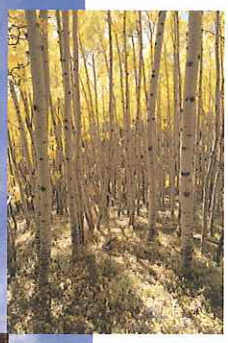
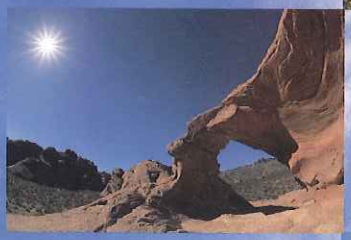
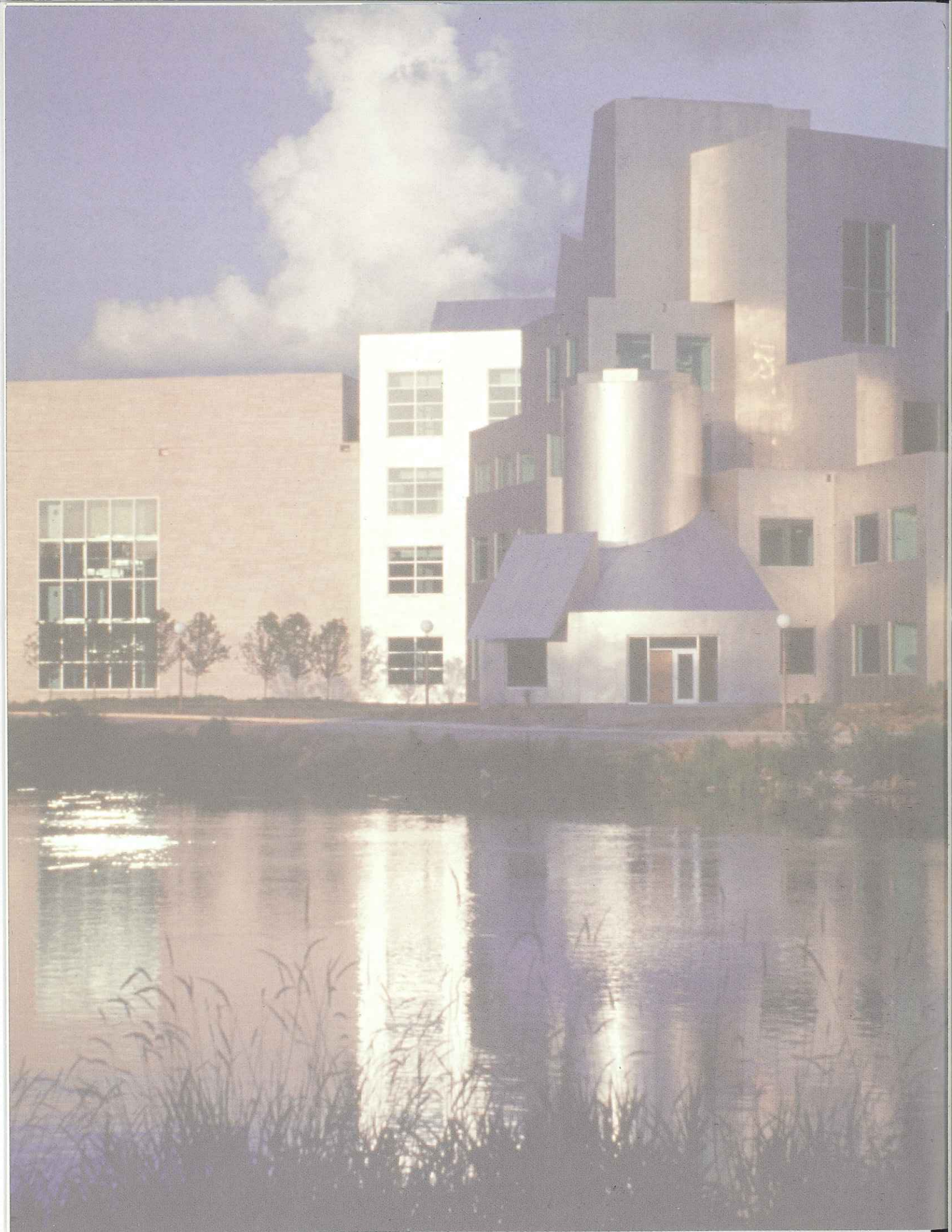
THE CENTER FOR GLOBAL AND REGIONAL ENVIRONMENTAL RESEARCH

1997 Annual Report





THE UNIVERSITY OF IOWA



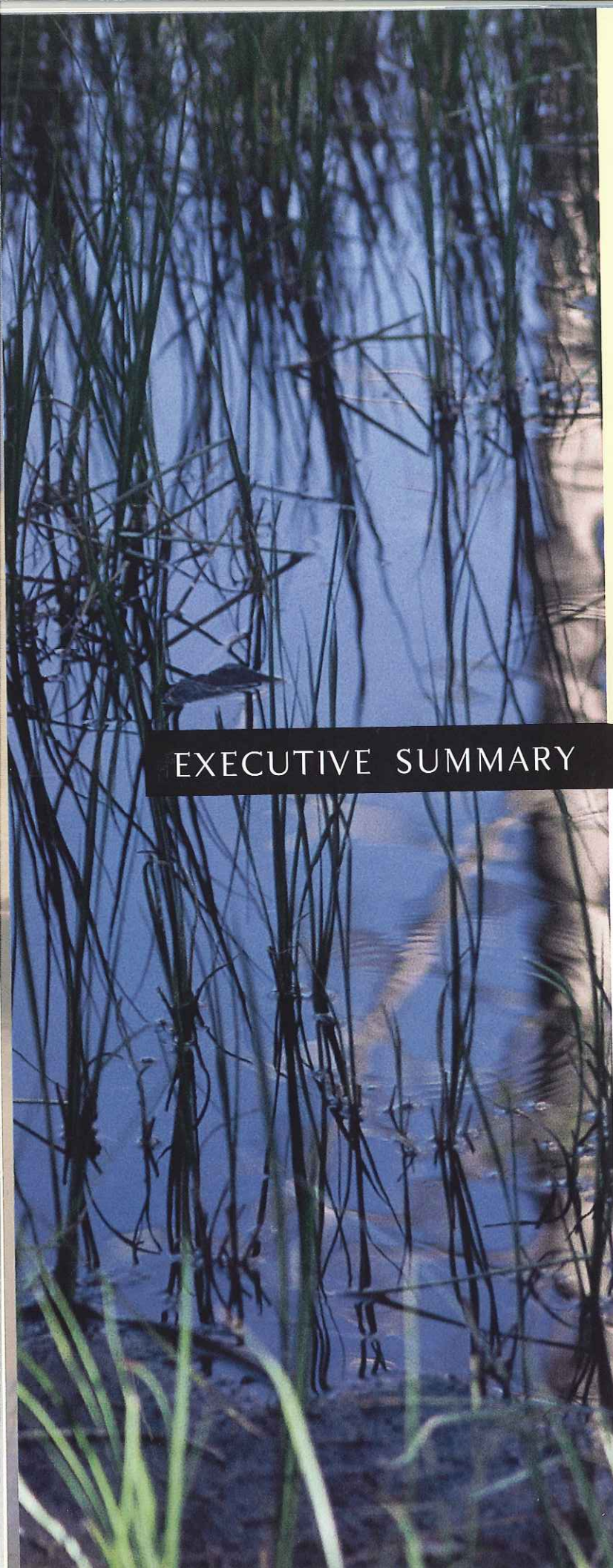
THE CENTER FOR GLOBAL AND REGIONAL ENVIRONMENTAL RESEARCH

The Center for Global and Regional Environmental Research — CGRER — was established in 1990 with the intent of promoting interdisciplinary efforts that focus on global environmental change. Housed on The University of Iowa campus in the Iowa Advanced Technology Laboratory, CGRER is supported by revenues generated from public utilities, as mandated by the state of Iowa's Energy Efficiency Act. Funds are used to support research and provide services to faculty members and students across the state who are interested in environmental change. CGRER membership consists of faculty and professional staff members from Iowa's colleges and universities. CGRER currently is composed of 66 members (an increase of five members in 1997) from 22 departments.

While environmental change is constant and natural, CGRER focuses on the human-induced *acceleration* of such change caused by modern technologies. Concerns about global change encompass multiple issues including its effects on natural ecosystems, environments, and resources, and on human health, culture, and social systems. Because global change promises to touch virtually every aspect of life and require the interpretation of many fields of science and engineering, the humanities, medicine, and law, an understanding of global change requires collaborative efforts among the many disciplines involved. CGRER's mission is to foster such collaborative interdisciplinary actions in three ways:

- by promoting dialogue among specialists and agencies,
- by educating students and the general public, and
- by fostering and supporting relevant research projects.

This annual report summarizes CGRER's activities in each of these three areas. Because CGRER's output is commensurate with that of its many members, a summary of which would require a small book, this annual report includes only a sampling of significant projects and efforts. Yet this sampling provides a vision of CGRER's multiple efforts to achieve its ultimate goal: assisting Iowa's agencies, industries, and citizens to assess and prepare for global change and its effects.



EXECUTIVE SUMMARY

In 1997 CGRER expanded the scope of its activities near and far, with faculty, staff, and students examining issues of environmental change in Iowa, in the Midwest, and around the globe. Their interdisciplinary activities fell into the general categories of dialogue and outreach, education, and research delineated in this Annual Report. The following examples of each are but a sampling of CGRER's 1997 initiatives.

The Climate Convention negotiations at Kyoto were constantly in the headlines in 1997. In preparation for Iowa's meeting reductions in greenhouse gas emissions, CGRER members completed the report *Iowa Greenhouse Gas Action Plan*, a cooperative effort with the Iowa Department of Natural Resources with funding from the U.S. Environmental Protection Agency. This plan outlines 16 policy actions that Iowans could take to decrease greenhouse gas emissions. It proposes a strategy for investing in Iowa's economy while mitigating greenhouse gasses, improving energy efficiency, diversifying agricultural production, raising renewable energy crops, and increasing competitiveness in manufacturing.

In 1997, CGRER began a directed seed grant program to explore "Iowa's Environmental Future." Using World Wide Web and Geographical Information Systems (GIS) technologies, CGRER is applying its expertise to assess how Iowa's environment has changed since the time that tallgrass prairie dominated the landscape, and how the environment might continue to change under projected global warming scenarios. When completed, the results of this study

will be made available to schools, businesses, NGOs, and decision-makers throughout the state.

In addition to stimulating research and education through awarding several grants, CGRER received external funding for new research initiatives. One of the several awards received was a prestigious Camille and Henry Dreyfus Foundation Award that supports a two-year postdoctoral fellow who will examine the catalytic role that aerosol particles play in exacerbating smog and air pollution in urban environments, and in the chemistry of our atmosphere.

CGRER and its members continue to serve as one of the state's primary sources of expertise on global and regional environmental problems through development of new educational materials and through presenting many speeches and forums. CGRER also offers a seminar series, a 1997 highlight of which was a speech by Mario Molina, a 1995 Nobel Prize winner in chemistry, on global atmospheric pollution. Through these and other outreach activities, we continue to dialogue with a diverse array of individuals, agencies, and governments, including the United Nations World Meteorological Organization and World Health Organization in Geneva, Switzerland, with which we established ties in 1997.

Active research grants and contracts awarded to CGRER members grew to over $18 million in 1997. This represents a powerful leveraging of our $400,000 annual budget, an amount entrusted to us through an annual assessment of 0.015% of the total gross operating revenues of Iowa's gas and electric utilities. We are grateful for these funds, which allow us both to operate the Center and to pursue new research questions. We look forward to further extending our programs in dialogue and outreach, education, and research in 1998.

Gregory R. Carmichael

Gregory R. Carmichael

Co-Director

Jerald L. Schnoor

Jerald L. Schnoor

Co-Director

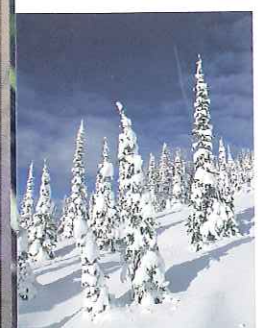
A MESSAGE FROM THE ADVISORY BOARD

STANDING ON COMMON GROUND

As the discussion about global change becomes a point of debate for policy makers, businesses, and the public, the core issue for Iowa is how to most effectively — and simultaneously — protect our economy and environment.

A pivotal role for the Center for Global and Regional Environmental Research is to bring to the forefront a common ground of indisputable importance for Iowa. That common ground is the economic benefit that directly results from reducing air emissions.

In the state of Iowa, we have already proven that economic growth is a major outcome from the development of renewable energy and the improvement of energy efficiency. For example, ethanol

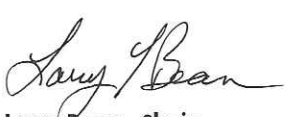


produces $1.5 billion in annual economic activity for the state; farmers have reduced the use of nitrogen-based fertilizers by more than $360 million over the last ten years; and wind turbine capacity has grown by 100% since 1995. All of these successes help the state's economy while reducing air emissions.

In 1997, CGRER was a leader in substantiating the economic and environmental opportunities available for the state. The *Iowa Greenhouse Gas Action Plan*, published in the spring of 1997, established 16 strategies for reducing Iowa's emissions to 1990 levels. Equally as important, these strategies are projected to save Iowans $300 million annually in reduced energy costs, plus an additional $32 million a year in avoided greenhouse gas emissions. Another important contribution has been the partnerships CGRER has established with state and national organizations to leverage interest and support in the Center's mission of understanding global change.

Looking forward, CGRER is well poised for a significant role in expanding Iowa's knowledge about economic and environmental savings through emissions reductions. The Center's research efforts are important to documenting the scientific, economic, and societal benefits of mitigating Iowa's environmental risks.

Economic benefit has proven to be a key to protecting Iowa's environment. By understanding and embracing the potential of these financial opportunities, persons debating the issue of global change can stand on common ground, working together for a better future for Iowa.



Larry Bean, Chair

CGRER Advisory Board

ADVISORY BOARD MEMBERS

Larry Bean
Iowa Department of Natural Resources
Energy Bureau

Representative Clyde Bradley
Iowa House of Representatives

Paula Dierenfeld
Iowa Utilities Board

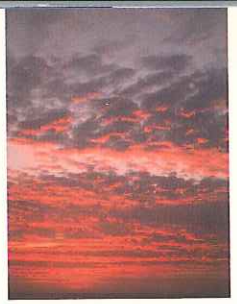
Senator Robert Dvorsky
Iowa Senate

Senator William Fink
Iowa Senate

Robert R. Holmes
IES Utilities, Inc.

David Osterberg
Osterberg & Sheehan,
Public Utility Economists

Dorothy Paul
United Nations Association



CGRER PROMOTES INTERDISCIPLINARY DIALOGUE AND OUTREACH TO ADDRESS IOWA'S NEEDS

Today's complex environmental changes often simultaneously touch multiple elements of our Earth and human society. When problems result, attempts at solution are most successfully achieved if embraced by several disciplines, or by specialists and agencies that normally may not work together.

CGRER aims to create the dialogue that brings specialists together with one another and with public agencies requiring their expertise. Successful results may range from avid discussions to the conception and completion of a major research project.

CGRER COLLABORATES WITH IOWA'S GOVERNMENTAL AGENCIES

When governmental agencies need technical advice on broad environmental issues, they can come to CGRER. CGRER served as a clearinghouse for several such issues in 1997, drawing researchers and specific projects together to address specific needs.

For example, in 1997, CGRER co-director Jerald Schnoor received a grant from the University of Northern Iowa to assist with the Iowa Comparative Risk Project. This project, organized through the Iowa Department of Natural Resources with funds from the U.S. Environmental Protection Agency, provided a comprehensive scientific summary of Iowa's environmental risks and problems and also surveyed the public about its conceptions of these issues. The end product was a document intended as a public policy tool for long-term environmental planning. Schnoor performed the risk assessment for Iowa's drinking water and consulted on other matters.

The year 1997 marked the completion of the Iowa Greenhouse Gas Action Plan, another CGRER project funded by the Iowa Department of Natural Resources with monies from the U.S. Environmental Protection Agency. This policy-setting document, an outgrowth of the 1992 United Nations Conference on Environment and Development, constitutes Iowa's effort to reduce its own greenhouse gas emissions. CGRER, together with the Iowa Public Policy Center, spearheaded the writing of the action plan.

When the U.S. Army Corps of Engineers (COE) realized the need to improve the quality of water flowing through and from the Iowa Army Ammunition Plant in Middletown, Iowa, it came to CGRER for assistance. In 1997, Professors Diana Horton (UI Department of Biological Sciences) and Jerald Schnoor (UI Department of Civil and Environmental Engineering) consulted with the COE about the concept of using a wetland to remove remaining contaminants (RDX and TNT) left from decades of munitions manufacturing. The wetland's plants would help purify the water through a process called "phytoremediation." Horton consulted about the construction and revegetation of the wetland and Schnoor and his graduate students analyzed a variety of native wetland plant species, as well as soil and surface water samples, for presence of the toxic contaminants and their metabolites. The COE has earmarked funds to continue these studies in 1998, the year that the wetland will be completed.

CGRER FUNDS INTERDISCIPLINARY MODELING WORKSHOP

Much of the work in global change is now fed into data bases that are used to develop predictive computer models. Because the development of these models lies at the forefront of computer technology and data interpretation, regular discussions and a sharing of approaches are crucially important. In December, 1997, CGRER was the major sponsor of a workshop on modeling the dispersal and migration of tree species organized by George Malanson (UI Department of Geography). The workshop was attended by nine biologists, ecologists, and geographers from across the country who specialize in the modeling of plant migration. The three-day workshop was intended to provide an opportunity to share information and review existing models. However the discourse was so productive that an entire new dispersal and migration model was designed. Attendees now are sharing the task of writing the computer code to implement this new model.

CGRER BRINGS VISITING RESEARCHERS TO THE UNIVERSITY OF IOWA

Visitors who come to work at The University of Iowa likewise stimulate a sharing of ideas among disciplines, just as they initiate new research efforts. In 1997, five visiting researchers from three continents were hosted by CGRER on the University of Iowa campus.

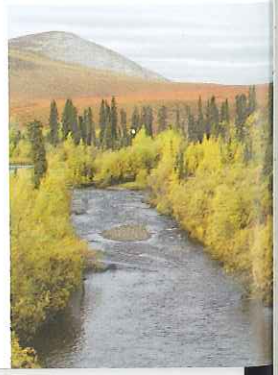
Sharad Adhikary, director of the Himalayan Climate Center (HCC), Nepal, visited as part of a long-term collaboration between HCC and CGRER. His activities focused on the preparation of a proposal submitted to international funding agencies to conduct a detailed monitoring program in Nepal that will assess anthropogenic pressures on air quality and land use in the Himalayan mountainous region.

Thorjørn Larssen, from the University of Oslo, Norway, worked on modeling soils of China that have been affected by acidic deposition.

Malva Andrea Mancuso, from the University of Sao Paulo, Brazil, worked on examining and modeling groundwater transport of contaminants into a lake in Rio de Janeiro.

Maite Mendez-Gil, from the University of Santiago de Compostela, Spain, visited as part of a newly established collaboration that applies air quality models developed at CGRER to the study of air pollution in Spain. The first such application is helping to analyze the effects of a large power plant in northwestern Spain.

Shang-Gyoo Shim, Principal Research Scientist at the Korea Institute of Science and Technology (KIST) and an Iowa alumnus (PhD, 1987, Chemical & Biochemical Engineering), visited as part of a long-standing research collaboration between CGRER and KIST. Activities focused on the study of long range transport of pollutants in East Asia, and included a variety of transboundary modeling investigations as well as the operation of a long-term air pollution monitoring site at Cheju Island, S. Korea.



CGRER HOSTS SEMINAR SERIES

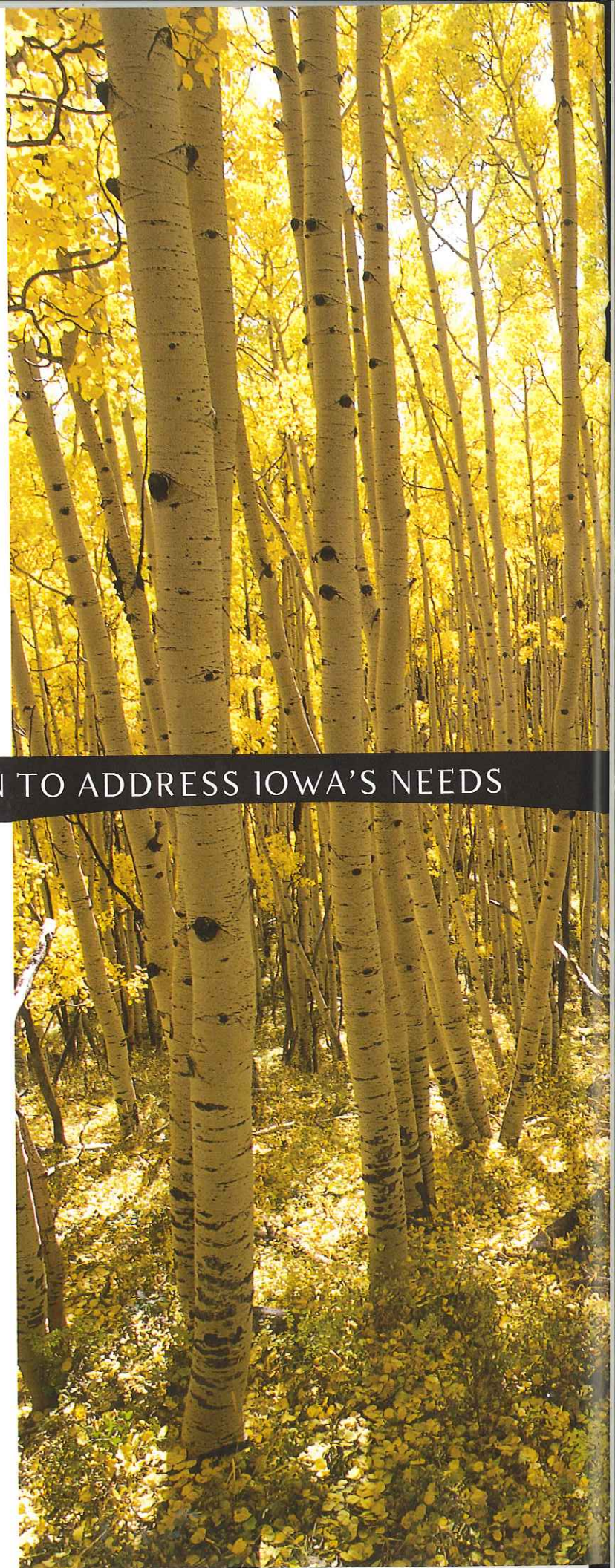
Dialogue that invigorates interdisciplinary thought patterns also has been stimulated by the 12 CGRER seminar speakers who came from 11 institutions to speak on how their research efforts relate to global change issues.

1997 SEMINARS

Speaker	Affiliation	Title of Seminar
Allan Ashworth	North Dakota State	How Warm was the Interior of Antarctica During the Late Cenozoic?
Brent Danielson	Iowa State University	The Effects of Landscape Features on Small Mammal Populations in an Intensively Managed Forest Ecosystem
Diane Debinski	Iowa State University	Using GIS and Remotely Sensed Data to Predict Biodiversity in Montana Meadows of the Yellowstone Ecosystem
David Greene	Concordia University	Modeling Regeneration in Burns and Strip-Cuts
Dave Hollander	Northwestern University	Continental Records of Climatic and Environmental Change Over the Past 100 Years: Insight from High-Resolution Lacustrine Archives
Hans Peter Kohler	Swiss Federal Institute of Technology, Zurich, Switzerland	From Environmental Microbiology to Industrial Biotechnology: Different Stages in the Career of an Enzyme
Thorjørn Larssen	University of Oslo	Acid Rain and Acidification of Soils in China
Luis Lecha	National Climate Center, Institute of Meteorology, Cuba	Climate and Human Health
Elizabeth Lynch	Loras College	Holocene Vegetation History of a Parks Forest Vegetation Mosaic, Wind River Range, Wyoming
Mario J. Molina	Massachusetts Institute of Technology	CFC's and Stratospheric Ozone *and* Chemistry on Ice Particles
Jeffery Nekola	Univ. of Wisconsin, Green Bay	Paleorefugia and Neorefugia: Rare Species Biogeography on Northeastern Iowa Fens and Algific Talus Slopes
Susan Powers	Clarkson University	The Wettability of NAPL-Contaminated Sands

Looking into the future, the attack on global change problems will best be led by professionals taught to understand these problems' diversity, complexity, and multidisciplinary nature. CGRER attempts to train such individuals by fostering the teaching of interdisciplinary courses. CGRER serves as a beacon that attracts highly qualified students to The University of Iowa to engage in interdisciplinary environmental research. It encourages these and other students to broaden their studies and research through considering the multidisciplinary aspects of global and regional environmental problems.

Well-trained students are CGRER's most significant and visible product. In 1997 approximately 12 masters degrees and 15 doctoral degrees were awarded to students working with CGRER members.



CGRER PROVIDES EDUCATION TO ADDRESS IOWA'S NEEDS

CGRER RECEIVES FUNDING FOR POST-DOCTORAL ASSOCIATE

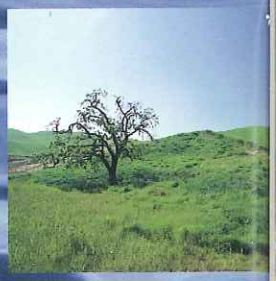
The 1997 award of a highly competitive grant to CGRER from the Camille and Henry Dreyfus Foundation will greatly aid CGRER's educational mission. This grant, awarded to Professors Vicki Grassian (UI Department of Chemistry) and Gregory Carmichael (UI Department of Chemical and Biochemical Engineering), will fund a two-year post-doctoral associate in environmental chemistry at CGRER, initiating an effort to construct an interface between the fields of chemistry and environmental chemistry.

CGRER FUNDS TEACHING WORKSHOPS

CGRER also extends its educational purview to the broader public through grants, outreach projects, and publications. A major contribution here was CGRER's 1997 funding of workshops on Iowa's greenhouse gas issues for public school teachers. These workshops, to be offered by Professor Carl Bollwinkel for graduate credit at UNI, will train 30 elementary, middle school, and high school teachers in use of the Iowa Greenhouse Gas Action Plan and supplementary materials as a basis for environmental education and action. The $10,000 awarded by CGRER will supplement a REAP grant to offer these teachers two weekend training workshops early in 1998, instructional materials, and additional support and contact while the teachers are implementing these materials with students.

CGRER SHARES ENVIRONMENTAL CHANGE INFORMATION

CGRER also reaches out to the public through its biannual newsletter, *IoWatch*, which is distributed to approximately 350 persons associated with CGRER and to other interested readers. In 1997, both issues of *IoWatch* alerted readers to the human health complications that may attend global warming. Research and educational efforts of CGRER members were also summarized.



CGRER FOSTERS GLOBAL CHANGE RESEARCH TO ADDRESS IOWA'S NEEDS

Research lies at the root of understanding global change and its effects. Thus CGRER traditionally has funneled about a third of its funding into seed grants for research projects focused on identifying and dealing with global change issues. In addition, CGRER fosters research by acquiring state-of-the-art facilities and equipment and providing these to its members and their students, and by pursuing external funding for multi disciplinary projects.

The success of these initiatives is demonstrated in part by the leveraging of CGRER's budget (approximately $400,000 in 1997) into external funding. In 1997, the current funding of CGRER members as a group totaled $18 million.

CGRER AWARDS SEED GRANTS ON IOWA'S ENVIRONMENTAL FUTURE

CGRER, through its seed grant program, encourages new research initiatives that will breed major additional funding or programs. In some years, CGRER chooses to give a number of smaller grants on a diversity of global change topics. In 1997, seed grant funds totaling $50,000 were instead fed into a consolidated program called "Iowa's Environmental Future."

Through Iowa's Environmental Future, three faculty members, George Malanson (UI Department of Geography) and Eugene Takle with William Gutowski (ISU Department of Atmospheric

Sciences), are attempting to unite existing Geographical Information System (GIS) data bases into a single, easily accessible, interactive mapping system. Malanson is creating a user-friendly front end to existing GIS data bases, which will allow users to overlay and interweave GIS maps with ease. He is anticipating the types of questions that will require integration from a variety of data bases, and is building these questions into his software. Malanson is now testing the initial running system of his program. Takle and Gutowski are assembling climate-related data bases that will serve as the backbone of a user-friendly information system. They are simultaneously examining the interactions between land use changes and climate, through exploring ways to couple high resolution land surface data with lower resolution regional climate models.

This consolidation of GIS systems, which eventually will be available to all Iowans through the World Wide Web, will allow students and educators, the business community, public agencies and policy makers, and the general public to integrate a variety of environmental maps and existing data bases in order to interpret the outcomes of policies impacting the state's land use and quality of life. A variety of related interdisciplinary social and economic issues can be considered tangentially.

CGRER RECEIVES EXTERNAL GRANT FUNDING

While most of CGRER's externally funded research flows through members academic departments, a growing number of research grants are awarded to CGRER directly.

In addition to the Dreyfus Foundation award (see page 10) and three awards for interpretation of Iowa's environmental status (see page 7), CGRER in 1997 received four additional grants.

One of these grants, awarded to CGRER by the UI Center for Health Effects of Environmental Contamination, is funding attempts to compute risk assessments for heat stress in Iowa in past years. This will allow predictions of changes in heat-related illness and death that would occur in Iowa with various climatic warming scenarios.

The three additional grants, awarded to CGRER co-director Gregory Carmichael, allow Iowa researchers to apply their expertise to other parts of the globe.

One, awarded jointly to CGRER and Argonne National Laboratory by the World Bank and U.S. Department of Energy, will assess the human health effects of the growing use of coal and other fossil fuels in Shanghai and Beijing, China. The benefits of modern air pollution control technologies will also be examined.

A second grant, funded to CGRER from NASA's Mission to Planet Earth, will take a multidisciplinary look at the effects of regional environmental change on agriculture in China. This multi-institutional project will attempt to integrate numerous climatic, air quality, and agricultural computer models into a single integrated system for use elsewhere around the globe.

A third grant, awarded jointly to CGRER and Argonne National Laboratory from the U.S. Department of Energy, aims to design computer tools capable of examining the joint effects of air pollution and climate change, and developing coordinated response measures, in Southeast Asia.

CGRER PROVIDES RESEARCH FACILITIES AND EQUIPMENT

The Iowa Advanced Technology Laboratories, near the center of the university's campus, house CGRER's administrative offices and provide space for multidisciplinary research activities of CGRER's faculty members and their students. Extensive computer communication networks connect researchers with their home departments and with colleagues throughout campus and beyond. Conference facilities provide excellent arrangements for small workshops as well as large conferences and symposia.

A GIS laboratory, established in 1990 by a grant from the UI President's Strategic Planning Initiative and an equipment donation from Hewlett-Packard, continues as the hub of CGRER's research activities. The laboratory provides CGRER with state-of-the-art computer hardware and software for use in the management, analysis, and visualization of environmental data. In addition to 40 gigabytes of on-line hard disk storage, several pieces of equipment were added in 1997: a Silicon Graphics Workstation, a Pentium-II and Power Mac G3, and a read-write CD-ROM device.

Marc Armstrong (UI Department of Geography) led an effort which resulted in an exciting new grant in 1997, a NASA award from the Centers of Excellence in Applications of Remote Sensing to Regional and Global Integrated Environmental Assessments Program, to establish a Laboratory for the Immersive Visualization of the Environment. This new laboratory, which will utilize virtual reality technology, should be operational in 1998.

CGRER continues to expand its global positioning system (GPS) facilities and now is completely set up for differential field analysis. Equipment includes two GIS-grade mobile receivers that record position information and other attributes, a mobile base station for differential correction, a real-time differential correction unit (new in 1997) for use in obtaining radio-corrected data from permanent base stations in the field, and a laptop computer for control and correction of GPS hardware and analysis software.

CGRER also continues to operate two outdoor stations, Oxford Farms and Amana, both at rural sites within 20 miles of Iowa City. These sites provide locations for field-related teaching and research activities. In 1997, Oxford Farms was used by Annmarie Eldering for monitoring rural air quality.

The November, 1997, provision of GPS equipment to the State Archaeologist's Office is an example of the positive benefits of providing GPS equipment to researchers. Archaeologist Mark Anderson, who was surveying a proposed rerouting of U.S. Highway 20 for the Iowa Department of Transportation (IDOT), was seeking an alternative to the laborious task of hand-mapping archaeological sites and associated data. After receiving several days of training from CGRER employee Glenn Larson, Anderson and his associates were able to use the hand-held GPS data logger, along with a backpack-held GPS receiver and antenna, to trace the route and to record data on historic and prehistoric cultural resources in the field. Upon returning to Iowa City, Larson differentially corrected the archaeological data and exported them in a format that could be interpreted by the archaeologists using ArcView software.

This technology not only proved itself faster and easier than the traditional hand-recorded mappings, it also was more accurate. And IDOT feels that it will facilitate their handling of the data. In fact, the results of this pioneering effort appear so advantageous that IDOT is hoping archaeologists will use GPS technologies on all future IDOT projects. The State Archaeologists' Office is planning to extend use of the GPS to other archaeological and interdisciplinary projects as well, such as efforts with the Iowa Department of Natural Resources that require coordination of multiple environmental factors.

GENERAL INFORMATION

BUDGET

In fiscal year 1997 (July 1, 1996- June 30, 1997), three-quarters of CGRER's $400,000 of funding was spent on research, education, and outreach directed toward global change issues (Figure 1). Administrative costs consumed the remaining quarter of the budget.

This funding, received in total from an assessment on Iowa's gas and electric utilities through the State Department of Commerce, was magnified many times in the millions of dollars of external grants and contracts awarded to CGRER members (Figure 2). In calendar year 1997, CGRER members were performing research that brought in a total of $18 million in external funds. This included both those grants awarded to CGRER directly and other grants awarded to CGRER members through their respective departments. Of this $18 million, $4.8 million was new funding that was initiated in 1997, while the remaining $13.2 million came from ongoing projects.

FIGURE 1. CGRER'S EXPENSES*

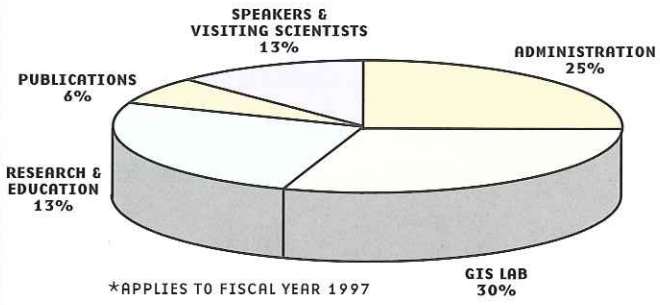
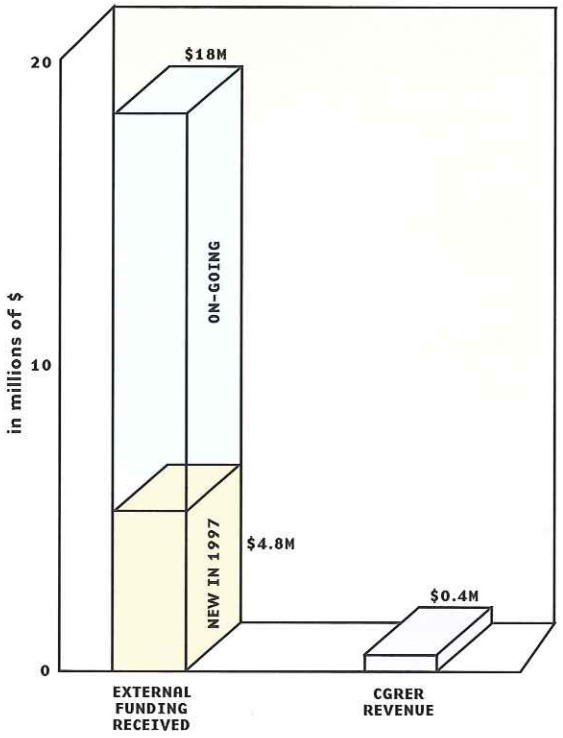


FIGURE 2. 1997 LEVERAGING OF CGRER'S INCOME*



*APPLIES TO CALENDAR YEAR 1997

ADMINISTRATION AND MEMBERSHIP

CGRER is directed by University of Iowa professors Gregory Carmichael (Department of Chemical and Biochemical Engineering) and Jerald Schnoor (Department of Civil and Environmental Engineering). Center activities are guided by an elected Executive Committee that consists of eight members plus the two co-directors. The Executive Committee meets monthly to plan initiatives and chart CGRER's course. An Advisory Board of eight members from outside the academic community meets annually to lend oversight to CGRER's activities (see page 5 for Advisory Board members).

Since 1992, CGRER has employed two full-time staff members: administrative assistant Jane Frank, who oversees office operations, and data systems coordinator Mark MacLennan, who manages the Geographical Information Systems computer laboratory. In 1997, the laboratory's high usage necessitated the hiring of a third full-time employee, data information specialist Glenn Larson, who assists MacLennan with his management tasks. CGRER reports directly to the University of Iowa's Vice President for Research, Dr. David Skorton.

CGRER consists primarily of its 66 members:

ANTHROPOLOGY
Michael S. Chibnik
Russell L. Ciochon

BIOLOGICAL SCIENCES
Stephen B. Heard
Stephen D. Hendrix
*Diana G. Horton
John D. Nason

CHEMICAL AND BIOCHEMICAL ENGINEERING
*Gregory R. Carmichael

CHEMISTRY
*Vicki H. Grassian
Sarah C. Larsen
Josef B. Simeonsson

CIVIL & ENVIRONMENTAL ENGINEERING
Pedro J. Alvarez
A. Allen Bradley
William E. Eichinger
*Robert Ettema
Witold F. Krajewski
Lou Licht
Wilfrid A. Nixon
A. Jacob Odgaard
Gene F. Parkin
*Jerald L. Schnoor
Richard L. Valentine

ECONOMICS
Thomas F. Pogue
John L. Solow

ELECTRON SPIN RESONANCE FACILITY
*Garry R. Buettner

GEOGRAPHY
Marc P. Armstrong
Hong Jiang
*George M. Malanson
David L. McGinnis
Michael L. McNulty
Tad Mutersbaugh
Claire E. Pavlik
R. Rajagopal
Rebecca S. Roberts
Gerard Rushton

GEOLOGY
*Richard G. Baker
E. Arthur Bettis
Robert S. Carmichael
Lon D. Drake
*Luis Gonzalez
*Gregory A. Ludvigson
Mark K. Reagan
Holmes A. Semken, Jr.
Frank H. Weirich
You-Kuan Zhang

HISTORY
Paul R. Greenough

LAW
Burns H. Weston

MATHEMATICS & COMPUTER SCIENCE
Florian A. Potra

MECHANICAL ENGINEERING
V.C. Patel
Theodore F. Smith

MICROBIOLOGY
Lacy Daniels

PHYSICS & ASTRONOMY
John D. Fix
Louis A. Frank
Donald A. Gurnett
John S. Neff
Steven R. Spangler

PHYSIOLOGY & BIOPHYSICS
G. Edgar Folk

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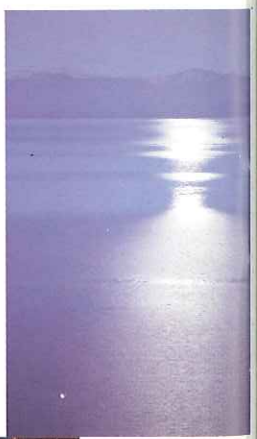

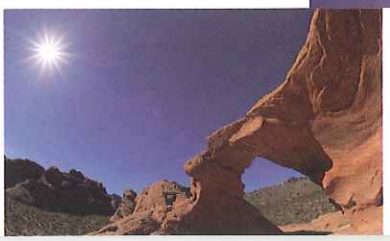

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