at its worst intolerably cruel.

512 Utilize Final Causes in Science? The Seventeenth-Century Controversy. EMERSON THOMAS MCMULLEN. Indiana University.

The use of teleology (final causes) in science was ineffectually challenged in the seventeenth century by Francis Bacon, René Descartes, Thomas Hobbes, and Benedict Spinoza. This attack failed for three major reasons. First, there were defenders who could offer philosophical arguments countering those of the attackers. Second, there was the influence of the natural theological tradition which expanded greatly during the scientific revolution. Third, the use of final causes in science was productive, the discovery of the circulation of the blood being a prime example. Other examples include the use of teleology in the debate over spontaneous generation, in determining the origin of fossils, and in proving the sine law of the refraction of light. Final causes were more effective than is generally thought. The future scientific use of teleology was undermined, not by the Baconian or Cartesian philosophies, but by the success of the Newtonian method. The way of the future was mathematization and quantification in the physical sciences. The biological sciences, however, were not as readily mathematized. Parts of it were still under the influence of Harvey's methodology and there final causation could more comfortably remain.

513 Greek Climate Cycle: Identification, History and Prediction of Occurrence. MELVIN C. HUDSON (Private Research)

Greek literature from Aristotle's era and later, identifies a climate cycle and provides a means for estimating times of warm and cold phases. The timing identified by the literature is compared to historical climate. Initial analysis indicates that this climate cycle is in agreement with the two hundred year cycle identified for glacier advance and withrawal by Jean Grove in her book, The Little Ice Age. From the cycle timing, the decade of the 1990s should be cool, possibly suppressing evidence of greenhouse warming. A hot period should occur in the mid-twenty-first century approximately as predicted by the ice core studies of Dansgaard.

514 Tele-cybernetics and Ethics: A Proposal to Correct a Facet of the Legal Profession. G. ARTHUR MIHRAM (P.O. Box Nº 1188; Princeton, NJ 08542), DANIELLE MIHRAM (University of Southern California; Los Angeles, Calif. 90089-0182).

The source of the widespread ethical misconduct contemporarily has been identified as a combination of the powerful and

pervasive power of television broadcasting and of a product of its ancillary ethos: the grant-seeking mechanism, currently the focus of leading academic institutions [ABSTRACTS, AAAS 1990: p. 172; and AN EPISTLE TO DR. BENJAMIN FRANKLIN, 1974(1974)]. More recently, the broadcasting medium's persistent demands for 'free and protected' speech have forced scientific editors to consider quashing scientific debate in their journals out of fear of facing both the effort and the inordinately large expense to defend themselves and their journals from libel lawsuits [SCIENTIST, 01.X.1990: p. 1ff]. We Americans, swayed today by the TV broadcast medium's ethos [cf. TIME Magazine, 25.XI.1974: p. 17], have been distracted from the relationship between Science and Law (political science) in a republic: "For Here We are Not Afraid to Follow Truth Wherever It May Lead, Nor to Tolerate Error So Long as Reason is Left Free to Correct It"—T. Jefferson. Replacing this [the (proper) ethos of our republic] with a mercenary motivation for human pursuits reveals a deficiency in the legal profession, one which we had earlier voiced [e.g., 1990 AAAS Ethics/Integrity Panel, 17.II.90, New Orleans]: All legal expenses for civil disputes, libel included, must be borne by the loser in the court, as is the case with the British common law, basis of our American jurisprudence.

515 A Report and Analysis of the Occurrence of a "Kantian" Pure Intuition of the Total Reality. RICHMOND WILLIAMS (Dynamic Institute of the Omniological Sciences).

This paper describes an altered state of consciousness which lasted only a few seconds, but has all the characteristics of a "Kantian" pure intuition of the total reality. I refer to this unique experience as "The Omnivision". The Omnivision consists of a complete set of fundamental relationships which span the full range of possible thought. It begins before the beginning in Total Disorder, and ends in Total Singular Order; it includes the First Cause, the Final Effect, and everything in between; it reveals the origin, nature, purpose, and plan of our Universe, and traces its development from beginning to end. The Omnivision constitutes the widest possible view and contains the limits of the knowable, beyond which nothing more can be known. The entire experience was purely intuitive, and revealed things and events of which I could not possibly have had any direct experience. A thirty-year search of the relationships contained in The Omnivision, and research of the full range of the natural sciences, including theology, cosmology, and quantum physics, confirms The Omnivision to be a glimpse of the Total Reality.

516 EGOLOGY---A Multidisciplinary Spatial Focus. ROBERT A. THOMPSON, PH.D., P.E., (Chairman & President, Spatialworld Corporation), LOUISE S. THOMPSON, M.A. (Vice President).

The Space Age is unique because the spatial vantage point itself has become a tool. This psychological breakthrough permits a vital contrast that can individually redirect the future for all humankind. As the spatial perspective allows the eye to move from earth's surface to a remote point above it, earth-based myopia disappears. All former parameters appear simultaneously. The Space Age thus stimulated the ecological movement, raising public consciousness first about the physical environment and then turned toward more social with human rights worldwide. From this intellectual quantum jump, planetary interconnections permeating earth's biospheric shell and physical-chemical core were identified, affecting any one part of it, chemically, biologically, or socially, could affect us all. Outermost to the planetary shell of ecology, an EGOSHELL, needed both for educational dissemination and workplace use, appears. A meaningful, multidisciplinary spherical shell-like metaphor results, one containing the traditional tree-branch model, permitting fuller understanding from increased knowledge and greater human resource utilization. Global lifestyle crises are averted by the emergence of an Institutional Decalogue.

AIAA Lecture from Egoshell (PROMETHEUS BOOKS), reviewed in AAAS Science Books & Films & Journal of Economic Literature.

517 Serum Catechol amine Levels and Open-field Activity in Recombinant Inbred Mice. D. F. PEELER and I. MARAWI (University of Mississippi Medical Center).

Previous findings of genetic differences in serum catecholamine (CA) levels as a funciton of time of day and strain, and the complex correlation of these with various behaviors, have been extended to include a wider range of times of day and an additional behavior. CA were determined from serum of individual mice collected at one of five times of day. The strains C57BL/6ByJ, BALB/cByJ and the seven recombinant inbred strains derived from them (viz., CXBD, CXBE, CXBG, CXBH, CXBI, CXBJ, CXBK) were represented at each time of day. Other subjects of the same strains were tested for activity levels in an open-field device under two different levels of illumination. Analysis of variance revealed main effect differences among strains and among times of day for both norepinephrine (NE) and epinephrine (E). The times of peak levels of NE and E overlap but do not exactly coincide. Time of day is essentially not a significant factor for E level among strains, but is highly relevant for NE. Five strains have significant changes over the five times of day; four show no significant effect. All correlations between CA levels and open-field behaviors are negative. No significant correlations occur between these behaviors and serum E. Whether or not the correlations between strain means for NE and open-field behaviors are significant is a complex function of the level of illumination at the time of testing, previous experience and the particular sector of the open-field where activity occurs. Interpretation of the relationship among genetic background and biological and behavioral variables must take into account the conditions and constraints of measuring techniques.

518 A Neural Net to Analyze Human Interdependent Interaction Styles. W.F. LAWLESS, A.B. COOK, & C.R. FULLER. Virginia Tech, Blacksburg, VA 24061. BITNET Lawless@VTVM1. Artificial Neural Nets (ANN) have been used for speech and image recognition, and in analyzing dynamic structures, such as acoustic or in-flight structure loadings. In this study of interactions, an ANN will analyze voice and heart rate data from human dyads. Voice will be captured from each participant with two directional hyper-caroid mikes in a 150 dB sound chamber, and heart rates with ear monitors (two channels voice, two channels heart rate). The net will be a supervised back-propagation non-linear net with two hidden layers and a gradient error, energy minimization algorithm. It will discriminate between dynamic interdependent, well-functioning dyads (social stabilizers) and non-interdependent dyads (social explorers). After convergence, the internal weights will produce a regression or discriminant function. Discriminant predictions from static analysis (self-reported history and expectations) with SPSS will be compared with the neural net results.

519 **Calculating and Estimating Effect Sizes from Between Group, Within Group, and Single Cases Designs for Meta-analyses.** **DAVID B. ALLISON (Kennedy Institute, Johns Hopkins University School of Medicine), BERNARD S. GORMAN (Hofstra University).**

Meta-analysis, the quantitative synthesis and review of research literature, is being employed with increasing frequency across a variety of scientific disciplines. The derivation of effect sizes is one of the most problematic aspects of meta-analysis. The purpose of this paper is to review, describe, and explain methods for deriving measures of effect, or effect sizes, from a variety of research designs. Moreover, an attempt will be made to aid the prospective meta-analyst in deriving or estimating effect sizes in difficult to handle situations such as when data are reported incompletely or with unusual statistics. Tables are developed which allow the transformation of a broad array of statistics to effect sizes. Particular emphasis will be placed on the calculation of effect sizes in interrupted time-series (single case) designs. A piece-wise regression approach which can simultaneously account for treatment effects on level and slope while controlling

for effects of trend and most cases of autocorrelation will be presented. Methods for integrating effects sizes from divergent research designs will be presented.

520 Enhanced Fluency in Stutterers as a Function of Phase Shifted Vocal Tone Feedback. R. L. WEBSTER, M. BOLEN (Hollins College).

Vocal tone (VT) is generated at the larynx as a function of vocal fold openings and closings during phonation and normally represents a background signal within the skull whenever a person speaks. The present experiment introduced phase shifted VT signals to the ears of stutterers during standard reading tasks to determine whether or not levels of stuttering and speaking rates could be influenced. Fourteen moderately severe stutterers participated. VT was detected at the larynx, digitally phase shifted, amplified and returned to the ears with a custom built digital phase shift system. During a baseline condition, participants read aloud without the apparatus in place. In all other conditions a throat microphone and dual earpieces were attached to participants. A continuous oral reading task was used during the presentation of different phase shift values. Each delay condition was in effect for 2 minutes. VT was returned to the ears at 85 dB SPL. Phase shifts were specified in terms of digitally induced delay values. The values were zero delay and 10 intervals ranging from 3.31 msec to 5.56 msec in one-quarter msec increments. Participants were randomly assigned to either an ascending or descending sequence of delay intervals. Strong fluency enhancing effects were observed under delay conditions for all stutterers. Delay conditions produced significantly ($P<.01$) less disfluent speech and faster reading rates than the baseline condition. Different delay intervals yielded different levels of fluency enhancement for individuals. Delay changes as small as one-quarter msec produced clear changes in speech. All stutterers showed at least one VT delay value that produced essentially fluent speech. These findings strengthen the hypothesis that stutterers experience anomalous sensory feedback associated with speech production. VT is specifically implicated as a sensory signal to be investigated for its possible role in speech motor guidance.

521 Gender Gap in Aptitude Test Scores: Exploratory Analysis of Possible Determinants. RICHARD H. FRANKE and HEATHER E. ROBERTS, Loyola College, Baltimore, Maryland.

Scholastic Aptitude Test scores declined substantially for both male and female American students from the 1960s to about 1980. However, while males experienced SAT drops from 1969 to 1980 of 31 points in verbal and of 22 points in math scores, females dropped 46 and 27 points. In 1969, verbal scores of females exceeded those of males by 7 points, but by 1980 had dropped to 8 points below males. Math scores of females had been 43 points lower, and by 1980 dropped to 48 points below males. The gender discrepancy remains about the same in 1990. Changes in demographics of test takers do not explain fully either score drops or the increased gender gap. These seem to be explained by changes in the environment of early childhood. The paper focuses on differential responses of males and females to changes in the social environment.

522 Response to Horror Film Content: Catharsis or Incentive? JOYCE A. SWEEN (Department of Sociology, DePaul University, Chicago, IL), CHRISTINE UNFRED (DePaul University, Chicago, IL)

This study on the mass media and its socio-psychological effects on young adults, examines audience response to horror films of the type known as "slasher" films. The study, jointly funded by the American Medical Association and DePaul University, reports on an initial assessment of young adults' (ages 18 to 20 years) sentiments toward the content of five films, randomly chosen to represent this genre. Viewers (N=200) were assessed both prior to and after exposure to the films on various attitudinal measures and intensive interviews were carried out with randomly selected viewers. Responses are correlated with demographic and other background characteristics.

523 Norm Referencing for a Sample Group Variance of Zero: Resolving the Statistical Problem of a Direct Analysis of Learning Disabilities. RUTH M. GEIMAN, PH.D. (Betty Jane Memorial Rehabilitation Center) Tiffin, Ohio; WALTER L. OLSON, M.D. (Toledo Neurological Institute) Maumee, Ohio.

The symptoms of learning disabilities could not be examined directly due to a variance of zero. Norm referencing samples perform test items without error, and therefore without variance. To correct for this problem and to develop the statistical tests to validate symptoms, the binomial equation was used with a critical value. This procedure, suggested by Johnson and Jackson in 1959, is the key to analysis of test items when sample variance equals zero. As a result, a complete battery of tests is written and validated to directly analyze the processing deficits connected with learning disabilities. Four norm referencing studies will be reported. The tests are accepted by Recordings for the Blind, Princeton, New Jersey and Sight Centers in Ohio and Chicago as validation of processing deficits.

524 The Adjustment of Young Adults with Mental Retardation in Applied Service Settings: A Comparison of Parametric and Nonparametric Statistical Techniques. RICHARD F. ITTENBACH, DAVID E. CHAYER, ROBERT H. BRUININKS, MARTHA L. THURLOW (University of Minnesota).

The methodological problems facing many researchers of community adjustment are multifaceted. Along with the need to conduct valid and reliable multivariate studies is the realization that many underlying distributions do not meet the criteria necessary for parametric analyses. While recent developments in statistical and computational methods have laid the groundwork for a comparative analysis of techniques using community adjustment data obtained in applied service settings, no such study appears to have been conducted. The purpose of the present study was to test the hypothesis that no difference existed across levels of mental retardation for four dependent variables, jointly and separately, using four different statistical tests: (a) parametric MANOVA, (b) nonparametric MANOVA, (c) multiple nonparametric ANOVAs, and (d) logistic regression. Three of the four analyses resulted in highly similar results. Whether multivariate or univariate, parametric or nonparametric, the pattern of significance remained the same across the three classical and quasi-classical designs. Allowing for differences in magnitude, power, and shared variance, the same two variables emerged as statistically significant in each of the three sets of analyses. Patterns of significance for the follow-up analyses were also identical when comparing samples of persons with mild and moderate retardation but not when comparing samples of persons with moderate and severe/profound retardation. Substantive differences were found using the fourth technique, logistic regression, when attempting to predict group classification of persons with mild or moderate retardation and when attempting to predict group classification of persons with moderate or severe/profound retardation. The techniques were compared using interpretational as well as statistical criteria.

525

Attention deficit disorder, alcoholism and drug abuse: MMPI correlates Jack M. VAETH, Arthur M. HORTON, Mitra AHADPOUR (University of Maryland Medical School)

Earlier research had demonstrated that alcoholics with attention deficit disorder residual type (ADDRT) differ from other alcoholics on the Minnesota Multiphasic Personality Inventory (MMPI). The purpose of this study was to explore the influence of drug abuse on the relationship of ADDRT and alcoholism as reflected on the MMPI. Groups of 49 male alcoholics, 28 ADDRT alcoholics, 25 ADDRT alcoholic and drug abusers and 18 alcoholic and drug abusers were all administered the MMPI. Statistically, significant differences were found between the alcoholic and ADDRT alcoholic groups on scales Pd, Pa, Sc, Si, F and K. For the ADDRT alcohol and drug abusers versus the alcohol and drug abusers groups, they differed statistically on scales Hs, D, Pd, Pa, Pt, Sc, F and K.

526 Assessing Treatment Evaluation Within Drug Abuse Treatment Programs. FRANK M. TIMS (National Institute on Drug Abuse), ARTHUR MACNEILL HORTON, JR., (National Institute on Drug Abuse).

This report presents the findings of a recent (1988-1990) National Survey of 1200 drug abuse treatment programs. The purpose of the survey was to ascertain the extent to which drug treatment programs performed treatment evaluation activities. Information was obtained regarding actual performance of treatment evaluation activities, the sources of personnel used in the evaluation, the nature and types of data collected and analyzed, the purposes for which evaluations were conducted and program changes that occurred as a result of the survey. Aspects of treatment evaluation are related to program characteristics.

527 Research Participation As A Factor In The Retention Of Students In Science And Engineering. WAYNE STEVENSON (Oak Ridge Associated Universities), FRANK M. VIVIO (Argonne National Laboratory).

There is growing concern that science and engineering disciplines are not maintaining a sufficient number of students at the graduate level. To help assure adequate supplies of well-trained professionals for the future, effective strategies for retaining students through appropriate educational programs must be identified. Recent analysis of the educational paths and career aspirations of former participants in the U.S. Department of Energy (DOE) Laboratory Graduate Research Participation Program suggest that involvement in major research projects should be an important element of any overall strategy to retain students in the science and engineering workforce. These results and analyses of surveys conducted documenting impact of participation by graduate students and faculty in research participation activities at DOE contractor facilities will be presented. Comparisons are made between these groups and the population of U.S. scientists and engineers.

528 College-bound High School Students' Perceptions of Scientists and Scientific Occupations. ASHTON D. TRICE (Mary Baldwin College).

A sample of 1,064 public school students from three states were surveyed concerning their perceptions of scientists. The sample was obtained from senior and sophomore college-bound English classes. In the first part of the survey students were asked to indicate whether 15 characteristics (e.g., "is honest," "makes a good living") pertained to three scientific (chemist, biologist, and psychologist) and two control (police and elementary school teacher) occupations. Students were then asked to describe what each person did during a typical work day. Only chemists were viewed as "smart" by the majority of students (although 18% said a college education was not necessary to be a chemist). All three scientific occuptions were viewed as requiring hard work with low pay. One fourth of the students could not describe the work of each of the scientific occupations, and the descriptions stereotyped chemists as working in factories, biologists as studying marine animals, and psychologists as counselors. Less than one percent of the descriptions mentioned research or the scientific method. No differences were noted by sex or age. The low level of knowledge about scientific careers and nevative stereotypes are likely to contribute to the anticipated shortfall of students entering the sciences.

529 High School Science Students: What Can They Tell Us About Science Education? STEPHEN H. STOW (Oak Ridge National Laboratory), TOM L. ASHWOOD (Oak Ridge National Laboratory).

A questionnaire regarding science education was distributed to over 250 participants in DOE's High School Science Honors Workshops, which let selected top-quality students from each state and some foreign countries visit national laboratories for research participation each summer. The open-ended questions addressed what initiates, enhances, and decreases students' interests in science, when they became interested, what needs to be done to improve science education, and the adequacy of high school math. Consistent trends were found in the answers regarding very early ages when interests were spawned, as well as specific individuals, such as teachers or family members, who were instrumental. Pre-college science teachers are a key to enhancing or decreasing interest in a science profession, and the need for "hands-on" classroom activities is great. Need for teaching of concepts, rather than facts, was frequently cited, as was the abysmal status of science teaching resources in many places. While there is consistency among answers, there is also a great diversity of interesting answers, which are statistically presented and analyzed. The majority of the participants plan to enter life science, pre-med, and engineering professions.

530 A Drug Education Program With Teeth. LAURENCE MC GOWAN, Marlborough Public Schools, Marlborough, MA 01752.

Young people are said to be drawn into drugs for three main reasons: (1) curiosity, (2) peer pressure, and (3) parental use. Larry McGowan, a Grandteacher, uses a series of 25 weekly science lessons to fortify fourth and fifth graders with knowledge of:

WHAT THEIR GENES ARE...
WHERE THEIR GENES ARE...
WHAT THEIR GENES DO...
HOW THEIR GENES MAY BE DAMAGED...
WHAT HAPPENS TO BABIES WITH DAMAGED GENES...
WHY THEY WILL SAY NO TO DRUGS.

The curriculum employs "Fast Plants" from the University of Wisconsin, and hands-on activities in Biology, Physics and Chemistry. He calls the program "Why Say No?". Drop by his poster session for more information.

531 Evaluating the Effectiveness of Teaching Software. JOEL A. MICHAEL and ALLEN A. ROVICK (Rush Medical College, Chicago, Illinois)

Evaluating the effectiveness of teaching software generally involves the administration of pre- and post-tests bracketing the use of the software in question. However, when the software is used in a laboratory-like setting, with students working in groups and with an instructor present, it is essential to isolate the contribution, if any, of *each* of the educational inputs: software, peer teaching, and instructor inputs.

In a study of the tutoring process, each of us tutored students before and after they used one of our CBE programs. Student performance was improved (fewer errors and less time on task), but it was not possible to demonstrate that the effect was due to the software itself.

One approach to separating the contributions to improvement is a study in which, following a pre-test, groups of students were administered a post-test after having: [a] used the program in class (program + peers + instructors), [b] used the program in groups but with no instructor (program + peers), [c] used the program individually (program only), and [d] had no experience with the program but with the same time interval between tests (control).

While such a protocol will not allow us to deal with the *interactions* between educational inputs, it will allow us to more nearly isolate the effect of students' use of the teaching software. *(Supported in part by ONR Grant No. N00014-89-J-19152 to Ill. Inst. of Tech., Chicago, IL.)*

532 The JASON Curriculum Project. FRANK WATT IRETON (National Science Teachers Association).

During May 1990 over 250,000 students traveled to participating museums to view via satellite telecommunications the live exploration of Lake Ontario and ship wrecks from the War of 1812. The students and their teachers prepared for their visit by using science and social studies curriculum materials developed by the National Science Teachers Association (NSTA) with assistance from the National Council for the Social Studies (NCSS.) NSTA is cooperating in the JASON Project with Dr. Robert Ballard of Woods Hole Oceanographic Institution (WHOI), NCSS, and the Museum Satellite Network. During the museum site visit students participate in the exploration and discovery via satellite video and audio links. Students can question scientists and control the JASON remotely operated underwater vehicle (ROV) from the museums. The goal of the JASON Project is to interest students in pursuing science and technology career goals. In this session I will demonstrate JASON curriculum and how it was developed using the resources of NSTA, NCSS, WHOI, and teachers from the museum sites. The JASON Curriculum Project is funded in part by the National Science Foundation.

533
Cross Cultural Requirements and the Science Curriculum
MERLE BRUNO and NANCY LOWRY (Hampshire College).

A growing number of American colleges and universities are recognizing the need to educate all undergraduates to be part of a global, multicultural world. How do such concerns affect the science curriculum?If science students learn that global concerns are just tacked on to their list of requirements, then they are learning the simple lesson that has become a stereotype of western science--that it is value-free, impersonal and has little relation to life. Among the many things wrong with this image is that it tends to discourage students who are interested in values, people, and life from considering careers in science. At Hampshire College all students must present tangible evidence that they have intellectually engaged in a substantive way with the experience of peoples of the Third World or of American minority groups. Students are encouraged to integrate this work into their science concentrations to provide perspectives that they might otherwise miss. The science curriculum has incorporated the philosophy embodied in this requirement by supporting curriculum reform in three ways: design new courses that focus on third world issues, concerns, or perspectives; revise standard science courses to include more cross-cultural or global examples; seek out new candidates for faculty positions whose research has involved them in issues of the Third World or American minorities.

534 Analysis of Plant RNA Viruses and Bacillus thuringiensis in a NSF Supported Project-Oriented Biochemistry Laboratory Course Improvement. T. A. SALERNO (Mankato State University), J. E. RIFE (Mankato State University).

We have improved our biochemistry laboratory curriculum by implementing a project-oriented laboratory course. The students, who learned basic biochemical lab techniques in a previous quarter, collaborate in teams to solve a general research problem. To do this, they thoroughly search the literature, select specific aspects of the problem to investigate, design experiments for these investigations, perform the experiments, analyze the data and present oral and written reports on the project. In the past three years, students have characterized the plant RNA viruses, brome mosaic virus and cowpea chlorotic mottle virus and the insecticidal bacterium, Bacillus thuringiensis. The juniors and seniors have been challenged to be creative in their design and to effectively collaborate and communicate their results. Through the improved lab format, they have been given the opportunity to refine the research and analytical skills they will need in an industrial or academic research setting.

535 Evaluation of an Innovative Science, Engineering, and Mathematics Curriculum. PATRICK D. BROPHY (Rose-Hulman Institute of Technology, Terre Haute, IN 47803).

In the Fall of 1990-91 the Integrated First Year Curriculum in Science, Engineering, and Mathematics (IFYCSEM) was introduced at Rose-Hulman Institute of Technology. IFYCSEM was designed, and is being taught, by professors from chemistry, mathematics, physics, mechanical engineering, and electrical engineering. The curriculum is a sequence of three 12 quarter hour courses, one each quarter of the freshman year. The courses cover the same material as traditional freshman courses in calculus, chemistry, mechanics, electricity and magnetism, graphical communications, computer programming, and introduction to design. IFYCSEM emphasizes problem-solving and integration of concepts found within the above courses, while de-emphasizing symbolic and numeric manipulation through the use of a computer algebra system. One-hundred and twenty entering freshmen (from a class of 352) volunteered to enroll in this innovative curriculum, and 60 were chosen. This paper reviews the evaluation scheme and initial experiences with this curriculum.

536
Development of curriculum materials for global change education in secondary school science. ROSANNE W. FORTNER, VICTOR J. MAYER, DANIEL W. JAX, and DAVID ELLIOT (The Ohio State University).

Integration of science disciplines with social, political and economic factors is difficult in secondary school science classes. Curriculum materials addressing global climate change are being developed to assist teachers with such integration of subject matter and also provide an impetus for inclusion of current information about global impacts of human activities and natural processes. Materials apply remote sensing data, on-line data collection and analysis techniques, simple modeling, cooperative learning activities, proxy data, and classroom computer skills for the study of earth systems. Scientists with the Byrd Polar Research Center are cooperating with science and environmental educators to produce innovative and usable materials to serve not only curricular goals but offer the excitement of cutting edge science to students making career choices.

537
Earth Systems Education and Science Curriculum Restructuring. VICTOR J. MAYER and ROSANNE W. FORTNER (The Ohio State University) and WILLIAM HOYTE (Northern Colorado University).

Efforts at restructuring the nation's science curriculum are underway. Their major theme is the reduction of factual material with emphasis on understanding basic science concepts. Earth Systems Education (ESE) has an additional goal--an integrated study of physical and biological processes within Earth's subsystems. The Program for Leadership in Earth Systems Education funded by NSF is preparing 60 teams at least one from each state consisting of elementary, middle and high school teachers. A curriculum framework of Earth Systems understandings is the basis for a unique development process with implications for all integrated curriculum restructuring efforts. A pilot, funded by OERI, is a two year integrated course for all students of Worthington High School (OH). Issues have arisen with implications for all science curriculum projects.

538 Geologic Map of Washington - Southwest Quadrant: Its Use in Teaching Introductory Geology Classes. ELIZABETH N. LYONS (Bellevue Community College, Bellevue, WA)

The 1987 Geologic Map GM-34, Washington State Dept. of Natural Resources, by Walsh et al, is the first in a series of 4 maps that will detail the geology of this diverse state. The S.W. Quadrant includes three great volcanoes: the USA's largest (Mt. Rainier), most active (Mt. St. Helens) and Mt. Adams with its adjacent extensive volcanic field. The volcanoes lend themselves to class sessions in volcanism, rock cycle and plate tectonics. Students can use this map as an introduction to geologic maps, stratigraphic columns, and map symbols. Additionally, Mt. Rainier holds the most extensive alpine glacier system of the 48 states, and the map includes the Quaternary deposits of the southern extent of the Puget Lobe of the Cordilleran Ice Sheet. The far eastern edge of the map shows the border of the great flood basalts, & extensive strike-slip, dip-slip and thrust faulting in the southeastern corner. Pacific coastal features include outstanding spit development of Long Beach and others. A topographic and drainage map is included. The poster session includes the map, explanation, details of the map, photos of geology of the volcanoes, proposed field trips and a lab exercise as well as Mt. St. Helens' rocks.

539 New York to London by Way of the Panama Canal: Geographic Literacy among a Sample of U. S. College Students. RAYMOND A. EVE (University of Texas at Arlington), MONIKA COUNTS (University of Texas at Arlington.

Recent surveys conducted among U. S. students at the elementary and secondary levels have suggested a dismal level of geographic literacy is the rule. The authors have conducted an exploratory study among approximately 300 university udergraduates related to this topic.

Students were surveyed as to assess their abilities to: locate places on a world map, to pair various geographic features of the globe with approriate countries or continents, to recognize elements of cultural literacy belonging to various geographic areas, and to recognize the location of various well-known monuments or other man-made icons. Unlike most previous studies, ours contains a wealth of background data on students (including educational experience) which are intended to establish the correlates of performance level of geographic literacy. Surprisingly few variables are actually correlated with performance levels and this is discussed.

540 Noah's Ark, Ancient Astronauts, and Creationism in the Classroom? Combatting Pseudoscientific Beliefs in the Public Schools. RAYMOND A. EVE (University of Texas at Arlington.

In a recent survey of approximately 300 high school life science and biology teachers, the author found surprisingly high levels of belief in various types of pseudoscience. This was especially true of a "sudden creation" of mankind (approximately 30% of the respondents taking this position). Data will be presented documenting levels of various such beliefs. Other data will be shown to indicate the sources of such beliefs. Finally, data will be presented which bear on teachers' understanding of scientific theory and method and how these might be improved. Particular attention will be given to distinquishing common human errors in reasoning, media effects, effects of science education procedures, and sociocultural effects,and the implications of each for improving student performance.

541 ENHANCING THE SCIENCE KNOWLEDGE OF ELEMENTARY SCHOOL TEACHERS, ALLAN K. HOVLAND (St. Mary's College of Maryland) VIRGINIA A. COLTEN-BRADLEY (St. Mary's College of Maryland)

This paper will describe SCIENCES, a successful inservice program for elementary school teachers that demonstrates the benefits that can be derived from the collaborative efforts of a small college and the local school systems. Sensing that the local school systems were not immune to the national dilemma in the science preparation of elemtary school teachers, the authors contacted the science supervisors of the neighboring counties to seek advice on on the need for an science insevice workshop for their teachers. This resulted in the development of SCIENCES. SCIENCES has three components- a summer workshop, an innovative writing assignment, and a series of academic year follow-ups. The program is designed to encourage teachers to integrate the teaching of science with the teaching of language arts and math. The summer workshop features sessions in science content areas where teachers learn about integrating the subjects while being introduced to hands-on activities that cultivate development of process skills. In the writing assignment, teachers development their own instructional units that incorporate the theme of the workshop. Peer reviewed collections of the units are distributed to the participants. The program is entering its fourth year and has been highly praised by participating teachers and their school administrators.

542 A Scientific Perspective. SHERMAN DICKMAN, University of Utah.

Scientific knowledge and explanations have become generally accepted as the most trustworthy source of information about events and behavior. A scientific perspective--the way scientists think as scientists--will be presented as a model for the K-12 education of all people. Some of the differences between the scientific way of thinking and traditional ways are: (1) Differences in definition and use of terms such as observations, facts, evidence, types of knowing, and truth. (2) The practice of science makes assumptions explicit. The role of assumptions in thought processes, on sense perceptions, on explanations and theories will be delineated by examples. (3) Scientific knowledge is dynamic and self-correcting. In this process science has exposed many errors of common sense knowledge. (4) Science has limitations. It does not furnish explanations for all events and processes at present, nor is it likely to in the future. Thus science, "The Endless Frontier," is compatible with mystery, the unknown.

543 Teaching Values in Science Education. JOSEPH SANDERS (SCASS/Long Beach Schools).

One major recommendation for the improvement of science education is to emphasize values in teaching science. Such emphasis helps students to apply science directly to their lives, especially in considering problems of social interest and concern. The focus on values can also convey much of the character of scientific inquiry by helping students to understand how scientists generally think and work. So, in both respects an emphasis on values contributes in significant ways to producing a scientifically literate citizenry. Even so, few practical guidelines or methods exist to assist teachers in implementing the recommendation. This paper offers practical suggestions and guidelines for incorporating a value dimension into precollege and undergraduate coursework and activities. Applicable teaching objectives are encouraged across a representative range of examples, by focusing upon the values of open-mindedness, curiosity, accuracy, and quantification. Second, analysis techniques are discussed for identifying values in regular class activities. A schematic is also introduced and discussed that helps in formulating and asking value questions in an easily understood, stepwise manner. Most important, a conceptual application method is developed sequentially, as a means of helping teachers to generate specific value awareness and understanding activities, as part of a particular science content area. The teacher activities and materials that are provided for follow up work also reference major current state and national science education documents.

544 Environmental Education Models For A Global Age. JOSEPH SANDERS (SCASS/Long Beach Schools).

Environmental education is still a relatively new, but crucial, part of science curricula. The utilization of effective models particularly suited to promoting scientific literacy and environmental competencies is therefore an ongoing concern for educators. Equally as important, they must be alert to ways of adapting those models to meeting the local needs, concerns, and objectives of the constituencies they serve. In this paper, three models for environmental education development are discussed. The models may be used separately to initiate new programs, or functionally integrated to enrich and enhance those already existing programs that are still too narrowly based. The three presented are: Thematic Competencies, Scientific/Global Values, and STS (Science/Technology/Society) models. Each one of the models is discussed in some detail, and referenced to recent, major programs of national and international scope. Special attention is given to the UNESCO-UNEP Environmental Competencies, the AAAS—Project 2061, the Manitoba Protocol's Principles of Sustainable Development, and to the new (1990) *Science Framework for California Public Schools, K - 12*, a leading edge document for science education. Specific examples of concept mapping, matrix specification (including thematic content, thinking processes, scientific and environmental values), as well as activities development are considered as practical steps for implementation of the models.

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