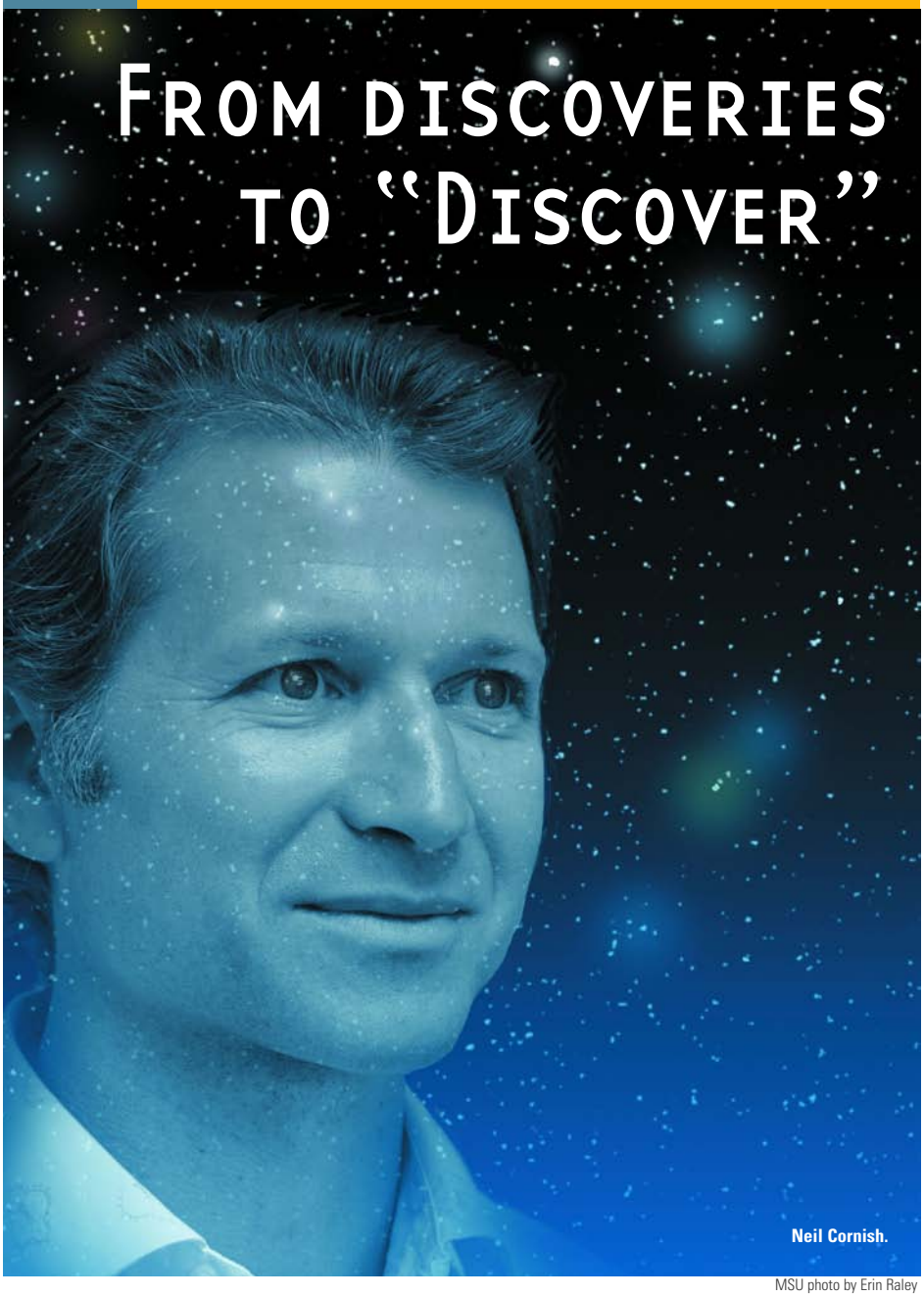
Research and Creative Activities
Discovery
Montana State University

Volume 16, Issue 1 • Winter, 2005

From discoveries to "Discover"



MSU photo by Erin Raley

By Evelyn Boswell, MSU News Service

Last year ended with a big bang for a Montana State University astrophysicist who helped determine that the universe is 78 billion light years across.

"Discover" magazine listed the finding as one of the top 100 discoveries in 2004 and recognized Neil Cornish of MSU for his involvement. The article titled "Astronomers Measure Cosmos Width" is located on page 58 of the January 2005 issue.

Cornish is also part of an American Museum of Natural History exhibit that recently went online. Cornish explains gravitational waves and two projects to measure them—the Big Bang Observatory and the Laser Interferometer Space Antenna—on the museum's Web site.

Cornish
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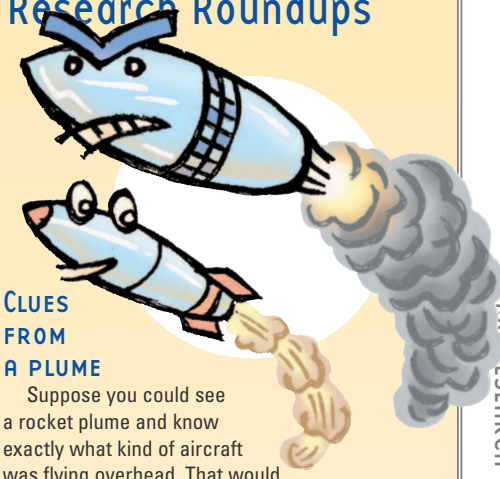
Research Roundups



Clues from a plume

Suppose you could see a rocket plume and know exactly what kind of aircraft was flying overhead. That would be helpful for a missile defense system, said Tim Minton, associate professor of chemistry and biochemistry at MSU. Scientists already know that trails of rocket exhaust emit light at unique frequencies. Millions are spent each year on measuring these plumes during missile launches or thruster firings, but that information is incomplete and difficult to interpret. Theoretical models have been inadequate. Minton and others at MSU recently received $1 million to start developing the country's first center for studying plume signatures and chemistry in the laboratory.

Geology locked out

Changes in land ownership in Montana and other states are making access to some classic geologic sites hard to obtain. "It's hugely important," argued MSU geology professor David Mogk, that field experiences in the form of day trips, regional excursions and field camps remain open to students. But increasingly, as private lands change hands and get subdivided, geologists and their students are being denied access to traditional sites. Mogk issued a "call to arms" at the last Geological Society of America meeting. Mogk wants geologists to begin working to expand access before it's too late. For one, geologists should begin cultivating good landowner relations. For another, geologists must develop a heightened sense of stewardship of geologic sites and leave a light footprint when visiting.

Dairy cow power

Farmers with small operations might be able to benefit from turning manure into electricity. Blair Stringam, assistant professor of agricultural operations technology at Montana State University, wants to develop technology for very small farms by building a methane digester on a dairy farm near Amsterdam. If all goes well, manure from the dairy cattle will be pumped into a 45,000 gallon enclosed tank. An anaerobic process will break down the manure and turn it into methane gas. The gas will generate electricity. Construction could begin in March. The digester might be operating by the end of the summer. Stringam hopes the two-year project will generate electricity for the farmer and NorthWestern Energy. He hopes the lessons learned will serve others, too.

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Cornish
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"These things seem to kind of come up randomly. You never quite know when something is going to appear out of the blue," Cornish said of the "Discover" listing and exhibit opening.

You could say the same thing about the universe that has fascinated Cornish since childhood. He grew up on a sheep farm in the Australian bush and went on to study things like black holes, neutron stars, white dwarfs and the size of the universe.

"The amazing night sky out in the country far from any lights—I think that was one of the things that got me interested in the universe early on," said Cornish whose accomplishments have been discussed in lofty terms.

William Hiscock, head of the physics department at MSU, said, "Back when we hired Neil as an assistant professor, I pointed out that depending on which way nature chose the topology of the universe, this work was a potential Nobel prize winner."

Cornish and his colleagues used the NASA Wilkinson Microwave Anisotropy Probe to collect data from radiation left over from the formation of the universe. That information showed that the universe is 13.7 billion years old and 78 billion light-years across. "Discover" mistakenly reported that the universe was 156 billion light-years wide, thinking that 78 billion was the radius of the universe instead of its diameter.

The mapping project has been the big story in cosmology over the past two or three years, but gravitational waves are the next frontier, Cornish said. Gravitational waves are produced during movement in space.

"It's an exciting area, a lot of discovery potential," Cornish said, adding that gravitational waves are expected to enlighten scientists about some of the universe's most extreme objects.

"This work was a potential Nobel Prize winner."

Cornish is one of the leading scientists for both the Big Bang Observatory and the Laser Interferometer Space Antenna. The antenna will be launched around 2014. It will detect and measure gravitational waves produced by things like giant black holes or compact binary star systems. The observatory will detect and measure gravitational waves that have been around since the beginning of the universe. It will be launched in another 20 to 25 years.

Both projects will be based in space, which means they won't be affected by earthquakes or weather patterns on Earth.

Discovery is published three times a year by the Office of the Vice President for Research, Creativity and Technology Transfer and the MSU News Service. Annette Trinity-Stevens and Evelyn Boswell, editors. Publication design by Robert Rath. For more information call (406) 994-5607 or visit www.montana.edu/wwwvr

Lake trout trackers float and

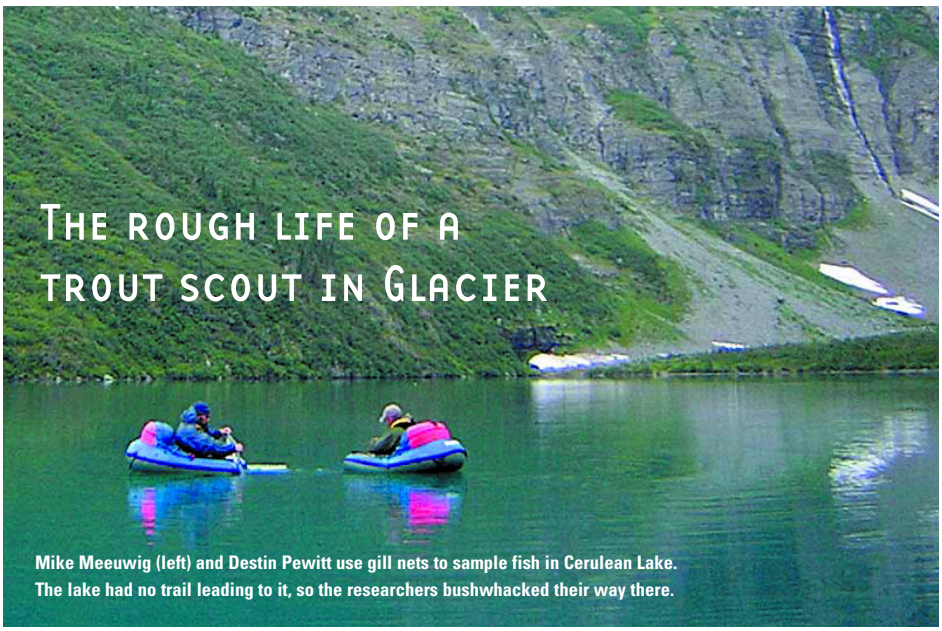

Photo courtesy of Mike Meeuwig

The rough life of a trout scout in Glacier

Mike Meeuwig (left) and Destin Pewitt use gill nets to sample fish in Cerulean Lake. The lake had no trail leading to it, so the researchers bushwhacked their way there.

By Evelyn Boswell, MSU News Service

Surrounded by mountains, uplifted by wildlife, Mike Meeuwig spent his summer catching fish in remote lakes in Glacier National Park. A drifting inner tube carried him over crystalline waters. Mule trains hauled his gear.

"That's a pretty tough place to have to work all summer, but somebody has to do it," said Christopher Guy, Meeuwig's advisor and assistant leader of the Montana Cooperative Fishery Research Unit.

From June through September, Meeuwig, a doctoral student in ecology, and two technicians hiked trails to Akokala Lake, Arrow Lake, Lake Isabel and Lincoln Lake and bushwhacked their way to Cerulean Lake to find out how far lake trout have invaded Glacier National Park. All the lakes are west of the Continental Divide. So are the other 10 lakes Meeuwig will visit over the next two years in a study funded by the U.S. Geological Survey.

"These lakes haven't been surveyed systematically in a number of years, and some of them never," Guy said.

Nonnative lake trout were introduced into Flathead Lake about 100 years ago and are believed to be the source of the lake trout that threaten the native bull trout population in Glacier. Meeuwig said he and his technicians were happy to find bull trout and no lake trout in the five lakes they surveyed in 2004.

The researchers hiked between four and 14 miles to reach those lakes. They used gill nets, angling and electrofishing to determine the number and type of fish in the lakes. They sorted and counted the fish by species. Then they weighed and measured the fish and took genetic and muscle samples before returning the fish to water.

He plans to develop recommendations for a park management plan, Meeuwig said. One suggestion might be to place barriers in streams to keep lake trout from swimming into additional lakes.

Map courtesy of Christopher Guy

This map shows Glacier National Park and 15 lakes that will be surveyed over three years for lake trout.The five lakes noted by asterisks were surveyed in 2004.

FLY IN QUEST FOR INVASIVE FISH

Photo courtesy of Joe Shaw

Chasing shadows in Yellowstone

MSU graduate student Nathan Seldomridge flies over Yellowstone Lake looking for lake trout shadows cast from lidar, a laser radar device.

By Jean Arthur, MSU News Service

Montana State University researcher Joe Shaw redefined the term "fly fishing" when he and a student flew over Yellowstone Lake this fall looking for fish shadows.

Shaw used lidar technology, laser radar. The lidar mechanism resembles a telescope. Shaw bolted it into an airplane, which flew over the lake while researchers beamed a laser ray into the water. The College of Engineering team hoped to locate groups of spawning nonnative lake trout that threaten the native cutthroat trout population. The study can potentially help Yellowstone National Park fisheries biologists create a plan to eradicate the predator that was first found in Yellowstone Lake in 1994.

"We send a lidar pulse down—it looks like a green beam of light—and it scatters off the objects suspended in the water," explained Shaw, an electrical and computer engineering professor. "We record the depth of the objects and images of shadows of the objects using an electronic camera."

Nathan Seldomridge, a graduate student in electrical engineering, said, "We were not counting individual fish but flew 500 feet above Yellowstone Lake's West Thumb area where fisheries biologists indicated we would find schools of fish spawning. It's a statistical process on the chances of seeing different schools of fish. So we are counting the signal from big schools of fish."

Lake trout usually spend their days 30 meters deep where lidar cannot penetrate because of murky water, Seldomridge said. But during September's spawning season, they swim about 10 meters down.

"We can't be sure that we saw any lake trout until the data analysis is complete this spring," Seldomridge said. "But lidar has been proven to see silhouettes of fish. So from relative size, we can tell if what we see is lake trout, which are generally three to four times the size of cutthroat."

Adult lake trout reach four to 25 pounds while Yellowstone cutthroat mature to about one-and-a-half pounds.

After logging seven hours of data, the task remains to read the shadows cast from fish in the lidar beam and recorded on video. Rianon Tiensvold, a junior in electrical and computer engineering from Frenchtown, examines each video frame for fish shadows. She works in Shaw's Optical Remote Sensor Lab through an Undregraduate Scholars Program award.

"The project offered a lot of challenges for the technology and took a couple of years to organize," said Shaw. "In the end, we hope to demonstrate the utility of this technique and develop even smaller systems that could be flown often on small airplanes to help monitor the Yellowstone Lake environment."

The project is funded by the Montana Space Grant Consortium. It was a collaborative effort with the National Oceanic and Atmospheric Administration.

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Indians along the trail

Lewis and Clark passed through 18 ecological regions on their way to the Northwest. The Native Americans who lived in those zones made clothes and homes that varied with the materials in those surroundings, said Jennifer Woodcock of Miles City, a master's degree student at MSU. Montana Indians used hides to make their clothes and lodges, for example. Indians along the Columbia River wove clothes and turned rushes into mat lodges. The Mandan and Hidatsa Indians of North Dakota lived in earth lodges. Woodcock is researching the cultural geography of 19 tribes that lived along the Lewis and Clark trail. Her findings will be added to http://yoda.cec.umt.edu/lewisclark/, an existing web site about the physical geography of the trail.

Lichen ties

Of all the pristine sites in Montana and Wyoming, the Lewis and Clark Caverns State Park is most like Yellowstone National Park when it comes to lichens. The two parks have 123 species in common, according to Jessie Salix who researched lichens for her master's degree from MSU. Salix collected samples from 22 places in the Lewis and Clark park and found 164 species of lichens. Almost half of them grew on rocks. One-third grew on bark or wood. The rest grew on moss, litter, soil or some other material. The diversity of lichens indicates the relatively undisturbed condition of the state park, Salix said.

Camping in a crater

Lugging rocks out of Mount St. Helens is no easy task. MSU geologist Todd Feeley, three undergraduate students, two graduate students and assistant professor Mark Skidmore flew by helicopter into the crater during the summer of 2003 and camped overnight. By the time they left, they had collected 30 to 40 bags of rocks, each bag weighing five pounds. The rocks were samples for MSU studies, Feeley said. Last summer, the MSU team hiked into the crater with sledgehammers and lab equipment. They were probably one of the last groups allowed in the crater before eruptions closed it to researchers. MSU was placed on a waiting list to receive new samples.

Plans unveiled for new chem/biochem building

By Carol Schmidt, MSU News Service

Montana State University in December unveiled the design for a $23-million chemistry and biochemistry building that will house researchers working on such advances as anti-cancer therapies, drugs that combat bacteria and fungi and ways to protect eyes from laser damage.

Ground is expected to be broken this summer for the 73,000 sq. ft. MSU Chemistry and Biochemistry Research Building, designed by L'Heureux, Page, Werner, PC architecture firm of Great Falls.

The building, which will be located adjacent to the present Linfield Hall parking lot, will be paid for entirely through research funds with no direct costs to Montana taxpayers.

"This building reflects the growing level of national and international prominence of the research and education program in chemistry and biochemistry at Montana State University," said David Dooley, MSU Provost who first came to MSU as chairman of the MSU Chemistry and Biochemistry Department.

Dooley is co-chair of the proposed facility's building committee. Dooley added that the success of the faculty in the competitive national research-funding arena is the primary source of the building's funding.

Sara Jayne Steen, Dean of MSU's College of Letter and Sciences and co-chair of the project's building committee, said the university recognizes that the state is in a difficult economic climate. "So we have proposed a different funding model to allow the state and university to move forward with this project."

Steen said that when completed in the summer of 2007, the building will house laboratories and offices for about 20 MSU researchers and 180 graduate assistants, research assistants and support staff. Many of those researchers are creating high-tech jobs in Montana as well as working on advances that will provide a better quality of life for all, not to mention improving MSU's quality of education.

> "This building reflects the growing prominence of the research and education program in chemistry and biochemistry at Montana State University."

Funding for the project will come from bonds based on indirect costs recovered on grants and contract awarded to chemistry and biochemistry researchers. These funds are referred to as Facilities and Administrative (F and A) costs, according to Tom McCoy, MSU's Vice President for Research, Creativity and Technology Transfer.

Cecilia Vaniman, university planner with MSU Facilities Services, said the centerpiece of the brick, glass, masonry and metal building will be cutting-edge laboratories that will line the outside of the building, although the design and model reveal a stately four-story atrium and staircase.

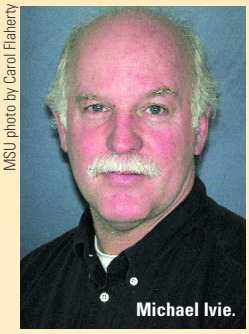
"It will be a phenomenal space for scientists, post docs, graduate students, undergrads and those interested in this kind of science," Vaniman said. She added that undergraduate classroom labs have been remodeled and will remain in Gaines Hall. "But there will be a lot of student interaction here (in the MSU Chemistry and Biochemistry Research Building). We are very excited about it."

MSU hopes to begin construction in the summer on a $23-million Chemistry and Biochemistry Research Building. L'Heureux, Page, Werner of Great Falls designed the building, displayed in this recent rendering.

People

Ivie heads Entomological Society of America

MSU photo by Carol Flaherty



Michael Ivie.

Michael Ivie, associate professor of entomology, is now president of the Entomological Society of America. The organization has approximately 6,000 members from around the world, one-third of them students. During his one-year term, Ivie plans to focus on mentorship and increasing the number of students who go on to participate as young professionals. He will deal with staff downsizing and a massive reorganization within the society. Ivie is responsible for the annual meeting, which will be held Nov. 6-9 in Fort Lauderdale, Fla. The meeting will focus on the effect entomologists have on hunger, health, biodiversity and the environment. In keeping with the effort to attract more young professionals, this will be the first tie-free annual meeting in 30 years.

Biofilm scientist named to National Research Council group

Anne Camper, Center for Biofilm Engineering, was named to the Water Science and Technology Board Committee on Public Water Supply Distribution Systems: Assessing and Reducing Risks, organized by the National Research Council of the National Academies of Science and Engineering. The committee's duties over the next two years will be to investigate issues associated with public health risks that may be associated with drinking-water distribution systems. An associate professor in civil engineering, Camper also is an adjunct associate professor of microbiology and an associate dean in the College of Engineering. She studies the biological treatment of drinking water and microbial regrowth in drinking-water distribution systems.

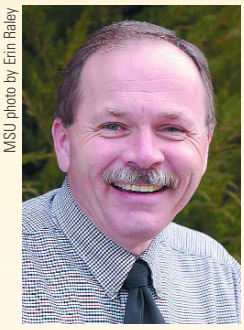
Anne Camper.

Photo courtesy of James Meyer

New Fulbright Scholar helps Croatian farmers recover from war

Croatian farmers have been coming to MSU since 1998 to learn how to set up agricultural cooperatives. Now **Marty Frick**, associate professor of agricultural education, will spend six months in Croatia. The 2004-2005 Fulbright Scholar, who has been to Croatia before and is trying to help the country recover from its 1991-1995 war with Serbia, will teach cooperative business courses at the University of Zagreb. His curriculum—already translated into Croatian and posted on a Web site—explains how to set up western-style cooperatives for meat products, livestock, milk and honey. Frick will be a visiting professor at the University of Osijek in eastern Slavonia, as well. He will also spend half his time conducting research for a how-to book on cooperatives.

MSU photo by Erin Raley



Marty Frick.

Nursing student wins fellowship to study in Russia

Douglas Christensen is taking a semester reprieve from his studies as a junior majoring in nursing to allow a semester-long study abroad experience at the Moscow Academy for Humanities and Arts in Russia. Christensen received a prestigious Benjamin A. Gilman International Scholarship for nearly $5,000 to help with his expenses in his study-abroad experience. Christensen came to MSU after 14 years as a court reporter in Montana, many of those years in Havre. The U.S. Department of State sponsors the Gilman scholarship, which was developed to provide support for students who have not studied abroad before. Christensen is one of 192 Gilman recipients chosen from 1,276 applications.

MSU photo by Carol Flaherty

Douglas Christensen.

Advisor hired to help students consider health professions

Jane Cary is MSU's new health professions advisor. She helps students figure out where their personality and skills would fit in the mosaic of health professions. She also helps them add to their skill mix by choosing additional classes wisely. Whether students dream of becoming a doctor or nurse, a physical therapist or dentist, they need more than intelligence, said Cary, who started at MSU last fall. Jobs related to other people's health require high levels of responsibility, as well as empathy and motivation, Cary said.

Experience in research is a plus when applying to health professions schools. MSU's emphasis on helping undergraduates find work in research labs is a definite advantage in that area, she added.

MSU photo by Erin Raley

Jane Cary.

MSU physicist receives international medal

William Hiscock, head of the physics department at MSU and director of the Montana Space Grant Consortium, received the 2003 Frank J. Malina Astronautics Medal from the International Astronautical Federation. It is the only worldwide award in this field, and Hiscock was the only recipient for 2003. Hiscock received his medal and certificate during the 55th IAF Congress Award Banquet held Oct. 8, 2004 in Vancouver, British Columbia. The award is given to an educator who demonstrates excellence in taking the fullest advantage of the resources available to promote the study of astronautics and related space science. The federation is dedicated to space exploration, development and research in all forms. It has 161 members from 45 countries.

MSU photo by Erin Raley

William Hiscock.

Pink ice holds ancient secrets

Photo courtesy of Brent Christner

Martyn Tranter of Bristol (standing) and Brent Christner of MSU work together to figure the amount of ice Christner needs to cut for a sample.

By Evelyn Boswell, MSU News Service

Two chunks of ice have Montana State University researchers pondering the secrets they'll reveal about life in extreme environments and ancient Greenland.

Pink and containing water that's several hundred million years old, the ice came from the bottom of the Greenland Ice Sheet, almost two miles below the surface of the ice. It arrived at MSU Dec. 1 and was unveiled by Brent Christner, a postdoctoral researcher in MSU's Department of Land Resources and Environmental Sciences.

This map of Greenland shows the source of MSU's pink ice. NGRIP refers to the North Greenland Ice Core Project. The international project is led by Danish scientists.

Map provided by Brent Christner

"I was a little nervous going through customs, but customs was a breeze," Christner told the scientists who gathered in MSU's Cold Regions Laboratory.

Christner flew to Copenhagen last fall to negotiate for samples and bring them home. He carried his samples on the plane in a cardboard box and had the flight attendants store them in a refrigerated cart. He was able to get them back without being x-rayed to ensure that any microbial DNA remained intact. The ice survived a 17-hour flight across the Atlantic Ocean, security checks and custom inspections.

Back at MSU, Christner opened his box in the Cold Regions Laboratory. Then he removed five containers of blue ice—the kind you might use while packing food for a picnic—from around the Greenland ice. Among the MSU researchers watching were internationally renowned scientists John Priscu of the Department of Land Resources and Environmental Sciences and Ed Adams of the civil engineering department.

Adams is known for his research into avalanches and snow, but he has worked with Priscu during four seasons in Antarctica. Priscu is a polar biologist who has studied Antarctic ice for more than 25 years. He was instrumental in getting the National Science Foundation to fly the LC-130 aircraft to Greenland to help the Danes retrieve the ice and having a portion sent to MSU.

"I have only seen it in photos shown to me by Danish scientists," Priscu commented.

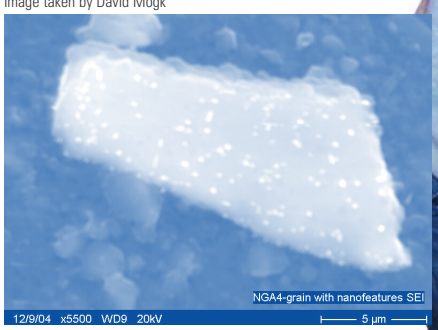
Since the unveiling, the MSU researchers have examined the ice to see how contaminated it became during the freezing process. Scott Busse in the chemistry department used an NMR to check the ice for contaminants. Other MSU researchers involved in geochemical and mineraological analysis include Mark Skidmore and Dave Mogk in the Department of Earth Sciences.

The scientists are especially interested in the measurements that pertain to the biological and chemical makeup of the ice, Christner said. With such information, they may be able to extrapolate to the environment and potential ecosystem in Greenland's subglacial environment.

"At this point, we can't unequivacally say if there's life in these samples, due to the apparent contamination that occurred, but we are not discouraged and still have many options to explore," Christner said.

The MSU researchers did find drilling fluid in their samples; it was not entirely surprising given the nature by which they were obtained, Christner said. It does, however, change somewhat their approach to the ice. To sidestep the effect of the contamination and suspicion about results, the scientists can analyze parameters, such as gases and ion concentrations. Those would not be affected by the presence of drilling fluid.

Image taken by David Mogk



This image, taken by a scanning electron microscope, shows an organic particle within the pink ice MSU received from Greenland. The tiny features on the particle may be small cells.

Brent Christner pulls some ancient ice out of a plastic bag in MSU's Cold Regions Laboratory in Cobleigh Hall. Ice there is generally stored at minus 30.

Photo courtesy of Brent Christner

Tough break leads to new career path

By Annette Trinity-Stevens, MSU News Service

Until she got to sixth grade, Katie Newell, 20, was reasonably sure she wanted to be a biologist like her father, Jay.

MSU photo by Erin Raley

But one day during hunting season she crossed the highway near Lavina, Mont., and switched career goals.

Not casually, mind you. She was helping her dad, who works for Montana Fish, Wildlife and Parks, at a game check station when she crossed the road to use a restroom. On her way back a car hit her.

Surgeries on a broken leg ensued and, despite the horror of being struck by more than a ton of moving metal, Newell began to think about medical school.

"I remember being amazed that the doctors were able to do surgery on my knee with an extremely small incision," she said.

Now a junior in biomedical science at Montana State University, Newell hasn't wavered from her goal. As a sophomore she began doing research in a lab on campus to increase her odds of getting into medical school. A year later she's about to become a coauthor on a research paper on developmental biology.

She's thought about the type of medicine she wants to practice—obstetrics, pediatrics or some combination of the two. She's considered where she'll practice—in a rural area like Roundup, Mont, where she grew up. And she's dreamed about using her healing skills for the international relief organization Doctors Without Borders, either before she settles into practice or after she retires.

Described by her research advisor as inquisitive and a hard worker, Newell already has made real contributions to science.

"She's progressed quickly into being independent and able to proceed to the next step on her own," Roger Bradley, an MSU assistant professor of cell biology and neuroscience, said.

Newell has worked with Bradley to learn more about defects that can occur at the embryonic stage of growth. They work with the embryos of African clawed frogs—Xenopus embryos, to be precise—but the work may relate to such birth defects in humans as spina bifida, in which the neural tube doesn't completely close, and anencephaly, a disorder involving incomplete brain or spinal cord development.

"She's progressed quickly into being independent and able to proceed to the next step on her own."

Newell gets paid for her time in the lab during the school year through the Undergraduate Scholars Program and through the Complex Biological Systems program in the summer. Both programs are aimed at giving students hands-on opportunities to apply what they learn in class or to steer their learning in an independent direction.

"A lot of the techniques we've done I've heard about in class but had never done until coming to the lab," Newell said. Overall, she added, the Undergraduate Scholars Program has given her a head start on classroom material.

She'll continue the research this semester, but next year, as a senior, she anticipates being too busy applying to medical schools in the fall and spending time with friends during her final semester at MSU in the spring to spend much time in the lab.

Despite the broken leg that changed her career goals, Newell runs between six and seven miles a day, even when the temperatures in Bozeman recently plunged to below zero. She also backpacks and skis a little, but her real free-time pleasure is reading. Saturday nights she's likely to be engrossed in a book, which is the lifestyle, she laughs, of a "dork." Right now she's reading "Stiff," which chronicles the use of cadavers throughout history.

"To not get caught up in what everyone else is doing" would be her advice to other students, she said. "Do what you want to be doing."