Science | Environment | Solutions

DRI Magazine

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DRI at 50

Who we are • What we do • What the future holds

DRI Research Foundation Trustees

In this issue

On the cover

DRI volunteer Callie McConnell pauses on the southwestern margin of the Greenland ice sheet in 2004. She and her brother, DRI hydrogeologist Dr. Joseph McConnell, participated in a NASA-funded, 440 km snowmobile traverse across the ice sheet along the Arctic Circle to collect ice cores and ice-penetrating radar data. They were examining the interface between the ice and the bedrock, and recently de-glaciated terrain.

Photo ©2004 Joseph McConnell, Ph.D.

"To contribute more effectively to the security of the nation and to promote the general welfare of the State of Nevada and its citizens through the development of educational and scientific research, the board of regents of the University of Nevada is authorized to establish an educational and scientific research division of the university, to be known as the desert research institute."

Senate Bill No. 182
March 23, 1959

www.dri.edu

DRI Magazine is published by DRI, a nonprofit, statewide division of the Nevada System of Higher Education. DRI is internationally recognized for excellence in environmental research. DRI operates two campuses: one in Las Vegas and one in Reno at the Dandini Research Park. Articles appearing in DRI News may be reprinted with appropriate attribution given to the DRI.

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Photo by Sara Jenkins

Letter
From the President

Photo by John Byrne

President Stephen G. Wells, Ph.D.

Greenhouse on the Reno campus

In 1959, the Nevada Legislature and Governor Grant Sawyer took a bold and forward-looking step, particularly for such a rural state. Decades before research in environmental sciences would come into vogue, Nevada invested in it. Who could have thought that the passage of five decades would find that experiment grown into a world-class institution for environmental sciences — today's DRI?

When it began, DRI had just a handful of scientists and staff, focused largely on regional issues related to arid lands. Fifty years later, DRI's talented, innovative, and inventive research faculty work on every continent, studying environmental problems that transcend political boundaries and finding solutions that benefit humankind.

How did we do it? After all, with a population of just 285,000, the nation's seventh-largest state in area must not have appeared the most fertile ground to launch such an undertaking. The key to DRI's success has been the hard work and talent of its faculty and staff. The faculty at DRI are highly talented, intrinsically entrepreneurial, exceptionally motivated, and visionary in their approach to problems in science and engineering. They occupy a unique position in higher education because they are not tenured. The institute remains, as it was from the start, a "soft-money" branch of higher education in Nevada where faculty have to generate funding for their own salaries and research through grants and contracts.

Why did such talented and creative scientists join DRI in those early years? Why do they still? At DRI, their energy, vision and talent are rewarded with the freedom to conduct the research of their dreams. In the early years, there was a thirst in Nevada's higher education system for significantly expanding the role of research in the educational mission and bringing talent from across the nation and around the world to DRI. In turn, the success of this talent and growth in the institution's reputation has become self-propagating, drawing in more talented scientists and engineers.

Just as in the past 50 *years* DRI will be in the vanguard 50 *years* from now

Another important component of the institute's success has been the DRI Research Foundation, established in 1982 to raise external funds for the institute, and its Board of Trustees. The Foundation raises funds to support research as well as for capital improvements, new research instrumentation, and upgrading equipment. With the majority of DRI's budget generated by specific research projects (and a relatively small, but crucial, percentage of state monies for operation, maintenance and administrative positions), discretionary funds obtained through financial gifts are essential to advancing the institute's mission.

Especially valuable have been financial gifts that foster and support new research and build critical infrastructure supporting researchers with new facilities and equipment who make valuable contributions to science. Two particularly important examples of Foundation support include fundraising in support of the Dorothy Gallagher Great Basin Environmental Research/Frits Went Laboratory on the Reno campus, and the Storm Peak Laboratory, located at 10,500 feet in the Colorado Rockies.

The mission of the new desert research institute that was established in 1959 was to contribute to the security of the nation and promote the welfare of Nevada through education and scientific research. Leading the way were a handful of visionary scientists, notably atmospheric physicist Wendell A. Mordy, Ph.D., who became the fledgling institute's first director. Dr. Mordy fulfilled his vision and put DRI on a worldwide course by seeking scientific talent for DRI, and by establishing unique laboratories at DRI of national and international scale. One example of Dr. Mordy's vision is that DRI will be completing one of the few state-of-the-art facilities in advanced computation and visualization to better understand Earth's environmental problems, and to enhance our scientific efforts to solve these problems.

A half-century after DRI's founding, we are celebrating not so much the passage of time as the continuing fulfillment that vision and mission, evidenced by the roster of important contributions to science that DRI researchers have made.

A few examples: Our research faculty — long in the vanguard in atmospheric research — developed the use of chemical "fingerprinting" to track atmospheric pollution to its source. Today, we study air-quality problems around the world, and apply our basic knowledge in atmospheric chemistry and physics to better our understanding of the role that air pollution plays in climate change, including rainfall reduction in drought-stricken regions of the western United States. Since DRI's beginning, and with the vision of Dr. Patrick Squires, faculty established expertise in weather modification, cloud seeding specifically, to help increase precipitation in the arid regions of Nevada and the western United States, and has maintained a worldwide reputation in this technology since the institute opened its doors.

In DRI's early years, Dr. George Burke Maxey was a pioneer in developing the first scientific approach to estimating the recharge to groundwater resources in arid basins, a critical issue in these times of persistent drought. Dr. Maxey and his colleagues at DRI contributed to our basic knowledge of regional groundwater flow in these arid basins, leading to the establishment of the University of Nevada's graduate program in hydrology and the first Ph.D. graduating from the University, Dr. Roger Morrison. Institute scientists continue to pioneer methodology and modeling techniques to aid in the assessment of subsurface- and surface-water resources in Nevada, the western United States, and as far away as Africa and South America. We successfully employed satellite-based and airborne remote sensing to find suitable drinking water wells for villagers in Ghana, which has expanded into support for the Conrad Hilton Foundation's West

Africa Water Initiative that reaches Mali and Niger. In recent years, research faculty have drilled deep into Arctic and Antarctic ice sheets to examine a record of the Earth's atmosphere that goes back tens of thousands of years. They've learned startling new knowledge about how quickly climate change can occur, and the impact that industrial activities have had and may continue to have on the global environment.

With the renowned botanist Dr. Frits Went, DRI's ecologists and biologists forged new studies and technologies to address life in the extreme environments of arid regions, including their adaptations and symbiotic relations with other living organisms. Now DRI faculty, such as Drs. Alison Murray, Chris Fritsen and Duane Moser, are breaking new ground in studying the biologic, ecology and genetics of life in extreme environments in Earth's polar regions, as well as its deepest oceans and mines.

Our success can be measured in a number of ways. First and foremost is the caliber of the research faculty and staff who are drawn to DRI, but important as well is our record of retaining them. Many of DRI's scientists/engineers and staff have conducted and supported research for more than 30 years, including Drs. John Hallett, Alan Gertler, Bill Albright and Ken Taylor. Their success has resulted in the National Science Foundation consistently ranking DRI in the top 20 institutes nationally, out of more than 430, in research and development expenditures in environmental sciences. The regularity with which DRI faculty publish in such prestigious journals as *Science* and *Nature* demonstrates their stature. The more-general media have taken note as well. After DRI researchers Drs. Joe McConnell, Ross Edwards and colleagues determined that eight times as much black carbon was deposited in Greenland's ice from 1906 to 1910 than during the previous 100 years, reflecting the dramatic effect of the industrial revolution on the environment, *Discover* magazine ranked the study 19th in their review of the top 100 science stories of 2007.

DRI's success can also be measured by our longstanding research relationship with clients like the U.S. Department of Energy, manager of the Nevada Test Site. DOE has demonstrated confidence in DRI's ability to monitor and model the groundwater beneath the Nevada Test Site for many years, and to monitor air quality to protect the health of "downwinders." Because our research is objective, the people of Nevada and the nation trust the findings that DRI provides. Because of our expertise in atmospheric research, the Federal Emergency Management Agency turned to DRI's Western Regional Climate Center to provide the public with data about the air quality at the World Trade Center site in the immediate aftermath of the 9/11 attacks. They asked DRI to make the results publicly available online. DRI had a Web site up and running in two days.

Through the leadership of Dr. Eric McDonald, the Department of Defense has come to recognize the unique talent and contributions of DRI's earth scientists, who have helped solve problems related to military operations in desert terrains as well as the functioning of weapons in Iraq.

These examples are only the "tip of the iceberg"; the list goes on in terms of the talent at DRI and their contributions. From anthropology and archaeology, DRI has helped understand the history of humanity's management of resources in the past to better understand and improve the management of resources in the future.

In the final analysis, DRI's success lies in its ability to apply basic research to solving environmental problems for the benefit of humanity, whether it is through helping China protect the ancient Terra Cotta Warriors and Horses of Qin Shi Huang from the effects of air pollution, locating fresh-water sources in west Africa, or helping to preserve the air and water quality of the Lake Tahoe Basin from airborne and waterborne pollutants.

When DRI was established, environmental sciences was a lonely field. We were the pioneers. Now, as the world is increasingly focused on environmental issues, we are in the vanguard. Just as the world is focusing increasingly on environmental challenges, our credibility and expertise is firmly established and widely acknowledged, and our capacity to take on such pressing issues as renewable and sustainable energy and climate change is greater than ever before. DRI is no longer an experiment. It is an investment that has paid off, one that will provide even greater returns for humanity for generations to come.

Stephen G. Wells, Ph.D.
President DRI


LAKE TAHOE BASIN
AIR AND WATER QUALITY
Nevada/California
DATING FOSSILS AND TOOLS
Spain
DRI
EXTREME DESERT HABITATS
Chile

DRI's Global Reach

A small sampling of the 300 projects DRI is working on around the world.

Graphic by Kunder Design Studio

Jen Fisher, Ph.D., postdoctoral fellow in the Moser Laboratory.

Photo by Sara Jenkins

DRI Today

In the 50 years since it was established by an act of the Nevada Legislature, DRI has grown from a small group of visionary scientists, academic leaders and entrepreneurs into a unique organization that reaches across the nation and around the world. It combines the classic academic tradition of high-quality basic research with the productive focus of applied interdisciplinary research. Research is conducted in response to the needs of a variety of public and private entities.

DRI strives for sustainable management of natural resources at home in Nevada. Yet with funding from such sources as the National Science Foundation, the U.S. Department of Defense and the Department of Energy, its entrepreneurial, can-do approach enables scientists and staff to respond effectively to changing regional, national and global priorities as well.

In its first year of operation, DRI garnered more than $2.5 million in research funding. Today, that number is approaching $40 million. From 1999 until 2006, DRI leveraged $60 million in state support to bring $227 million in research funding to Nevada. The institute has grown 85 percent since 1999 while using only about 1 percent of the Nevada System of Higher Education's annual budget.

DRI employs advanced visual-research technology for environmental computing, modeling and simulation.

The core of DRI is its three research divisions:

DAS DEES DHS

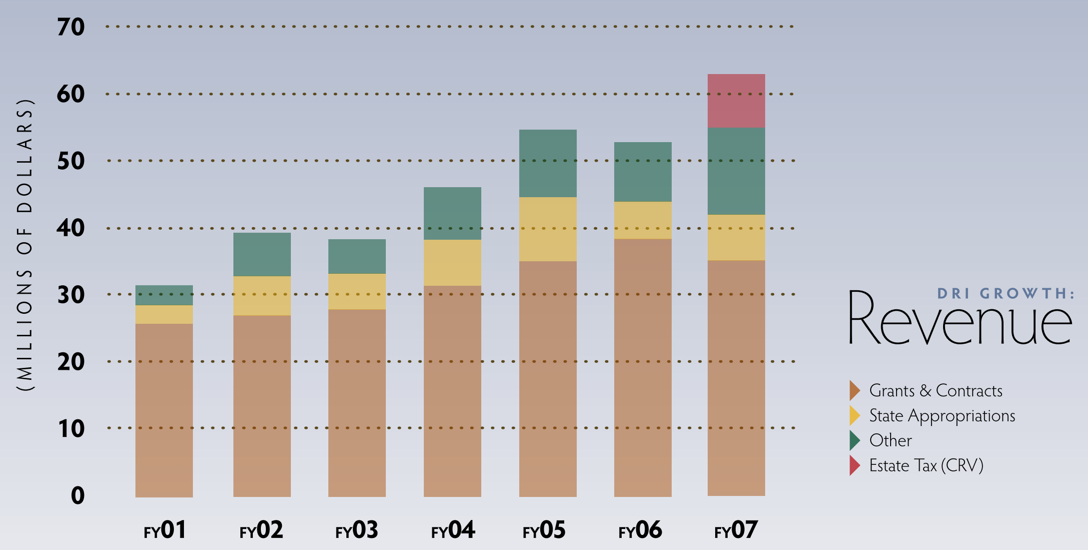
Photo by Sara Jenkins

The Division of Atmospheric Sciences (DAS) conducts air-quality and atmospheric research in a range of areas. These fields include meteorology, climate, aerosol formation, atmospheric chemistry, visibility assessment, urban air quality and the transport of pollutants. Faculty conduct fundamental and applied research into both natural atmospheric processes and air-quality issues of regional, national and planetary interest. Research is accomplished through field and laboratory observation, theoretical and laboratory analysis, and computer modeling at many spatial and temporal scales. DAS specializes in the development of instrumentation and techniques for ground-based, aircraft and satellite observational programs. It is the home of the Western Regional Climate Center.

The Division of Earth and Ecosystem Sciences (DEES) attracts scientists who are as diverse in their scientific backgrounds as the world they study. They bring to DRI a broad, unifying interest in the causes, mechanisms and history of landscape change over a range of spatial and temporal scales — the geomorphic surface environment, the soils mantling the surface, and the vegetation and other biota (including humans) that inhabit and modify it. DEES faculty focus on biogeochemical cycling and responses of plants and animals to changes in climate and anthropogenic factors, and on life in extreme environments. DEES research encompasses ecosystem sciences, geological research, archaeology and anthropology, and remote sensing, landscape modeling and advanced visualization.

The Division of Hydrologic Sciences (DHS) works to improve knowledge and understanding of hydrologic systems, and to encourage more effective and efficient management of water resources. Its scientific interests involve the natural and human factors that influence the availability and quality of water resources. Its early research efforts focused on the nature of water resources within the complex geology of Nevada's many isolated groundwater basins, and on regional groundwater flow. Today, DHS scientists work on issues common to arid and developing regions worldwide. Research encompasses aquatic biology and chemistry, ecological engineering, environmental processes within snow and ice, groundwater hydrology and hydraulics, surface and subsurface flow and contaminant transport, and watershed hydrology.

DRI



Graphics by Kunder Design Studio

Photo by Steven Braun

From its first home at the University of Nevada in Reno to its contemporary campuses in Reno and Las Vegas, DRI has worked to guide the development of its physical infrastructure through careful and purposeful planning. The goal, as always, is to provide appropriate facilities to support advances in environmental sciences.

DRI Locations

Photo by Steven Braun

View of the Northern Nevada Science Center (NNSC), the Elizabeth Stout Conference Center and the Dorothy Gallagher Great Basin Environmental Research Facility in the background.

Reno

DRI's Reno campus is located east of U.S. 395 on Raggio Parkway, just a few miles north of the city. After obtaining the 467-acre Reno site (known as the Dandini Research Park) through land patents from the U.S. Department of Interior in 1972, DRI completed a facilities master plan. The plan established the basic layout for the campus, and partitioned the land to allow co-development of the Dandini Research Park with Truckee Meadows Community College.

Today, DRI buildings occupies about 35 acres of the Dandini Research Park. They include:

- Computational Research and Visualization Building. Constructed with $25.4 million in state, federal and DRI funding, the 40,000-square-foot CRVB provides more than 50 enclosed offices, 70 cubicle work stations and eight workrooms. Its scientific centerpiece will be one of the world's most technically advanced 3-D visual-research devices, a six-sided total immersion system that will enable DRI researchers and others to model actual environments and landscapes. This will be in addition to DRI's existing four-sided device.
- George B. Maxey Science Center. The first building on the site was completed in 1977. A substantial addition was completed in 2007.
- Dorothy S. Gallagher Great Basin Environmental Research Laboratory
- Field Operations Building, Reno-Stead Airport

Las Vegas

In 1980, DRI obtained 11.4 acres about a mile east of Las Vegas Boulevard (the Strip), on East Flamingo Road. Today, the institute's second-largest campus includes:

- Southern Nevada Science Center Phase I (three buildings), completed in 1992. The nearly 44,300-square-foot building was the first to be built on the site. It houses laboratories, conference rooms, multiple-use space and administrative offices.
- Frank H. Rogers Science and Technology Building Phase II, completed in 2003. At 66,000 square feet, it enabled substantial expansion of DRI's research activities, and provided a home to the Nevada Atomic Testing History Institute (NATHI), a one-of-a-kind facility that includes archives and a museum documenting the Nevada Test Site (NTS). The building is named for the site's chief operating officer during its first decade and the father of philanthropist James Rogers, CEO of Sunbelt Communications Co. and chancellor of the Nevada System of Higher Education, who donated $3 million to the project.

DRI's Southern Nevada Science Center

- Phase III (proposed). At approximately 65,500 gross square feet, the proposed Phase III building reflects DRI's plans to expand its roles in hydrologic sciences and renewable energy research. The building would include wet laboratories, faculty offices, and space for a unique new research tool, the Eco-Flume™ Laboratory. It would be used to study the interactions of river flow, sediment, nutrients and contaminants.

The Frank H. Rogers Science and Technology Building, which houses the Atomic Testing Museum.

Photo by Steven Braun

Satellite Facilities

Storm Peak Laboratory

A permanent mountain-top facility, DRI's Storm Peak Laboratory in Colorado occupies the 10,500-foot summit of Mt. Werner. Readily accessible under all weather conditions, the laboratory enables atmospheric research on a recurrent long-term basis.

Stead Operations and Maintenance Facility

DRI's Stead Operations and Maintenance Facility is approximately 10 miles northwest of Reno, at Reno Stead Airport. It is the operations center for the Nevada State Cloud Seeding Program, run by DRI's Division of Atmospheric Sciences.

Photo by Chris Talbot

Incline Village

The Tahoe Center for Environmental Sciences is a partnership of public and private institutions of higher education, including Sierra Nevada College, the University of California, Davis, DRI and the University of Nevada, Reno. This shared center provides DRI researchers and their collaborators a place to discuss research, work on data interpretations, and create models all at one location.

Boulder City

Completed in 1977 in a community about 30 miles southeast of Las Vegas, DRI's Boulder City facility is the institute's oldest. Occupying three acres, it houses the underground lysimeter, buried containers of soil equipped with a weighing device and drainage system that measure evaporatranspiration and percolation.

DRI's broad-based, multidisciplinary approach to environmental research is ideally suited to investigating the water-clarity problems of Lake Tahoe, in the Sierra Nevada.

Photo by Sara Jenkins

Science Benefiting

Nevada, the Nation and the World

Nevada

GreenPower

The GreenPower program supports and promotes the use and development of "green" sources of energy in Nevada by educating Nevada's K-12 students and educators. Since its inception in 2000, GreenPower has been a partnership among the DRI, volunteer GreenPower Committee members, NV Energy and their customers. It is funded by customers voluntarily adding a few tax-deductible dollars to their monthly electrical bill.

Students at Victoria Fertitta Middle School (Las Vegas), a GreenPower school, learn about solar energy.

Nevada Test Site

For half a century, DRI has supported DOE and its predecessor agencies with environmental research for the safe testing of nuclear devices and mitigation of impacts from such testing. DRI's work began as nuclear testing moved underground, with DRI providing a strong geology and groundwater focus aimed

The Nevada Test Site north of Las Vegas.

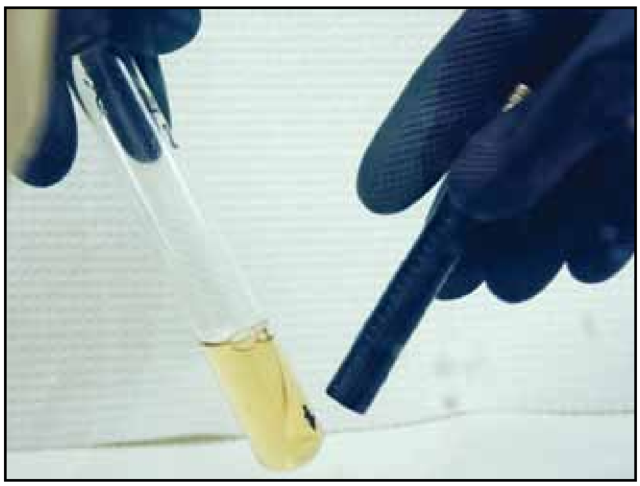


Photo by Sara Jenkins

Anaerobic bacteria, Moser Laboratory

Walker Lake, a terminal lake that supports a unique ecosystem.

Lake Tahoe research in 1964.

at characterizing subsurface environments that would contain nuclear blasts. DRI conducted some of the earliest assessments of radionuclide contaminant migration and helped establish monitoring programs, work that evolved into complex field, laboratory, and numerical modeling research in support of environmental remediation, monitoring, regulatory compliance, and waste management for the DOE Environmental Management Program, and DOE Office of Legacy Management.

As national needs have evolved, so has DRI's support for DOE, adding research for cultural resources, stockpile stewardship and nonproliferation, and technology development for the DOE National Nuclear Security Administration. DRI continues to conduct geologic and groundwater investigations for DOE, but also has active programs in atmospheric sciences, soil and geomorphological sciences, archaeology, risk assessment, and comprehensive environmental monitoring.

Lake Tahoe Basin

Environmental problems of Lake Tahoe and the Lake Tahoe Basin are the focus of important research by DRI scientists. At stake are Lake Tahoe's famous blue waters, the clarity of which has been declining at an alarming rate. Much of that decline can be attributed to air pollutants, sediments, and nutrients like phosphorous and nitrogen that encourage the growth of water-clouding phytoplankton and algae. The complex ecology of the Lake Tahoe Basin makes it a perfect fit for DRI and its broad-based, multidisciplinary approach to environmental research.

Walker Basin Project

Walker Lake, in central Nevada, is one of only three closed — or terminal — desert lakes in with a freshwater fishery in the world. Its water originates in California's East and West Walker Rivers, which flow into Nevada and combine to form the Walker River. The Walker River ends at Walker Lake, and no water flows from the lake. These waters support agriculture, recreation and wildlife within the ecosystem of Walker Basin. This federally funded project involves collaborative environmental and economic research conducted by researchers with DRI and the University of Nevada, Reno. It also involves the acquisition of water and water rights from willing sellers under the coordination of the Nevada System of Higher Education.

The Nation

Community Environmental Monitoring Program

The Community Environmental Monitoring Program (CEMP) is an important part of DRI's environmental-monitoring activities for the U.S. Department of Energy. It includes 29 monitoring stations across a 160,000-square-mile region of Nevada, Utah, and California surrounding the Nevada Test Site and Nevada Test and Training Range. Central to the program are citizens in the towns where the monitoring stations are located whom DRI trains to help collect data to ensure that no releases of radiation or radioactive material are occurring. Through data-transmission technologies, DRI's Western Regional Climate Center (WRCC) makes data from meteorological instruments and gamma radiation sensors at the stations available to the public online at www.wrcc.dri.edu/cemp.

Iraq

When American troops in Iraq reported that their combat

DRI scientists are working to preserve China's Terra Cotta Warriors and Horses.

The West Africa Water Initiative provides clean water to thousands of people.

rifles were jamming and failing to fire dependably, the problem seemed to be related to dust combined with the properties of the standard American cleaner, lubricant and preservative (CLP). The Army commissioned DRI to analyze Iraqi dust samples and how Iraqi dust reacts with gun lubricants used in Iraq, and to develop recommendations for additional testing that would help solve the problem. Working with the United States Military Academy at West Point, DRI scientists learned that three gun lubricants react with Iraqi dust, forming aggregates that increase the average size of particles. The Army switched to a different CLP.

The World

West Africa Water Initiative

Envisioned by the Conrad N. Hilton Foundation and launched in late 2002, the West Africa Water Initiative (WAWI) is a $42 million partnership among 11 major public and private institutions. WAWI was founded to improve access to clean water and sanitation in the West African countries of Ghana, Mali, and Niger. It addressed the interconnectedness of clean water, human health and socioeconomic advancement. DRI is among the major participating organizations.

Terra Cotta Warriors and Horses

In 1974, two Chinese farmers digging a well discovered the tomb of Qin Shi Huang, the first emperor of China. Ground-penetrating radar revealed approximately 7,000 life-sized terra-cotta warriors, horses, chariots and weapons in the mausoleum. Today, the Emperor Qin's Terra Cotta Warriors and Horses Museum attracts 1.5 million visitors annually. However, the exposed figures have started to decay due to a combination of air pollution, raised temperatures and humidity, and pollution from visiting tourists. DRI scientists are working with colleagues in China to determine what is in the museum's air, and how to preserve the artifacts.

Climate change

Understanding past, current and future climate-change issues is a complex multidisciplinary endeavor that engages scientists in all three DRI research divisions. DRI researchers have made strides in measuring changes in understanding the Earth's climate-change history, and mankind's role in those changes, by examining remnants of the atmosphere found in ice cores retrieved in Greenland and Antarctica. In another example, featured on the cover of the September 18, 2008 edition of the prestigious journal *Nature*, DRI scientists used the institute's EcoCELL facility on the Reno campus to study the CO_2 uptake of prairie grasslands.

Education

A commitment to education is an integral part of the institute since its inception. From its first year of operation in 1960, DRI has supported graduate and postdoctoral students, providing financial support as they work on research projects. Undergraduate students find opportunities to work with DRI scientists as well. Many DRI scientists also teach at Nevada's universities and community colleges, and make up a large proportion of graduate faculties. DRI offers fellowships, scholarship and awards to institute-affiliated students as well.

Renewable energy is a growing part of DRI's research.

Photo by Sara Jenkins

DRI PRESIDENTS

The history of DRI was shaped by these distinguished scientists who stepped up to lead the organization throughout the years.

Dr. Stephen G. Wells • *1999-present*

Dr. Stephen G. Wells became president of DRI on January 1, 1999. Dr. Wells was already a familiar face at the institute, having served as executive director of its Quaternary Sciences Center (QSC) since 1995. Prior to joining DRI, Dr. Wells was a professor of geomorphology at the University of California, Riverside, and a professor and chair of the geology department at the University of New Mexico. He holds a Ph.D. in geology from the University of Cincinnati.

Dr. Stephen G. Wells

Dr. Wells' own research career has focused on the specific factors, past and present, that shape and change the Earth's surface, such as volcanoes, floods, forest fires, erosion and wind. As executive director of QSC, he oversaw a research group studying the dramatic processes of environmental change occurring in the last 2 million years.

As Dr. Wells leads DRI into its second half-century of worldwide research, change remains very much a part of his work. For instance, as he assumed the DRI presidency, nearly half of the institute's faculty and staff were preparing for a complex relocation from the Stead Science Center to the new Northern Nevada Science Center expansion at DRI's Dandini Research Park All of this needed to be accomplished while keeping vital research projects underway and on schedule. In January 2009, he oversaw the opening of the institute's 40,000-square-foot, $25.4 million LEED-certified Computational Research and Visualization Building, where scientists from around the world will have access to a technically advanced, six-sided 3-D visual-research device.

Dr. Wells' presidency began at a time of major change in the national research marketplace. In the wake of this change, he sees DRI's multidisciplinary nature and flexible, entrepreneurial structure as the keys to responding to new opportunities and adapting successfully. He also sees the institute achieving an even broader national and international research role, and he strives to expand DRI's interaction with Nevada's university campuses in teaching and research.

Dr. James V. Taranik • *1987-1998*

Dr. James V. Taranik

Dr. James V. Taranik became president of DRI in 1987. He was internationally known for his research in aerospace remote sensing. His professional career had already included senior positions with the National Aeronautics and Space Administration, the U.S. Department of the Interior, the Iowa Geological Survey, and the University of Iowa. Prior to joining DRI, he was dean of the University of Nevada, Reno, Mackay School of Mines. He holds a B.S. in geology from Stanford University and a Ph.D. in geology from the Colorado School of Mines.

Dr. Taranik's efforts greatly increased the institute's capability for employing sophisticated satellite imagery across many areas of research at DRI, and he remained directly involved in the improvement of remote sensing for environmental applications and geological exploration. In 1994, he was on the team that prepared radar equipment that recorded some 25 million square miles of images from the space shuttle Endeavor. He also served on a national blue ribbon panel seeking to declassify remote sensing technologies for use in environmental research.

Dr. Taranik instituted strategic and budgetary planning processes that helped define the institute's mission both internally and externally. He also reorganized the DRI Research Foundation, created DRI Research Parks, Ltd., and established a long-range facilities plan that led to the construction of nearly 150,000 square feet of new facilities for DRI, including the Great Basin Environmental Research Laboratory, the Southern Nevada Science Center, and the Northern Nevada Science Center expansion.

Dr. Taranik left DRI in 1998 to assume the Arthur Brant Chair in Exploration Geophysics at UNR's Mackay School of Mines. He was the institute's longest-serving president.

Dr. George Hidy • *1984-1987*

Dr. George Hidy

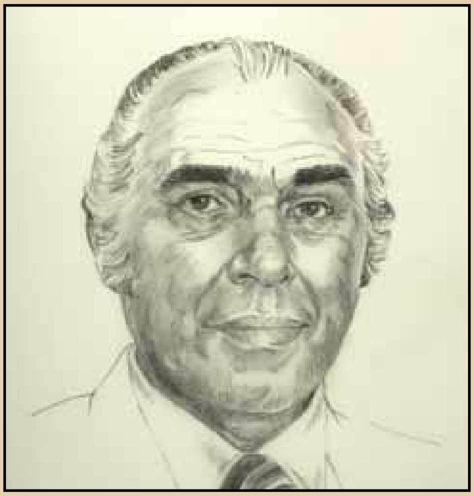
Dr. George Hidy became president of DRI in 1984. He was formerly vice president and chief scientist for the national scientific consulting firm Environmental Research and Technology, Inc. He was a leading research scientist in aerosol science and technology whose interests at the time concentrated on air-quality impacts of power plant operation and the general problem of acid deposition.

Reflecting Dr. Hidy's expertise, and responding to the changing research market, DRI shifted the emphasis of some of its research to the environmental impacts of energy generation, which attracted financial participation from the electric utility industry. As a result, the Energy and Environmental Engineering Center was formed in 1985. A team of researchers from this new center soon pioneered chemical "fingerprinting" techniques that could identify the sources of air pollutants transported over long distances. Related innovations also allowed researchers to determine the relative contributions of different pollutant sources — wood smoke, auto exhaust, industrial emissions, etc — to air pollution.

In 1986, Dr. Hidy helped make DRI home to the Western Regional Climate Center. One of six federally designated climate centers nationwide, the WRCC is part of a program initiated by the National Oceanic and Atmospheric Administration to promote research of climatic trends and conditions in the western United States and coordinate the dissemination of climate data.

Dr. Hidy left DRI in 1987 to become vice president of research for the Electric Power Research Institute.

Dr. Clifford Murino • *1980-1983*



Dr. Clifford Murino

Dr. Clifford Murino became DRI's president in 1980. With a Ph.D. in geophysics from St. Louis University, he had previously served as atmospheric technology director for the National Center for Atmospheric Research. Dr. Murino brought a strong background in the use of advanced computer techniques for research management and fiscal administration and set out to develop a long-range fiscal strategy for the institute.

Part of that strategy was the establishment of the DRI Research Foundation in 1982. The purpose of the DRI Research Foundation is to raise funds that the institute can use to foster and support new research, to make capital improvements, or to purchase and upgrade equipment and instrumentation. The DRI Research Foundation has become an increasingly important part of DRI's funding structure.

As an atmospheric physicist, Dr. Murino helped further DRI's reputation as a leader in cloud-seeding technology, particularly through the State of Nevada Cloud Seeding Project. As part of this project, DRI scientists seed clouds over northern Nevada watersheds in an effort to increase spring runoff.

Dr. Murino also established DRI's Statewide Advisory Committee, composed of respected leaders in Nevada's economic and government sectors, to provide guidance on the best ways to apply the institute's capabilities to help meet Nevada's needs.

Dr. Murino left DRI in 1983 to become president of the University Corporation for Atmospheric Research.

Dr. Lloyd Smith • *1975-1979*

Dr. Lloyd Smith

Dr. Lloyd Smith was named president of DRI in 1975 after serving a year as interim president. A native of Reno, Nevada, Dr. Smith had previously served as senior scientific advisor to California's Stanford Research Institute. He had also served on DRI's National Advisory Board, and so was familiar with the workings of the institute and the challenges it faced.

One of those challenges was to respond to changing priorities in research funding. As a result, Dr. Smith led the institute in two structural reorganizations of its research areas. By 1978, the institute's researchers worked within five centers: the Atmospheric Sciences Center, the Energy Systems Center, the Bioresources Center, the Water Resources Center, and the Social Sciences Center.

Dr. Smith also helped usher in two new physical structures. DRI's northern Nevada headquarters, the George B. Maxey Science Center, was completed in 1977, as was the Solar Energy Research Facility in Boulder City. This facility was devoted to applied research and development in solar energy technology, energy conservation, energy storage, and related fields. It closed in the early 1980s with the decline in government and industrial support for alternative-energy research.

During Dr. Smith's term, DRI's Social Sciences Center entered into its first Department of Energy contract to help mange the cultural resources of the Nevada Test Site in southern Nevada. It has proven to be one of the longest-running relationships in DRI's history. Since beginning surveys in 1977, DRI researchers have identified thousands of prehistoric and historic cultural-resources sites in the area. Dr. Smith retired from DRI in 1979.

Dr. John M. Ward • *1970-1974*

Dr. John M. Ward

Guiding the transition of DRI from a small, university-based research group into a separate entity within the reorganized University of Nevada System was the immediate challenge facing Dr. John M. "Jack" Ward, who assumed the presidency in 1970. Dr. Ward, recruited from his position as dean of Oregon State University's School of Science, was a plant biologist who had achieved renown through his work with the National Science Foundation and National Health Service.

Dr. Ward quickly began working to develop a modest but important level of state support for the institute's administrative expenses, reducing the overhead burden on research grants and contracts. This state funding was an important element in the ability of the institute's research faculty to initiate and expand research programs.

Working with Special Assistant Dr. Alessandro Dandini, Dr. Ward and the institute were able to acquire a 470-acre tract of U.S. Bureau of Land Management land on the northern boundary of Reno, eventually named the Dandini Research Park in honor of Dandini. Dr. Ward's efforts with the executive and legislative branches of Nevada government also laid the groundwork for obtaining state funding for the Maxey Science Building, the first phase of development for the Northern Nevada Science Center located within the research park, and for a solar energy research laboratory in Boulder City.

Dr. Ward supported strong academic ties with the University of Nevada, Reno, and the University of Nevada, Las Vegas, to allow institute faculty to teach graduate-level classes and graduate students to work under DRI scientists on research projects.

Dr. Wendell A. Mordy • *1960-1969*

Dr. Wendell A. Mordy

The driving force in DRI's first 10 years was atmospheric physicist Dr. Wendell A. Mordy, who led the institute from its beginnings in 1960 until 1969. Dr. Mordy was an entrepreneurial visionary who saw and seized opportunities available to the fledgling institute. Driven by his own scientific interests, he helped DRI become a leader in atmospheric physics research. A strong administrator, he successfully launched other projects in areas as diverse as hydrology, climatology, geochemistry, biochemistry, solid-state physics, chemistry, behavioral sciences and archaeology.

Perhaps Dr. Mordy's most important strength was his ability to convince some of the greatest scientists of the day to pursue their often groundbreaking studies under the auspices of a startup research institute in a vast but sparsely populated Western state. Attracted by the self-motivating structure of DRI, as well as the unique natural laboratory of the pristine Nevada desert, Mordy brought the best and brightest to the institute. Among them were atmospheric physicist Dr. Patrick Squires; hydrologist Dr. George Burke Maxey; and biologist Dr. Frits Went.

Dr. Mordy left DRI in 1970. Thanks to his vision and perseverance, what started as a handful of talented researchers working from the basement of the University of Nevada library had grown into a serious and respected scientific institute.

Master's degree student Susanna Blunt, of the Moser Laboratory, tests the water of Las Vegas Wash.

Photo by Sara Jenkins

50 *years* AT THE FRONTIERS OF SCIENCE

In 1961, Joy Leland arrived at the University of Nevada in Reno after earning an MBA at Stanford University, and stepped onto the proverbial ground floor of a startup environmental-sciences research institute established by legislation that Nevada Governor Grant Sawyer had signed into law on March 23, 1959. It was the Desert Research Institute — today's DRI.

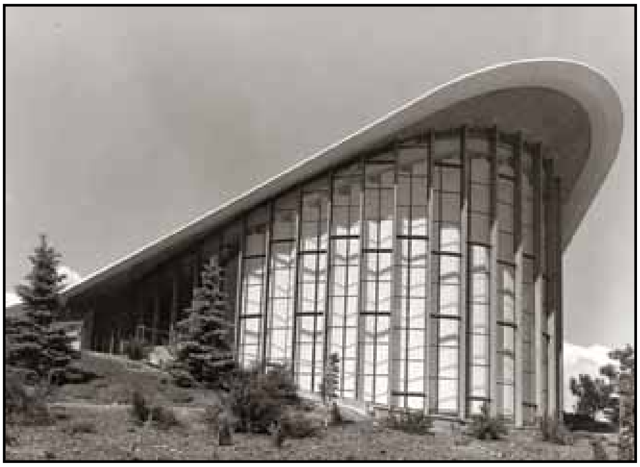
DRI scientists pioneered the field of Cold War archaeology. Here, they work with a pogostick, a device that was placed under a nuclear weapon to measure the power of the blast at the Nevada Test Site.

She was among the first three professional employees hired at DRI. The others were its visionary driving force and first director, atmospheric physicist Wendell A. Mordy, Ph.D.; and George Maxey, Ph.D., who developed DRI's water-resources research group into an internationally recognized program.

"There wasn't yet any great feeling of an organization," recalls Dr. Leland, who went on to earn a Ph.D. and a place among DRI's research faculty.

Fifty years ago, Nevada — the nation's seventh-largest state geographically — had roughly 285,000 people, and one didn't have to look far to find the old West. Yet by one legislative act, Nevada embarked on a course that, at its 50th anniversary, finds DRI in the upper echelons of environmental-sciences research institutions.

It was established as an educational and research division of the University of Nevada "to foster and to conduct fundamental scientific, economic, social or educational investigations, and applied research for industry, governmental or private agencies, or individuals."



The Fleischmann Atmospherium Planetarium in 1970.

DRI scientists study Owens Lake in the 1960s.

The institute's mission was to include encouraging and fostering a desire for research among students and faculty, to discover and develop research talent, and to acquire and disseminate the knowledge gained. From the outset, it was to enter into contracts with governmental or private agencies or individuals who needed its services and facilities.

From that early small group, DRI has grown into a world-class center of environmental research, with more than 500 employees, 180 researchers, major campuses in Reno and Las Vegas, and research that is approaching $40 million. Originally focused on arid-land issues in Nevada, the pursuit of new knowledge now takes DRI scientists to every continent.

Photo by Sara Jenkins

Joy Leland

Dr. Leland, long retired, says she's not surprised. "As soon as I met Wendell, I knew it wasn't going to be mundane."

Initial financial support for this venture came from the Max C. Fleischmann Foundation of Nevada, for a decade the institute's primary private benefactor. In the institute's first year of operation, it garnered more than $2.5 million dollars in research support, including a $900,000 grant from the Fleischmann Foundation.

As DRI established itself scientifically, it became more self-supporting, with the caliber of its scientists attracting research dollars from federal, industrial and private sources. Although DRI's entrepreneurial model meant they would not receive tenure, highly motivated researchers nonetheless were drawn to the flexible and bureaucracy-free research workplace.

As it became increasingly global in scope, it continued to rely on operational costs charged to research sponsors to support its activities. For every dollar that DRI receives in state funding today, it returns four dollars to Nevada. More than 90 percent of DRI's total annual budget is spent in Nevada.

The driving force in DRI's first decade was atmospheric physicist Dr. Wendell A. Mordy, an entrepreneurial visionary who served as the institute's director from 1960 to 1969. Dr. Mordy helped DRI become a leader in atmospheric-physics research. Yet he also launched projects in hydrology, climatology, geochemistry, biochemistry, solid-state physics, chemistry, behavioral sciences and archaeology.

Under Mordy, the institute recruited some of the best scientists of the day. Among them were:

Dr. Patrick Squires, a pioneer in weather modification who assembled a team that pioneered research into the small component of aerosols — suspended particles in the atmosphere — that result in the formation of cloud droplet. This research led to development of new instruments and ideas on the origin and loss of aerosol particles in the atmosphere.

Atmospheric chemist Dr. Alan Gertler, right, provides air-quality sampling training in Gvar'am, India.

Water sampling, Walker Lake

DRI assists with atmospheric studies in France.

Dr. George B. Maxey, who led groundwater research programs. Dr. Maxey helped develop the Maxey-Eakins Method, the first scientific approach to estimating the recharge of groundwater resources applicable to the Great Basin and similar basin-and-range areas of the West.

Dr. Frits Went, a botanist and elected member of the National Academy of Sciences. Dr. Went and his scientists developed basic understandings of the functioning of desert plants, including the nature of their water sources, and how they adapt their water use to drought conditions. They discovered symbiotic relationships between some desert shrubs and soil fungi. Dr. Went also designed the first greenhouses in Nevada capable of conducting climate-controlled experiments. These structures, known as phytotrons, were precursors to a facility-now called the Frits Went Laboratory. It is housed in DRI's Dorothy S. Gallagher Great Basin Environmental Research Laboratory, an advanced controlled-environment facility completed in 1992.

In 1961, the institute began to establish itself in two fields of research for which it would become particularly well known: weather modification, or cloud seeding; and research on the groundwater of the U.S. Department of Energy's Nevada Test Site in southern Nevada. By tracking radioactivity first from above-ground, and later from underground, nuclear-weapons testing, DRI scientists gained valuable insights into the basic workings of groundwater systems in desert environments. These projects enabled researchers to conduct the basic studies needed to understand an arid-lands ecosystem.

The desert's human history was a focal point early on as well. Dr. Warren D'Azevedo was the first director of DRI's Center for Western North American Studies, which concentrated initially on anthropology and history. Nevada's oral-history program, now under the direction of the University of Nevada, Reno (UNR), began in the 1960s under DRI's Mary Ellen Glass. DRI's Basque Studies program under Dr. William Douglass was the only such program in the United States. It was eventually integrated into the Basque Studies Program at the UNR library. Dr. Joy Leland made long-term studies of alcohol use among Native Americans. Dr. Bruce Dill studied the physiological adaptations of both animals and humans to extreme mountain and desert conditions. In 1977, DRI's Social Sciences Center entered into its first U.S. Department of Energy contract to help manage the cultural resources of the Nevada Test Site, where relatively undisturbed locales hold clues to how ancient inhabitants adapted to environmental changes.

The Desert Research Institute originally operated from various locations on the UNR campus, including the basement of Getchell Library, the third floor of Morrill Hall, and the Scrugham Engineering Building. From 1962 until 1968, a converted restaurant on Maryland Parkway was its Las Vegas headquarters. It then moved to a renovated duplex on the same street for the next 13 years. In 1965, DRI's northern Nevada headquarters moved to the Water Resources Building at the north end of the UNR campus.

Count Alessandro Dandini — a scholar, inventor and philanthropist who had supported the early development of the institute as a member of the UNR faculty — joined DRI, and it was largely through his efforts that the institute secured approximately 450 acres north of Reno that would grow into the Dandini Research Park, now the home of DRI in northern Nevada.

DRI's northern Nevada headquarters, the George B. Maxey Science Center, was completed in 1977. That same year, DRI opened its first state-funded facility in southern Nevada, the Solar Energy Research Facility in Boulder City. Most staff members in Las Vegas were located at a facility on Maryland Parkway, but they moved into the new Southern Nevada Science Center (SNSC) in 1992. SNSC was DRI's first state-funded Las Vegas facility, designed specifically for scientific research.

The Solar Energy Research Facility is an example of DRI's ability to respond to trends in research, although in this case the trend was short-lived. With the energy crisis of the 1970s squeezing the United States' resources and its consumers' pocketbooks, a push for the study of alternative, renewable energy forms began.

The Solar Energy Research facility, itself solar-heated and cooled, was devoted to applied research and development in solar energy technology, energy conservation, energy storage, and related fields. Specific research programs included studying solar ponds as methods of capturing and storing solar energy for peak demand electricity, and analyzing the feasibility of wind and solar power generation for remote, isolated communities. But by the early 1980s, with the end of the oil embargo and renewed availability of fossil fuels, government and industrial support for alternative-energy research declined. DRI shifted the emphasis of its studies to the environmental impacts of energy generation.

In the 1970s, DRI began a major project for Southern California Edison, which established new benchmarks for characterizing the long-range transport of pollutants and for detecting minute

The Mojave Desert's threatened tortoises are the focus of DRI research.

Greenland's ice sheet reveals a 100,000-year record of Earth's atmosphere.

Photo by Sara Jenkins

Community Environmental Monitoring Project monitors air downwind from the Nevada Test Site.

DRI scientists and staff worked in basic facilities in the early years.

Installing an ozone monitor on Sandia Peak in New Mexico.

changes in airborne particulates in the relatively pristine desert southwest. This project evolved into the Desert and Intermountain Air Transport (DMAT) study, a long-range look at the sources, transport, transformation and fate of air pollutants in the complex terrain of the Southwest.

A major thrust of the DMAT study was preservation of scenic resources of the region, particularly in its many national parks and recreation areas. DMAT provided the first scientific confirmation that air pollution from the Los Angeles basin was being transported 225 miles east into the Grand Canyon.

Drought conditions in 1977 prompted then- Nevada Governor Mike O'Callaghan to authorize the first Emergency Cloud Seeding Project, with DRI at the helm. The program was a direct application of the cloud-seeding principles and technologies DRI had developed over the years, beginning with the work of Dr. Patrick Squires, who had carried out pioneering experiments prior to coming to DRI. This emergency measure evolved into the State of Nevada Cloud Seeding Project, which seeds clouds nearly every winter in northern Nevada watersheds to increase spring runoff. As DRI honed its expertise in this field, it exported its knowledge to other states and to other parts of the world, and adapted its use for problems other than drought.

In February of 1980, Dr. Clifford Murino, an atmospheric physicist, became president of the institute. He directed establishment of the DRI Research Foundation in 1982 to raise discretionary funds for the institute. The DRI Research Foundation has helped raise outside funds for research, as well for capital improvements, new research instrumentation, and upgrading and replacing obsolete equipment.

The Foundation spearheaded the campaign to complete the Great Basin Environmental Research Laboratory, raising approximately $1 million. Over the years, the foundation has developed an increasingly professional approach to its mission and today directs a number of successful fundraising projects, including the annual Nevada Medal Dinner and Awards Ceremony.

DRI researchers broke new ground in air-quality research in 1986, when a team of scientists pioneered the use of chemical "fingerprinting" to determine sources of air pollution in Nevada. They were also able to track the movement of the various pollutants to their eventual points of impact.

Atmospheric chemist Dr. Alan Gertler has extended his expertise in the environmental impacts of mobile-source pollutants, including auto and truck exhaust, from the Lake Tahoe Basin in California and Nevada to North Africa, the Middle East and India. The institute has been involved in a series of tunnel studies, in which emissions from vehicles passing through roadway tunnels were measured and analyzed. Another major innovation in determining the extent of vehicle-caused pollution is the use of remote-sensing devices to measure the emissions of individual vehicles as they are driven.

Air pollution's effects on irreplaceable cultural sites are the focus of DRI research in China. Under of memorandum of understanding, in March 2005 DRI began joint research into indoor air pollutants at the Emperor Qin's Terra-cotta Warriors and Horses Museum in Xi'an city, Shaanxi Province. Thousands of pottery soldiers, horses, chariots and other artifacts were uncovered there in 1974. Most have been restored. However, due to a combination of general air pollution, raised temperatures and humidity in the museum and pollution from visiting tourists, the figures are showing signs of suffering from mold. Dr. Judith Chow and Dr. John Watson of DRI's Division of Atmospheric Sciences have applied their expertise in air-pollution research to determining what is in the museum's air, and how to preserve the artifacts.

In the years when DRI was first establishing its excellence in air-quality research, it also continued notable research in atmospheric physics. This area was one of DRI's first strengths, and remains so today. The risk in using aircraft in atmospheric research was tragically manifested in a 1981 plane crash that took the lives of two DRI researchers, Peter Wagner, and William Gaskell, pilot John Lapham and copilot Gordon Wicksten. A highly instrumented WWII-era bomber converted for research purposes went down in the Sierra Nevada during a study of winter precipitation processes.

DRI's Atmospheric Sciences Center added a new dimension to its capabilities in 1986 when it became home to the Western Regional Climate Center (WRCC). The WRCC is part of a program initiated by the National Oceanic and Atmospheric Administration to promote research of climatic trends and conditions in the western United States and to coordinate the dissemination of climate data.

Understanding of storm and cloud physics has also been advanced by DRI's Storm Peak Laboratory in Colorado, founded in 1983 and rebuilt in 1995. This high-elevation laboratory enables researchers to work inside actual storm clouds, without the expense and time restrictions inherent to aircraft-based research.

DRI has long been involved in polar research. In 1975, the institute hosted a national scientific workshop on polar research where scientists from around the world met to develop and coordinate a United States project for inclusion in an international polar program. In 1977, DRI helped establish the first satellite communications link between the United States and Antarctica, where DRI scientists continue to conduct research. Currently, DRI hydrologist and geophysicist Dr. Kendrick Taylor is chief scientist with the National Science Foundation's West Antarctic Ice Sheet Divide (WAIS Divide) Ice Core Project. This team of scientists, engineers, technicians and students from multiple institutions are embarked on a multiyear effort to obtain the most detailed record of greenhouse

Remote weather stations use satallite links to relay data to DRI.

Weather balloons carry small instrument packages that sample the atmosphere at various levels.

Photo by Sara Jenkins

Graduate students participate in research at DRI.

Key Benchmarks in DRI History

1960s

Dr. George Maxey helped develop the Maxey-Eakins Method, the first scientific approach to estimating the recharge of groundwater resources applicable to the Great Basin and similar basin-and-range areas of the West.

Dr. Patrick Squires was named head of DRI's Laboratory of Atmospheric Physics in 1966. His work concerned suspended particles in the atmosphere, particularly the small component of the aerosol that results in the formation of cloud droplets. Dr. Squires was responsible for assembling a research team at DRI that pioneered this field.

1970s

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1990s

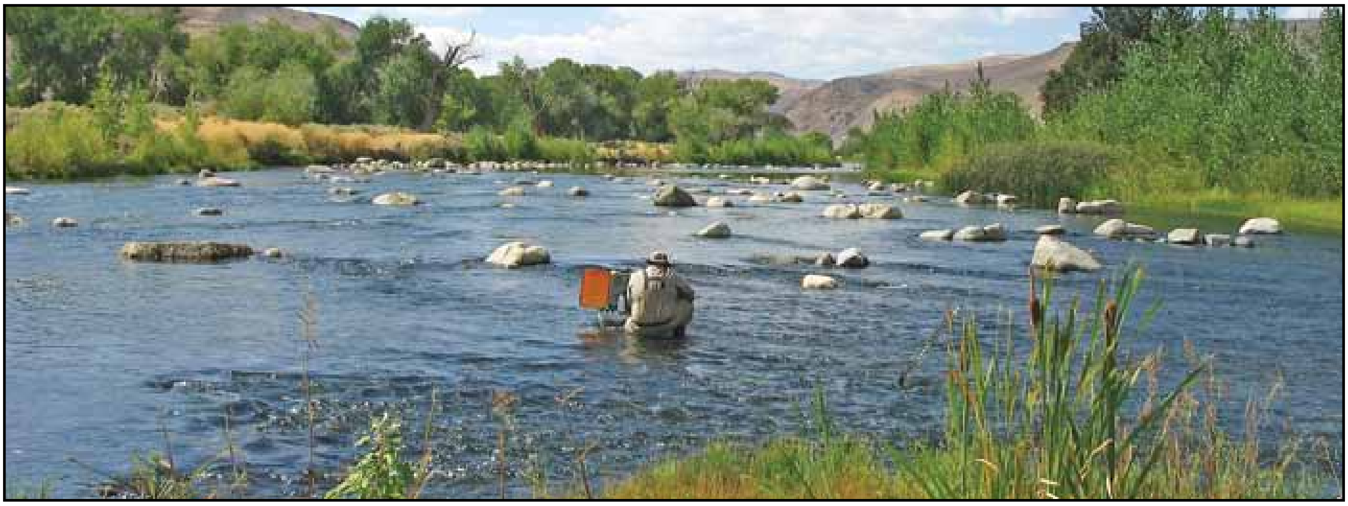
With support from the Conrad N. Hilton Foundation, DRI scientists successfully used satellite-based and airborne remote sensing to find suitable drinking-water wells for villagers in the west African nation of Ghana.

Several DRI researchers became involved in a massive international climate-research project known as the Tropical Ocean and Global Atmosphere study. This 10-year undertaking has united hundreds of scientists from around the world in an effort to better understand and predict the forces that shape the world's weather.

A study by DRI scientists Drs. Jay Arnone, Paul Verburg, Richard Jasoni, Jessica Larsen and Bill Coulombe and colleagues using 12-ton tallgrass prairie plots growing in DRI's climate-controlled EcoCELL facility found that after exposing the plots to one abnormally warm year, the amount of CO_2 taken up by the grassland ecosystems decreased for up to two years, limiting the role of grasslands as a "sink" for atmospheric CO_2. The study was a cover story in the journal *Nature*.

2000s

DRI scientists and colleagues determined that Northern Hemisphere industrial pollution resulted in a seven-fold increase in black carbon (soot) in Arctic snow during the late 19th and early 20th centuries. The study was led by Drs. Joe McConnell and Ross Edwards, DRI ice-core scientists working on the Greenland Ice Sheet.



Microbial ecologist Jim Bruckner, Ph.D., a DRI postdoctoral researcher, gathers water samples from a restored Truckee River gravel bed in 2007.

gases in Earth's atmosphere over the last 100,000 years by retrieving a 3,465-meter (11,360-foot) column of ice.

Dr. Joseph McConnell, who studies the role of human activities in global climate and sea-level change, has worked in both Greenland and Antarctica, including the WAIS Divide project. A finding from his research in Greenland was ranked 19th out of Discover magazine's 100 top science stories of 2007. Through a method he developed with DRI precipitation chemist Dr. Ross Edwards, McConnell and colleagues determined that eight times as much black carbon was deposited in Greenland's ice from 1906 to 1910 than during the previous 100 years. The study showed the dramatic effect of the industrial revolution on the Arctic environment and climate.

DRI has also conducted investigations of frozen lakes in the Arctic region, comparing them to those in the Antarctic. A DRI researcher headed the first Long-Term Ecological Research site, or LTER, to be established on the Antarctic continent. A nationwide National Science Foundation network, LTERs are set up to gather long-term basic ecological data about ecosystems.

In the 1980s the Biological Sciences Center focused on water, light and nutrient stresses on plants, in arid environments as well as globally. The center used two controlled-environment greenhouses, or phytotrons, developed by Dr. Frits Went to study the responses of plants to varying environmental factors. These early controlled-environment facilities would eventually give rise to the Gallagher Great Basin Environmental Research Laboratory. In this facility, the Frits Went Laboratory houses the DRI-designed EcoCELL facility (Ecologically Controlled Enclosed Lysimeter Laboratories). This facility enables researchers to realistically study artificial and natural ecosystems and provide insight into the large-scale responses of the Earth's ecosystems to different environmental factors.

The EcoCELL facility was highlighted in the September 18, 2008 issue of the journal Nature, which featured a study authored by DRI scientists Jay Arnone, Paul Verburg, Richard Jasoni, Jessica Larsen and Bill Coulombe and colleagues.

The study focused on quantifying the effects of a yearlong heat wave on grassland CO_2 uptake. For this study, 12-ton tallgrass prairie plots from Oklahoma are growing in the EcoCELL facility under a controlled environment that simulates a natural Oklahoma climate.

The four-year study found that after exposing the ecosystems to one abnormally warm year in the EcoCELLs, the amount of CO_2 taken up by the grassland ecosystems decreased for up to two years, limiting the role of grasslands as a sink for atmospheric CO_2. The amount of CO_2 absorbed from the atmosphere was effectively reduced three-fold during the course of the four-year study.

In 1987, geologist James V. Taranik, Ph.D., became president of DRI. Dr. Taranik was the former dean of the Mackay School of Mines at the University of Nevada, Reno, and was internationally known for his research in aerospace remote sensing. He directed DRI toward an academic structure.

Remote-sensing technology enables researchers to use satellites, aircraft, and other distant instrumentation to study the

The West Africa Water Initiative helvillagers obtain fresh water.

Sampling of Walker Lake, Nevada, for anaerobic microbes.

Photo by Sara Jenkins

An autoclave is used to sterilize materials.

Earth. As researchers became increasingly concerned with the Earth's processes on a global scale, remote-sensing techniques became more and more applicable to many of DRI's research projects as a means of acquiring environmental data from a unique perspective, and at a level of density that could not be realistically obtained by conventional land-based analytical techniques. The establishment of DRI's Image Processing Laboratory, renamed the Spatial Analysis Laboratories, in 1989 was an important step to improving the ability of DRI researchers to effectively acquire and apply such information.

With support from the Conrad N. Hilton Foundation, DRI scientists successfully used satellite-based and airborne remote sensing to find suitable drinking water wells for villagers in the west African nation of Ghana. The satellites were used to locate fractures in the Earth where groundwater would tend to accumulate, giving drillers the greatest chance of locating a good well. Results have been excellent, and the wells provided improved water supplies for many Ghanaians who had been continuously exposed to water-borne parasites and disease from using shallow, intermittent surface ponds.

While some DRI researchers have become experts at determining how climates have changed over the years, others have focused on the way life has adapted to those changes. The institute's early archaeological studies dealt mainly with the Great Basin's first inhabitants, but DRI scientists have conducted archaeology projects around the world. DRI archaeologists were involved in some of the first scientific archaeological studies in Siberia, looking at the stone tools used by people who lived in that area 11,000 to 8,000 years ago. Working with Russian colleagues, a breakthrough discovery occurred: the first fluted point ever found on the Russian side of the Bering Strait.

On November 19, 1998, the Board of Regents appointed Dr. Stephen G. Wells president of DRI, which he continues lead as DRI begins its second half-century. Wells, a geologist with research interests in geomorphology and Quaternary geology of arid and semiarid regions, came to DRI in 1995 as executive director of the institute's Quaternary Sciences Center. He has since led the institute through a rapidly changing research environment in which competition for research dollars has increased as defense industries move into environmental-research areas. And the scoof the research itself has continued to shift during Wells' time at the helm, as nations have become concerned with long-term and large-scale environmental questions, particularly the complex range of questions involving global climate change.

In the early 1960s, growing concern about the potential impacts of underground nuclear testing on groundwater resources led the Atomic Energy Commission, the predecessor to the U.S. Department of Energy (DOE), to seek the expertise of DRI in researching and monitoring the movement of contaminants in groundwater at the Nevada Test Site (NTS).

With this as a beginning, DRI has had a multi-decade research program for DOE that was formally continued in 2006 when DRI signed a five-year, $42 million Technical Research, Engineering, and Development Services Contract for the DOE, National Nuclear Security Administration Nevada Site Office. Although groundwater resources remains a major focus of DRI's research, the scope of its work for DOE has grown to include environmental remediation, management of radioactive waste, environmental monitoring and compliance, stockpile stewardship and nonproliferation, cultural resources, and technology development.

In 2007, as a subcontractor to Stoller Corporation, DRI also began research for the DOE Office of Legacy Management (OLM) where DRI focuses on contaminant transport, risk management, and long-term stewardship of sites across the nation that have been "closed" from a regulatory perspective, but where residual contamination and risk remain.

The focus of DRI's research for OLM is what is referred to as the "Offsite Test Areas," eight locations in five states where underground nuclear tests were conducted off the NTS. Two of the Offsites, the Project Shoal Area and the Central Nevada Test Area, are in Nevada. Finally, since 2005, as part of the Yucca Mountain Environmental Monitoring System Initiative (EMSI), DRI researchers have focused on developing baseline environmental conditions and designing monitoring systems for human and environmental protection if a repository for spent fuel and high-level nuclear waste were to be constructed at Yucca Mountain, Nevada.

It is technically impractical to remove radionuclides from groundwater caused by nuclear tests. As a result, a major focus area of DRI research for DOE is numerical modeling of complex subsurface environments to predict pathways and rates of contaminant migration. The results of these models are being used to support effective institutional controls and monitoring systems, to protect Nevada citizens and the environment from contaminated groundwater. Innovative groundwater data collection systems, geochemical evaluations, and rainfall-re-

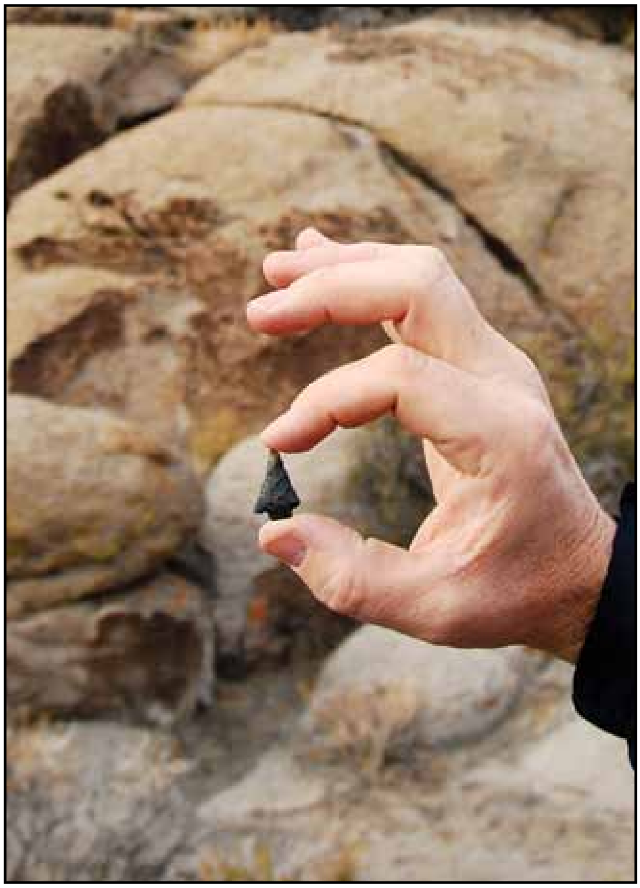


Photo by Sara Jenkins

Arrowheads are evidence of nomadic tribes that inhabited parts of todays Nevada Test Site.

DRI archaeologists and Nevada Test Site personnel examine the tunnel where the world's first contained underground nuclear test took place in 1957.

Photo by John Doherty

A study involving tallgrass prairie plots at DRIs EcoCELL in Reno was the cover story for the September 18, 2008 issue of the journal *Nature*.

charge investigations are part of the supporting research elements conducted by DRI.

Above ground, as part of research on remediation and management of areas of surface soil contamination from atmospheric nuclear testing, DRI is researching whether wildfires could lead to suspension and spread of contamination by wind and water erosion.

An important part of DRI's environmental-monitoring activities for DOE is its operation of the Community Environmental Monitoring Program (CEMP), a network of 29 stations across a 160,000-square-kilometer region of Nevada, Utah, and California surrounding the NTS and Nevada Test and Training Range. Citizens in the towns where the stations are located are trained by DRI to help collect data to ensure that no releases of radiation or radioactive material are occurring. Through a variety of data transmission technologies, DRI's Western Regional Climate Center (WRCC) makes available on a public Web site data from meteorological instruments and gamma radiation sensors at the CEMP stations in near-real time.

Cultural resource evaluations, protection of cultural sites, and consultation with Native Americans have been another important part of DRI's work for DOE, both for the NTS and Yucca Mountain. As part of its cultural resources program, DRI manages a state-of-the-art curation facility for DOE and other agencies in southern Nevada in the Frank H. Rogers Building on its Las Vegas campus. The more than 200,000 artifacts in the facility includes pieces from the earliest Native Americans in the region, the period of Euro-American settlement, as well as the history of atomic testing.

The advent of Cold War archaeology turned DRI's attention to relatively recent artifacts found on the Nevada Test Site: test structures erected during the era of above-ground nuclear-weapons testing, 1951 and 1963, to study the effects of atmospheric nuclear detonations on human-made structures.

Each year since 1988, DRI and AT&T have sponsored the Nevada Medal, an international award intended to enhance the

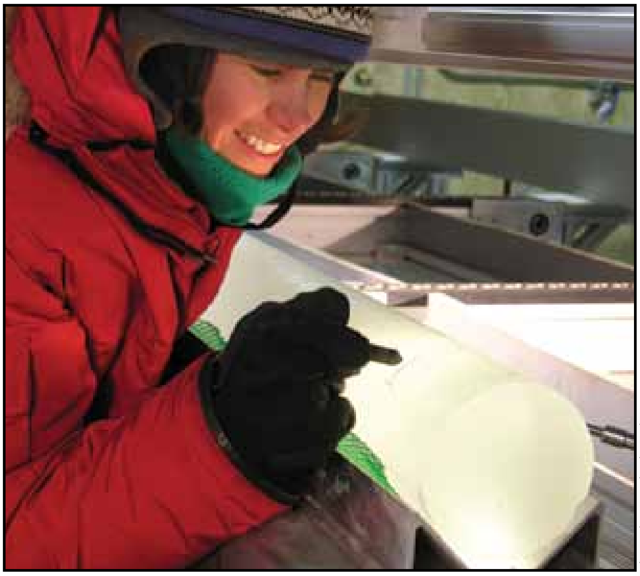
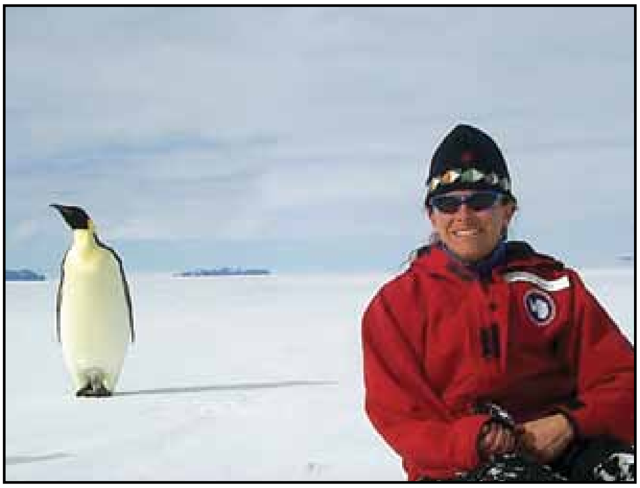


Photo by Kendrick Taylor

Rebecca Anderson examines an ice core from a depth of 560 meters (1,900 feet) from the WAIS (West Antarctic Ice Sheet) ice core project.



Alison Murray, Ph.D., with an Emperor penguin posing obligingly in the background, on the sea ice during a research visit to Antarctica.

prestige of Nevada among the scientific community and to recognize outstanding achievements in science and engineering. The first recipient was Dr. Verner E. Suomi, inventor of the "spinscan" camera that gives television weather reporters their satellite pictures. DRI kicked off its 50th anniversary at the 2009 Nevada Medal Dinners, where the award was presented to Francis S. Collins, M.D., Ph.D., former director of the National Human Genome Research Institute.

Another annual award, the Alessandro Dandini Medal of Science, honors a DRI researcher who has made a significant contribution to his or her field. The award was established in 1992 by Countess Angela Dandini in honor of her late husband, Dr. Alessandro Dandini. The first recipient was Dr. John Watson, whose research helped make DRI one of the nation's leaders in the study of air quality and pollution problems.

Private benefactors who believe in DRI's mission and recognize the value of its work have been instrumental in the institute's success. In 2008, DRI received a gift valued at more than $20 million from the estate of Sulo and Aileen Maki — generous DRI benefactors for four decades — to support water-resources programs in southern Nevada. DRI President Wells said the gift will enable faculty to generate additional external funding for long-term programs in hydrologic sciences.

With a growing number of large-scale and international projects, DRI is making great headway toward meeting the needs of the evolving 21st century research environment. Climate change, air pollution, water resources, renewable energy, the spread of invasive species ... these are just a few of the diverse topics that institute scientists will be studying in the decades to come, not only in Nevada and the United States, but around the world. DRI's expanded capacity to simulate real-world environments with state-of-the-art computational and visualization technology will be important to scientists far beyond Nevada. Yet DRI remains committed to finding sound, science-based solutions to environmental problems in Nevada, to educating future generations of researchers, and to passing along the knowledge gained in its studies to those most likely to benefit from it.

Editor's note: This article is based on *Desert Research Institute, 1959-1998, A History,* by Jackie Allen. The history is part of the book *Reinventing the System: Higher Education in Nevada, 1968-2000,* by James W. Hulse with Leonard E. Goodall and Jackie Allen (University of Nevada Press, 2002).

SPINOFFS

Some of DRI's earliest programs were transferred to or incorporated into other parts of the university system.

- The University of Nevada School of Medicine, founded in 1969, grew out of research at DRI's Laboratory of Environmental Patho-Physiology.
- DRI opened the Museum of Natural History in Las Vegas in 1968; it went to the University of Nevada, Las Vegas (UNLV) in 1972. It is now UNLV's Marjorie Barrick Museum.
- The Data Processing Center, established in 1960, was transferred to University of Nevada, Reno (UNR) in 1968 as well.
- DRI designed and built the Fleischmann Atmospherium Planetarium, and directed its operation from 1963 until 1975, when it, too, was turned over to UNR.

Collage *of Memories*

Wendadall A. Mordy

Dr. John Hallett Ph.D.

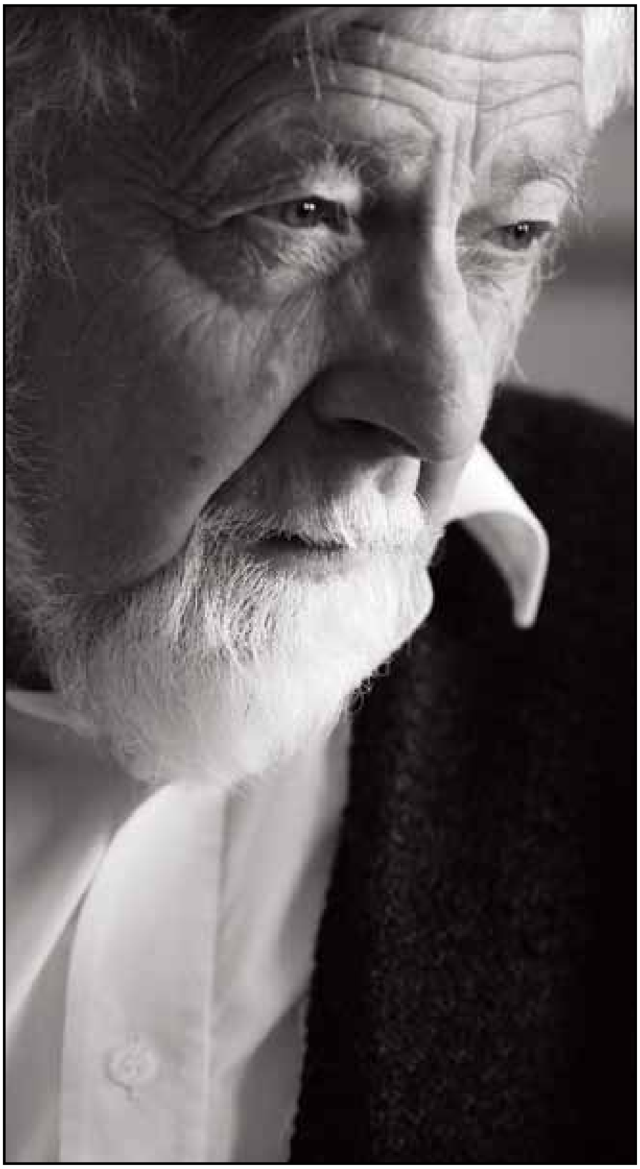


Photo by Sara Jenkins

After 43 years as an atmospheric physicist at DRI in Reno, the institute's longest-serving researcher, John Hallett, Ph.D., finds himself on a scientific frontier that may seem relatively new to some, yet it's one he's been working in for years: climate change.

"All of the instruments you see scattered about here have a key role in characterizing a changing climate," he says, his blue-gray eyes scanning the array of devices that crowd the Ice Physics Laboratory, which he directs.

To the uninformed, the boxes and wires might seem just so much electronic detritus. Yet the instruments, which he devised with colleagues at DRI and other institutions, are central to his work measuring the properties of precipitation, notably ice crystals, amid what he terms "a changing moisture climate."

Among the instruments is one deceptively simple-looking device — trademarked as the HotPlate Total Precipitation Sensor — that he developed with Roy Rasmussen, Ph.D., of the National Center for Atmospheric Research in Boulder, Colo.

The electrical, disk-like metal instrument represented a design breakthrough when it was announced in 2003 because it calculates real-time rates of precipitation at high resolution. That makes it useful in characterizing freezing rain and snow when placed, for example, along airport runways.

He currently is principal investigator in development of an enhanced "T-probe," a research instrument that could be

More than 40 years into his DRI career, atmospheric physicist is still "doing what I want".

mounted on aircraft to provide high-resolution measurements of ice particles and supercooled water in clouds. The device could prove relevant to detecting potential icing hazards.

Dr. Hallett's life in science has a number of meaningful touchstones. Born and raised in Bristol, England, at age 10 he witnessed an ice storm that made him wonder about the physics of ice crystals. He slept in air-raid shelters when warplanes bombed Bristol during World War II, in an era when many planes fell victim to icing, not flak. Alleviating the risks that icing poses to aircraft is a major focus of his research. As a teenager, he built his neighborhood's first television set, prelude, perhaps, to the measuring instruments he has developed over the years. After World War II, and especially after the Soviet Union launched Sputnik 1 in 1957, science was the place to be, and he was there.

Dr. Hallett earned a bachelor's degree in physics from the University of Bristol in 1953, then a Ph.D. in meteorology at Imperial College, at the University of London. He met many Americans at the latter, including one named Wendell A. Mordy, who'd been a military weather officer in World War II.

Years later, in 1966, his research and acquaintance with Dr. Mordy led him to the Desert Research Institute, at the University of Nevada in Reno. Dr. Mordy was DRI's first director. Dr. Hallett liked what he found and, with longstanding support from the National Science Foundation, has been a DRI mainstay ever since.

"The people I work with here are pretty good at what they do," he says, "and that's important."

A research professor in DRI's Division of Atmospheric Sciences (DAS), Dr. Hallett's interests include cloud physics, cloud electrification, atmospheric chemistry, climate dynamics and physical meteorology.

He holds DRI's Edgar J. Marston Professorship of Atmospheric Physics, and is a Fellow of the American Meteorological Society. He received DRI's Dandini Medal of Science in 1995, and in 1998 he became the first DRI researcher to receive the prestigious Nevada Board of Regents' Researcher Award. He played a central role in development of the University of Nevada, Reno's atmospheric sciences graduate program, which he directed for a decade.

"John has made major contributions over four decades to our understanding of the formation of ice crystals in the atmosphere, both primary and secondary processes, and the role ice crystals play in cloud dynamics and electrification," says Ken Kunkel, Ph.D., director of DAS.

Reflecting on DRI's growth over its first half century, Dr. Hallett hesitates to guess at what the next 50 years could bring. Only one thing is certain, he says: There will always be mysteries for scientists to solve.

"There are lots of things that we don't understand out there," he says, gazing at a computer monitor that displays measurements from field instruments in the Sierra Nevada to the west. "There are still major problems out there to be investigated that have great scientific and practical applications."

Beyond 50

DRI won't be resting on its laurels in coming years

In coming years and decades, the world will be turning increasingly to science for answers to such complex environmental problems as climate change, adequate water resources, a growing population, air and water quality, and the need for secure and sustainable energy sources. With its international research faculty and continually expanding capacity to do research, DRI will be better positioned than ever before to pursue authoritative, science-based data for practical solutions.

The National Science Foundation ranks DRI 19th out of 432 higher-education institutions nationally in R&D expenditures in environmental sciences. From that strong position, the institute is planning a future in which its global leadership in environmental sciences will expand. It will accomplish that, in part, by further building long-term research capacity through such facilities and programs as the new $25.4 million Computational Research and Visualization Building, opened on the Reno campus in January 2009; the new Nevada Water Resources Data, Modeling and Visualization Center; the Renewable Energy Center and others.

Future objectives

- Be a world leader in environmental sciences.
- Foster scientific talent.
- Establish partners and collaborations.
- Provide research-focused educational opportunities.
- Leverage scientific innovation and intellectual capital needs through technology transfer.
- Serve as a model of entrepreneurialism in research.

Education initiatives

- Statewide Graduate Water Resources Program: Explore establishing an integrated statewide graduate academic program in water resources in collaboration with the University of Nevada, Reno, and the University of Nevada, Las Vegas.
- Statewide Renewable Energy Education Program: Help Nevada move toward energy self-sufficiency through collaboration with University of Nevada, Reno, and University of Nevada, Las Vegas.

DRIs proposed Phase III complex at the Las Vegas campus would bolster hydrologic-sciences, renewable energy and human-health research.

Research initiatives

- Develop decision-support systems for improved decision-making by government and the public.
- Expand informatics capabilities to analyze biological structure and function at the molecular level, and efficient and equitable use of water.
- Develop strong regional climate-modeling capability, and expand climate-change research.
- Employ advanced computer-visualization techniques to extract knowledge from data and modeling results across a broad spectrum of research areas.
- Research, development and commercialization of renewable energy that includes workforce development and outreach.
- Build a program in environmental change and human health.

DRI continues to build successful research initiatives in southern Nevada, especially in the areas of hydrologic sciences, environment and health, environmental assessment, restoration and monitoring, and environmental hazards. However, demand for DRI research in these programs is taxing available space, especially in hydrologic sciences.

Growth in DRI's hydrologic sciences research will be strongly supported in the future by the $20 million gift in 2008 from the estate of Sulo and Aileen Maki. The purpose of the gift is to develop water resources programs in southern Nevada.

To meet growing needs, DRI is proposing the Phase III complex at its Las Vegas campus, the Southern Nevada Science Center on East Flamingo Road. At approximately 65,500 gross square feet and $40 million (2008), it is designed to include additional wet labs, computational-research areas, an auditorium, faculty offices, an expanded library and classroom facility, and public areas.

It also would include a world-class research tool known as the Eco-Flume to study complex interactions between river flow, sediment, nutrients and contaminants. As proposed, the LEED Gold-certified building would accommodate the growth of DRI's hydrologic and renewable-energy research.

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