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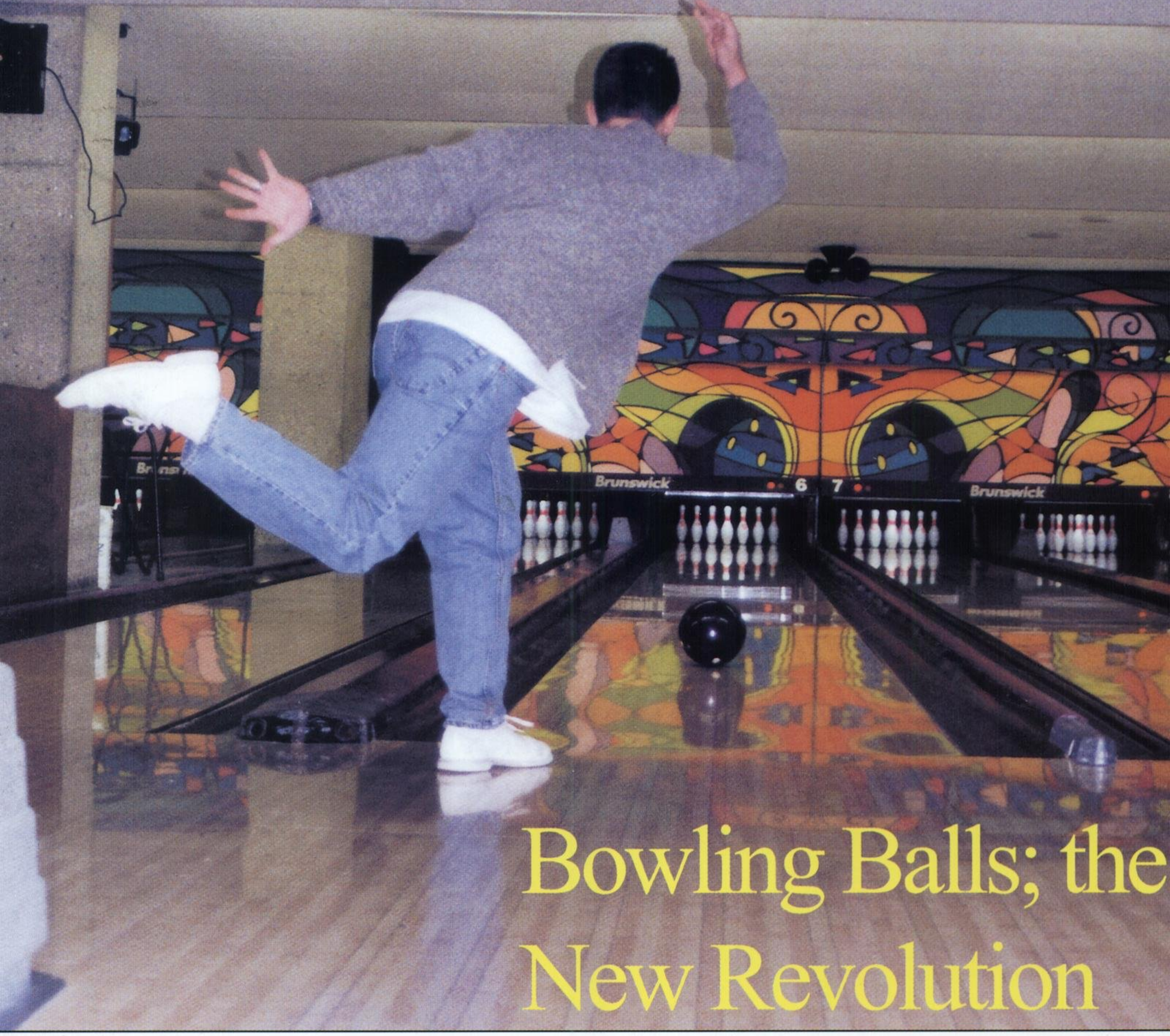
WISCONSIN ENGINEER



Bowling Balls; the New Revolution

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WISCONSIN ENGINEER

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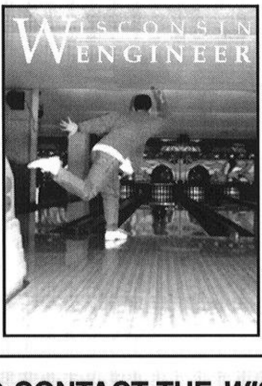
FEATURES



On the Cover:

Rolling to perfection with a hook to reach that perfect game. Find out a little about the engineering behind the bowling ball and the seemingly unreachable 300 game.

DEPARTMENTS

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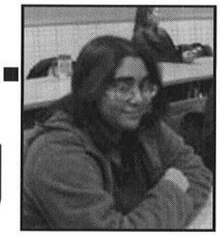
One Last Hurrah... but Still Rambling



Soma: Have you heard of the new Buddhist hamburger stand?
Kari: No, I haven't.
S: They'll make you one with everything.
K: Ok … wait, I get it! Soma, you were always full of them, especially at midnight at CAE.
S: Except then I was usually not joking around—you just laughed a lot.
K: We've come a long way, Shorty.
S: You would have never called me that when we first started working together as editors.
K: Yeah, you were just a nerdy engineer until you met me. Ha, ha.
S: I've never been so insulted in my whole life. At least I have a real major.
K: You're just jealous because I can speak without using an acronym for every other word! But on a serious note, we actually complement each other well.
S: Yes, it really helps us along when we're editing articles late at night.
K: I'm sure going to miss those nights. Everything got to be a little too funny. I'm surprised no one in the computer lab has thrown anything at us yet.
S: Two giggling girls aren't exactly common sights at CAE. But even though we laughed a lot, we always got our work done….eventually.
K: But it's all over now—Soma, stop crying!
S: Those are tears of laughter.
K: There have been plenty of those. So, what have we learned from these three semesters?
S: One—never bring popcorn into CAE. Two—the shortcut for a page break in Word is Control + Enter. Three—if I suddenly lost my voice in the middle of a sentence…
K: …I would finish your thought for you. …That was weird. Four—There really are people at CAE at midnight on a Saturday night. How sad.
S: Five—making people do what you want them to do isn't easy.
K: Six—but if they do and end up a better writer, it sure feels good.
S: Wow, so despite the goofy late night sessions, we managed to do our job.
K: Yeah. And I think we did it well, too.
S: Well, I guess this is it. Our last hurrah.
K: I'll miss ya, girl (or anteater—inside joke, ha, ha!).
S: (*I'm going to be a duck!*) I'll miss you, too.

K&S: *Well, goodbye to all our loyal Wisconsin Engineer readers. It's been fun!*

Kari Cox Soma Ghorai

The College of Engineering University of Wisconsin-Madison ECMA ASM UNIVERSITY OF WISCONSIN MADISON

The *Wisconsin Engineer* magazine, a charter member of the Engineering College Magazines Associated, is published by and for engineering students at UW-Madison. Philosophies and opinions expressed in this magazine do not necessarily reflect those of the College of Engineering and its management. All interested students have an equal opportunity to contribute to this publication.
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Sixty Years Strong

By Matt Feirer

With 60 years of forward momentum to its credit, the Engineering Expo has burst into the new millennium. Over the century, many things have changed, the University has grown and the College of Engineering has expanded. One thing has remained constant: the infallible student spirit and determination in putting together the biennial Expo.

In 1912, the University of Wisconsin College of Engineering started a tradition, with a parade, a float and a band, celebrating St. Patrick as their patron saint. In 1923, the Law School started claiming St. Patrick as their patron saint as well. Over the years the rivalries intensified, resulting in a riot in 1938. Finally in 1940, the engineering faculty decided to redirect the energy of the students by holding the first Expo, which has been held biennially ever since.

"Engineering students never let the tradition of excellence die."

Assistant Dean Don Woolston

Decades of Expos have been paved with tradition. As he pulled out his collection of old Expo buttons, Don Woolston, assistant Dean of Pre-Engineering, recalled the one thing that really stands out about Expo is that the "engineering students never let the tradition of excellence die." Turning a 1953 Expo button over in your hand really brings you back in time. What were past Expos like? The campus must have looked so different.

Originally, Expo resembled a science fair. Now, it's a chance for both the student body and industry to show off new innovations. Woolston commented that "industry sees this as a great opportunity…they love Expo as a goldmine in public relations."

Over the years, the Expo has gone from more of a "hard core" engineering festival, to a family wide event. Kids of all ages are involved in events, such as the Bridge Building competition, the Egg Toss competition, the Rocket Rally, the Writing Challenge and the Rube Goldberg Competition.

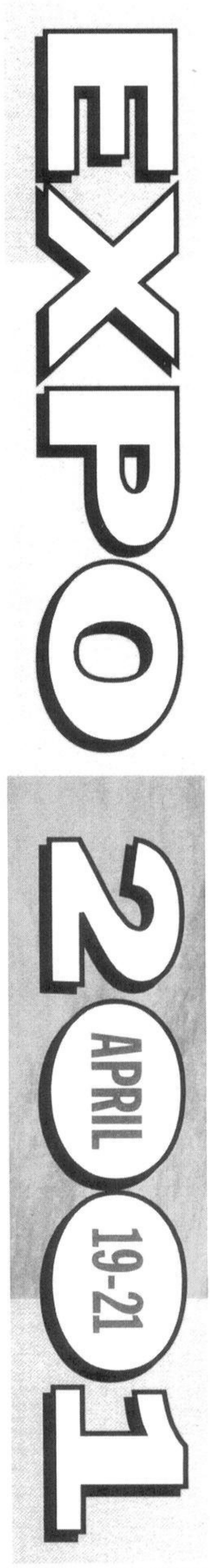
Expo gives student organizations a chance to show off what they have been learning and to incorporate classroom ideas into real projects. There are five different entry fields: individual undergraduate, individual graduate, small group, student organization and special/other entries. These groups are judged by a mix of faculty and industry representatives. The students compete for a total of $12,000 in prizes. Awards are given for the first, second, third and honorable mention exhibits in each category.

This year many of the old favorites will return. Formula SAE will showcase several of their racecars. One will be set up on a virtual lateral display so people can experience how it feels to drive a racecar. The American Society of Civil Engineers will present their concrete canoe and steel bridge. Our own Wisconsin Engineer will set up a maze of UW-Madison engineering history straight from the 105-year-old archives.

Moving into the new millennium will find us enjoying technical marvels unimaginable today. The Expo will be there, year after year, giving the public tiny glimpses into this future bounty. I feel that the Expo will continue its role as an entertainment entity, while still retaining the technical spirit that sprouted out 60 years ago.

Explore all that the Expo has to offer. Learn what you can, but while you're there don't forget to play. Let your imagination and sense of curiosity run free. Enjoy Expo 2001 folks!

Author Bio: Matt Feirer is a freshman with interests in Zoology and Ecology and loves life at the UW.



Mountain Bike Technology: This Ain't No Wal-Mart Bike

By Tamara Larson

As a child I can remember, like most of you, getting that first "cool" bike. We're talking the no-training-wheels, handlebar-braking, gear-changing, "I'll be home for dinner," top-of-the-line department store bike. Be it the purple and pink ten-speed or the black and fluorescent-green mountain bike, the majority of 8 to 12-year olds were the kings and queens of the road. What are these kids riding now? With technology, mountain bikes will never be the same.

Even though the mountain bike has only been around for a little more than 20 years, the many different aspects of mountain bike design are beyond the realm of most of the general public, myself included (an amateur mountain bike competitor). This article will

We're talking the no-training wheels, handle-bar breaking, gear-changing, "I'll be home for dinner," top-of-the-line department store bike

take a brief look into the history of the mountain bike, discuss different frame materials, create a basic understanding for front and rear suspension technology, as well as, look at several different aspects of wheel and pedal design.

HISTORY OF THE MOUNTAIN BIKE

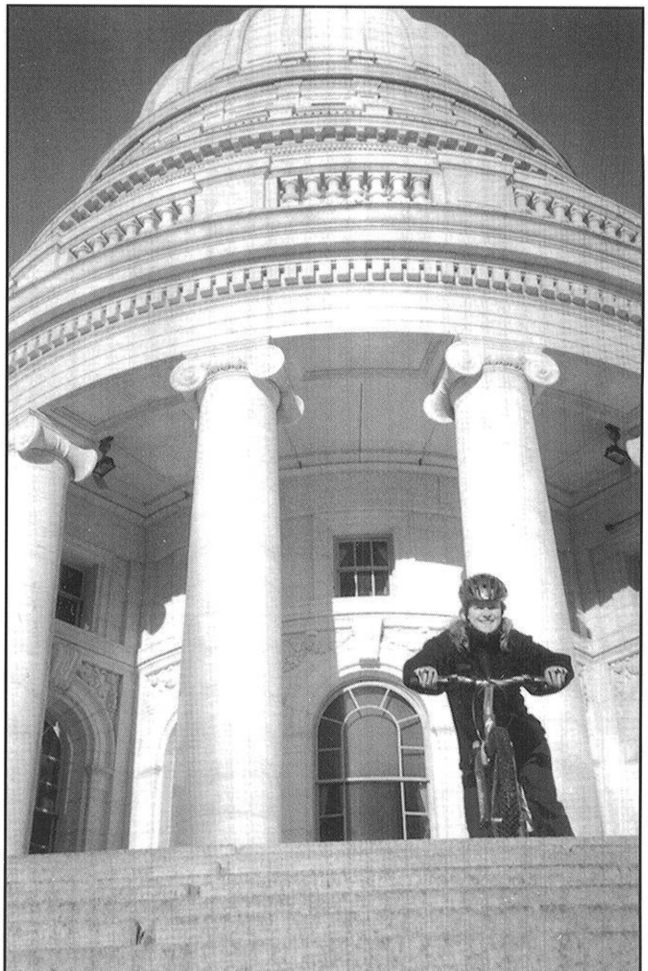
According to the magazine, *Bicycling*, the invention of the mountain bike is the work of four Marin County, California, natives: Gary Fisher, Charlie Kelly, Tom Ritchey and Joe Breeze. The idea originated when the four of them were competing in the West Coast Open cyclocross race in early December 1974. This form of off-road racing was done with bikes consisting of the same skinny tires used for road racing. In the midst of all of the skinny-tired bikes, the four men noticed three other unique competitors riding bikes called ballooners. Although the balloon-tire bikes were great for going down hill, they were only one speed, unlike the cyclocross bikes that had as many as 21 speeds, therefore lacking the necessities for uphill climbing.

According to Breeze, there was something special about the ballooners; "they were outfitted with thumbshift-operated derailleurs and drum brakes operated by motorcycle brake levers." It was then that Fisher, Kelly, Ritchey and Breeze realized that they had just seen, "the prototype for what would evolve into the mountain bike you ride today." From that point on, multiple-speed balloon-tire bikes made the climb uphill almost as fun as the downhill descent. In 1977, Breeze came out with the first multiple produced mountain bike called the Breezer, which sold for $750

FRAMES

Mountain bike technology has come a long way since the first derailleur was placed on a ballooner. For instance, the frame of the mountain bike comes in many different materials. The most readily used materials are steel, chromoly, aluminum, carbon fiber and titanium. According to Darin Schultz of Budget Bicycle Center in Madison, "Frame quality is the most important part in bike design." He said that even when you put great components on a cheap frame, "the bike would perform better, but it would still feel like you're riding a cheap bike." In other words, a smooth ride is one of the most important considerations when riding because it permits longer rides without fatigue, and it allows for better handling in rough terrain, which in turn makes the rider faster and more agile.

Steel frames are most readily used in department store bikes and lower end mountain bikes. Steel is extremely strong and allows for a rigid frame, but can be considered too heavy for most riders. Some riders who prefer the strength of steel, but prefer a lighter



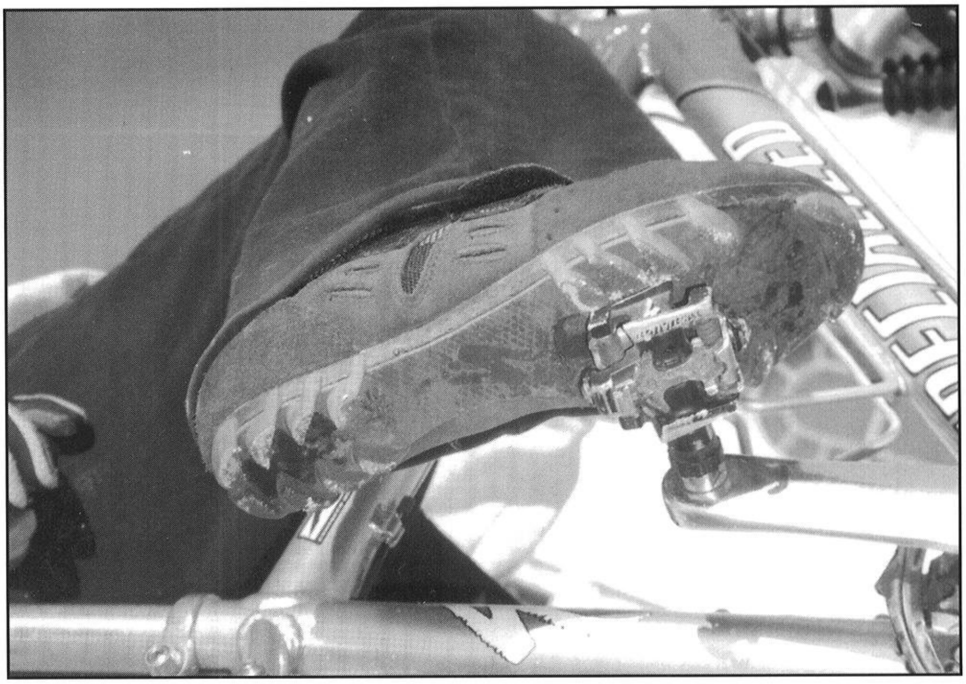
Source: Karen Croysdale

Technical stunts such as riding down these steep stairs can be accomplished with a little experience, a good mountain bike, and a fearless attitude.

bike usually ride a chromoly frame because it is a steel composite used on many dirt bikes that are known for their ability to endure large amounts of physical abuse.

Aluminum is next in line after steel and is the most common material used in bike frames. Its lightweight and efficient frame transfers power straight from the rider to the ground. Most aluminum frames weigh a mere 3 to 4 pounds and can take a pretty good beating from the amateur to expert rider. The cost of just the aluminum frame can range in price from $300 to more than $1,000.

The last two bike frame materials, carbon fiber and titanium, are for those riders who want to shave every last gram of excess weight off their bikes while still having the benefits of a stiff and rigid frame. Only the more experienced riders can appreciate the light, yet strong design that comes along with the extra cost. With technological advancements in carbon fiber, bike manufacturers such as Cannondale, have moved from thermoset carbon fiber to thermoplastic carbon fiber, allowing the frame to weigh as much as a half a pound less than the previous models.



Source: Karen Croysdale

Much more power can be generated during a challenging hill climb with these clipless pedals because it connects the rider to the bike to create a full circular motion when riding.

FRONT SUSPENSION

The main purpose of a front suspension fork is to create a smoother ride for the biker. This is accomplished not only by absorbing the impact from bumps and jumps, but also by dampening the rebounding effect as the spring unloads. The front suspension is part of the fork, and most designs have a shock on either side of the wheel. New innovated designs like the Lefty by Cannondale have strayed away from the standard fork design by placing the entire suspension on the left side of the bike. Most front suspension bikes allow 50 to 75mm, and as much as 100mm, of travel. The travel height can be adjusted to suit the rider's preference depending on the type of terrain that will be traveled. Mountain bikes consisting only of a front suspension are often called hardtails because they do not have a rear suspension system.

"Frame quality is the most important part in bike design"

REAR SUSPENSION

Although rear suspension is similar to front suspension in that it allows for a smoother ride, it also has other important attributes that cannot be found on a hardtail. For instance, rear suspension was first introduced for downhill riding because it eliminated a lot of the jutting forces created in the back of the bike from steep and rugged downhill descents. According to Schultz, mass production of rear suspension bikes began in the early 1990s. Since that time, rear suspensions have become more sophisticated and lighter. There are two different types of suspensions: steel coil and air springs. Both types use oil dampening to control suspension movement, but price differences can be accredited to how easily adjustments can be made.

WHEELS

A bike wheel consists of the tire, the rim, the spokes and the hub. The most important aspect to consider when choosing a wheel is the strength to weight ratio. The lighter the wheel, the less force is required for acceleration and the easier it is to climb those excruciating hills. On the other hand, the amount of abuse the wheel can endure should not be overlooked. Like any part of a bike, cost also increases as the strength to weight ratio increases. An average wheel set can range in price from $250 for aluminum rims to $800+ for ceramic rims.

PEDALS

There are three categories of pedals: platforms, clips and clipless. The platform pedal is the most inexpensive and is recommended for light recreational riding. The next step up from the platform pedals is clips, which resemble cages that encase the toe and the front part of the foot. The most expensive and most effective pedals are called clipless pedals. They are considered a necessity for competitive riders and can only be used with the proper shoes. The bottom of the bike shoe is specially designed to click into the pedal to allow for greater circular power, but at the same time permit easy release. Most riders who switch to clipless pedals have tipped over at least once because they have forgotten to "clip out."

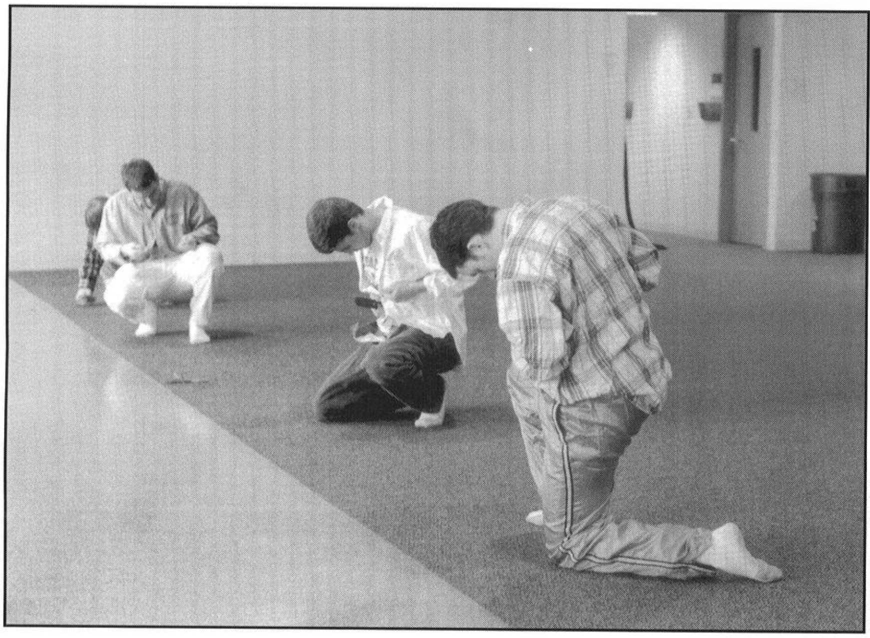
Since the days of the ballooner, mountain bike technology has played a major role in the advocacy of the sport. Advancements have allowed riders the ability to choose what they want in a bike. With mountain biking still in its infancy, there is just as much new technology to be discovered as there are new trails to be dared.

Breeze, Joe. "Who Really Invented the Mountain Bike?" Bicycling. Vol. 37 Issue 3, p60, March 1996.

Olsen, John. "Show Down." Bicycling. Vol. 39 Issue 4, p82, May 1998.

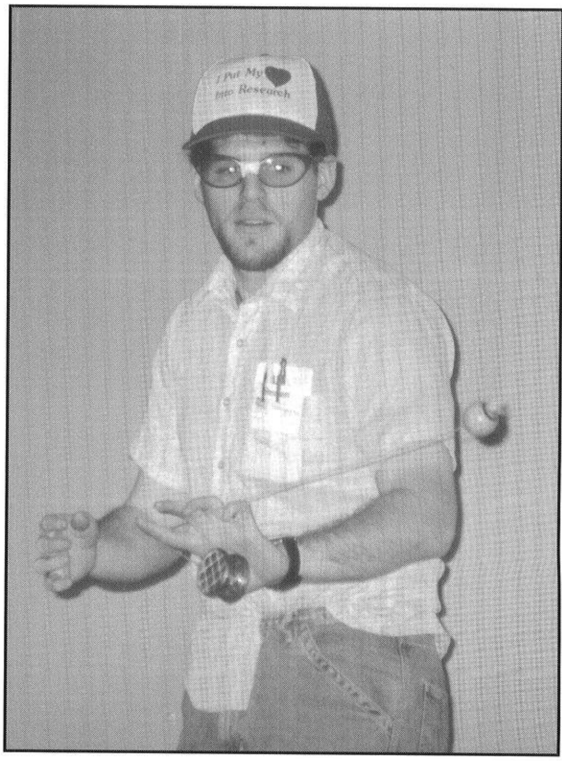
Author Bio: Tamara Larson is a junior majoring in Civil Engineering and Construction Management. In her rookie season at the Wisconsin Off-Road Series, she managed to flip over her handle bars, tumble down a 30-foot hill, get the wind knocked out of her, destroy her back rim, dent the top tube of her aluminum frame, give her mom an ulcer, win a couple medals, get dirty and have fun.

A Picture Perfect E-Week



Source: Renee Weinberger

(Above) Baring all for team spirit, participants stripped wire and clothing for Polygon's stripping relay. People didn't actually strip to their underwear, however, outifits were provided that fit over participants' clothing.



Source: Karen Croysdale

(Above) Chris Mulhall, a yo-yo with a geeky hat, competes for the Road Warriors team in the Mr. Engineer beauty pageant contest. He was a runner-up, but his teammate, Jayda Everett, won the Miss Engineer honor.

Source: Renee Weinberger

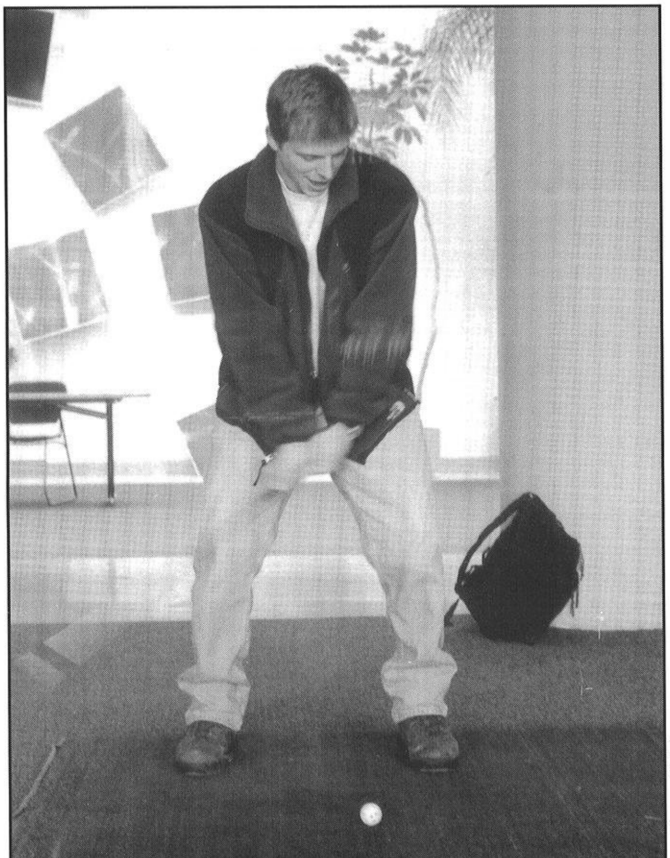
(Left) Lines were long between classes for an opportunity to play Gran Turismo 2 for Playstation on a projection screen. The Road Warriors sponsored this difficult event. Teams were given one point for participation, but the challenge was earning the second point, awarded only to teams that raced the best time in the hour. Conveniently, the Road Warriors won the majority of the best times.

Source: Renee Weinberger

(Above) Road Warriors, Laura Elern, John Schuster and Katie Orgish (from left to right) sing "Baby Got Back" for Biomedical Engineering's Karaoke Night contest. The trio won second place in that contest, helping the Road Warriors win the overall E-Week championship.

Source: Karen Croysdale

(Above Right) Betsy Widmaier from Theta Tau, creatively surrounds her egg in a crash-proof nest to compete in the Egg Drop contest. Her egg survived a fall from a ladder, yet was utterly demolished when dropped from the third floor. Earning all of the points from the Egg Drop contest helped Theta Tau win fifth place overall.



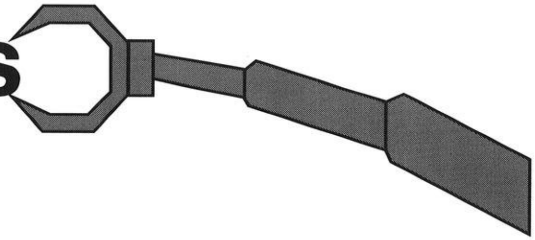
Source: Renee Weinberger

(Below) An engineer clubs a wiffle ball with the hopes of hitting a floating target in ASCE's Pitch and Putt contest. Alas, he missed, but still scored one point for participation.

Source: Karen Croysdale

(Below) Assistant Dean Don Woolston was one of several people to enjoy the benefits of being a target in the Pie Toss contest.

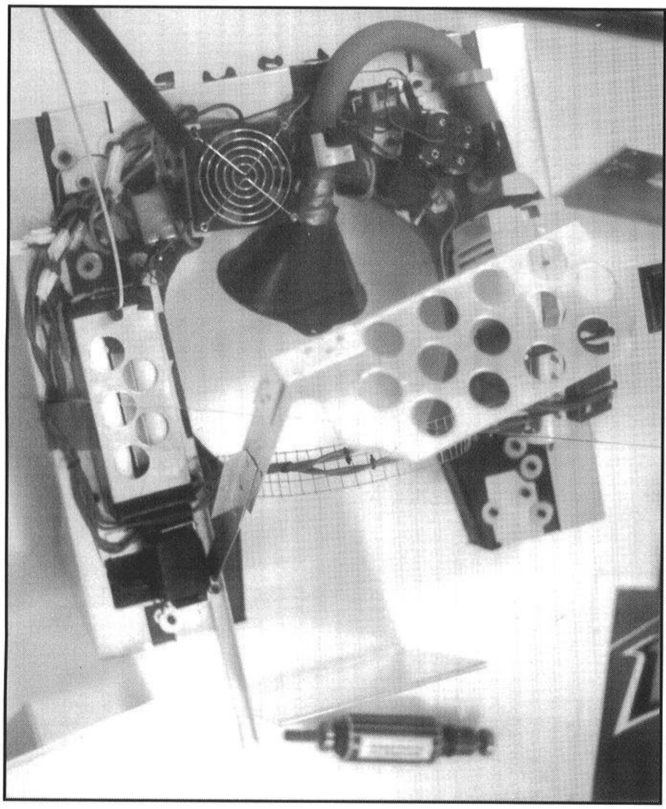
The Usual Robots



By Adam Roth

You may remember reading about "rescue robots" in our November issue and how they may change the future of large-scale rescue operations. They're designed to be cheap, versatile and able to locate and rescue helpless victims—all without putting additional lives in danger. But how do ideas such as these come about? Surprisingly, many are originally designed in robotics competitions around the world.

Since 1995, the University of Wisconsin-Madison has been running its very own robotics competitions at the student-run Engineering Expo. The competition, now called Op Robotics, has always been a huge hit and has brought together countless engineers to battle it out in a test of intelligence and ingenuity.



Source: Renee Weinberger

A usual robot? Unlike last year's robot competition, this year's promises to be more terrain intensive.

Timin Musallam, a senior in Mechanical Engineering, is chair of the competition being held at Expo 2001. He has dedicated much of his own time and effort to working with the teams and sponsors of this year's Op Robotics event.

The upcoming competition will have two separate events. One of the events, the Security Patrol Competition, is based around the idea of the rescue robots. In this event, robots will have to automatically navigate their way around a course while turning off light bulbs that represent victims. Creating a robot that can turn off a light bulb is easy, as simply touching the bulb will do, but creating a robot that can find the light bulbs is truly challenging.

The other competition will be Terrain Explorers, a sort of rover exploration event. You may remember the Mars rover, Sojourner, which traversed the rocky terrain of the Red Planet while collecting and analyzing rock samples in 1997. The Op Robotics team wants to recreate this type of environment. The event will be run here on campus on a local volleyball court made up to resemble rocky Mars terrain. Tennis balls will then be randomly placed around the court. The objective will be to design a robot that can go out and collect as many balls as possible in the time allotted and return. The contest aims to simulate real-life Mars exploration conditions by requiring the teams to control their robots from an enclosed location away from the court, using radio controlled motors and onboard cameras--just like the scientists at NASA.

Musallam is anticipating that at least 10 teams from the area will apply, including students, classes and high schools. The teams, ranging anywhere from 40 people to a person working alone, will each submit one robot per competition to compete with all the other teams. They hope that other universities across the nation will come to compete as well. Purdue University just ran an event similar to the Security Patrol competition, and the Op Robotics team is hoping that many of the teams that built robots for that will come to compete here.

Creating a robot that can turn off a light bulb is easy, but creating a robot that can find the light bulbs is truly challenging

Aside from being judged on their robot's performance, each team will also be given a score based on design. Professors and people in the industry will judge the robots based on how they look, how creative they are and their overall design. Cash prizes then will be awarded to the top teams.

In addition to the two competitions, one of the most exciting features of Op Robotics is an interactive event called Op Robotics Challenge in the Mechanical Engineering building. People can come in and see interactive displays, real robots doing tasks, presentations and even get a chance to speak with some of the experts. They want people to be able to enter the building and get a good idea of what robotics is like.

National Instruments, the sponsor of the competition, is doing a great job of providing the support and funds that the competition needs. They're working hard to provide technical support, and if a team needs a part, it merely has to submit an order form and

National Instruments will see what they can do.

If you would like to participate in future Op Robotics competitions, it's as easy as going to the web page and filling out the application. There are plenty of resources available for help, and the more people there are, the more fun it will be for everyone. Musallam says they're trying make the competition better every Expo, one step at a time. He thinks that maybe some day there will be a Big Ten championship.

For more information, visit these web sites:
Op Robotics: *http://www.cae.wisc.edu/~expo/op_robotics/op_home.htm*
National Instruments: *http://www.ni.com*

Author Bio: Adam Roth is a second-year student majoring in Chemical Engineering and Japanese. He hopes to get involved in robotics in the future and will be studying in Japan next year. This is his first article.

Source: Renee Weinberger

IEEE robotics team members Matt Starzewski, John Griesbach, Baron Reznik, Zander Krahn, Greg Hummel, Paul Zeman, Justin Konkle, Brandon Ripley, Timin Musallam, Nick Vandehey and Jesse Gunkel plan the robot course.

Marching In Time at Camp Randall

The west side featured in this photo may be renovated to include 32 suites, 900 club seats, and a four story athletic office building.

The "Bud Song" and Camp Randall

In 1979, Badger fans in the upper deck of the stadium noticed that the deck vibrated when the band played the "Bud Song". Alarmed, since collapse of the upper deck would be tragic, engineering experts investigated the cause of the vibrations and found that sympathetic vibrations caused it. Sympathetic vibrations occur when vibrations in one object are transferred to another object. The frequency at which an object vibrates due to sympathetic vibrations is called the fundamental frequency. The experts found that the fundamental frequency of the upper deck is 2.3 Hertz, which also happened to be the beat of the "Bud Song". So when the fans stomped in time with the song, the deck absorbed the energy through sympathetic vibrations. Next, the experts found that the deck moved only 1/10 of an inch and that it moved as one mass, which meant that there was no danger of it crashing down. Just to soothe the more queasy fans, however, the "Bud Song" is no longer played in Camp Randall.

By Jessica Shoemaker

The crowd roars with excitement and enthusiasm as the Badgers score a victory once again. The color red overloads the senses like being lost in the middle of a poppy field, while the noise overloads the ears to the point of deafening. Saturday Badger home games are like holidays in Madison, with shouting and routing during the afternoon and partying all night after the victory. The theme of two teams warring against one another is not a new theme to Camp Randall. Camp Randall has a long and proud history, a famous present and a hopeful and confident future.

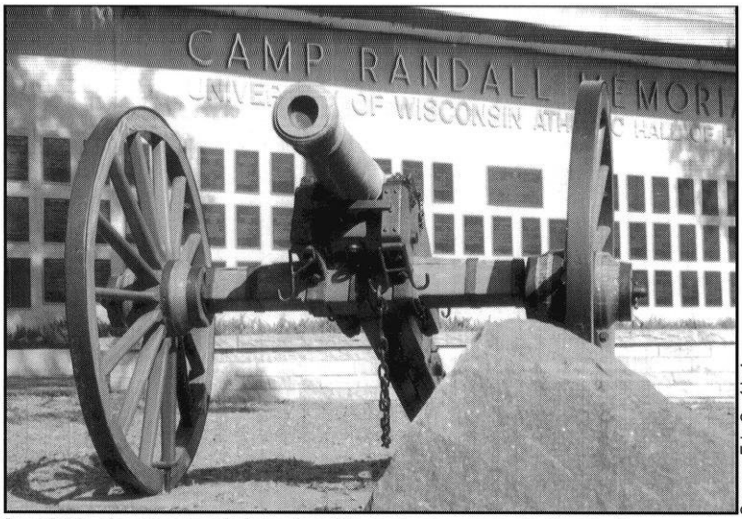
War-like competition at Camp Randall goes back almost 140 years to the Civil War. At that time, the Wisconsin Agricultural Society owned the 50 acres that today is Camp Randall and used it for the early state fairs and a racetrack. The Wisconsin Agricultural Society donated the land to the state for the training of Civil War troops. The grounds were named Camp Randall, after the governor of the time, Alexander W. Randall. Throughout the Civil War, 70,000 or about 76.6% of Wisconsin's troops were trained at Camp Randall.

In 1893, after the veterans petitioned against the land being plotted and sold for business development, Camp Randall was presented to the University and used for athletics like track-and-field and later for baseball and football. The football stadium, built over the old fairgrounds in the northeast corner of the Camp Randall grounds, was used for the first time in the fall of 1895 when the Badgers defeated the University of Minnesota Gophers 6-0. The capacity of the first stadium, 3,000 people, sat on wooden bleachers, and the grandstand had rooms underneath for lockers, showers and toilets.

In 1911, the Camp Randall Memorial Arch was constructed. Two years later, the land east of the entrance became a memorial park, and the canons were mounted. Troops did not leave Camp Randall for once again it quartered soldiers during World War I and was used to train the WAVES, Women Accepted for Volunteer Emergency Service, during World War II.

In the fall of 1914, the entire bleacher section was condemned and torn down. The university rented temporary bleachers for the east, north and west sides of the field. Though the athletic department was only granted half of their desired $40,000 for a new stadium, work started anyway in mid-1915, but weather and problems delayed construction.

November 20, 1915, was an unforgettable day in the history of Camp Randall. This homecoming game against the University of Minnesota was attended by 15,000 dedicated fans. About a minute into the second quar-



Source: Erin Seyfried

In 1913, the memorial park with canons was dedicated.

ter, a loud cracking sound was heard near the west bleachers, and within seconds, three 100-foot sections collapsed, spilling 1,800 people on the ground. Despite this disaster, hardly any serious injuries ensued, and the game was only interrupted for 15 minutes. In response to the accident, legislation granted another $20,000, and donations totaling $2,300 poured in.

The new stadium, built on the east side of a 40-foot hill that sloped away from Breese Terrace, was ready for use for the opening home game of 1917, but the official dedication of the new stadium wasn't until the homecoming game against the University of Minnesota in front of 10,000 fans, a sold-out stadium.

Expansions on the new stadium continued through the next 47 years. The legislation of 1917 granted the athletic department $10,000 for further expansions. The grandstand of the old stadium was moved to the east side of the new field, which added 3,000 seats. In 1921, 4,000 seats were added toward the 7,500-seat project which was completed in seven years.

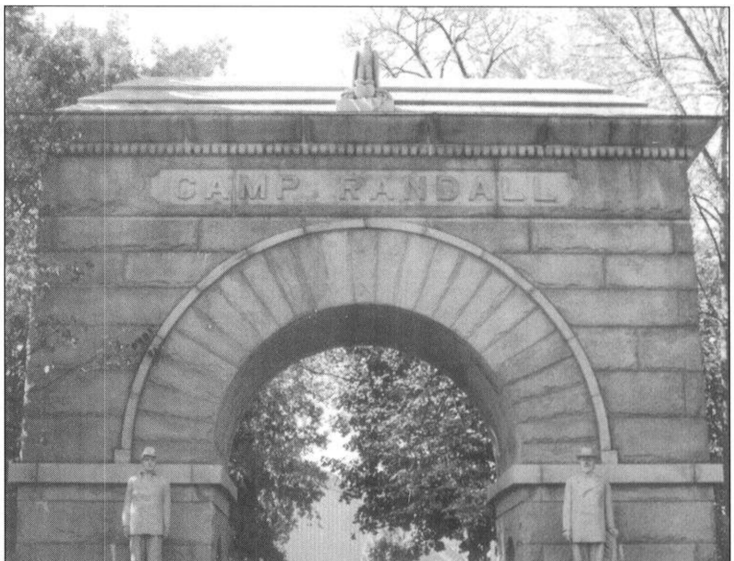
By 1940, an addition was built that completed the bowl-shaped stadium, raising the capacity to 45,000. In November of that year, 7,500 seats were added to the east side of the field, and dormitories were built underneath for students and military personal. In 1951, the dormitories were closed and converted into offices for the Extension Department in 1954.

In May 1950, the north-end bleachers were raised, and all temporary bleaches were replaced with permanent concrete ones. This addition cost $569,000 but still kept Camp Randall as one of the smallest college stadiums in the Big 10 Conference. Starting in 1957, a new construction project, costing $480,000, added 10,000 seats by lowering the field and removing the running track. By July 1958, the expansion was nearing its last stage, raising the total capacity to 63,710.

Then in the early 1960s, the athletic department decided to expand upwards by adding a second deck to the west side of the field and a two-story press box. Completed in 1965, the project raised the total capacity of 75,935, which has not changed until now.

Recently, the athletic department designed a renovation plan with the assistance of an architect. They plan on renovating all the way down to the infrastructure, since that has not been changed since built in 1917. A few of the problems that brought about this decision for expansion are overcrowding of the exits and entrances, restroom capacity and quality, concession stand availability, complaints for more seats and the condition of the infrastructure.

The proposed renovation plan includes expanding the east and west side concourses, building three levels of 32 suites and 900 club seats, closing the southeast corner for the addition of more seats, constructing a four-story office building for the athletic department, adding a new score board, sound system, and permanent lights, and creating a food service building and loading dock. The plan also includes renovations to the surrounding landscape to make it more aesthetically pleasing.



Source: Erin Seyfried

The arch, constructed in 1911 has had many fans pass underneath.

The total renovation, projected to cost $99.7 million, will be financed by funds coming from the athletic department, Badger Fund annual fund gift-support bonds, private gifts and the state legislation. Despite everything being planned, only the early stages of the renovation plan have been approved. John Finkler, assistant for Capital Projects/External Relations, said that "they are very hopeful and feel confident" that the proposed petition to the state legislation will pass.

The planned date for breaking ground is in December, after the end of the 2001 football season. The athletic department hopes the project will be done for the 2004 season.

It is extremely doubtful that in 1861, the people of Madison would have ever dreamed that their Camp Randall would become a nationally known football stadium, worthy of an almost $100 million in renovation, but then, who knows what will become of Camp Randall 140 years from now.

For more information, see the official website of University of Wisconsin Athletics h*ttp://www.uwbadgers.com*

Author Bio: This is Jessica Shoemaker's first time writing for the *Wisconsin Engineer*. She is a junior double majoring in English and French.

Students Help NASA Prepare for Mars Mission

By Matt Gorajski

One day, will Earthlings be mingling with Martians? One of NASA's educational outreach programs may someday make this a reality. These programs include student competitions that are geared towards groups of all ages. This year NASA is hosting a competition between student teams from various universities, including the University of Wisconsin-Madison, to design a MarsPort Cryogenics and Consumables Station (MCCS). The MCCS is a mechanical unit that will be sent to Mars before a manned craft arrives. Its function is to store gases captured from the Martian atmosphere to be ready for the crew's use when they land.

The idea of a manned flight to Mars brings with it a multitude of risks and problems. A one-way trip takes a grueling six months in outer space. In the absence of gravity, bone and muscle atrophy can be severe, and without Earth's protective atmosphere, radiation is so intense that it would be healthier to live in a nuclear reactor for six months. Ion blasts from the sun can send subatomic particles crashing through the bodies of astronauts at enormous speeds, and a single critical mechanical failure can mean doom for astronauts millions of miles from home. Despite

The ISRU plant will gather useful gases from the thin Martian atmosphere. The MCCS will liquefy these gases and store them until the manned craft arrives

the dangers, NASA has not given up the dream of a man walking on Mars and is actively preparing for a mission. Although NASA has no formal plans, a trip is projected for some time in the next decade.

One important issue that NASA needs to tackle in planning a long-term flight is supplies for six months. This multitude of heavy supplies costs a lot to get into orbit. On average, getting one pound into orbit costs several thousand dollars. To overcome this handicap, a year and a half before a manned spacecraft leaves Earth for Mars, a special unit, called the In Situ Resource Utilization (ISRU) plant, will be sent to the red planet, along with two additional units, the Mars Ascent Vehicle (MAV) and the Earth Return Vehicle (ERV).

Designed to drastically reduce the mass of a flight to Mars, the ISRU plant will gather useful gases from the thin Martian atmosphere (composed mainly of carbon dioxide at a pressure about equal to that at 33,000 feet on Earth), which the MCCS will liquefy and store until the manned craft arrives. Along with a large supply of hydrogen brought from Earth, the ISRU reactor will convert the carbon dioxide it collects into water, oxygen and methane. The methane and oxygen will be used as rocket fuel for the MAV, and the water and oxygen will serve as back-up supplies for the expected crew. In addition, the unit will capture buffer gases, such as argon and nitrogen, to be used with oxygen for breathing and for purposes such as pneumatic tools.

Each team working on the project consists of five students and a faculty advisor. Their objective is to create a theoretical design for an MCCS unit (meaning that they don't actually build a model). As one might expect, the unit is to be as energy- and mass-efficient as possible. The MCCS must be able to function without maintenance for 18 months.

Wisconsin Engineer interviewed Stephanie Diem on her participation in the program:

WE: How did you find out about the competition?
SD: Professor [Gil] Emmert, the Chair of the Engineering Physics department, sent out an email to everyone in the department describing it.
WE: About how many hours a week do you spend on the project?
SD: We have to attend two one-hour classes per week, plus I spend a few hours outside class on research each week. We also had to prepare a 40-page final report. A team website is in progress, and we have to complete a community outreach program aimed at contributing our knowledge gained from this experience to students, faculty and the general public. We will be touring grade schools and high schools. Thirty percent of our evaluation is based on our outreach program, so it is a major aspect of the project.
WE: What are your roles as students in the project?

Source: Matt Gorajski

UW-Madison engineering students are working with NASA to design the MarsPort Cryogenics and Consumables Station (MCCS).

SD: Since our advisor, Professor [John] Pfotenhauer, is an expert in cryogenics, he gave us an idea of a basic plan and information on where we could find answers to potential questions. We took it from there.

WE: What has been the most difficult part of the project for you?

SD: The most difficult part has been coming up with the right questions to ask and then getting them answered. We've had to sort through the 500-page NASA document describing the mission for guidelines. Then, once we had our questions, it was difficult to get them answered. Our resources include libraries, of course, but NASA and companies that work with NASA also have valuable information that we need. Getting replies to emails sent to NASA was problematic, and many times the red tape from companies was an obstruction.

WE: Do you get paid for your work?

SD: Yes; for completing the project, each group gets $2,000, and any team recognized for "exemplary accomplishments" receives an extra $500.

WE: Who are your other group members?

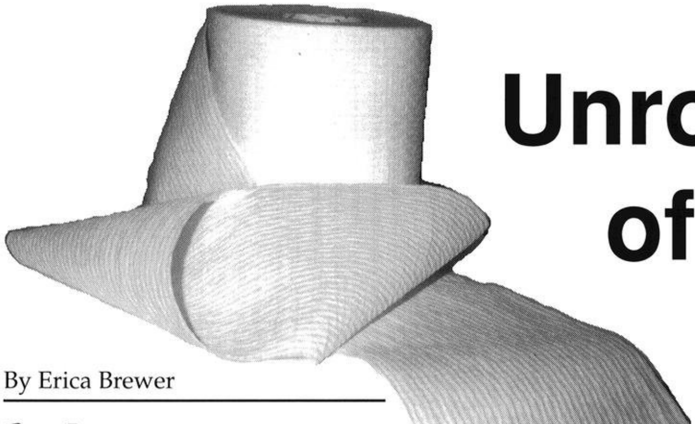
SD: Anders Brown, Christopher Orsina and Robert Slowinski. Professor Pfotenhauer is our faculty advisor, and Jong Baik and Robert Duckworth are graduate students that also contributed to the project.

WE: How is your group doing?

SD: We have been selected as one of the six competition finalist teams, and in May we will be going to the Kennedy Space Center in Florida to present our report and attend a forum on exploratory missions to Mars.

At the May conference in Florida, NASA plans to incorporate the teams' innovations from their work into their own leading design concepts for the MCCS. Visit the UW-Madison student team's exhibit at Expo and their website at *http://www.cae.wisc.edu/~aiaa/projects/marsport/marsport.html*.

Author Bio: Matt Gorajski is a sophomore in Engineering Mechanics and Astronautics. This is his first article for *Wisconsin Engineer*. One day he will design the propulsion systems to take the MCCS to Mars.



Unrolling the Future of Toilet Paper

By Erica Brewer

You had better not come back from the store without it, or your roommates will be mad. Toilet paper is right there on the list along with the usual milk and bread. While you may be opting to pay for sandpaper instead of quilted softness, you might want to reconsider that dry toilet paper in your shopping cart.

Kimberly-Clark Corporation has found a new spin to toilet paper on a roll. They have added moisture and a new dispenser to a product that hasn't had an innovation like this since the 1890s.

After three years of development, the Cottonelle Rollwipes should be ready for consumers by the upcoming summer in the northeast and southeast parts of the U.S.

The concept of moist toilet paper on a roll came after the company looked at responses from a consumer survey, said Linda Kwong, representative for Kimberly-Clark at Brouillard Communications. "Sixty-three percent of respondents in a Kimberly-Clark survey have used a moist cleansing method after toileting, and one out of four use a moist cleansing method on a daily basis."

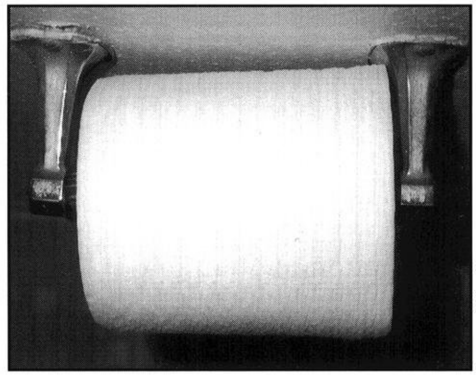
With those statistics in mind, Kimberly-Clark designed a dispenser that provides consumers with both a conventional roll of toilet paper and the new moist roll. The moistened rolls of toilet paper are kept in an enclosed dispenser at the top, as it attaches to dry toilet paper from a spindle below. No major installments are involved, just the initial cost, which is an estimated $8.99 for the dispenser and four rolls of toilet paper. Replacement rolls will cost an estimated $3.99 for a four-pack.

With all the excitement of moist toilet paper on a roll, some skeptics questioned the downfall of the toilet tissue. One concern was how safe the material is that actually moistens the rolls. According to Kwong, the solution is mostly water.

"The moist solution is over 90% water. Other ingredients include a water dispersible strength stabilizer to hold the sheet together and give it strength," said Kwong.

Kwong also said that the moistened toilet paper has a fragrance. "In consumer tests and in home trials, consumers liked the freshness of the scent," she said.

Another question with the new moist toilet paper was how it would effect septic and sewer systems. In order to prevent any problems, Kimberly-Clark Corporation has implemented a new patent-pending technology to prevent septic and sewer problems. "Rollwipes are fully dispersible. This patent-pending technique causes the product to break up in water like dry toilet tissue, making it safe for sewer and septic systems," said Kwong.

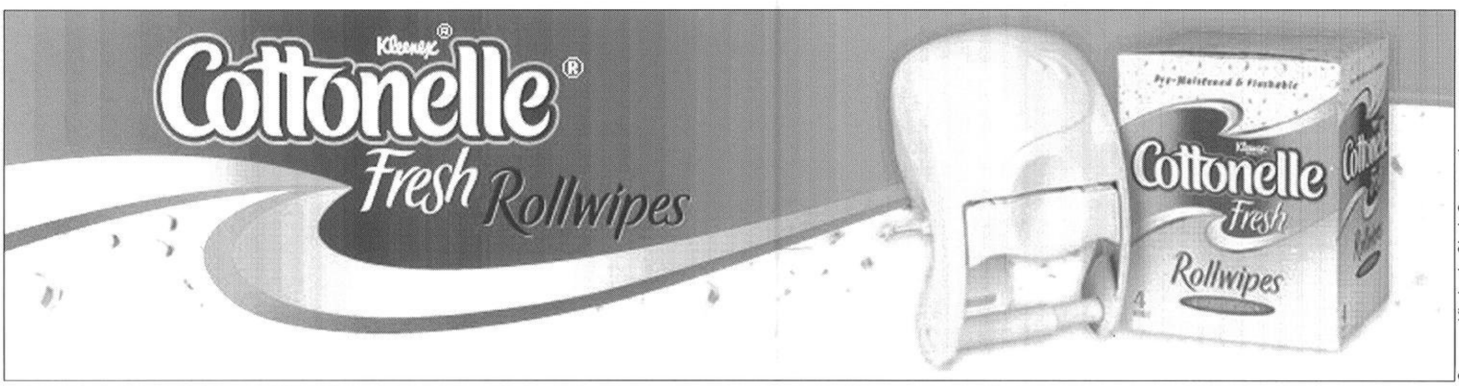


Source: Erica Brewer

Before the 1890s, toilet paper came in square sheets in a box, unlike the rolled toilet paper above.

While the toilet tissue can break up in water, Kimberly-Clark Corporation hopes that the unrolling of their latest product will break their competitor's position in the $4.8 billion toilet paper market of the U.S. Your roommates just might appreciate the new Rollwipes compared to the cheap stuff you buy.

Author Bio: Erica is a Family and Consumer Journalism major, Communication Arts major and is working to complete her Technical Communication Certificate.



Source: Kimberly Clark Corporation

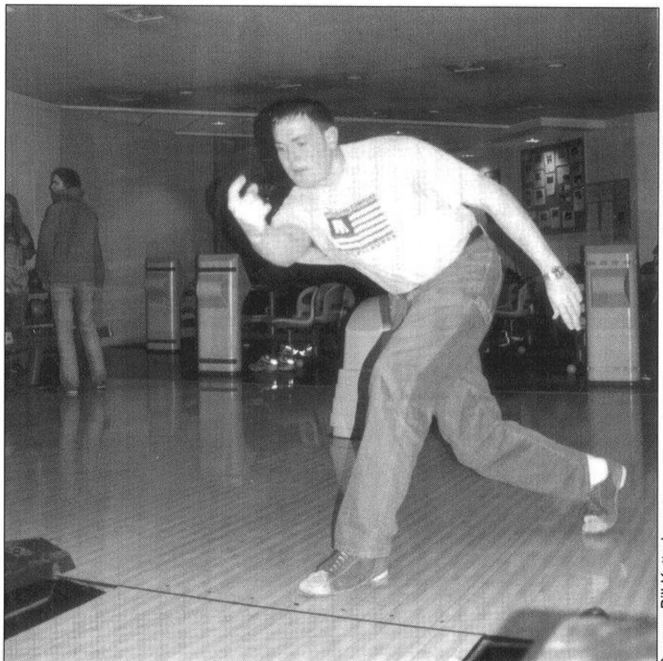
Cottonelle Rollwipes will be hitting the retail shelves this summer.

Bowling: Not Just a Sport, But a Science.

By Jackie Polzin

To bowl or not to bowl? The fundamental question in the search for ultimate recreation. Don't linger over the details of this question for too long. Bowling is fun, inexpensive, provides an excellent forum for quality human interaction and allows for fashion liberties not thoroughly explored since the mid-1960s. Besides, what other sport encourages the consumption of alcohol on the playing field? Having answered the fundamental question posed, a more serious matter presents itself--what to bowl with.

A ball, you say. And you would be right. But bowling balls today are a marvel of the scientific world. Finding the best ball is as difficult as finding that special someone, though at least bowling balls come in the same shape and size. As you've always been told, it's what's under the surface that counts. And yes, they are worth spending a little more of your pocket cash on to obtain.



Source: Bill Ketterhagen

New bowling ball advancements can help the average bowler improve their score.

Decades ago, rubber was the primary material used in the manufacturing of bowling balls. It served its purpose of a) rolling, and b) providing the traction needed on the lane to throw an effective hook ball. For all of the bowling amateurs or non-bowlers out there, the hook ball is the key to increasing your bowling average to a competitive level. Plastic soon overtook the rubber balls because it allowed for more versatility in manufacturing and is cheaper as a raw material.

...bowling balls today are a marvel of the scientific world

Urethane balls and resin have both had their moment in the spotlight as the avid bowler's choice, but like anything in life, improvements simply pave the way for more improvements. Such is the history of the bowling ball. If you consider materials science of bowling a trivial matter, there are Ph.D.s working with Columbia 300, Brunswick and other bowling ball manufacturers that would readily disagree. Bowling is a billion-dollar enterprise and much of it is up for grabs.

The latest in bowling ball innovation is particle technology. Bits of mica, pigment, glass or other solid materials are mixed into the coating material. It adds traction to the surface of the ball, much like snow tire cleats. This allows for a great hook shot even on the oiliest of lane conditions. Lanes are regularly oiled, but the amount of oil is subject to change, even within a game. A ball that performs consistently throughout changes in the lane conditions will prevail in the quest for the ultimate bowling ball.

With all the improvements made in bowling balls in recent years, average bowling scores have increased. The perfect game of 300 is not the historical landmark it once was, though a bowler of my status would still wet her pants on the occasion. As average bowling scores continue to increase, there is talk of making the game more difficult to bring scores back down to the par of days past. It is possible that the bowling ball of the future will be a ball of disadvantage.

Along those lines, Ebonite manufacturing company has focused their latest line of bowling balls on looks as opposed to function. Yes, the ball still rolls. It just bears an original design, such as the giant billiard ball collection, various sport ball imitations and even one model containing a boxing glove imbedded in the core of a transparent ball. For all you hell-raisers out there, the skull model has recently made its debut. It is only a matter of time before Britney and the boy bands are dueling head to head for the designer bowling ball market.

Right here on campus, Union South plays its part in keeping our bowling facilities up to the changing times. However, if you are looking for designer balls, you had better bring your own.

Bill Woehrle's bowling classes are as popular as ever. In his 16 years instructing bowling, he's witnessed most of these changes firsthand. While technology has changed the face of the game, it hasn't interfered with his work of building bowling champions. He will be the first to agree that the person who lands the newest bowling ball innovation will have spent their time wisely. So, get to it. As for the shoes, don't bother. They are still as cute as ever.

Author Bio: Jackie is a senior at UW-Madison, majoring in English. She is currently in training to master her hook shot and to improve her bowling average under the instruction of Bill Woehrle.

Holding Back the Great Lakes: A Study of Slope Stability

By Kathryn Wooddell

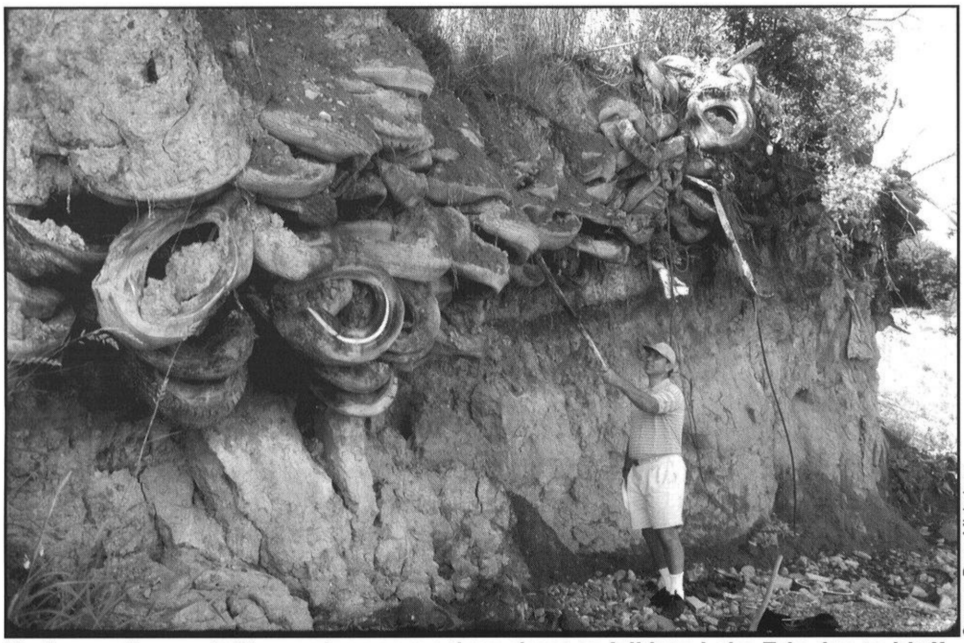
Who has not seen the dramatic accounts of dams bursting, rivers overflowing their banks, and homes being demolished as slope failures and earth flows carry them into the ocean? Episodes such as these give testimony to the power of nature. Through news of the devastating earthquake in India this February, we have been reminded of this awesome power. In many cases, we cannot help feeling completely defenseless when confronted with nature's wrath. As we struggle to decipher her seemingly chaotic behavior, we seek ways to control her temper. In doing so, we come to a humbling realization that in order to tame nature, we must be obedient to her. Not only must we realize that our actions have consequences, but we must also be able to identify these consequences and plan the solutions accordingly.

To play by the rules of nature, one must first learn the rules. For scientists, such as the team of researchers led by Professors Dave Mickelson, Chair of the Geological Engineering Program, Tuncer Edil and Chin Wu, this means gathering quantitative data on the processes leading to bluff and shoreline erosion. Quantitative data will aid in the prediction, and possible prevention, of slope failures on the bluffs lining the shores of the Great Lakes. Thus, the goal of the ongoing shoreline research at the University of Wisconsin-Madison is to develop a model that will accurately predict shoreline recession.

The development of a model that has the power to predict recession along the shoreline is an important step in controlling erosion and shaping land-use management policy. "I hope this research will contribute to land-use decision-making along the shore of Lake Michigan as well as the other Great Lakes," stated Lisa Brown, a former UW-Madison graduate student, in her Masters of Science thesis focusing on the influence of water level, wave climate and weather on costal recession along Lake Michigan.

According to Mickelson, UW-Madison's slope stability research has its roots in the need to develop model ordinances for shoreline development in the Great Lakes region. Funded by the Coastal Management Program in the 1970s, Mickelson and Edil worked to provide the geologic and engineering data necessary to develop setback ordinances. The intent of these ordinances was to keep the construction of homes and other structures at a safe distance from the edge of the bluffs.

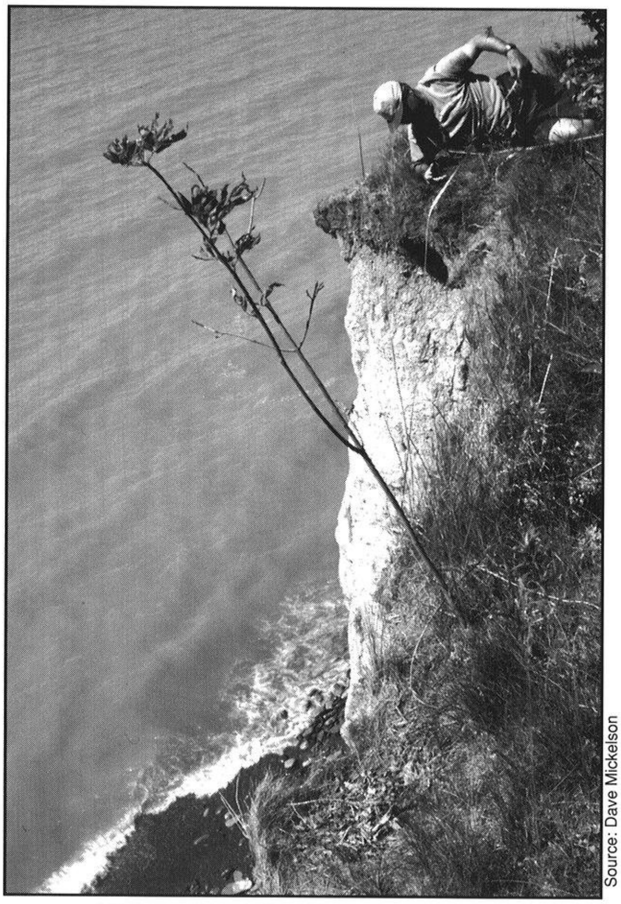
To determine the critical distance, Mickelson and Edil not only had to determine the lake and coastal processes influencing the erosion of the bluffs, but they also had to assign a factor of safety to the slope of the bluff face. A low factor of safety would indicate that the slope of the bluff was not sufficiently sturdy and most likely unsuitable for construction near the bluff's edge. Utilizing the Bishop's Equation for rotational slope analysis and entering measurements from the bluff's slope profiles at various locations, factors of safety were assigned to the bluffs, thus aiding in the development of setback ordinances.


Source: Dave Mickelson

Professor Tuncer Edil examines some tires about to fall into Lake Erie due to bluff failure near Painesville, Ohio.

The work completed by Mickelson and Edil in the 1970s laid the foundation for the continuing slope stability research at UW-Madison. Several graduate students, under the guidance of these professors, have recently made significant contributions to both the slope stability project and the continuing research of processes influencing bluff and shoreline recession.

Lisa Brown's research, for instance, aimed to quantify the relationships influencing bluff erosion for two sites on Lake Michigan. As Mickelson explained, "The role of the project is to provide information about how much sediment comes off the bluff, and how is this amount related to fluctuations in lake level?" To answer this question, Brown studied air photos from the 1950s to the present and documented the amount of bluff retreat relative to lake levels. She found evidence that led her to conclude that there exists a correlation between periods of high lake



This bluff is one of many being studied to determine the rates of bluff erosion and slope stability.

level and accelerated rates of erosion, a relationship well known to the residents of the area. Brown, however, was able quantify the relationship.

Taking a strict engineering approach, John Chapman, a former Geological Engineering undergraduate and graduate student of Civil and Environmental Engineering, concentrated on the predictive capabilities of various slope stability methods. He used four different methods of calculating slope failure, one of which was the Bishop's Method used previously by Mickelson and Edil. In his study, Chapman determined the extent of bluff erosion since Mickelson and Edil's initial study in the 1970s. Revisiting the slope profiles from then, he tested various methods of predicting slope failure. The results of his research indicate that a combination of slope analysis techniques yields the best results in terms of predictive capabilities. Specifically, he concluded that a combination of the Bishop's Method and an infinite slope analysis produces the most accurate results.

The topic of slope stability along any shoreline is increasingly important, as the accelerated rate of development along shorelines places countless homes and other structures in danger of needlessly sliding into the water. Because water level fluctuation is episodic, explains Mickelson, low water times may last 10 to 15 years. During these times, funding for slope stability is uncertain, and people tend to forget high lake level times when building on the shoreline. "People's memory of high lake level, erosional events is pretty short—especially when the attraction of a beautiful view entices people to the lake's edge."

Author Bio: Kathryn Wooddell is a junior majoring in Geological Engineering and Geology. She became acquainted with slope stability research by working in Dave Mickelson's Quaternary Lab.

Máquina: The Engineering Machine

By Jeannine Washkuhn

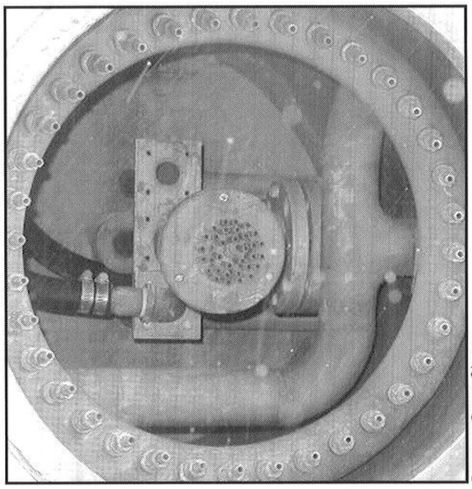
If you are an engineering student, you walk by the Máquina nearly every day between classes. If you are in the Computer-Aided Engineering (CAE) labs, you see the fountain magnificently glowing purple and blue on your login screen. This year, the spiraling steel sculpture is the logo of the biennial Engineering Expo. This grand machine stands proudly as the symbol of the College of Engineering at the University of Wisconsin-Madison.

The stainless steel sculpture, shaped like two calipers (measuring tool commonly used by engineers), is located at the south end of Engineering Mall. William Conrad Severson, 1947 UW-Madison Art graduate, created it in 1994. The main purpose of the fountain was to serve as a continuous project that would enable students to gain hands-on experience and was therefore appropriately named Máquina, or "machine" in Spanish. This year's Engineering Expo is titled "From Concepts to Reality." No other part of the engineering campus can more visibly demonstrate this than Máquina. The dreams and visions for Máquina are becoming reality as each new student project is completed.

Under the fountain lies an operating room where the different spraying patterns and effects are controlled by electrical circuits. Among a network of pipes, four water pumps supply the power that is needed for the entire system. A 20 horsepower (hp) pump supplies power for Máquina, while another 20 hp pump and two 5 hp pumps work to power the north end. The impressive icicles that you may occasionally see suspended from the fountain are intentional. During the colder months, the fountain is operated in "winter mode" and ice formations are often seen when the conditions are right.

There are many fun and interesting ways for students to interact with the fountain. To begin with, there are numerous silver columns lining Engineering Drive outside of Engineering Hall that have motion sensors. When these sensors are activated, the fountain can change its pattern or small jets of water may jump into the air. Wave your hand over one of these and if you look closely, you will be able to see the variation. Next, by going on the Internet and locating a few different web pages, you can watch people walking by on the fountain camera. You can even control Máquina for five minutes. If you have both screens up at once, you can watch the fountain as you control its patterns. Also, a touch screen located in the Information Place in Engineering Hall allows students to control the display of the water. And finally, there are some Electrical and Computer Engineering classes that involve projects to improve the fountain.

Engineering students do not only improve upon Máquina, but also maintain and oper-



Source: Gene Chyou

A close-up view of one of the fountain's many nozzles.

The dreams and visions for Máquina are becoming reality as each new student project is completed

Source:Gene Chyou

Lee Powers explains the electronics behind the spray patterns of the fountain.

ate it. A student organization named The Máquina Project oversees the various maintenance and operational tasks that need to be completed. Kyle Gudmunson and Lee Powers head The Máquina Project team and are recent successors to this important and

By going on the Internet and locating a few different web pages, you can watch people walking by on the fountain camera. You can even control Máquina for five minutes.

enlightening job. They change the fountain into summer or winter mode, clean filters and oversee maintenance and improvement projects.

Our beloved Máquina serves as the hub of the engineering campus and as a gathering spot for students during warmer weather. The next time you are walking by our grand machine, take a minute to reflect on the reality of the dreams and visions of the many people who have contributed to the fountain. Remember that your concepts can also become reality, as have those of many hardworking students before you. And then wave to the camera and watch out for the mist ... because you never know who is taking a break in the computer lab.

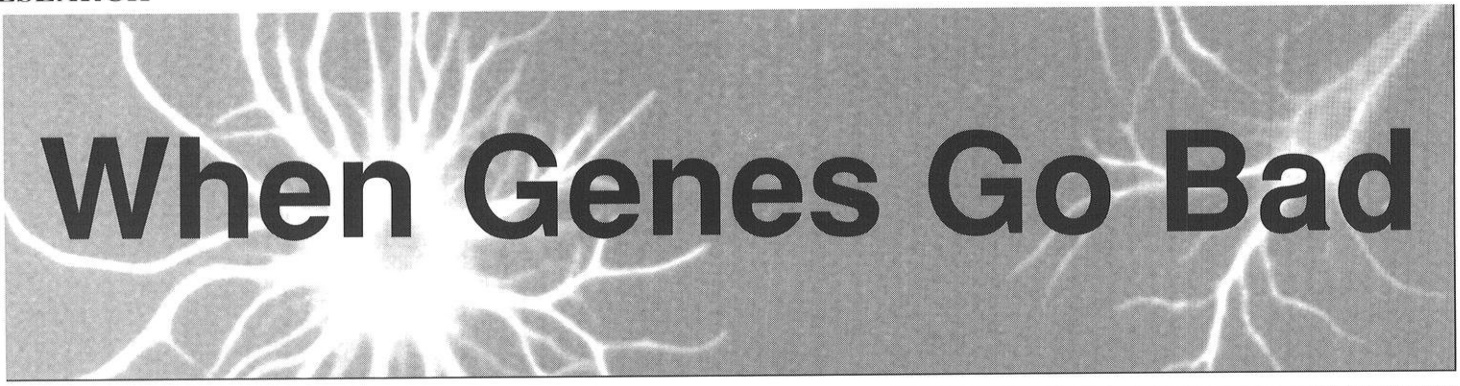
Source: Gene Chyou

An underground passage allows access to the north end of the fountain.

Author Bio: Jeannine would like to thank Kyle Gudmunson and Lee Powers for their help with this article. She is looking forward to the warmer months when she can go online and try to mist her friends walking by Máquina on windy days.

Source: Gene Chyou

Lee Powers and Kyle Gudmunson, leaders of the Máquina project, look up from the fountain's underground.

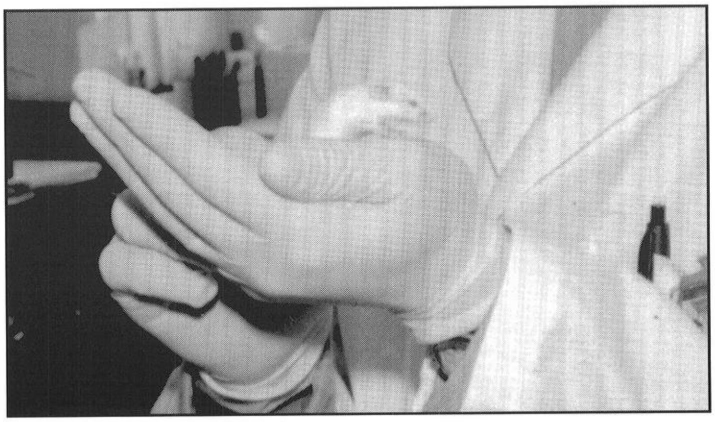


When Genes Go Bad

By Dana Mott

Scientists are slowly but surely unlocking the mystery of the blueprints for life. They are discovering the vast domain of the encoded instructions in genes. Along the way, they have found there can be countless numbers of tiny defects in these genes that dramatically affect the way the body works. Diseases attributed to these defects plague the lives of millions of people around the world.

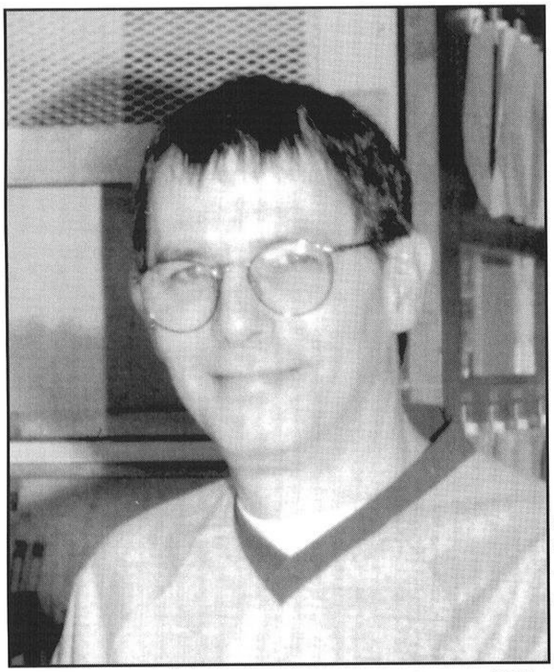
Hard-working scientists continually search for what causes genetic diseases and what can be done to prevent or cure them. Professor Albee Messing, a researcher at the University of Wisconsin-Madison's Waisman Center, is working on a rare genetic disease called Alexander's Disease, a children's disorder in which abnormalities occur in the protective myelin sheaths around nerves. Without healthy myelin, nerves cannot function properly. The disease usually shows up by about six months of age, but some adolescent cases have been reported. Victims can have seizures, spasticity and severe developmental difficulties. Death usually occurs within five or six years, although in juvenile cases the victim may live as long as ten years.



Source: Monica Petrie

A brave mouse in the lab

The characteristic feature, used to diagnose the disease, is the presence of dense clusters of proteins, or Rosenthal fibers, in the brain. An earlier study done by Messing connected Alexander's Disease with another protein made in the brain, glial fibrillary acidic protein (GFAP). GFAP is a major component of astrocytes, cells that help nerves and myelin work properly. In the study, Messing genetically engineered mice to produce excess GFAP. The mice then developed Rosenthal fibers in their brains. Other research of Alexander's Disease patients found that all victims have an abnormality in the gene that produces GFAP, causing the GFAP to be mutated.



Source: Monica Petrie

Professor Albee Messing, a researcher at UW's Waisman Center

With the link made between the disease and GFAP, studies will now focus on the abnormal gene. "I am convinced that it is the abnormal GFAP that starts the whole process," Messing stated. He and his partners will now begin to genetically engineer mice to have an abnormal GFAP gene. Their goal, said Messing, will be to find out whether the mutant GFAP is in the Rosenthal fibers. The researchers will also investigate the immediate effects of the abnormal GFAP to determine whether Rosenthal fibers are a result of the GFAP, or if they are themselves a cause of the disease. Messing said that the team will also research the role of astrocytes in the nervous system.

In all of this research, genetic technology has been key. According to Messing, the most helpful tools have been gene chips. Gene chips are like microscope slides, only they are used to arrange and view genetic material. Gene chips allow a researcher to display thousands of genes side-by-side to compare them.

Where can this technology and research lead? When asked about the future of his research, Messing said that they hope to ultimately find a cure for Alexander's Disease. In addition, information obtained about GFAP and its functions could help researchers learn more about other seizure-causing diseases. The team's study of the role of astrocytes is also important. If scientists learn enough about them, they could find a way to regenerate damaged nerves in the central nervous system. Researchers like Messing could hold the key to restoring a healthy life to Alexander's Disease victims and many others.

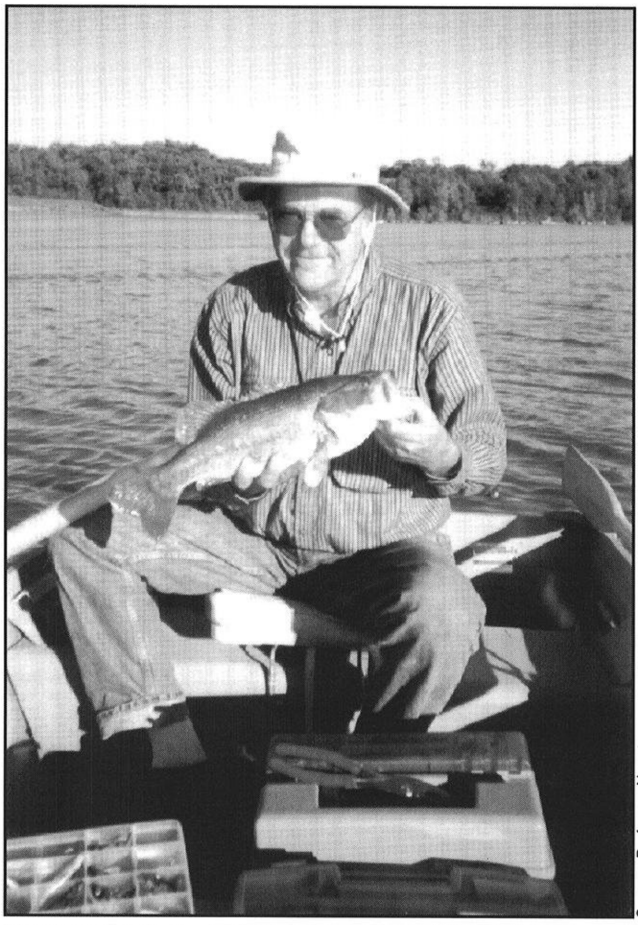
Author Bio: Dana Mott is a sophomore majoring in Chemical Engineering. She enjoys reading, bowling, cooking and cross-country skiing. She lives in the Koinonia House on Orchard Street and has a roommate who makes a killer batch of cream puffs. Yum, yum!

Knowing Novotny

By Curt Challberg

Sixty some years ago in Chicago, the man now titled Professor Emeritus Novotny was born. Approximately two-thirds of the years since then have been spent with the University of Wisconsin-Madison. As the instructor for Electrical and Computer Engineering 230: *Electric Circuit Analysis*, he finds himself in the midst of his 86th semester here.

Growing up in a fairly routine childhood, it became apparent early to Novotny that he was destined to work with electricity. His father had a career repairing motors, and as a boy, Novotny thoroughly enjoyed helping his dad in the shop. This fascination with machines grew, and one day the young boy scared himself and his mother by finding out what happens when a scissors is plugged into a wall outlet. Though frightening, the ball of fire and partially disintegrated tool only increased his amazement. Receiving a shock after putting his finger into a light socket served this same purpose even further. By the time he had reached his junior year in high school, Novotny's experiences and excellence in math and physics had led him to choose Electrical Engineering for a career.



Source: Professor Novotny

Perhaps Professor Novotny will be touring with Babe Winkleman on the professional fishing circuit soon.

Once entering college at the Illinois Institute of Technology, he progressed rapidly through the system, receiving his Masters Degree in five years. After completing his career at Illinois and marrying his high school sweetheart, Novotny's life at Madison began. He spent one year as a full-time student to earn his Ph.D. and two years on research sabbaticals. The rest has been spent as a professor, though he stresses the variety of jobs "professing" can actually entail. His career has included four years acting as chairman for the Electrical Engineering Department, heading research teams for 20 years, writing two books, consulting for outside firms and teaching undergraduate studies. He spent his sabbatical years, 1974, 1981 and 1986, in Holland and Belgium, researching topics including power electronics, AC/DC conversion and energy cost vs. motor design.

Leisurely, Professor Novotny spends his summers in Madison, enjoying the surrounding lakes. He likes spending time with his family and gardening in his backyard where he experiments with native plants. His favorite hobby, though, is fishing. He used to partake in this close to home, but he says that local lakes have become rather crowded, recently. Now he prefers to look for less populated waters and has traveled from Northern Wisconsin to Alaska to do so. Novotny currently is planning a fishing trip to Saskatchewan for the summer.

Though frightening, the ball of fire and partially disintegrated tool only increased his amazement.

When asked about his most interesting or funniest experiences as a college instructor, several things come to Novotny's mind. One memorable moment was the time he gave himself a 120-volt shock and had a laughing student ask him to do it again because he had not seen it. He also likes to tell how, as a young professor, he had to wear a tie to keep from being mistaken as a student.

After all this time, he concluded, "The most interesting thing is, day in and day out, seeing the differences in the way each student learns. How I understand something may seem completely backwards to a listener. I find interaction with young people stimulating and fun. I enjoy coming up with a way to present a subject of difficulty and watching a student understand it. I enjoy teaching very much."

Author Bio: Curt Challberg, a Minnesota native, is an Electrical Engineering junior in his first year at UW-Madison.

Cutting Up the Cheese Process

By Karen Mandl

The stands of Lambeau Field are filled with loyal Packer fans donning their trademark cheeseheads. These cheeseheads have not only become a necessity for Wisconsin football fans, but they have also come to symbolize the importance of cheese in Wisconsin's culture.

In 1910, the State of Wisconsin proudly captured the nation's cheese crown by producing more cheese than New York. The crown stayed here until 1995, when it was passed west to California. During that time, cheese consumption rose to an astonishing 28 pounds per person per year.

The major cheese producer is not the only change to hit the industry. According to Mark Johnson of the Wisconsin Center for Dairy Research at the University of Wisconsin-Madison, the most significant change is that "the process has gone from being done by hand, to being almost entirely automated." The actual process has not been changed, but these technological advances have been the best things for cheese since the cracker.

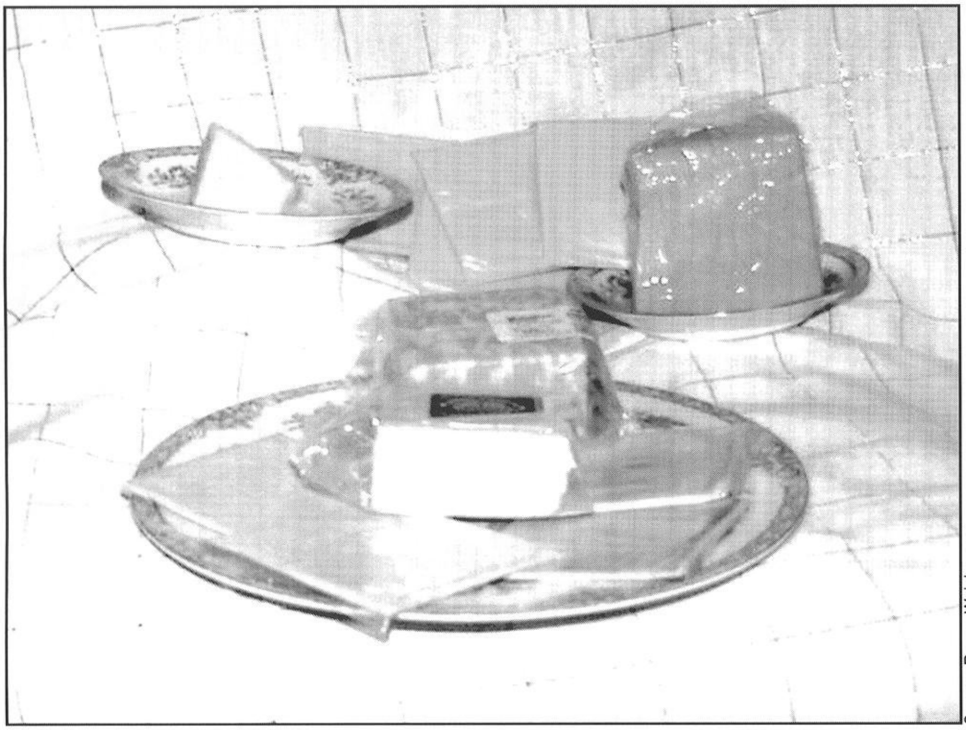
The basic cheese making process involves inoculating pasteurized milk with a bacteria starter culture. These bacteria ferment the sugars in the milk and produce acid. When there is enough acid, the milk takes on a gelled form. This gel is then cut into small cubes and heated to kill off the starter bacteria and to aid in the separation of the curd from the whey. The curd is the solid portion that is used to make the cheese. The whey is the liquid portion that is mostly removed from cheese to control its moisture content. The curds are then salted, stirred, pressed, stored and aged.

Making the variety of cheese flavors involves using different starter cultures, each specific to a certain kind of cheese. For example, to make cheddar, Colby and Muenster cheeses, no new bacteria have to be added. The naturally occurring bacteria in the milk do all of the work. The difference in flavor comes with how long the cheese is aged. Adding *propionibacterium shermanii*, a bacteria that has CO_2 as one of its fermentation products, makes Swiss cheese. The production of this gas is what leaves the "eyes" in the cheese, not little mice as some childrens' tales may suggest.

These technological advances have been the best things for cheese since the cracker

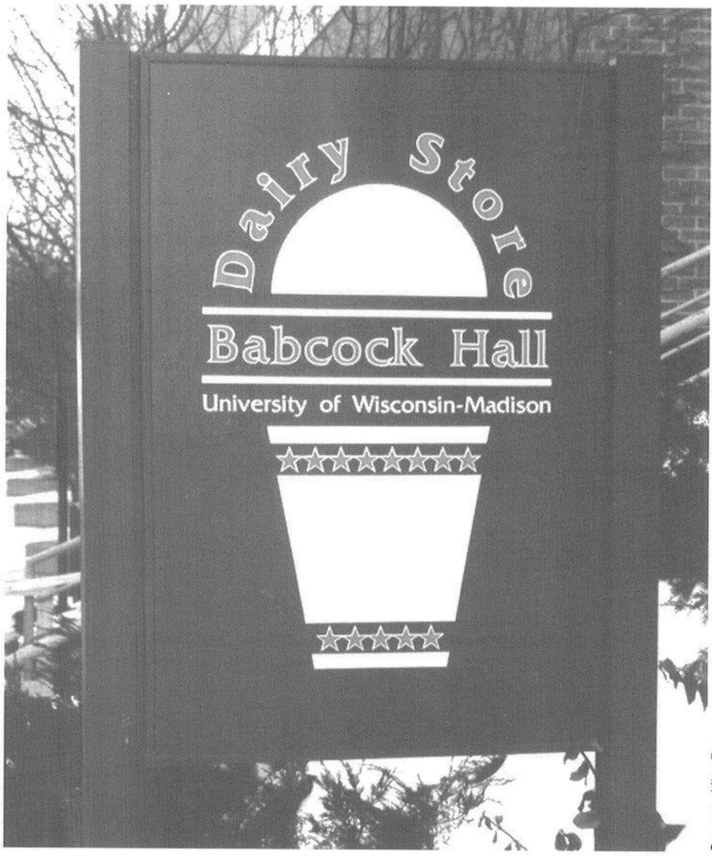
Each cow's milk is different; therefore, it is necessary to standardize the milk to get a consistent product. The composition of the milk is very important to the properties of the cheese. For example, the composition of the milk in mozzarella will affect how the cheese melts, a useful property for the food industry to know as more and more cheese is being used as an ingredient in other foods. In the past, producers would simply measure the fat content and add cream as necessary. This was done via slow analytical tests specific to fat. Which test was done depended on the resources of the cheese producer. Now, computers can measure the fat, protein and moisture content and then add what is needed automatically. This automation saves time and labor.

The old process took place in large kettles that held about 1,000 pounds of milk. The vats were heated over open fire. Now stainless steel vats that can hold up to 65,000 pounds allow the milk to be heated through heat exchange with hot water that is water-jacketed around the outside.



Source: Renee Weinberger

A sampling of various types of cheese which can be made faster and cheaper due to technological advancement in automated equipment.



Source: Kim Benson

Babcock Dairy Store, home to cheese making on campus, will undergo changes soon.

The old way of cutting the solidifying cheese involved running wire knives through the mass. This method was often rough on the forming curd. A rough cutting may cause fat to be lost from the product, which will result in a loss of texture and taste. Now, the new kettles lay on their side and automated knives circulate through the curds in a gentle way that does not cause excess movement.

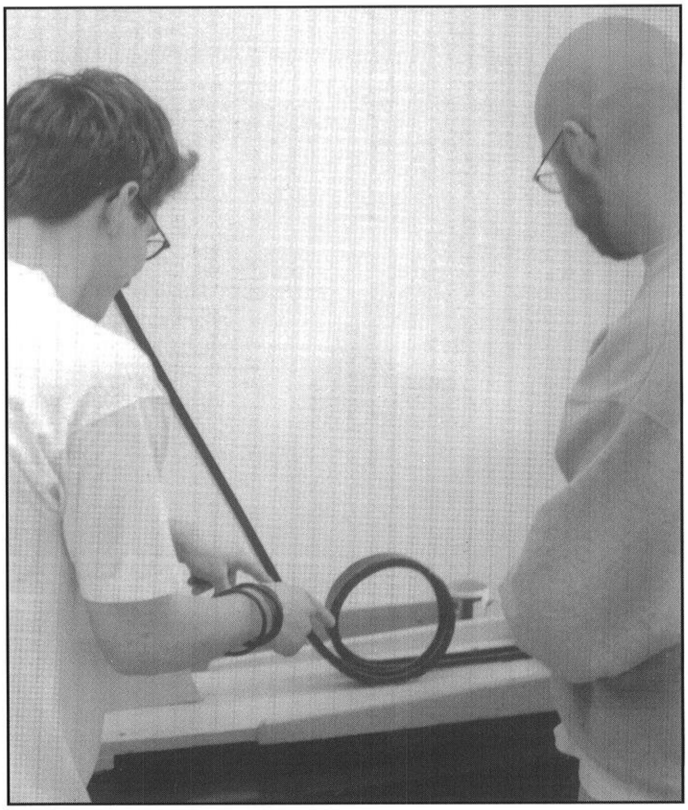
The old method for separating the curd from the whey involved draining the whey from the kettle. This system was not extremely accurate. Modern methods include electronic sensor devices that will give signals as to when the correct amount of moisture has been eliminated. Another method places the curd and whey mixture on a special drainage conveyor. As the cheese moves along, the whey drains through the conveyor screen. At the end of the run, the cheese is flipped onto a second conveyor. By flipping the cheese over, the whey is drained from both sides and the final cheese product will be more pliable. The salting and pressing procedures have become computerized as well, allowing for a consistent product.

Johnson predicts that the future holds even more automation for cheese processing, particularly for milk standardization. Milk will soon be shipped in from other states such as New Mexico, where it will be standardized to different specifications and possibly even condensed. This condensation will allow cheese makers to skip the dehydration step.

Despite the loss of its cheese crown, Wisconsin is still known for its quality cheese. Wisconsinites are so proud of their product that they wear it at football games. Just be glad Wisconsin is not known for its fertilizer.

Author Bio: Karen Mandl is a third-year Food Engineering major. She loves cheese.

Inverted in Ohio



Source: Craig Reid

Physics Students model loops in wooden roller coaster.

By Greg Joseph

Nothing much compares to the experience of riding a wooden roller coaster, or any roller coaster at all, for that matter. The feeling of sneaking up to that line between control and disaster is a mix of primal fear, rage, bravery and excitement. Sure, riding a roller coaster isn't quite death defying, but it doesn't feel too far off.

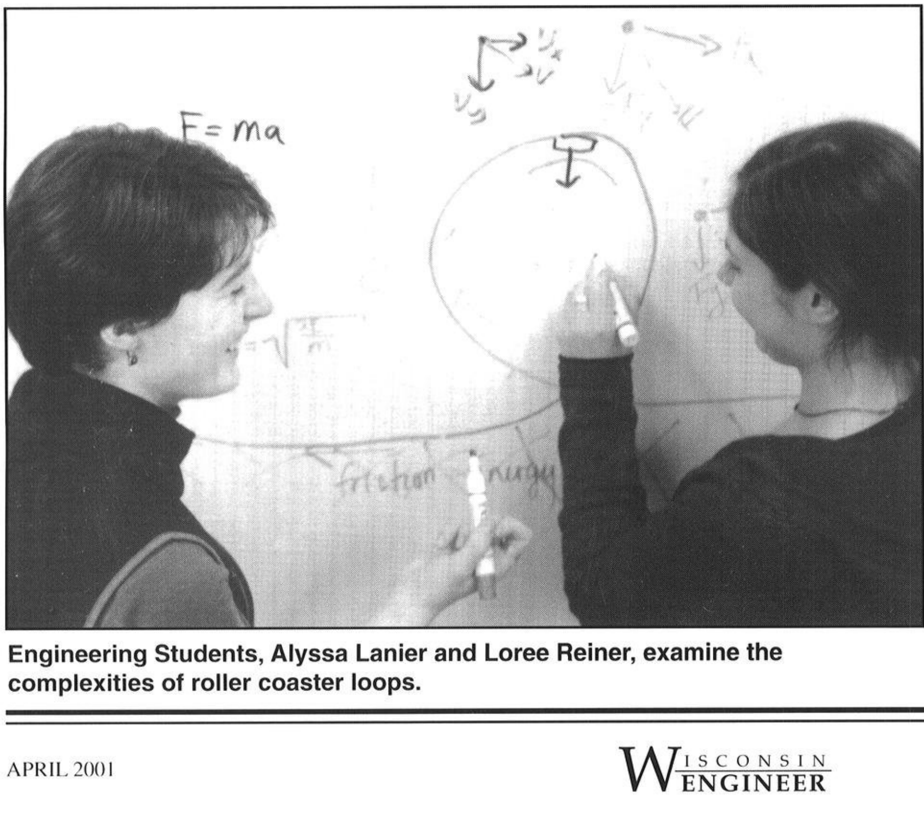
Just as drinking a merlot is distinctly different than drinking a white zinfandel, so too is the experience of riding a steel coaster different from riding a wooden one. You don't get whipped around two corkscrews and then three loops while your feet dangle free, and you don't pray that you tied your laces tight enough when you're riding a wooden coaster. You do, however, get the rush of fear-induced adrenaline as you hold tight to the one old lap bar and go speeding under the bulky wooden structure, close enough that you're sure that if you were an inch taller, the ride would be fatal. Also exhilarating are the uncomfortably loud noises that accompany the feeling that the whole thing is about to fall apart.

Basically, the experience on a wooden coaster is more of a complete sensory rush, but until recently it has been overshadowed by the ability of steel coasters to defy gravity and flip their occupants upside-down. This has now changed with the introduction of a roller coaster named Son of Beast.

Paramount's "Kings Island," in Kings Island, Ohio, hosts Son of Beast, the first wooden roller coaster that fully inverts its passengers. It was designed by the Roller Coaster Corporation of America and the renowned Werner Stengel, a German engineer who has designed roller coasters and thrill rides all over the world. On its first day, May 26, 2000, it took its passengers over 378 miles of southern yellow pine and climbed up to a frightening 218 feet at the ride's highest point. It takes over two minutes to trek through the 1.3 miles of track, and riders find themselves face to face with almost 4.5 g's. The first drop, which stands at 214 feet, sends passengers down a 55.7° angle at over 78 miles per hour.

But what's spectacular about this ride, aside from its breathtaking height and speed, is its 118-ft. vertical loop. Riders report that after plummeting down Son of Beast's drops and being deafened by the moaning of the yellow pine and rushing wind, the loop is an experience in peace. The world is flipped and there is a silent pause, just for a moment, before this coaster sends its occupants back into the clamorous world of traditional wooden roller coasters.

Son of Beast is not only famous for being the world's first and only looping wooden roller coaster. It breaks four other world records: It's the tallest and fastest wooden roller coaster, has the highest hill and has the most feet of roller-coaster track in the world. It comes within 400 ft. of breaking the world's record for longest wooden roller coaster as well, but leaves that honor to its predecessor, The Beast.



Source: Craig Reid

Engineering Students, Alyssa Lanier and Loree Reiner, examine the complexities of roller coaster loops.

Wooden Roller Coasters

Great American Scream Machine
Opened: 1973 Location: Six Flags Over Georgia, Atlanta, Georgia, USA Height: 105′
This wooden roller coaster was the tallest one in its time. Many people consider it one of the most beautiful wooden structures built.

The Rattler
Opened: 1992 Location: Fiesta Texas, San Antonio, Texas, USA Height: 179′ Drop: 166′
This unique roller coaster broke the height, speed and drop records for wooden roller coasters when it opened. The builders blasted through a limestone quarry cliff to create a tunnel for this coaster, making it even more special.

Montezum
Opened: 1999 Location: Hopi Hari Theme Park, São Paulo, Brazil Height: 146' Drop: 139′
Montezum is the first wooden roller coaster built in South America. It was also one of the first wooden coasters designed with safety and maintenance in mind. These new innovations were made possible by computer aided design.

Colossus
Opened: 2000 Location: Terra Mitica Theme Park, Benidorm, Spain Height: 122′ Drop: 118′
The lovely Mediterranean Sea is the backdrop for this wooden roller coaster built on the three-tiered limestone quarry overlooking the water. Colossus is the first wooden roller coaster to use magnet brake technology.

For more information, visit www.rcca.com/rcca.html

This wooden roller coaster does what no other coasters do, and to this we credit its designers, engineers and manufacturers. The best way to thank them, of course, would be to find some free time, a ride to Ohio, and then experience the spectacular Son of Beast.

Author Bio: Greg Joseph is a sophomore, hopefully finding his way into the school of journalism sometime in the near future.

Where Do We Go From Here:

Diversity In Engineering

By Ifeyinwa Offor

Why not be a lady engineer? Del Himmenlfarb, Irene Lee and Elizabeth Jackson, the only three women engineering students at the University of Wisconsin-Madison posed this question in 1952. Their self-imposed title "Lady Engineers" depicts the attention commanded by these intelligent pioneers.

In an article, they described how they handled the "various reactions" exhibited by teachers. Often they found it "necessary to convince them [teachers] that [they were] serious about becoming engineers." These women set out to encourage and convince other females that despite some of the obstacles they might face, engineering is a "stimulating career well worth the work it requires."

What exactly were these women up against? Looking back through many of the 1960 to 1962 issues of the *Wisconsin Engineer*, I noticed something that both disturbed me and tickled my curiosity. One feature in every issue was titled "Woman of the Month." Noticing this, I flipped to the appropriate page, expecting to find a feature on an outstanding female engineer. Instead, sprawled out covering full spreads were multiple pictures of one "special woman," including her size, height and measurements. Beneath the pictures was a brief summary of the woman's interests. In addition to other interests, one woman added, "...and men, of course."

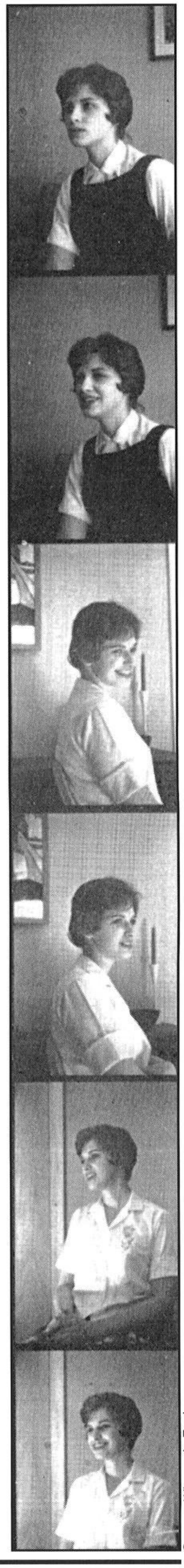
Source: Wisconsin Engineer

Ann Gibson(above) and Barbara Rychlowski(right) were featured as the "Girl of the Month" in an issue of the *Wisconsin Engineer* from the 1960's.

Another section of a 1962 issue, titled "Fill in Your Own Lines" by Ronald Neder, pictured the caricature of a naked woman wearing stilettos. The curves of strategic parts of her anatomy were left unfilled. Beneath the picture was an assortment of jokes, many which implied that women were nothing more than scenery: "A bathing suit—like a barbed wire fence—is designed to protect the property without obstructing the view."

As if these obstacles were not enough, other possible roadblocks presented themselves as well, and still do—racism. What does one do when faced with not only the burden of turning gender stereotypes into inconsequential details of the past, but also the burden of always having to prove your worth to those who would much rather see you fail? If white female engineers were considered different or odd at best, what would a minority female engineer be considered? Did these women fail, or did they persevere and survive?

I would argue that they have not only survived but thrived. The role of the female has expanded, places once uncharted have become familiar, and lives have brought new fulfillment. More specifically, says Tara Mahan, a third-year student majoring in Biomedical Engineering, "There has been a rise not only in female engineers, but in minority engineers as well ... there is reason to believe that the future for female engineers will be a posi-



Source: Wisconsin Engineer

tive one." Yet, despite the progress of the last few decades, much still needs to be done.

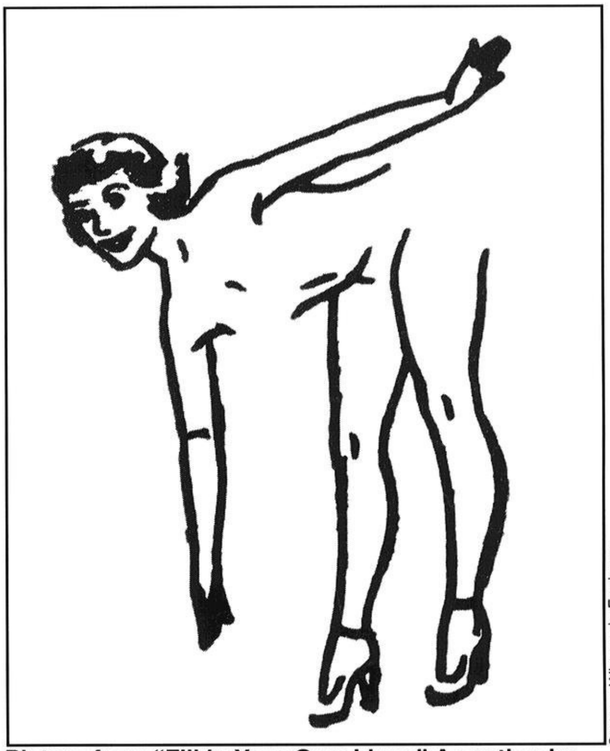
Discrimination and a lack of opportunity still exist for women in engineering fields. How do women combat these issues? More directly, how do minority women presented with an issue of both gender and race deal with the prejudices of others? These questions and more were presented to Tara Mahan, an African-American female, who knows well how to rise above the ignorance of others.

"Do people ever doubt my abilities? Yes, they do. For example, sometimes we'll be doing a project in say, a group of four. When it comes to dividing up the tasks, often times I am delegated to do the simplest, most menial tasks." When asked what she does in this situation, Mahan said, "Well, the only thing you can do when presented with others' ignorance: assert yourself. Instead of allowing them to make me feel inferior, I take charge and state what I will do, making sure that my tasks are equal to those of others present… when we get together again they [fellow students] act surprised, as if they doubted my capabilities, which they obviously did."

This is no easy task as anyone who has ever been belittled can attest to. I asked Mahan if this confidence was something innate or something that she acquired. She responded, "I have learned that the key is to stay focused and to never doubt myself. If I begin to doubt myself then it's all over."

Prejudice is nothing new. The question is how to deal with these problems. Other females in the engineering profession have given Mahan valuable insight to prepare her for the male-dominated workforce, "…if you are a minority and a female there will be doubters in all corners. The key is not to give up, to stick through it." With all the discouragements it is a wonder there are any female engineers at all.

Although the world is slowly rising to the fact that only with diversity may we know true intelligence, much still needs to be done to combat the inherent prejudice that women of all backgrounds face. Despite this, Mahan quickly assured me that while "studying engineering is difficult, it is not impossible." Words of wisdom that could apply to any goal, and that we all would do well to remember.



Source: Wisconsin Engineer

Picture from "Fill in Your Own Lines" A section by Ronald Neder from several 1960's *Wisconsin Engineer* issues.

Author Bio: Ifeyinwa Offor is a sophomore double majoring in Legal Studies and Afro-American Studies. Although this is her first bite at engineering she has found the taste interesting. Eat on.

Just One More

Reminiscing about Engineering

Boy the days do go quickly. The Wisconsin Engineer Magazine recently had the opportunity to sit in on a conference where engineers recalled the days when men were men and women were women, and for some, the days of their youth. Here is a rough transcript of several of these trips down memory lane, organized by engineering discipline. The names have been kept secret to protect the engineers from embarrassment.

Biomedical Engineering:

Ah yes, I fondly do remember the first biomedical class I took out of college. This was before the days of Nixon, back when biomedical engineering wasn't even its own discipline in most universities. To think, we didn't even have any sort of idea of genetics back then. All our tests were run on monkeys and rats, taking weeks to nail down conditions and results!

Oh yeah? The first class I ever took was before the term bio-medical was even created! You were lucky to get recognition for your course! My first interviewer thought I was some sissy male nurse!

You had a class? Luxury! We didn't even know people had DNA at my time! I had to test the materials of medical instruments for toxicity by ingestion of small parts of them!

You were lucky to have instruments! All we had were sharp rocks, pointy sticks and leaves for bandaging! And I'll be damned if they were even washed in a mud puddle!

Sticks? Mud puddle? Try living in Mesopotamia! We were lucky if we had sand to rub on our wounds that a camel hadn't spit on. You had it easy!

Civil/Environmental Engineering:

Wow, thinking back to my first days as a Civil/Enviro Engineer, I can remember how difficult it was. We had to design and build a structure out of poured concrete and rebar. We built a dam blocking the flow of a small stream.

Concrete and rebar? Where do you get off? When I started out, all we had were bricks and mortar and stock lumber. We eventually got our hands on some cast iron and were some happenin' dudes.

You had bricks and mortar? We had to saw the giant redwoods of California for lumber, all by hand! And we had to minimize the impact of the falling trees to boot! And boy, when we got our hands on bricks and mortar, I'll be a turkey's cousin if we didn't have to use them right away. The wolf had already blown down our houses made of sticks and hay.

Sticks! Why we had nothing of the sort! We had to build our structures out of quarried stone and floated down the river Nile! Try doing that with gangs of slaves, incompetent farmers and a measurement system based on the cubit!

The cubit??? Geez, try building a hole in the ground with a measurement system based on the length of the king's toe! Try telling that to young people today and they just don't believe you.

What luxury! Try coming back to my time, when all we had was the wind, some water and a few primitive bacteria to get anything done. You try making the face of the modern world with that.

Chemical Engineering:

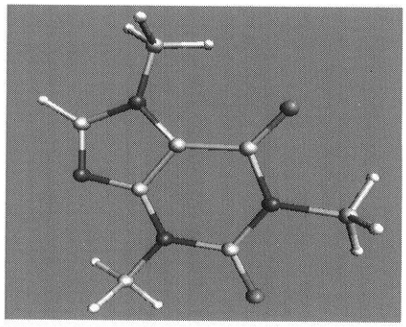
Boy these days pass quickly. The first chemistry class I had, we handled acids in fragile jars and mixed chemicals with wild abandon. We had acid dropper fights most every day.

Hah. My first chemistry job was before I even got to college. We washed clothes in vats of lye and gelled horse hooves and bones for glue between loads. And when I got to school, I'll be a monkey's uncle if we didn't scar each other with the buckets of high molar sulfuric acid we used everyday.

We melted thru our sink by semester's end. You were lucky to have a sink. We had a single bucket! Try to isolate three reactants and bring a fourth out of solution in a wooden pail sometime!

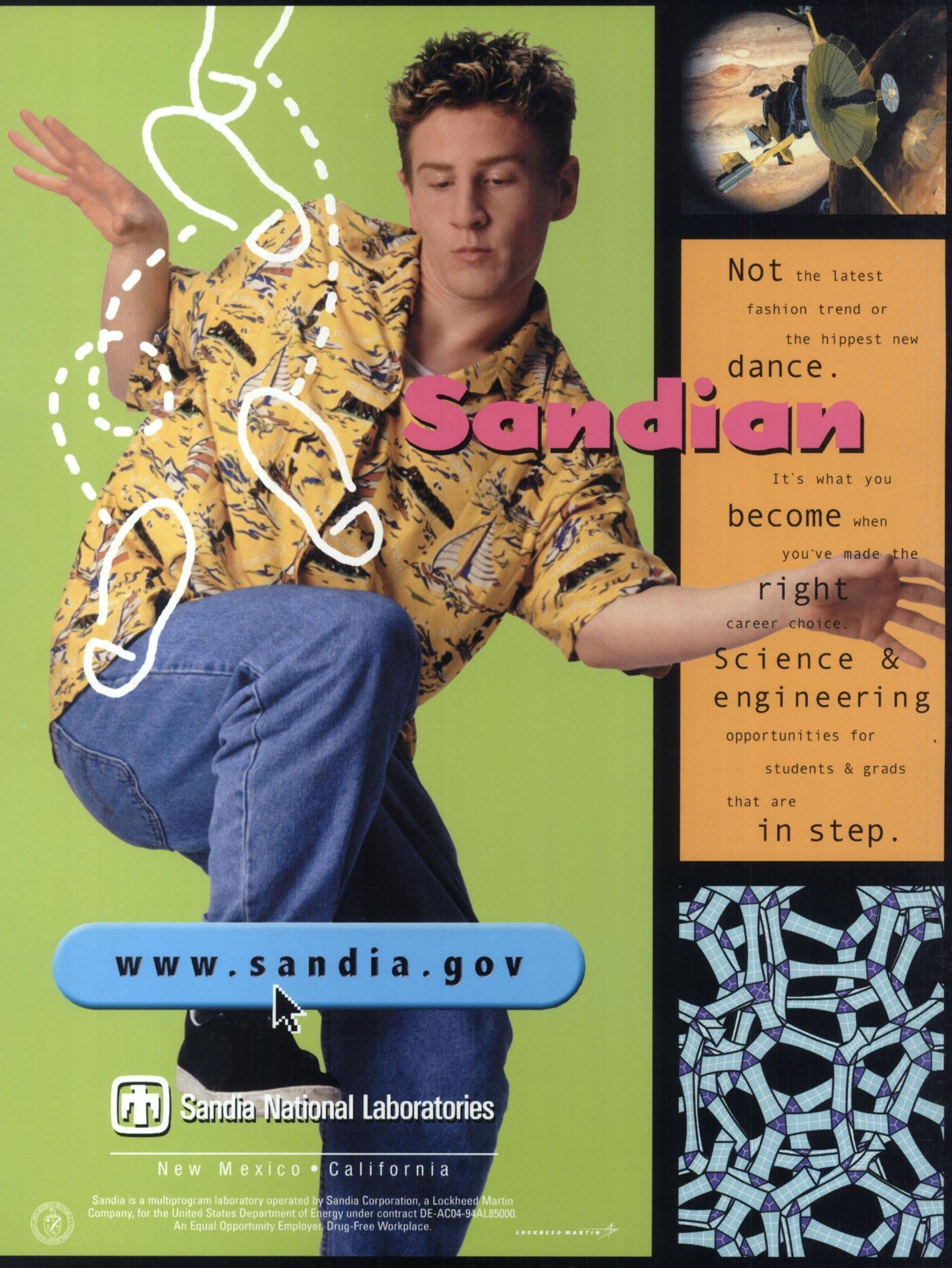
You had a bucket? We would have KILLED for a bucket! All we had was a puddle on the side of a volcano! We had to gather our chemicals directly from lava flows too. You try that next time you need some sulfurous salts.

You had lava? What opulence you had! We had to forge our chemicals in stellar furnaces, the cores of stars! You try coaxing a pair of helium atoms together next time you need some lithium.



Spring 2001

Source: Susan Hellstrom



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