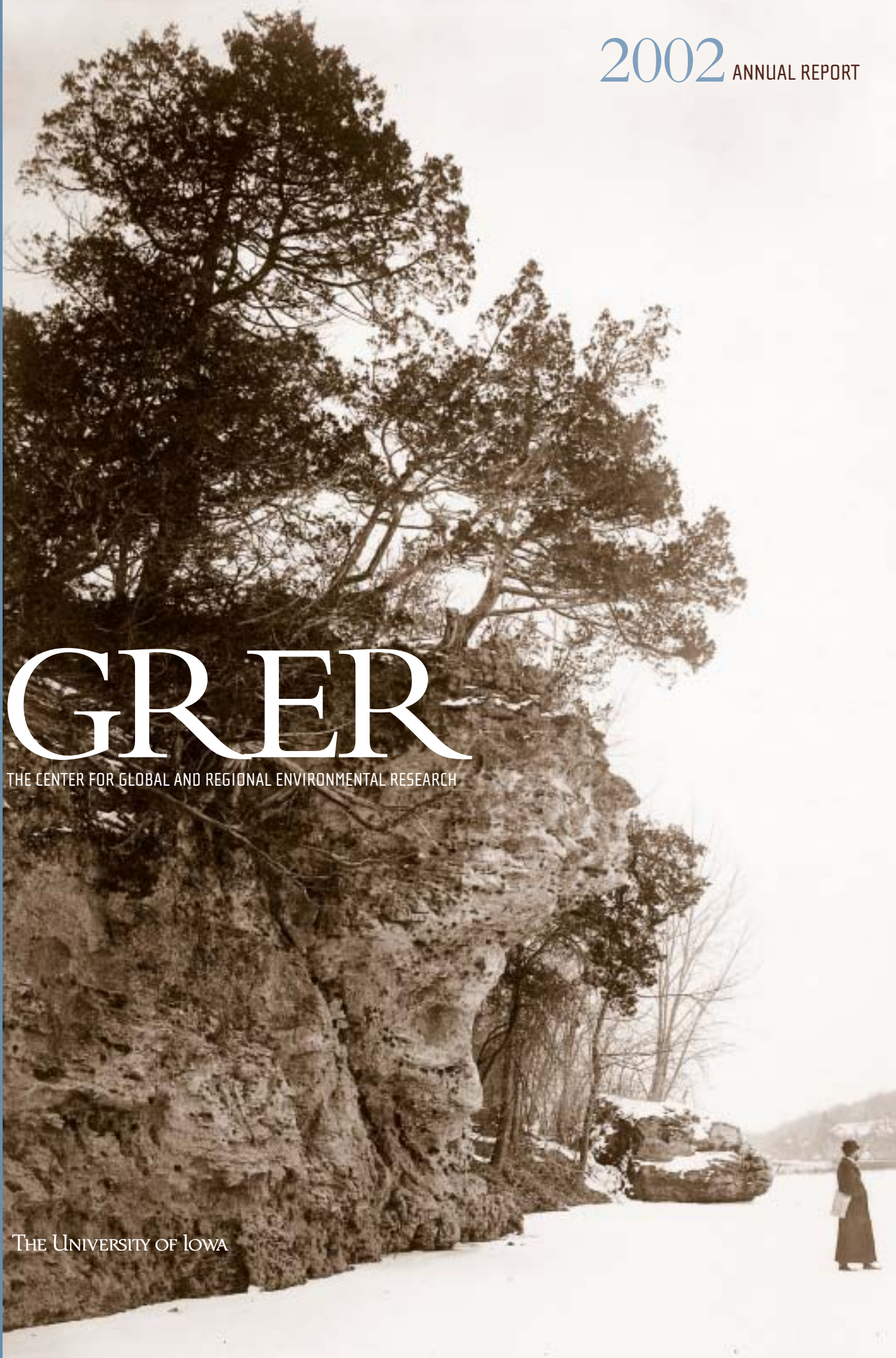


CGRER

THE CENTER FOR GLOBAL AND REGIONAL ENVIRONMENTAL RESEARCH



THE UNIVERSITY OF IOWA



front cover: Palisades, Cedar River, Linn Co.

Graphics in this Annual Report are taken primarily from the Calvin Photographic Collection, Paleontology Repository, UI Dept. of Geoscience (see the collection at <www.uiowa.edu/~calvin>). These photographs, all taken in Iowa around 1900 by Samuel Calvin (Professor of Natural Sciences at the UI and State Geologist) and others, impress us with the way things have changed – and remained stable – in the past 100 years.

CGRER

THE CENTER FOR GLOBAL AND REGIONAL ENVIRONMENTAL RESEARCH

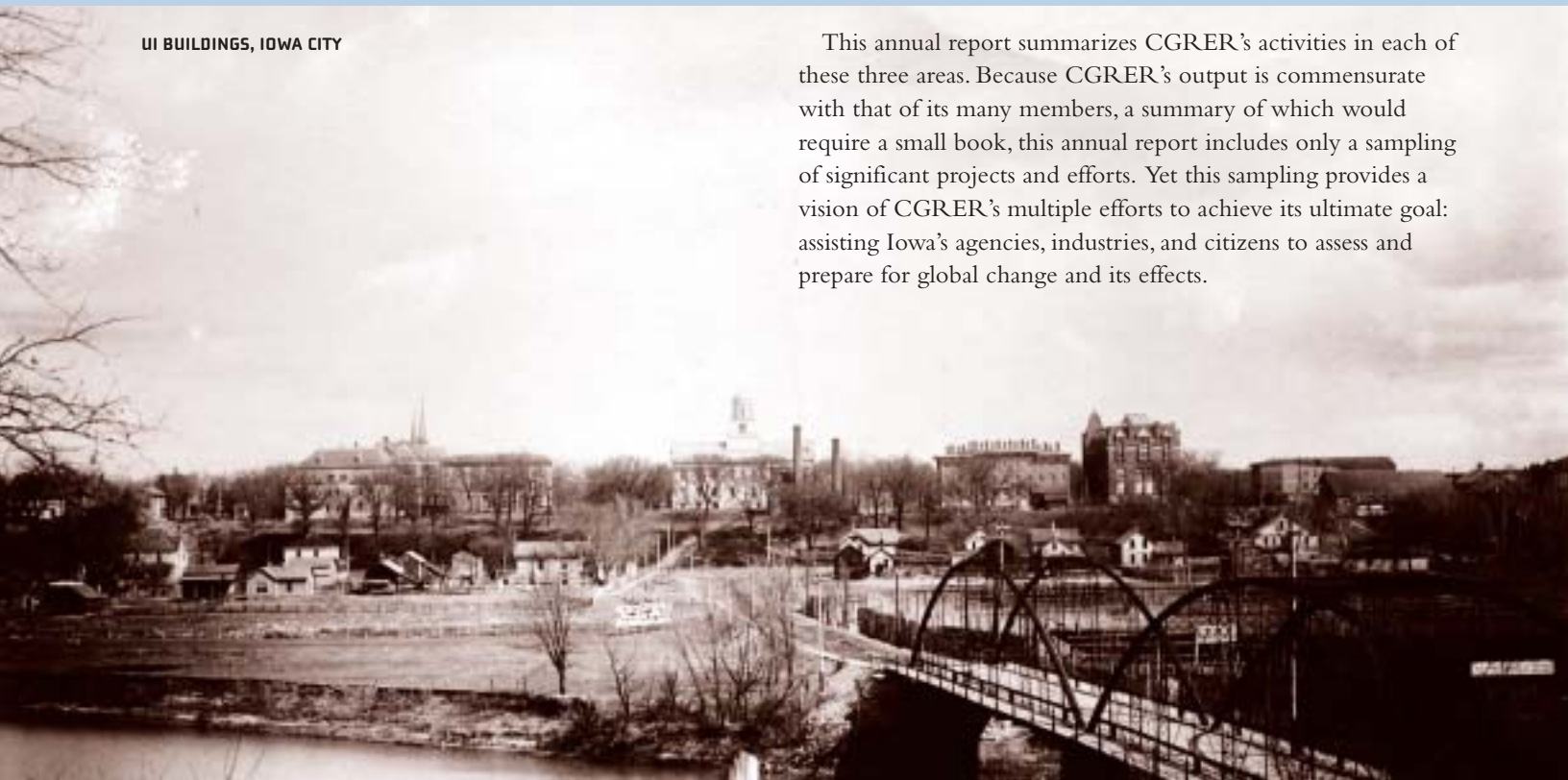
The Center for Global and Regional Environmental Research – CGRER – was established in 1990 with the intent of promoting interdisciplinary efforts that focus on global environmental change. Housed on the University of Iowa (UI) campus in the Iowa Advanced Technology Laboratories, CGRER is supported by 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 is composed of faculty and professional staff from Iowa’s colleges and universities. CGRER currently is composed of 65 members 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.

UI BUILDINGS, IOWA CITY

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

CGRER was established over a decade ago to promote interdisciplinary studies related to how we humans, through our lifestyles, impact the environment at all levels, on a local to global scale. We have worked to achieve this mandate in several ways. CGRER has brought together faculty, students, and staff from diverse disciplines. CGRER members collectively have accumulated vast experience in analyzing complex environmental issues from diverse scientific, social science, and economic perspectives. Much of our work has focused on the human dimensions of environmental, technological, and economic change. CGRER members are now utilizing their accumulated skills to improve the scientific basis upon which to build effective environmental policies. In

addition, many CGRER efforts are focused on the sustainable, fair provision of water, food, and energy to divergent cultures. Ongoing examples of such studies and efforts are presented in this annual report.

The need for cross-disciplinary dialogue is becoming increasingly clear and critical. First of all, such dialogue is necessary because the environment does not segregate complex processes or phenomena by scientific discipline. For example, it is now widely recognized that the pressing environmental issues of air pollution and climate change are closely linked and share common causes and solutions. The fact that air pollutants and greenhouse gases arise largely from combustion of organic compounds (be they fossil fuels or biomass), and that aerosols play key roles in both air quality and climate change, are illustrative examples. In addition to degrading local air quality, sulfur dioxide emissions from fossil fuel combustion induce regional acid rain and contribute to hemispheric sulfate aerosol haze, which in turn exerts a cooling influence on the climate system. In contrast black carbon particles, emitted from a variety of combustion processes (including diesel engines), act to warm the climate system.

Integrating the complex scientific links between climate and air quality is difficult, but it's not the end of our efforts. We also need to extend our studies to include human and ecosystem health issues. Climate change, air quality, and human and environmental health share many commonalities that can guide new research. There is a clear need to pursue and coordinate research that can support environmental policies that achieve these multiple benefits (e.g., improve air

quality, safeguard human and ecosystem health, *and* minimize global warming). Such environmental solutions are challenging but achievable. However, the necessary research communities have different cultures, use different terminologies, and have varied approaches to problem solving. At CGRER we provide an environment where these barriers are removed, and such groups can interact and learn from each other.

In the end, it is the human dimensions that must be put at the core of environmental issues. The basic challenge is how we, as individuals and societies, meet our present needs without sacrificing the livelihoods of future generations of all living creatures. Whether we are addressing our vulnerability to environmental change, or the options for preventing further environmental degradation, careful consideration of present and future stakeholders and their social, economic, and environmental condition is essential.

To cope effectively with environmental change we must have real choices, and these arise only through knowledge and education. The diverse expertise and viewpoints nurtured at CGRER are being applied to pressing problems in Iowa and around the world. CGRER members are helping companies and countries to reduce emissions and environmental impacts. We are pleased to share with you our ongoing activities in this report, and we welcome a chance to interact with you.

GREGORY R. CARMICHAEL, CO-DIRECTOR
JERALD L. SCHNOOR, CO-DIRECTOR

LITTLE SIOUX RIVER VALLEY



ONEOTA RIVER, HOWARD CO.



▲ KINDERHOOK OOLITE, HUMBOLDT CO.



THE MILL AT LITTLETON, BUCHANAN CO.

MESSAGE FROM THE Advisory Board

Sustainable development and the human right to a clean environment remain elusive goals. Even though environmental degradation now affects every ecosystem on earth, with severe environmental impacts to health and human security, the plundering of the 'global commons' continues at an unprecedented pace.

We are – in many respects – in worse shape today than we were when the 1992 Rio Earth Summit provided Agenda 21, a road map for sustainable development. The main stumbling block to sustainability continues to be poverty. Lacking the basic means for survival, half the world's people struggle to live on less than \$2 a day. And, in the United States alone, many environmental initiatives and regulations that have guided 30 years of environmental progress are under attack or have already been rolled back. The recent 2002 U.N. World Summit for Sustainable Development in Johannesburg, South Africa, called both the developed and developing nations to move beyond debate and inaction.

Issues like global warming will be accepted as reality and understanding grows about the close web of interrelationships among population, development, the environment, human needs, and social responsibility. Facing a future of climbing temperatures, floods, and droughts ravaging regions around the world, mass migrations across political boundaries, and water wars predicted to be fought in the next 50 years, our major challenge is still to seek a common ground for a future that is both economically and environmentally sustainable.

Iowans need to be part of the solution because Iowans contribute to environmental problems and will be greatly affected by their consequences. By bringing our collective powers to bear and by putting aside any sense of apathy, complacency, or cynicism, we can swim upstream to influence U.S. action. Political forms of citizenship in the Iowa House and Senate can encourage individual and community environmental action. It has been my experience that whenever there are changes for the better, it is because people have taken charge of their own lives and transformed society as well as themselves.

As a member of the Advisory Board, CGRER stands as a visionary global model for science-based research, teaching, and public outreach to foster dialogue among many groups. CGRER's activities can result in innovative and successful improvements to sustain our living environment. From studies of how dust storms in Asia affect air quality in the Midwest, to studies of the effects of animal feeding operations on human health, CGRER's mission is pro-people, pro-nature, and pro-economic efficiency and growth. Even though we face formidable challenges and uncertainty about the future, CGRER leads us one step closer to stewardship of Planet Earth.

—Dorothy Paul

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CGRER Promotes Interdisciplinary Dialogue to Address Iowa's Needs

Dialogue

In 2002, CGRER continued to encourage dialogue among the many disciplines concerned with global change issues. The usual Seminar Series and hosting of Visiting Scientists were enhanced by CGRER's participation in the United Nations World Summit for Sustainable Development.

CGRER continued to publish the newsletter *IoWatch*, which in 2002 focused on the topic of sustainability. CGRER's web page (www.cgrer.uiowa.edu/) received nearly 5 million hits in 2002, 70% of which came from outside the University of Iowa.

PROFESSOR SAMUEL CALVIN AND CLASS, STATE QUARRY, JOHNSON CO.



U.N. World Summit for Sustainable Development

CGRER's involvement in global change issues enabled co-director Jerry Schnoor and CGRER undergraduate research assistant Ori Sivan to attend the World Summit and bring Iowa's concerns and outlook to the South African meeting. Attending as delegates of the Iowa division of the U.N. Association also meant that they brought their observations and conclusions back to Iowa. They have done this through giving numerous post-Summit presentations to a variety of audiences: the Iowa City Foreign Relations Council, the CGRER and College of Engineering Advisory Boards, the UI's Environmental Coalition, church groups, the Iowa City Rotary Club, and others.

Visiting Scientists

CGRER hosted the following nine international and U.S. visiting scientists in 2002:

- **SHARAD ADHIKARY** (Himalayan Climate Center, Nepal) visited CGRER from February 14 to March 18 to participate in strategic planning activities with Greg Carmichael, Paul Greenough, and Jerry Schnoor. The proposed activities will address sustainable development efforts in Southeast Asia.
- **DAVID STREETS** (Argonne National Lab) and **QINGYAN (JACKIE) FU** (Shanghai Academy of Environmental Sciences), who perform emissions estimates in China as part of larger collaborative efforts to characterize Asia's air pollution and its impact and movement, visited CGRER on March 28-29 and June 11 to work with Greg Carmichael on joint research projects.
- **TAO WANG** (Hong Kong Polytechnical University), who takes surface measurements in support of CGRER's Asian air pollution projects, visited CGRER on July 7 to collaborate with Greg Carmichael on joint research efforts.
- **YOUNG SUNWOO** (Konkuk University, Korea) visited CGRER for a few weeks in August to design a collaborative research project involving air quality studies in Korea, to be carried out while on sabbatical at CGRER in 2003.
- CGRER brought World Food Prize Laureate **PEDRO SANCHEZ** and **CHERYL PALM** (both Columbia University, New York) to Iowa City on October 21-22. Sanchez spoke at the University Lecture Series and the Iowa City Foreign Relations Council, and Palm spoke to the campus's Women in Science and Engineering group. The two also met with students, CGRER members, and campus dignitaries.
- **TOM CAHILL** (University of California, Davis), who takes surface measurements of aerosols in Asia and the western U.S., visited CGRER on October 28-29 to work with Greg Carmichael on interpretation of data in support of CGRER's multiple studies of air pollutants generated in Asia.
- **HIRAM (CHIP) LEVY II** (Geophysical Fluid Dynamics Laboratory, Princeton) visited CGRER from November 4-22 to work with Greg Carmichael on their new, jointly-held "Modeling and Emissions Analyses in Support of the Spring 2002 ITCT Field Experiment in the Eastern Pacific and Western U.S." research grant.



HISTORICAL LIBRARY,
SCHAEFFER HALL, IOWA CITY

Seminar and Lecture Series

As in past years, CGRER hosted a Seminar Series that included nine global change researchers from around the world (see table below):

SPEAKER	AFFILIATION	TITLE
Brian Currie	Miami University of Ohio	Stable Isotope-Based Paleolimnology of the High Himalaya and Tibetan Plateau
Howard Fairbrother	Dept. of Chemistry, The Johns Hopkins University	Role of Environmental Interfaces in Organohalide Remediation
Darren Grocke & Stuart Robinson	Dept. of Geology, Royal Holloway University Dept. of Earth Sciences, University of Oxford	Ocean-Atmosphere Interactions and Understanding the Global Carbon Cycle: The Importance of Terrestrial Carbon-Isotope Stratigraphy
Chris Holmden	University of Saskatchewan	Epeiric Sea Environment: Clues and Views from the Isotopic Perspective
Laura Jackson	Dept. of Biology, University of Northern Iowa	Restoring Prairie Processes to Farmlands
Alan T. Stone	Dept. of Geography & Environmental Engineering, The Johns Hopkins University	Iron as a Reactive Constituent in Soils
Stephen Walsh	Dept. of Geography, University of North Carolina; Ida Beam Distinguished Visiting Professor	Characterizing and Modeling Land-Use/Land-Cover Dynamics: Case Studies of Ecuador and Thailand
Page West	Dept. of Anthropology, Barnard College	Conservation as Development: The Social Effects of Conservation Interventions in Papua New Guinea

CGRER also co-hosted two speakers (Pedro Sanchez and Stephen Walsh) whose lectures reached university-wide audiences. Dr. Pedro Sanchez, Chair of the United Nations Millennium Project Task Force on World Hunger, came to Iowa City on October 21 as a speaker in the University Lecture Series. Sanchez had just received the \$250,000 World Food Prize for research that enables small farms in Africa and Southeast Asia to inexpensively replenish crucial nutrients in exhausted soils. Through agroforestry, farmers are now transforming depleted tropical soils into productive agricultural lands and once again feeding their villages.

Dr. Stephen J. Walsh, an Ida Beam Distinguished Visiting Professor, came to the UI from November 4 to 8. Walsh, from the University of North Carolina's Department of Geography and the Carolina Population Center, Chapel Hill, has focused his investigations on the interpretation and application of satellite imagery to a range of geographic problems. He presented two lectures while here, discussed research efforts with students and professors, and worked on a joint proposal that he and George Malanson later submitted to the National Science Foundation.

In Addition . . .

CGRER members continued their harvest of professional appointments and awards, honors that portrayed their success in maintaining meaningful dialogues with colleagues and the larger professional world. The following is a selection of such honors and awards garnered in 2002:

- **ALLEN BRADLEY** (UI, IIHR–Hydroscience & Engineering) has been appointed to the National Research Council’s Committee of USGS Water Resources Research. He also is Deputy Chair of the Research Applications Committee of the Consortium of Universities for the Advancement of Hydrologic Sciences, Inc.
- **GARRY BUETTNER** (UI, Electron Spin Resonance Facility) is now President Elect of the Oxygen Society, a professional organization for scientific researchers and clinicians interested in free radical biology, chemistry, and medicine.
- **GREG CARMICHAEL** (UI, Chemical and Biochemical Engineering) received the College of Engineering’s Faculty Excellence Award for Service.
- **ROBERT ETTEMA** (UI, IIHR–Hydroscience & Engineering) received ASCE’s Hunter Rouse Lecture Award for 2002. His talk, “Jack Frost: Bank Robber, Cattle Rustler, Conservationist,” was presented at the ASCE Conference on Hydraulics Measurement Methods and Instrumentation in Estes Park, CO.
- **WITOLD F. KRAJEWSKI** (UI, IIHR–Hydroscience & Engineering), newly appointed Joseph & Rose Summers Professor of Water Resources Engineering, was elected Fellow of the American Meteorological Society. He also has been appointed co-editor of *Advances in Water Resources*, a journal that emphasizes fundamental research findings.
- **BEN MIRIOVSKY**, graduate student co-advised by Allen Bradley and Witold Krajewski (UI, IIHR–Hydroscience & Engineering), was awarded a National Defense Science and Engineering Graduate Fellowship, administered by the American Society for Engineering Education (ASEE).
- **GENE PARKIN** (UI, Civil and Environmental Engineering) has been appointed The Donald E. Bentley Professor of Engineering.
- A paper by **JIM RAICH** (ISU, Botany), “The Global Carbon Dioxide Flux in Soil Respiration and its Relationship to Vegetation and Climate” (*Tellus* 44B: 81-99, 1992), was designated a Science Citation Classic in 2002 because of the large number of times it has been cited in other research papers.
- **MICHELLE SCHERER** (UI, Civil and Environmental Engineering) has been appointed Associate Editor of the peer-reviewed quarterly *Aquatic Sciences*, and also is a new Editorial Review Board member for the National Ground Water Association’s journal, *Ground Water Monitoring & Remediation*.

CLINTON STREET, IOWA CITY





CGRER Provides Education to Address Iowa's Needs

Education

In 2002, CGRER continued to foster well-founded thought processes regarding global change issues through once again hosting the Research Education for Undergraduates summer program. A CGRER-sponsored Sustainable Futures project challenged students to devise sustainability schemes specific to Iowa. And CGRER members devised novel methods for presenting global change subjects in their course curricula.

STUDENT	HOME INSTITUTION	FACULTY	PROJECT
Adam Christensen	University of Iowa Iowa City, IA	Vicki Grassian	Heterogeneous Atmospheric Chemistry of Trace Gases on Oxide Particles and Mineral Dust
David Drab	State University of New York Buffalo, NY	Len MacGillivray	Green Chemistry and Solid-State Synthesis
Shannon Kobs	Michigan Technological University Houghton, MI	William Eichinger	Remote Sensing Field Experiments
Nathan Lien	Wartburg College Waverly, IA	Jason Telford	A Novel Approach to Environmental Remed- iation: Development of Outer-Sphere Ligands for Uranyl Carbonate
Jim Loussaert	University of Iowa Iowa City, IA	Sarah Larsen	Spectroscopic Investi- gations of Environmental Catalysts
Andrew Ohrt	Gustavus Adolphus College St. Peter, MN	Keri Hornbuckle	The Fate and Transport of Semi-Volatile Organics in Environmental Systems
Jon Salsman	University of Iowa Iowa City, IA	Michelle Scherer	The Role of Green Rust Minerals in the Fate and Remediation of Ground- water Contaminants
Megan Shurn	University of Indianapolis Indianapolis, IN	Mark Young	Environmental Chemical Processes in the Air and Water
Andrew Sorensen	Cornell College Mt. Vernon, IA	Greg Ludvigson	Cretaceous Paleoclimatology
Kent Strodtman	Benedictine College Atchison, KS	Michelle Scherer	The Role of Green Rust Minerals in the Fate and Remediation of Ground- water Contaminants
Jennifer Wade	University of Iowa Iowa City, IA	Vicki Grassian	Heterogeneous Atmospheric Chemistry of Trace Gases on Oxide Particles and Mineral Dust
Andrea White	University of California at Davis Davis, CA	Greg Carmichael	Tropospheric Trace Gas Cycles in East Asia



Research Education for Undergraduates Program

This was the third and final year of the NSF-funded REU grant. Hosted by CGRER, 12 students came to the UI for eight weeks during the summer to participate in ongoing research projects (see table to the left). The REU program was directed by Vicki Grassian. The experience was designed to heighten student involvement in research and to help students make informed decisions about future science studies and careers. The success of the effort was demonstrated by Greg Ludvigson's student Andrew Sorensen who, in addition to performing laboratory research, participated in a week of field studies with Ludvigson in Utah, and also traveled to Denver in October to present his paper at the Geological Society of America's annual meeting.

Sustainable Futures for Iowa Program

CGRER's involvement in the World Summit for Sustainable Development (see page 7) included efforts to educate tomorrow's leaders about the issues at hand. Prior to the late-summer U.N. summit, CGRER sponsored a program titled "Sustainable Futures for Iowa," held through the Iowa United Nations Association (UNA). Iowa's college-aged students were invited to create a plan for a sustainable Iowa and to present it in written and verbal form. The students, working in small groups, addressed topics such as food production, transportation, land use planning, and energy. Portions of their papers, along with other essays and reports, are being printed by the Iowa UNA for distribution to Iowa's legislators and other interested parties. Six of the 45 participants also attended the World Summit.

New Opportunities for Engineering Students

CGRER members continue to broaden the content of their courses to include materials on environmental concerns and sustainability. Samples of innovations made in 2002 are listed below:

- Jerry Schnoor taught a course on *Water Quality Monitoring* at the Mississippi River Environmental Research Station (MRERS), a unit of IIHR-Hydrosience & Engineering. This was the first class held at this newly-opened riverside field station, a facility that is sure to expand teaching and research opportunities for many CGRER members.
- Greg Carmichael taught his new course *Green Chemical Engineering* to engineering undergraduates and first-year graduate students for the second time, and plans to continue doing so annually. Students are taught (through the use of case examples) how to incorporate the environmental implications of energy use, materials, regulations, and byproducts into the design of chemical engineering industrial processes.
- *Engineering Problem Solving 1*, a course taught by Keri Hornbuckle and Richard Valentine and taken by all incoming engineering undergraduates, included a three-lecture unit on sustainable development for the first time.
- CGRER members Jerry Schnoor, Pedro Alvarez, and Gene Parkin helped with the planning of a *Mexican service project*, to occur in 2003, whereby UI and ISU engineering students will help bring water and sanitation resources to the village of Xicotepec. The project, initiated by Rotary International, will also involve the NGO "Water for People," local Rotary groups, and others.
- And for engineering students around the world, Greg Carmichael assisted the World Bank in its creation of a multi-authored, online, distance learning course, *Urban Air Quality Management*. While focusing on Asian pollutants and controls, the course provides an interactive educational resource for students and professionals in any locale.

BISON, ELK, AND DEER BONES



In Addition . . .

CGRER members continued to educate the world at large about changing environments in a variety of ways: through writing, speaking, listening, and instigating research efforts. Following is a selection of such activities performed in 2002:

- A book by **MICHAEL CHIBNIK** (UI, Anthropology), *Crafting Tradition: The Making and Marketing of Oaxacan Wood Carvings*, will be published by the University of Texas Press in Spring, 2003. The book considers the immersion of wood carvers from Oaxaca, Mexico, into the international folk art market. Chibnik continues to work with ecologists from CIFOR (Center for International Forest Research) on a project concerning the production and marketing of non-timber forest products around the world, including development of a sustainable wood source for the Oaxacan wood carvings.
- **GREG CARMICHAEL** (UI, Chemical and Biochemical Engineering) served on a steering committee for *Air Pollution as a Climate Forcing – A Workshop*, a week-long international meeting held in Hawaii in the spring. The workshop included representatives of funding agencies, as well as scientists investigating air pollution, climate change, and human health concerns. The meeting strove to encourage interdisciplinary interactions, with the hope of identifying and instigating joint research agendas that address the interactions between our changing atmospheric regimen and human health.
- **LUIS GONZALEZ** and **GREG LUDVIGSON** (UI, Geoscience), with colleagues, have received a three-year, \$258,000 NSF grant, *Quantifying Changes in Hydrologic Cycle Fluxes over the Americas during the Mid-Cretaceous (Albian) Greenhouse World*. This project evolved from successful preliminary research that was supported by a CGRER Seed Grant, Graduate Student Travel Award, and other funding.
- CGRER research assistant **HAO HUANG** was one of 33 graduate students selected to attend a two-week Advanced Study Program Colloquium, *Interactions Among Aerosols, Climate, and the Hydrological Cycle*, held at the National Center for Atmospheric Research (NCAR) in Boulder in July. While there, he participated in research and heard lectures from global experts who came to NCAR as visiting lecturers. One lecturer was **GREG CARMICHAEL** (UI, Chemical and Biochemical Engineering), who spoke on chemical weather forecasting and on atmospheric aerosols in East Asia.
- **GREG LUDVIGSON** (UI, Geoscience) was invited to speak on *Continental Isotopic Records of Global Change in the Cretaceous Greenhouse World* at Indiana University, Iowa State University, and Northern Illinois University. He and colleagues addressed related topics in July at the International Workshop on Cretaceous Climate and Ocean Dynamics, Florissant, CO.
- In March, **JERRY SCHNOOR** (UI, Civil and Environmental Engineering) testified before the Water and Power Subcommittee of the U.S. House of Representatives Resources Committee on the need for the *Upper Mississippi River Basin Conservation Act*, a bill focusing on monitoring and modeling of nutrients and sediments in the Upper Mississippi.
- CGRER assisted with test studies examining the co-firing of coal and biofuels (oat hulls and cereal byproducts from Quaker Oats) at the UI's Power Plant.



DEAN KAY'S CAR AFTER WINDSTORM (1924)



CGRER Fosters Global Change Research to Address Iowa's Needs

Research

CGRER continues to procure and award research grants that further our understanding of global change problems and their resolution. In 2002, CGRER received four new grants from external sources and continued work on nine previously funded grants.

CGRER also funded four Seed Grant projects and hired a post-doctoral fellow to commence efforts in a Health and Environment Initiative. CGRER maintains state-of-the-art research facilities and computer equipment for the use of members and their students.

CGRER continues to shape new research initiatives in Iowa and around the globe. For example in 2002 Greg Carmichael joined the directors of the United Nations Environmental Program, International Panel on Climate Change, and others to form a steering committee for a new program called Asian Brown Cloud. This research and education program, now being established, will attempt to create a holistic view of Asian air pollution, one that merges efforts to address air pollution, human health, and climate change.

Lastly, CGRER became a member of the Upper and Middle Mississippi Valley Cooperative Ecosystem Study Unit (CESU), one of several federally-designated regional units that bring together research, educational, and land management institutions to improve diverse environmental efforts in a specified region. This new CESU will take form and assume action in future years.

Health and Environment Initiative

Post-doctoral fellow Meredith Gooding (an environmental toxicologist) arrived at CGRER in September 2002, simultaneously with anthropologist Roger Sullivan (a post-doctoral fellow for the UI's Global Health Studies Program, GHSP). Together they are charged with initiating a joint *CGRER-GHSP Health and Environment Initiative*, intended to pull researchers from both centers into interdisciplinary research efforts. Gooding and Sullivan both have two-year appointments. During that time, they will identify funding sources and submit proposals to bring in grant monies for diverse international studies that span the interface between environmental and human health concerns.



Grants and Contracts Awarded to CGRER

CGRER received the following four new grants in 2002:

ITR/AP & IM Development of a General Computational Framework for the Optimal Integration of Atmospheric Chemical Transport Models and Measurements Using Adjoint (Greg Carmichael, \$2,300,000, 5 years, from National Science Foundation):

Carmichael's research has dramatically improved our understanding of the transportation of atmospheric pollutants. Breakthroughs have relied in part on the improved ability to detect and measure atmospheric chemicals, and in part on complex numerical models (Chemical Transport Models) that are increasingly able to predict their atmospheric movement.

This grant focuses on the latter: the development and utilization of new Information Technology Research tools with the goal of producing an optimal "State of the Atmosphere" (one that closely integrates modeled and measured quantities of pollutants, to provide the best possible estimate of the atmosphere's chemical state). Improving atmospheric computational tools and associated software is critical to designing cost-effective emissions control strategies, interpreting observational data, and executing air quality forecasting (Chemical Weather Forecasting). Improved Chemical Transport Models will enable full utilization of the vast amounts of tropospheric chemical data that are now becoming available.

The grant is a partnership between the UI, Michigan Tech, the California Institute of Technology, the National Center for Atmospheric Research, and the University of Washington.

Modeling and Emissions Analyses in Support of the Spring 2002 ITCT Field Experiment in the Eastern Pacific and Western U.S. (Greg Carmichael and colleagues, \$310,902, 3 years, from National Oceanographic and Atmospheric Association):

Carmichael has made major strides in defining Asian air pollution, its movement, and the effects of interacting pollutants. Recently he has demonstrated that Asian pollutants move across the Pacific Ocean to California and beyond. This new grant will deepen our understanding of intercontinental pollutant transport, which is increasingly affecting air quality in the Western U.S.

The grant funded the 2002 California flights of a NOAA research plane loaded with instrumentation that provided real-time measurements of several dozen atmospheric gases and aerosols. These data should further characterize California's air pollutants that are derived from Asia, and identify how they may contribute to climatic changes. Timing and route of the NOAA flights was guided by Carmichael's current numerical models of pollutant transport. The remainder of the grant period will be dedicated to interpreting the data collected and using them to improve existing numerical models. These Chemical Weather Forecasting models will predict how the pollutants will vary with time. Such information is critical to designing American air pollution control strategies during this period of increasing Asian emissions.

The grant is a collaboration between the UI, Argonne National Laboratory, and the Geophysical Fluid Dynamics Laboratory at Princeton University.

Workshop on Mathematical Models for Water Quality

(Jerry Schnoor, \$41,225, 2 years, from National Science Foundation):

Mathematical models have greatly expanded our ability to understand and resolve environmental problems. To maximize their usefulness, researchers regularly need to examine whether their models are appropriate for the task at hand, and also to compare their applications with those of colleagues.



This grant enabled Jerry Schnoor to lead a 10-member U.S. delegation to a two-day European water-quality workshop that sought to provide this perspective. The joint Italian-U.S. workshop was held in Venice in November. Participants reviewed software, hardware, and documentation for principal models currently available to environmental professionals. They worked to calibrate and verify models with applications in Italy and the U.S. They then discussed how to best apply these models to protect and manage water resources. This workshop identified fruitful areas for assessment of water quality problems, including future research needs, and will aid the management of water quality problems in the U.S. and Europe.

Retrospective Analysis of Nearshore Marine Communities (Exxon Valdez Oil Spill Project #02656)
(Scott Carpenter, \$44,562, 2 years, from U.S. Geological Survey – Anchorage):

Scott Carpenter uses stable isotope analysis of biotic carbonates (shells) to extract information about ancient climate change. Through this new contract, he will perform carbon and oxygen isotope analyses of selected mussel and clam shells and other remains found at an archaeological site on Alaska's Katmai coast. His data will provide information about seasonal variation in temperature, salinity, and coastal productivity of the Gulf of Alaska during the last 6000 years.

This effort is part of a larger project to investigate long-term patterns of productivity and relative species abundance in nearshore, intertidal natural communities. The research dovetails with Carpenter's ongoing research on weathervane scallops collected in nearby deep waters where detailed records of temperature change have been observed – including marked increases in bottom water temperatures during El Niño events.

YELLOW RIVER AT ION GORGE,
ALLAMAKEE CO.

CGRER members also continued to work on the following nine externally funded Center projects that were initiated in previous years:

- *The Role of Heterogeneous Chemistry in the Photochemical Oxidant Cycle: A Modeling and Laboratory Study*, 3/15/98 - 3/14/05, DOE, \$1,113,864; PI: Greg Carmichael and Vicki Grassian
- *Conduct Carbon and Oxygen Isotope Analyses on Alaskan Weathervane Scallop Shells*, 8/31/01 - 6/30/03, Alaska Dept. of Fish and Game, \$95,600; PI: Scott Carpenter
- *Chariton Valley Biomass Project: Benefit-Cost Analysis - Switchgrass versus Coal for Iowa Electric Generation*, 11/27/01 - 10/31/02, Chariton Valley Resource Conservation & Development, Inc., \$69,093; PI: Jerry Schnoor
- *Impact of Mineral and Other Aerosols and Asian Emissions on the Chemistry of the Troposphere*, 4/1/97 - 3/31/03, NASA, \$838,976; PI: Greg Carmichael
- *Regional Scale Forecasting and Experiment-Specific Emission Estimates of Gas and Aerosol Distributions in Support of the TRACE-P Experiment*, 7/1/00 - 6/30/03, NASA, \$263,099; PI: Greg Carmichael
- *Three-Dimensional, Regional-Scale Modeling of the Processes Affecting Aerosol and Chemical Distribution in East Asia and Support of ACE-Asia*, 8/15/00 - 7/31/03, NSF, \$228,310; PI: Greg Carmichael
- *REU Site in Environmental Systems at the University of Iowa's Center for Global and Regional Environmental Research*, 7/1/00 - 6/30/03, NSF, \$181,732; PI: Vicki Grassian and Greg Carmichael
- *A Study of Organic Contaminants in Air and Water in Conjunction with Episodic Events*, 2/4/99 - 2/29/02, EPA, \$134,514; PI: Keri Hornbuckle
- *Dynamics of Gas-Phase Persistent Organic Chemicals*, 8/4/98 - 8/31/02, NSF, \$189,463; PI: Keri Hornbuckle

TERRILL MILL, IOWA CITY



Seed Grants

CGRER awarded \$75,815 of grant funds to four research projects for FY 2002-2003 (see table below). These seed grant projects will lay the groundwork for future proposals to other funding sources.

PROJECT DIRECTOR	AMOUNT AWARDED	TITLE OF PROJECT
Rhawn F. Denniston Dept. of Geology, Cornell College	\$16,140	Development of a High-Resolution Paleoclimate Data Set from New Zealand Using Speleothem Growth Banding and Stable Isotopic Ratios
Stephen Hendrix Dept. of Biological Sciences, UI Diane Debinski Dept. of Animal Ecology, ISU	\$19,975	Sustaining Pollinator Diversity in a Fragmented Landscape: What Landscape Features and Scales Affect Pollinator Diversity?
Tad Mutersbaugh and George Malanson Dept. of Geography, UI	\$19,700	Factors Affecting the Adoption and Conservation Value of Certified Organic Coffee Production in Oaxaca, Mexico
Mary Skopec Dept. of Geography, UI Lora Friest NRCS, Upper Iowa River Watershed Coordinator Nancy Hall Hygienic Laboratory, UI	\$20,000	Microbial Source Tracking in the Upper Iowa Watershed using <i>E. coli</i> Ribotyping

CGRER Aids to Researchers

In 2002, CGRER consolidated its office, meeting, and laboratory facilities on the fourth floor of the UI's Iowa Advanced Technology Laboratories (IATL), alongside the Iowa River. The acquisition of this dedicated space is expected to increase interactions among CGRER members and students.

CGRER continues to offer use of state-of-the-art computing, visualization, and global positioning system (GPS) equipment to members and their students. CGRER also functions as one of four departments on the UI campus to support and distribute geographical information system (GIS) software through its license with ESRI. Upgrades in 2002 increased the CGRER ImmersaDesk's computing and storage capabilities and its overall productivity. Much of the year's remaining energy was devoted to stabilizing equipment and organizing the laboratory following the move to IATL's fourth floor. These efforts laid the groundwork for a number of planned upgrades and equipment purchases to be made in 2003.

In Addition . . .

CGRER members continue to carry out research that is meaningful in understanding and dealing with Earth's environmental changes. The following is a selection of such research projects that won acclaim in 2002:

- CGRER members **PEDRO ALVAREZ, MICHELLE SCHERER, GENE PARKIN, and RICHARD VALENTINE** (UI, Civil and Environmental Engineering) have been successfully executing their grant, *Iron-Based Bioremediation of RDX-Contaminated Groundwater*, to discover methods to improve the cleanup of groundwater pollutants using biogeochemical processes. Their efforts with biologically-enhanced permeable reactive barriers—buried iron filings positioned to intercept the flow of chemically-polluted groundwater—competed with over 100 projects to win the *Cleanup Project of the Year* award from the U.S. Strategic Environmental Research and Development Program, their funding agency.
- Asian SO₂ emissions from coal pose significant threats to ecosystems, humans, and climatic stability. However CGRER research performed by **GREG CARMICHAEL** (UI, Chemical and Biochemical Engineering) and colleagues from other institutions has demonstrated that Asia's economic expansion is driving SO₂ emissions upward less than originally predicted. Thanks to China's reduced use of high-sulfur coal, the closure of small and inefficient plants, and similar factors, Asia's SO₂ emissions actually decreased between 1995 and 2000. This hopeful trend was reported in *Environmental Science and Technology* 36(22): 4707-4713.
- **ROBERT ETTEMA** and **JACOB ODGAARD** (UI, IHR-Hydrosience & Engineering), along with colleagues, received an \$800,000 grant from Pacific Gas and Electric to determine how to modify an intake to withdraw more cold water from a thermally stratified reservoir in California. The cold water is needed to improve the summer habitat of trout in the Feather River downstream of the reservoir. The project has created the first successful laboratory model of a large, thermally stratified reservoir or lake. It also has involved the development of a unique numerical model.
- **LUIS GONZALEZ** and **SCOTT CARPENTER** (UI, Geoscience), with colleagues, succeeded in documenting for the first time the correlation between El Niño and stable isotopes in stalagmites. Their findings indicate that variations in a stalagmite found in a Central American (Belize) cave reflect changes in the carbon cycle of the overlying rain forest that are related to El Niño. This research, carried out in the CGRER-supported Paul H. Nelson Stable Isotope Laboratory, demonstrates that El Niño impacts extend well beyond areas of observed weather fluctuations. The study was published in the October 18, 2002 issue of *Science*.
- CGRER has developed a two-step process for quantifying the amount of carbon sequestered in a forested area, a measurement crucial to determining the reduction of atmospheric greenhouse gases through reforestation. The simplified method for documenting changes in carbon storage is necessary for the commercial trading of credits for greenhouse gas emissions, which may be called for by future legislation and international agreements. The technique is described in an article by **NEY, SCHNOOR, and MANCUSO** published in *Environmental Monitoring and Assessment* 78: 291-307.

IOWA PIPE AND TILE WORKS, DES MOINES



▼ WEST SIDE OF IOWA RIVER, HIGH WATER, IOWA CITY



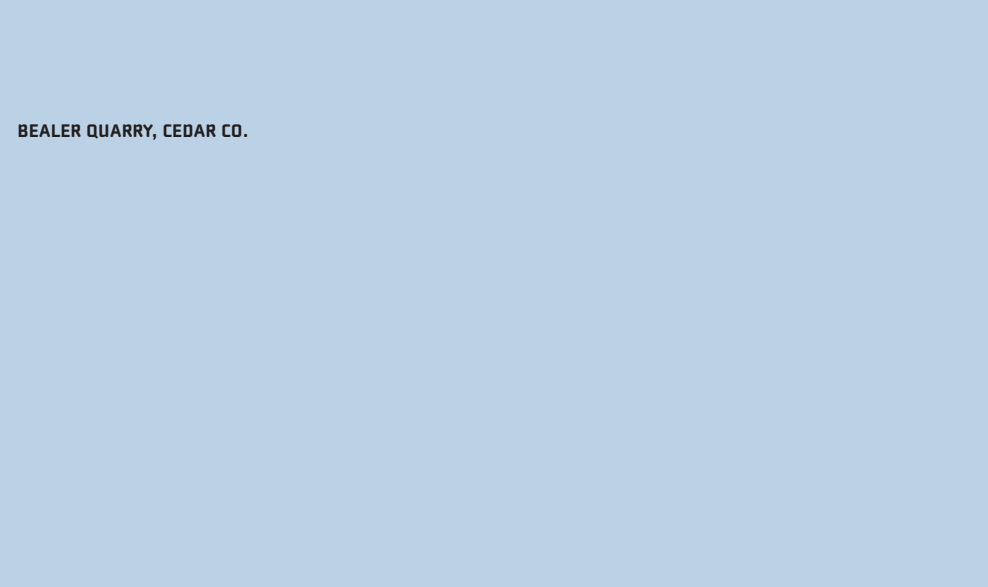
BOULDER FIELD



GLACIAL SCOURINGS, BURLINGTON



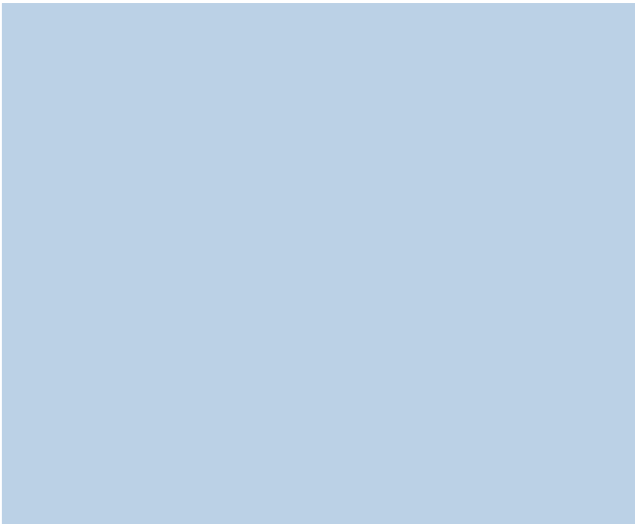
BEALER QUARRY, CEDAR CO.



IOWA RIVER FROM OBSERVATORY HILL, IOWA CITY



**WHERE THE FOREST MEETS THE PRAIRIE,
BUENA VISTA CO.**



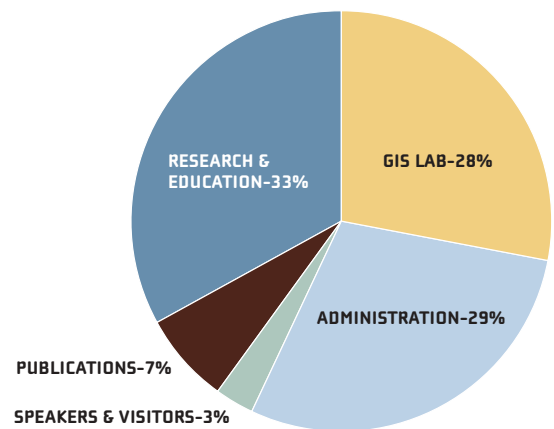
GENERAL Information

Budget

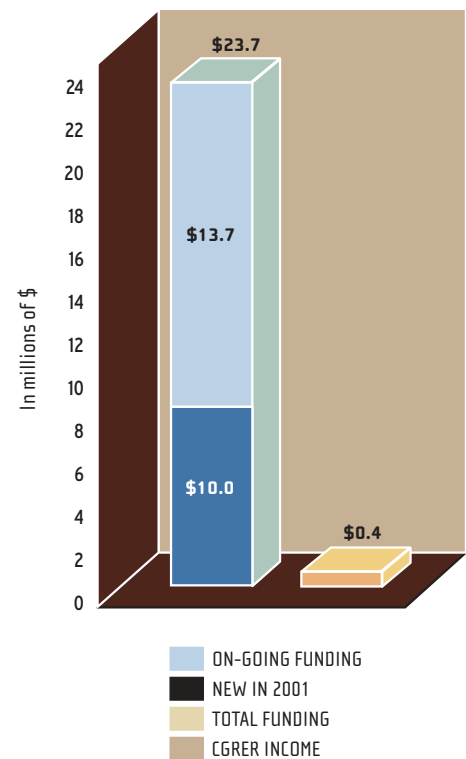
In fiscal year 2002 (July 1, 2001 – June 30, 2002), seven-tenths of CGRER's \$485,725 of funding was spent on research, education, and outreach directed toward global change issues (Figure 1). The remaining three-tenths of the budget was dedicated to administration.

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 2002, CGRER members were performing research that brought in a total of \$23.7 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 amount, \$10 million was new funding that was initiated in 2001, while the remaining \$13.7 million came from ongoing projects.

**FIGURE 1
CGRER'S EXPENSES**



**FIGURE 2
2002 LEVERAGING OF CGRER'S INCOME***



* Applies to Calendar Year 2002

Administration and Membership

CGRER is directed by University of Iowa professors Gregory Carmichael (Dept. of Chemical and Biochemical Engineering) and Jerald Schnoor (Dept. of Civil and Environmental Engineering). Center activities are guided by an elected Executive Committee that consists of 10 members plus the two co-directors. The Executive Committee meets monthly to plan initiatives and chart CGRER's course. An Advisory Board of six 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 fulltime staff members. Administrative assistant Jane Frank oversees office operations. Jeremie Moen manages CGRER's computer facilities with the aid of services contracted from the Iowa Computer Aided Engineering Network. CGRER reports directly to the UI's Vice President for Research.

CGRER Members

UNIVERSITY OF IOWA

ANTHROPOLOGY

Michael S. Chibnik
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* Stephen D. Hendrix
* Diana G. Horton

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* Sarah C. Larsen

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G. Edgar Folk

OCCUPATIONAL & ENVIRONMENTAL HEALTH

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PUBLIC POLICY CENTER

David J. Forkenbrock

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Dale L. Zimmerman

IOWA STATE UNIVERSITY

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