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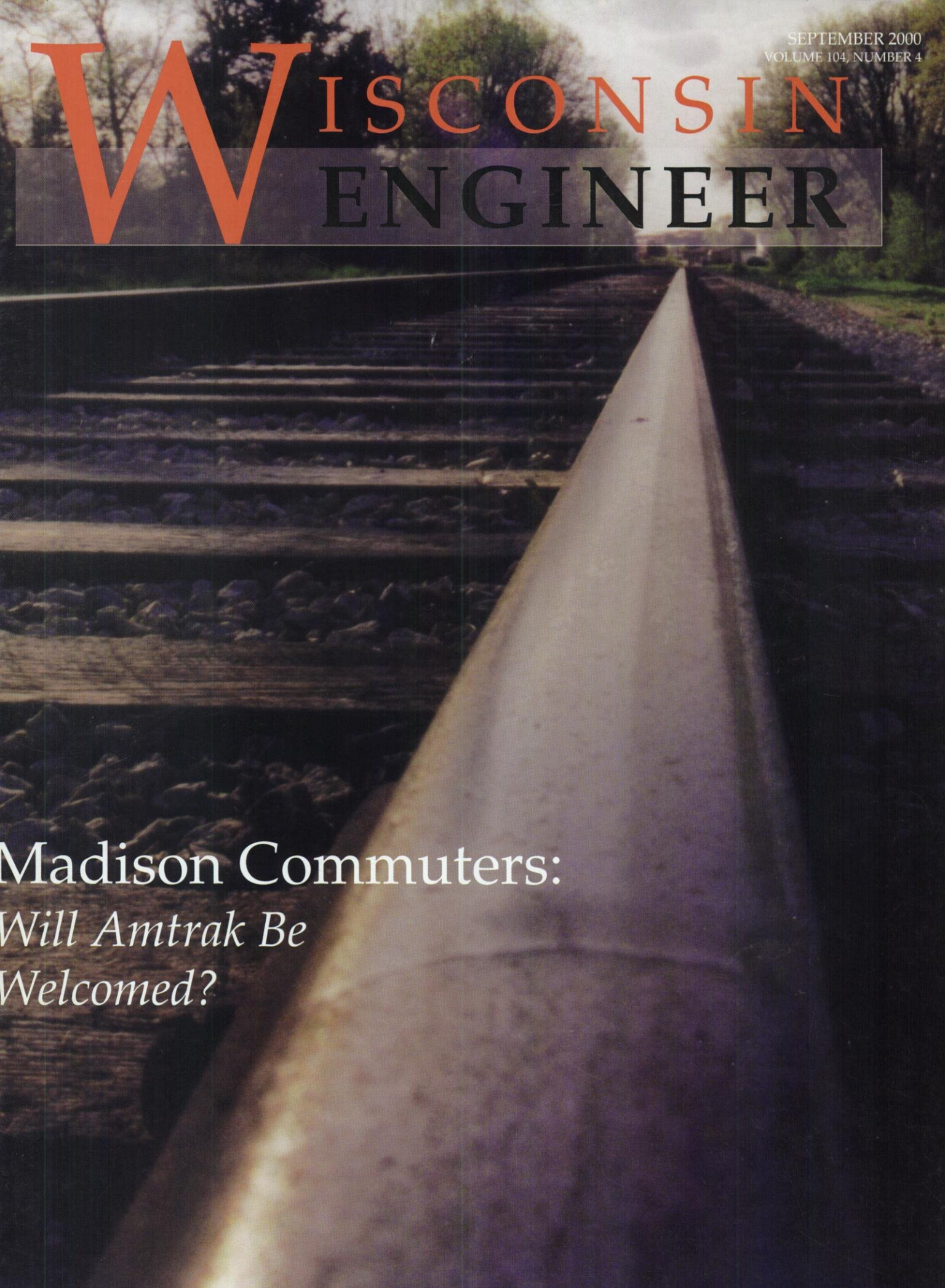
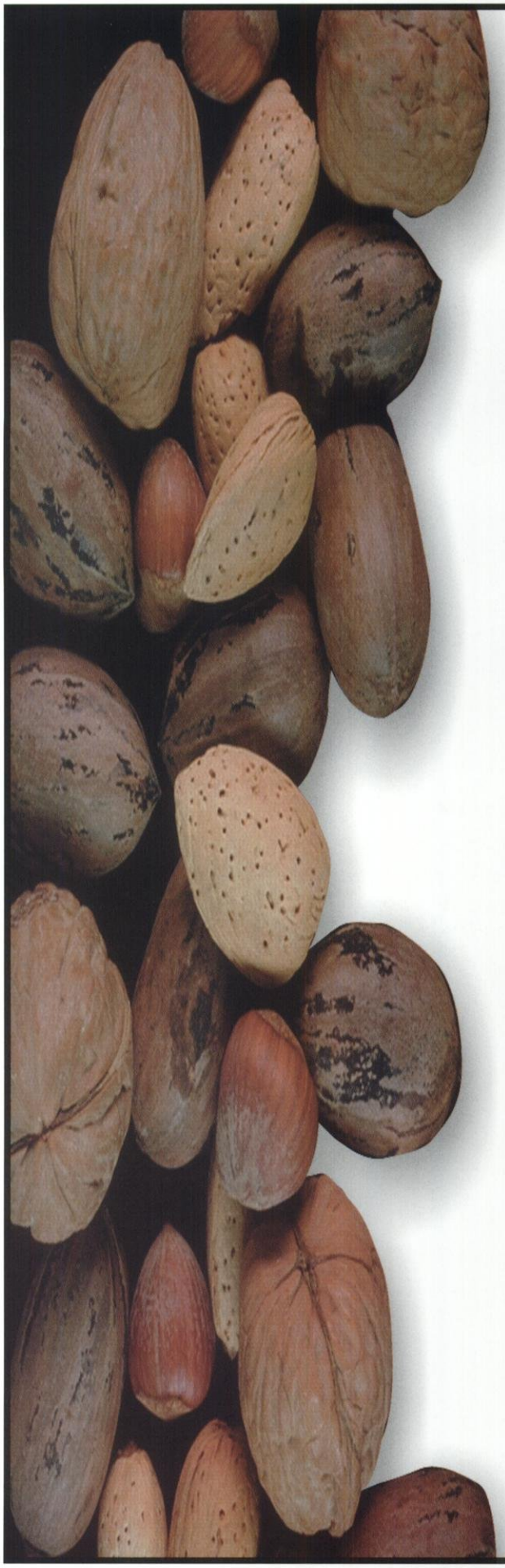
WISCONSIN ENGINEER



Madison Commuters:
Will Amtrak Be Welcomed?



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WISCONSIN ENGINEER

Published by the Students of the University of Wisconsin-Madison VOLUME 104, NUMBER 4 September 2000

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A Saturday Baseball Revelation

A bright, colorful commercial fades out with its funny jingle as the Saturday afternoon baseball announcers begin previewing the games for the day. Cubs vs. Dodgers. Yeah. I know what I'm doing for the rest of the afternoon. Hmm ... I better get a snack from the kitchen before the game starts. I bolt to the kitchen and then plop back onto the couch. What is this? A black and white, fuzzy screen shadows the game. No crowd noise, only the crackling static voice of the announcer. Where is my game? After a moment of bewilderment, thinking that I definitely missed something, I realize this is my game.

Finally, I find out that every inning, starting with 1939 television technology, Fox lets us view decade-by-decade changes in television and audio technology. We get to see how fans of the past saw their baseball once America's Pastime was finally televised. It is fascinating to watch just how dramatically the picture and sound quality improved. Technology sure is moving. Little conveniences, such as television graphics, we take for granted, not remembering that just 10 years ago, many technologies, especially computers and internet-related technology, did not exist.

Many of these exciting technologies of today are being developed right in front of our eyes—on college campuses. Hundreds of research projects aimed at improving modern technology are being worked on at this very minute at the UW. The only problem is that the only people that know about them are those directly involved or in the same field. You may not even know what historic advances are being researched right across campus. We need a way to spread news of these exciting projects to the rest of campus.

Thinking about all the amazing work being done with technology at the UW and watching its advancement, conveniently in my living room, made me realize that getting the student body proud of the work being done by their peers should be a main goal of the *Wisconsin Engineer*. Year after year, we publish a magazine full of articles about fascinating technological research at the UW, and now that technology is changing so fast, new and incredible engineering advances are just waiting to be discovered. As a writing editor, all of this gets me very pumped up about all of the stories that my talented writers will create.

Yes, I'm way too excited, but what about the students we publish this magazine for? Are they even reading it? Being an English major, far, far, from the engineering campus, I know that maybe a handful of liberal arts majors have read it. That's understandable considering that engineering technology may not thrill the interests of arts majors, but what's surprising is how many engineering majors have never even heard of the *Wisconsin Engineer*, even though we bombard the engineering campus with copies twice every semester.

My problem is that I need to get UW students to read the *Wisconsin Engineer* to learn about all the great work being done in their own fields. I've thought long and hard, and my only hope is to solicit the help of our loyal readers. Please, tell your friends; in fact, give them a copy. For goodness sakes, it's free! We need to get engineers excited about the work they are studying to do someday, and I hope it is through our magazine. By the way, did you know that the *Wisconsin Engineer* won Best All-Around College Engineering Magazine this year? Well, you do now and hopefully many more students will as well.

Oh, and my Cubbies did beat the Dodgers that Saturday afternoon. Only it lasted about 100 years.

Kari Cox

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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Getting Better All the Time

By Dan Lewison

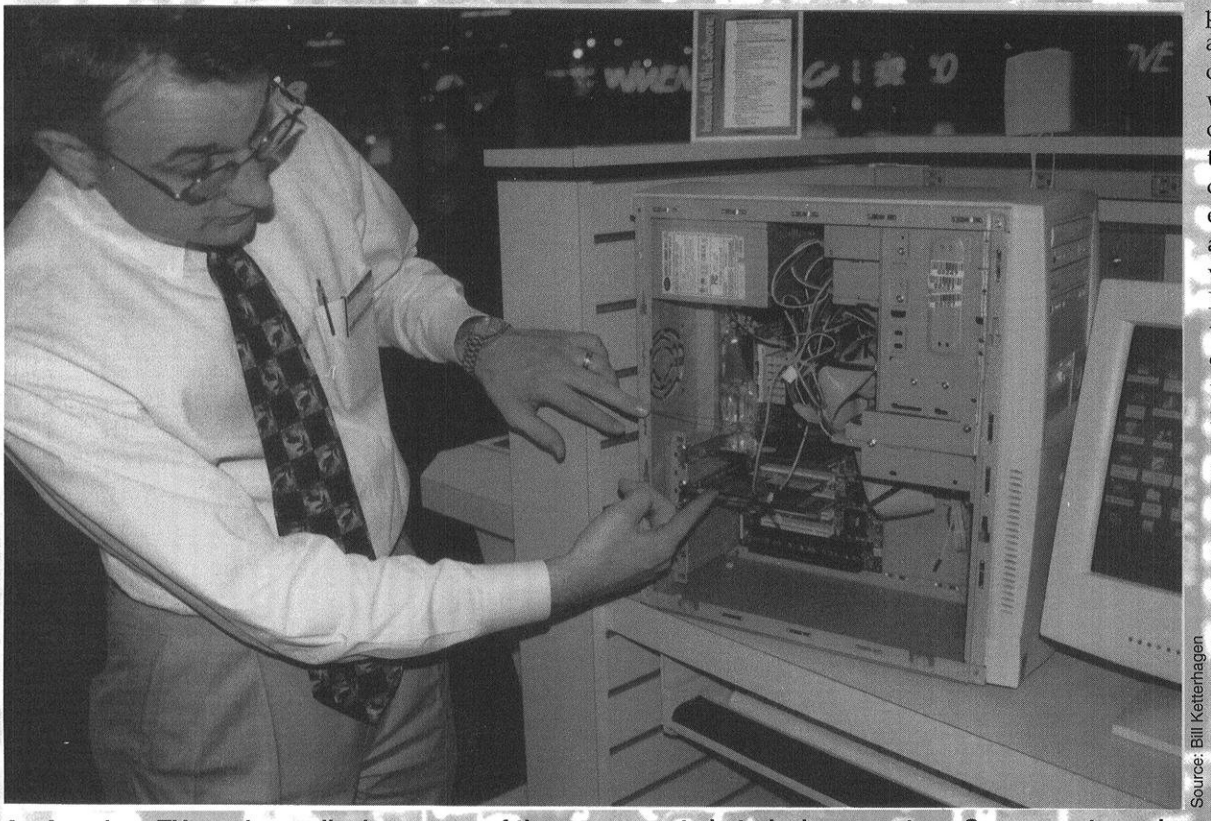
A decade ago computers began to innovate our everyday lives. They made our work so much easier, yet most people could not afford to have them in their homes. Today computers are a mainstay in our homes and at work, and these computers keep on getting faster and better. How has it been done? Great discoveries at the nano-scale have been making all the difference.

The warranty on an average computer is currently three to five years, which is a great improvement over what it has been in the past. The reason computers are lasting longer these days is due to great advances in nano-scale technology. For instance, the disk in the hard drive is traveling extremely fast, and manufacturers keep on making this component smaller. Like Professor Donald Stone says, "It's like a jet traveling at full flight right above the ground." There are constantly more advances in making components, like the hard drive, smaller and more efficient. Improvements in our knowledge of friction, expansion, lubrication and molecular interactions have revolutionized the quality and performance of computer components. Not only do they work better and last longer, but they are also actually getting cheaper and smaller.

Copper technology

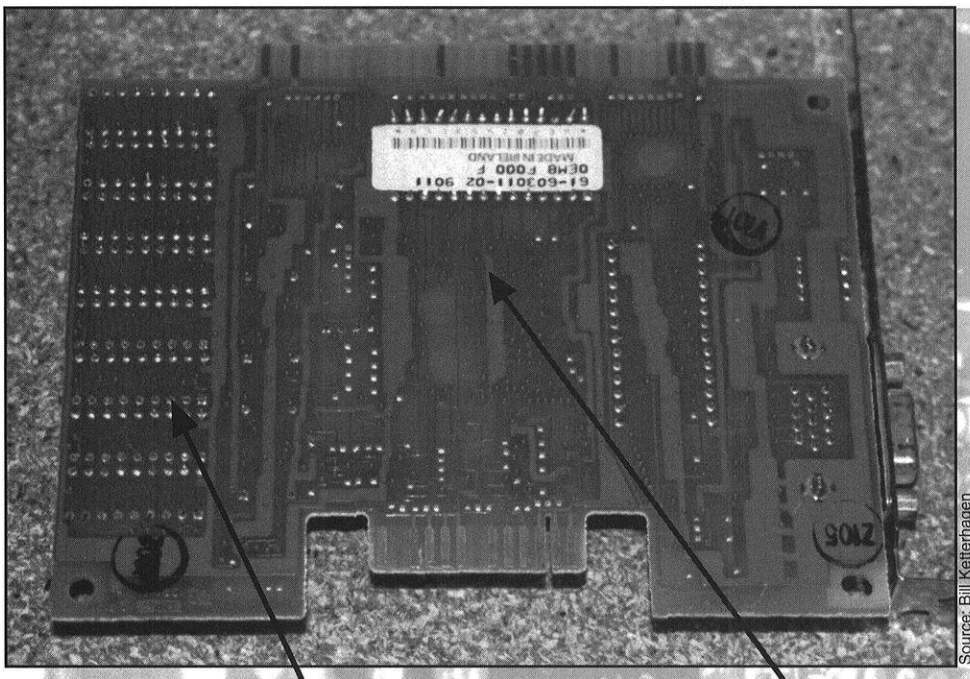
As you decrease the size of your components, you run into increased problems. The leads, tiny wires inside semiconductors that transfer information, need to be smaller. Problems arise with them because small-scale heating effects start to have more of an impact due to very high current density going through them. Traditionally, aluminum has been used for these leads and wires, but aluminum crystals have vacancies, tiny gaps between molecules. When high current is passed through the small aluminum wires, the vacancies are carried with the current and can pile up in one part of the wire. This atomic phenomenon causes an open circuit, which ruins the semiconductor. To alleviate this kind of problem, computer manufacturers made the leads with a metal that has fewer vacancies, like copper. However, aluminum is used because a chemical reaction between the copper and silicon makes it non-ohmic, ruining the point of using copper by making it less conductive. This problem has finally been overcome and computer manufacturers are set to use this new technology. The new copper leads also have a much lower resistance that creates greater performance and lower power consumption.

For all of us who cannot help but overload our computer with tons of programs, IBM recently announced that they discovered a way to store 100 times more data than today's computers



Source: Bill Ketterhagen

An American TV employee displays some of the components in today's computers. Components such as these are becoming smaller, faster and more cost efficient.



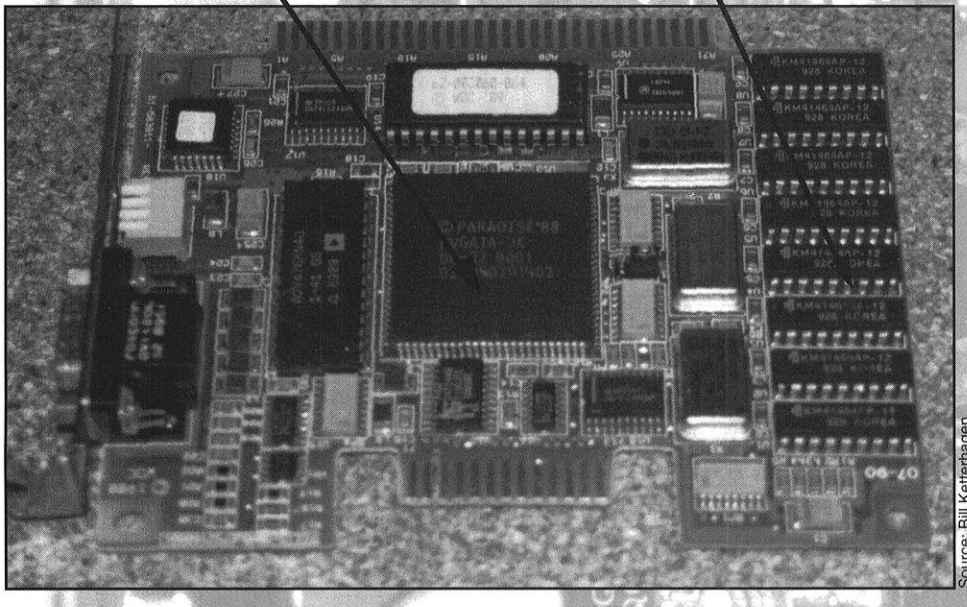
Source: Bill Ketterhagen

These are the solder holes on the underside of a circuit board. Solder mounts are more expensive and are being replaced by surface mounts.

Here is where the surface would be on the bottom of the circuit board.

The top view of the solder mounts on the same circuit board.

The top view of the newer, more costly effective surface mount.



Source: Bill Ketterhagen

With this technology and a new design technique that cuts down on the amount of capacitance inside the processor, companies like IBM are set to put processors on the market anywhere from 1.1 GHz to 2 GHz. Currently, computers can take in about 32 bits at a time, but with this new technology they will be able to take in 64 bits at a time. In other words, your computer can process data twice as fast.

A better memory

For all of us who cannot help but overload our computer with tons of programs, IBM recently announced that they discovered a way to store 100 times more data than today's computers. Researchers have discovered chemical reactions that cause tiny magnetic particles, each comprised of only a few thousand atoms, to automatically arrange themselves. IBM explained in technical terms that the same preset distance separates each particle from its neighbors, and the reactions permit precise control of the separation distance between them. Although this technology is not ready to be implemented, it is a great advance in memory storage.

Can you see that?

A problem with some older computers is that after extensive use, the monitor screen starts flickering, making it unreadable. In these monitors, thermal expansion over a long period of time breaks the leads connecting the semiconductor circuit board. The board is made of a glass composite, which does not expand well. The semiconductors are made of silicon and the leads are made of aluminum, both more expansive materials then glass composite. The difference in expansion creates a stress between the circuit board and the components attached to it, which will break the leads over time. In these old circuit boards, solder mounts were used.

To solve this problem, surface mounts have been developed to replace the solder mounts. Two advantages to using surface mounts exist: they do not require the manufacturing expense of solder holes, and they expand with the circuit board better. This makes it less likely that the leads will break. If the leads do not break, the computer monitor will not flicker.

With these kinds of advances in nano-technology, it is no wonder why computers are getting cheaper, smaller and faster. These days you can surf the Web in the palm of your hand and obtain your own personal computer for an affordable price. These possibilities were not even a thought in our minds a decade ago. The advances today are great, but do not blink because more things you never dreamt possible are coming your way!

Author Bio: Dan Lewison is a freshman who is currently working hard to figure out what engineering career he wants. Hopefully the right major will soon become clear to him. For now, he is enjoying his time testing the waters of engineering and keeping up his hobbies of bass guitar and intramural sports.

Wisconsin Primate Center:

Searching for Answers in a Barrel of Monkeys

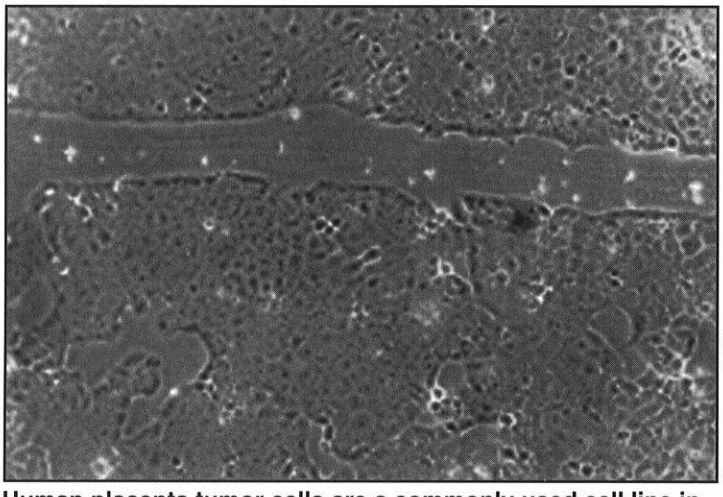
By Bryan Ulatowski

Yesterday, the Nightly News men tioned the epidemic might become wildly un-controllable. It seems more people are utterly disfigured. Only since the Middle Ages has the disease been so widespread, Kofi Annan, Untied Nations Secretary-General, preaches isolation and prayer for the growing number of victims, noting experimental human testing is in progress around the world. Yet, experts have little hope the spread of *microbacteria leprae* (Leprosy) will slow.

Leprosy causes surface nerve damage, which in turn leads to a loss of sensation in the hands, feet and eyes. Yet, realistically, the disease poses no threat to society, especially Madison residents. This far-fetched scenario of a leprosy epidemic is, in fact, untrue due to primate research.

Located here at University of Wisconsin-Madison, the Wisconsin Regional Primate Research Center (WRPRC) is one of eight primate research centers supported by the National Institutes of Health--National Center for Research (NIH-NCR). Nearly $15 million annually in funds has propelled the WRPRC to become home to numerous scientific breakthroughs. Primate research in the 1970s yielded approval of the antibiotics Dapsone, Rifampicin and Clofazimine to treat victims of leprosy in the 1980s with what is called Multidrug Therapy (MDT). Today leprosy does not cause great concern, but over half a million cases are still identified each year throughout the world. The most recent and potentially most important research discovery has been the stabilization of the embryonic stem (ES) cell, or developing cells that have been paused before differentiating and represent "blank slates" on the cellular level. James Thomson's research earned him *Science* magazine's 1999 "Breakthrough of the Year," and his continued efforts in Madison pave the way to solving the mystery presented in such human diseases as leukemia and Parkinson's disease.

Director Joseph W. Kemnitz, Ph.D., leads the more than 200 doctoral-level staff at the WRPRC into the expansive future of Primatology. Research groups include Reproduction and Development, Neurobiology, Physiological Ethology, Psychobiology, Aging and Metabolic Disease, Immunology and Virology and Immunogenetics. Due to the increase in demand for this research, the center recently doubled in size. The center will also host the upcoming AIDS 2000 Symposium in October. Located at the Monona Terrace, the symposium is one of many that help collaborate new ideas in this relatively young field of study.



Source: Renee Weinberger

Human placenta tumor cells are a commonly used cell line in the primate center.

In 1957, the National Institute of Health formed a planning committee to push the development of primate research centers, following the U.S.S.R.'s example of the already world-renowned Institute of Experimental Pathology and Therapy. In 1960, the first centers were established. A year later, the innovative Harry F. Harlow helped found the WRPRC. Built in harmony with the Henry Vilas Zoo, the center was only one of two to have a working relationship with a zoo and was traditionally used for breeding, research and observation of rhesus and stumptailed monkeys. In 1983, animal rights activists spray-painted zoo displays including the monkey facility. As a result of diminishing federal funding, fading research opportunities, and in the wake of escalating animal rights pressure on the Zoo and Primate Center, nearly 200 monkeys were sent to a Louisiana primate research center and a Texas sanctuary in 1998.

James Thomson's research earned him *Science* magazine's 1999 "Breakthrough of the Year"

Activists have always pushed the moral envelope on animal research, but last year they might have gone too far. Letters prepared with razor blades were sent to 80 U.S. scientists with intent to get public attention and to place fear in the scientists themselves. The letters were highly effective and illegal. In this year's February issue of *Scientific American*, Colin Blakemore, director of the University of Oxford's Center for Cognitive Neuroscience, explains how the threats affect his research. He has been beaten, his home vandalized, and demonstrations against his research at one point demanded 200 police in riot gear. "Students are not choosing to come into the arena of science involving animal research," Blakemore remarks. "There's a withering of that branch of science."[1] Eight letters went to UW-Madison researchers. Current director of the WRPRC Joseph Kemnitz and his family opted to leave town after protestors held "excessive" candlelight vigils in front of his home while writing epitaphs on his sidewalk and car in wax, illustrating once more how delicate an issue animal research is.

In moral respect, primate and embryonic stem cell research remain gapped by a wide difference in opinion. So far, Congress has refused to fund human embryo research. Dr. Alta Charo, who served on President Clinton's commission on bioethics, believes the subject's controversial nature does not appeal to the government. In *The Badger Herald*, Charo said that politicians were worried about "keeping a good scorecard for pro-life voters."[2] Since the government has not yet supported human embryo studies, James Thomson's ES cell research was conducted nearby at a private lab to avoid any possible endowment confusion.

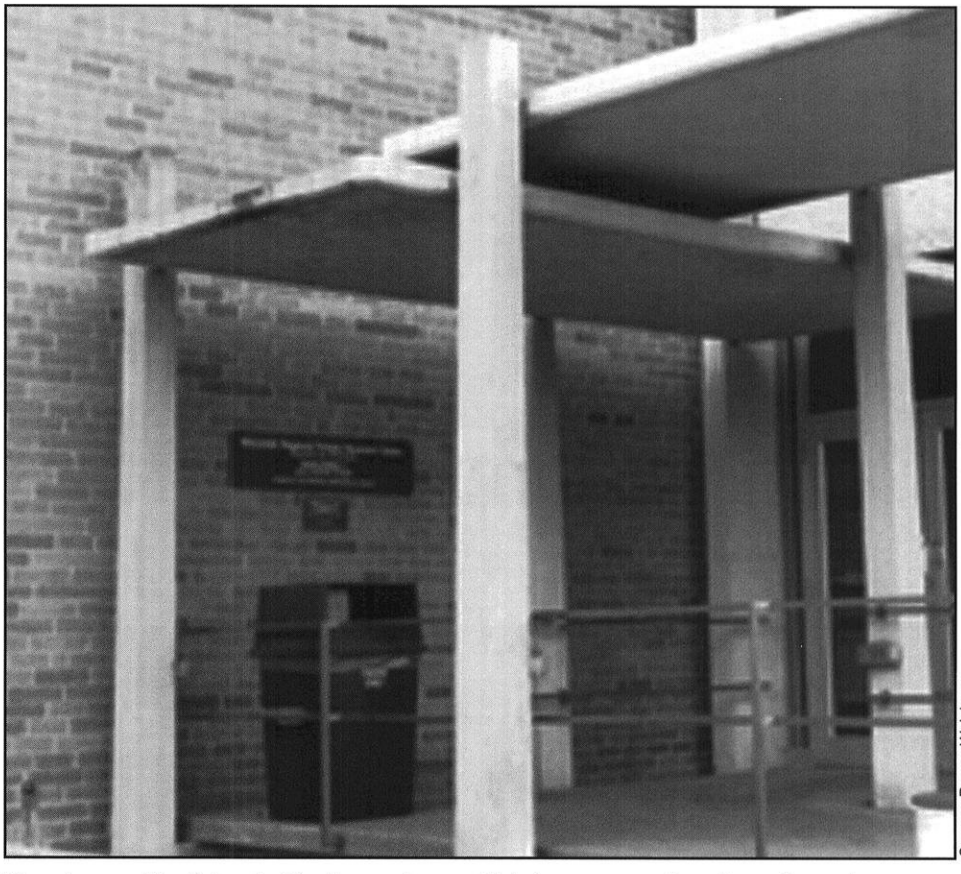
Dr. Thomson has isolated and kept in culture both human and monkey embryonic stem cells. Many human embryos are developed through *in vitro* fertilization in fertility clinics, but few are used. The leftover embryos are either destroyed, donated to couples that cannot conceive, or freed for research purposes. After culturing the embryo for five days, the inner cell mass is removed. This inner cell mass contains embryonic stem cells, each with the potential to differentiate into any kind of tissue. They are then cultured in a petri dish with a special broth to theoretically make groupings of cells. Hypothetically, these healthy, growing cells can then be injected into the tissue area of need. Some of the first tissues formed from rhesus monkey ES cells implanted into mice grew tooth, gut and muscle cells. However, just like any transplant or implant, the cells must be genetically engineered so each patient's immune system does not reject the cells as foreign bodies. This immunological engineering feat has not yet been accomplished.

In September of 1999, President Clinton released a statement regarding his National Bioethics Advisory Commission's (NBAC) findings on the obvious potential that fuels ES research. "The scientific results that have emerged in just the past few months already strengthen the basis for my hope that one day, stem cells will be used to replace cardiac muscle cells for people with heart disease, nerve cells for hundreds of thousands of Parkinson's patients or insulin-producing cells for children who suffer from diabetes."[3] The President and the NBAC have acknowledged the potential housed in ES research but first must determine moral standards.

Future hopes stem from the many advances realized through past primate research. Animal research has contributed in large part to such breakthroughs as the polio vaccine, Hepatitis B vaccine, high blood pressure medication, kidney dialysis, diabetes insulin treatments and chemotherapy. New organ maintenance and transplant techniques, new treatments for multiple sclerosis, and life-extending blood anticoagulants have been developed here at UW-Madison. Primate research in the 80s enlightened scientists on the depletion of nerve cells that contributes to Parkinson's disease. Cells in the part of the brain called the substantia nigra produce the neurotransmitter dopamine, which carries messages to different parts of the brain. As these nerve cells die off, a chemical imbalance results between dopamine and acetylcholine, another neurotransmitter, causing a lack of coordination that often appears as a tremor, stiff muscles and joints or difficulty moving. In a 1999 study on cynomolgus macaque monkeys, José López-Barneo, a physiologist at the University of Seville in Spain, transplanted dopamine-producing gland cells from the neck into the putamen, the area of the brain damaged by Parkinson's disease. Production of dopamine within the putamen is decreased because of Parkinson's disease. The gland cells are able to sense when oxygen levels are low, such as during a transplant surgery, at which time they release the neurotransmitter. After implantation, they continued to produce dopamine, which somehow caused the brain to make its own dopamine again. Scientists theorize human stem cells might be grown into the dopamine-producing putamen cells, replacing the depleting cells while improving coordination and reducing or eliminating tremors.[4]

Also in 1999, a study from the Mount Sinai School of Medicine (New York, NY) reported the discovery of a nerve cell linked to Alzheimer's disease. The neuron is found only in humans and great apes of 28 primate species studied, which suggests Alzheimer's, characterized by a progressive decline in judgment, memory and the ability to reason, is similar to Parkinson's in that both involve the breakdown of a certain type of nerve cell. The unusual, spindle-shaped cell is present in the anterior cingulate cortex of only humans, chimpanzees, bonobos, gorillas and orangutans. In human Alzheimer's patients, the abundance of this type of neuron is diminished by about 60 percent.

Most of the seven other regional primate centers focus their studies on the many different types of cancer. Over the last ten years, research on stem cells from bone marrow has provided some hope for patients suffering from leukemia, lymphoma, Hodgkin's disease and myeloma. These cancers alone claimed the lives of 60,500 people last year, and another 107,900 new cases were diagnosed.[5]



Source: Renee Weinberger

The sign on the Primate Center, a place which has encountered much controversy and seen many protests, is discretely hidden from the road.

The Wisconsin Primate Center maintains focus on aging and AIDS research. Late last year David I. Watkins of the WRPRC and two graduate students David Evans and David O'Connor uncovered key evidence explaining the AIDS virus's evasive nature. What makes AIDS so difficult to treat is the quick variability of the virus. Watkins found killer cells called CTLs play a bigger role in eliminating viruses then was previously believed. "Two important arms of the immune system that respond to infection are CTLs and antibodies," Watkins explains. "However, the antibody response does not fully develop until much later. By contrast, the peak of the CTL response coincides with early control of virus replication."[6] The AIDS virus eventually "hides" itself from CTLs by varying areas of its own proteins. Tracking these varied areas is vital to creating effective vaccines to destroy the AIDS virus.

Studies at the WRPRC have shown evidence of a biological mechanism whereby naturally low estrogen in aging female marmoset monkeys does not lead to osteoporosis. Meanwhile, center research on rhesus monkeys in June 1999 developed a technique for a better osteoporosis diagnosis called central region of interest (CROI) which identified 25 percent more older monkeys afflicted with low bone mass. The other research groups at the WRPRC have produced many progressive discoveries that may well lead to human treatment in the near future. A new drug called immunotoxin FN 18-CRM9 prolonged the survival of transplanted kidney tissue in all rhesus monkeys and moved into human clinical trials in February 1999. The drug works by destroying CTLs, the immune system kill response cells. When the CTLs grow back they are more likely to accept the transplanted tissue. Also, research scientist Dr. Hideo Uno says latanoprost, a drug presently used to treat human glaucoma, showed much greater potency than minoxidil for actually treating hair loss. Further studies might be taken up by the Swedish company Pharmacia-Upjohn, which currently use minoxidil in their product Rogaine®.

Not only here in Madison but around the world, primate research is helping scientists solve the biological problems facing the human race. The next "Breakthrough of the Year" may not come from Wisconsin or even from primate research, but as the past illustrates with Multidrug Therapy for leprosy and the development of a polio vaccine, understanding primates continues to be an essential part of further understanding our own biology and behavior. Animal rights activists will continue to protest. Primate research is by no means an easy issue to deal with. Nonetheless, scientists continue to strictly abide by endless government regulations and to methodically care for their animals. With its annual base grant of nearly $4.7 million from the NIH extending into the future and collection of renowned staff, the Wisconsin Regional Primate Research Center will deservedly keep UW-Madison at the forefront of biological research and engineering.

[1] Turville-Heitz, Meg, "Violent Opposition," *Scientific American*, Febraury 2000, http://www.sciam.com/2000/0200issue/0200techbus1.html

[2]Patterson, Alisha, "Professor Addresses Bioethics Issues," *The Badger Herald*, January 28, 1999, http://badgerherald.com/content/1999/spring/news/012899news4.html

[3]Office of the Press Secretary, Statement by President Bill Clinton, September 13, 1999, http://bioethics.gov/stemcell_pres_statement.htm

[4]Luquin M.R., R.J. Montoro, J. Guillen, L. Saldise, R. Insausti, J. Del Rio, J. Lopez-Barneo, "Recovery of Chronic Parkinsonian Monkeys by Autotransplants of Carotid Body Cell Aggregates Into Putamen," *Neuron*, no. 4 (April 22, 1999), p. 743, *http://www.primate.wisc.edu/pin/rh/rhjul30.txt*

[5]National Cancer Institute Seer Data

[6]Lenon, Jordana, "Researchers Find Clues To AIDS Virus Mystery," Office of News and Public Affairs, November 19, 1999, *http://www.news.wisc.edu/thisweek/view.msql?id=3427*

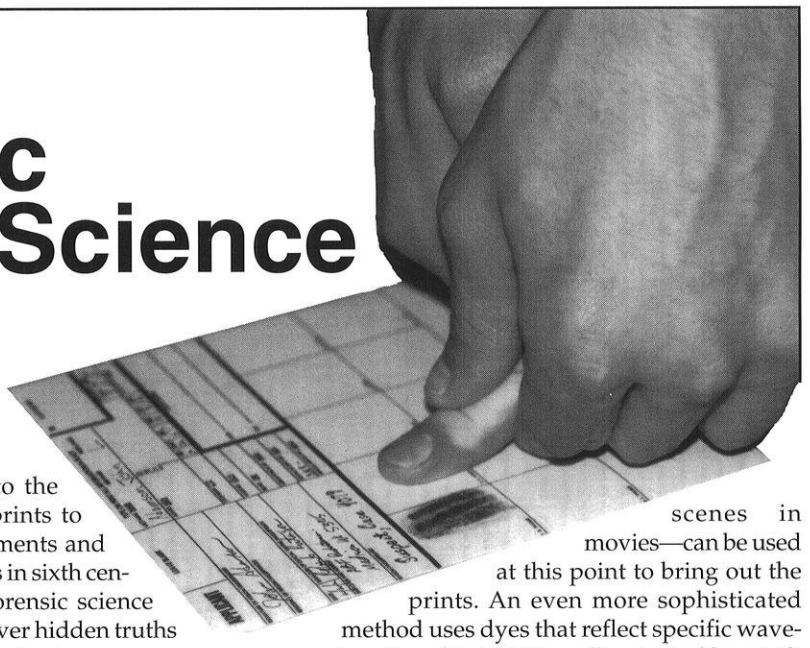
Author Bio: Bryan Ulatowski is a sophomore majoring in Chemical Engineering and minoring in Business who would once again like to thank Al Gore for inventing the Internet, without which composing this article would not have been possible.

Source: Renee Weinberger

Two monkeys relax on a limb at the Wisconsin Primate Center.

Modern Forensic Science

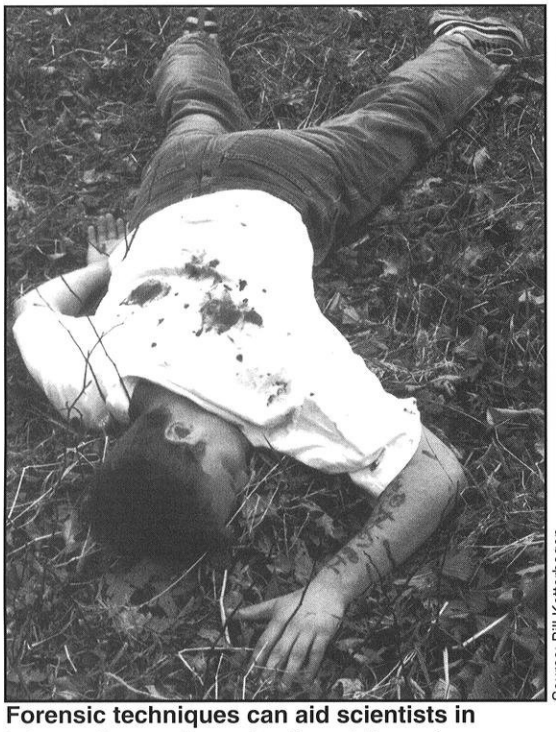
These Days, Detective Work is Anything but Elementary



By Ryan Sydnor

One gun. Two bullets. Tire tracks. Paint chips. Some broken glass. A bunch of blood stained grass and leaves-...- and one dead body. Contemplating the otherwise empty field in front of her, the investigator takes a sip of stale coffee and sighs. The corpse is the only one that knows what happened here, and he is unlikely to talk. A story lies somewhere within this grab bag of morbid items, and it is up to the investigator—along with numerous other forensic specialists—to find it.

There is a science to extracting the truth from a handful of obscure clues—minutia left at the scene that the average person would never notice. It is called forensic science, and it adds a crucial element of strength and credibility to our criminal justice system. Dating back to the use of fingerprints to identify documents and clay sculptures in sixth century China, forensic science works to uncover hidden truths behind human deeds.



Source: Bill Ketterhagen

Forensic techniques can aid scientists in interpreting and eventually solving crimes such as this fictitious murder scene.

As for the investigation we have walked into, the story begins to unfold at the crime scene itself. Investigators immediately work to develop a rough outline of the events that took place. The relative positions of the tire tracks and the body indicate that the automobile hit the victim from behind at a fairly high speed. From the footprints, they are able to tell that the other person—most likely a male—got out of the car and limped to the place where the corpse now lies, leaving a thick trail of blood. The nature of the bullet wounds and the location of the bullets show that this individual fired two shots into the victim as he lay face-down in the grass. For now, no one knows whether the gun found at the scene is the murder weapon.

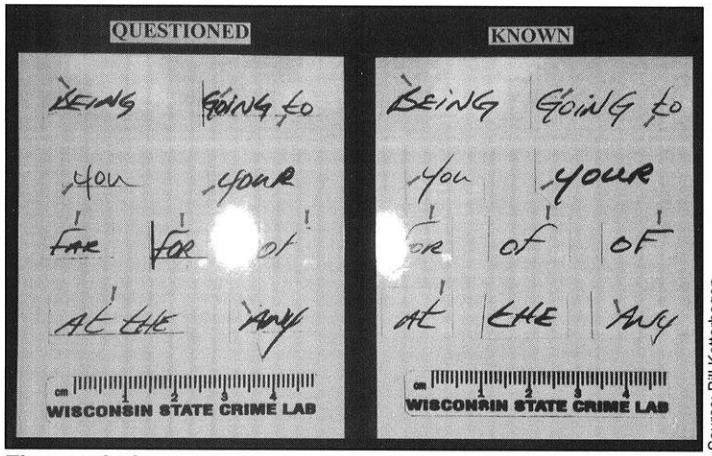
In Sherlock Holmes' days, the clarity of the situation might not have gone past this initial sketch, which is as potentially inaccurate as it is vague. The fog continues to clear at the Police Crime Laboratory, where modern methods of obtaining fingerprints surpass anything Sherlock ever used.

As Investigator Sheila Monroe of the Madison Police Department explains, "Now we have five or six different [fingerprint] tests to work with," one of which involves treating evidence with cyanoacrylate ("superglue") fumes in a vacuum chamber. The chemical adheres to the oil residues left by the person's fingers, making the prints easier to pick up. Basic dusting powder—the stuff they spread around homicide scenes in movies—can be used at this point to bring out the prints. An even more sophisticated method uses dyes that reflect specific wavelengths of light. When illuminated by an alternate light source, fingerprints (ideally) will appear as if by magic.

With no suspect in custody, there are no fingerprints to compare with those obtained from the scene. Luckily, the Crime Information Bureau (CIB) has a vast database of fingerprints called the Automated Fingerprint Identification System (AFIS), which can narrow the list of possible suspects to three or four individuals. Of course, computers cannot do all of the detective work; the final match has to be made with the human eye. A software program called Adobe Photoshop™ allows fingerprints to be enlarged and analyzed on a computer monitor—a major step up from Sherlock's magnifying glass.

Today's computer technology enables criminal investigators to do more than anyone dreamed in the days of Holmes and Watson—or even Matlock, for that matter. They can devise a computerized model of the crime scene and probable sequence of events, making it easier to visualize precisely what happened. Computers can also translate physical evidence (e.g., the tire tracks) into useful numerical data. As Monroe explains, "From skid lengths and other factors, the computer can even give a computation of the speed of the car." So we may be able to add "speeding" to the list of charges against our anonymous murderer.

At this point in the case, investigators know how the victim was killed, but they have only a hazy idea of what actually happened. The only prints found on the gun belong to the victim; so another gun was most likely used in the shooting. Having no leads beyond the physical evidence gathered, where



Source: Bill Ketterhagen

Fingerprinting and handwriting samples can provide compelling clues to help solve a crime.

do they look for the rest of the story? The State Crime Laboratory, of course—where criminal investigation truly becomes *science*.

At the State Crime Lab, one will find experts ranging from forensic pathologists to firearms specialists, all driven by the same obsessive need to find the truth. As summarized by Lucy Mormon, Supervisor of Chemistry at the State Crime Lab in Madison, "Inquiring, anal-retentive people work here." At this state-of-the-art crime laboratory, items like the bloodstained leaves, the bullets, the broken glass and the tire tracks may yield some essential answers.

First, let's consider the bullets. Firearms specialists like David Larsen know that the lands and grooves on a bullet—the marks made as it travels through the barrel of the gun—can be used as a kind of "fingerprint" for the weapon, as can the indentation the firing pin leaves on a cartridge (i.e., the ammunition casing). Over the past decade, a database called "Drugfire" has greatly augmented criminal investigation. First designed for tracking criminals involved in drug-related shootings along the east coast, "Drugfire" catalogs fired cartridges from thousands of guns. Larsen explains, "I could match a fired cartridge in Baltimore with a fired cartridge in New Orleans." This can be used to trace the route taken by a criminal at large.

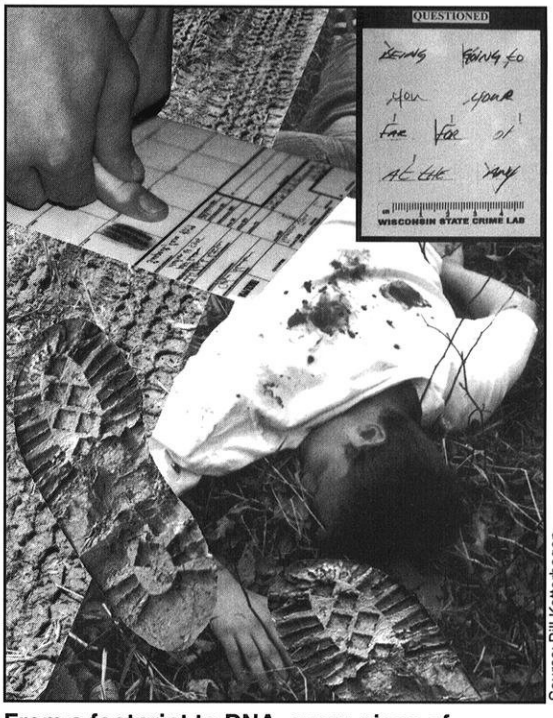
"Drugfire" is useless in the case we are following, since the evidence consists of bullets, rather than cartridges. Fortunately, experts at the Crime Lab are rarely at a loss of ideas. They fire several bullets from the gun found in the field, and then compare them under a microscope with the two bullets recovered from the scene. Clear differences in the markings on the bullets prove that another gun was used in the shooting. The search may be further narrowed by using DNA profiling, or fingerprinting, a technique brought into the spotlight during the O.J. Simpson trial. The basic process behind DNA fingerprinting begins with gel electrophoresis, which separates DNA fragments into bands according to size. To use this for identification, scientists look for certain chromosome regions with highly varying sequences of nucleotide bases, the "letters" of the DNA code. A person's genetic makeup can essentially be recorded as a unique bar code, which allows forensic scientists to find matches with great precision. Using the blood found in the field, scientists create an accurate DNA profile of the murderer.

Things finally begin to fall into place when a car and its driver are dragged out of a river less than ten miles from the crime scene. The driver's DNA clearly matches the profile made from the blood sample. A handgun is found in the vehicle's glove compartment. Using the test fire method described above, a firearms specialist links this gun with the bullets recovered from the crime scene. Tracks made across strips of paper with the car's tires seem to fit those made in the field. The car's windshield bears seven telltale bullet holes. Trace experts find the windshield glass to have the same refractive index as the fragments found at the scene. They also match the paint on the car, coat for coat, with paint chips found adhered to the victim's jeans.

To top off this growing mountain of evidence, the experts manage to lift fingerprints from the car's dashboard that correspond to those of the victim, proving him to have been in the passenger seat at some point. This is done using Small Particle Reagent (SPR), a suspension consisting of molybdenum disulfide (MoS_2), water and detergent. SPR makes use of surface tension to hold oily residues in place on a film of water. When the treated surface dries, all that remains is the MoS_2 that has bonded to the residues.

A forensic pathologist finds water in the driver's lungs, which means that he was alive when the car careened into the river. Two bullet wounds in the man's lower left side explain the trail of blood, as well as the probable cause for the accident. From the path taken by the bullets through the driver's body, along with the positions of the bullet holes in the windshield, forensic scientists can actually figure out where the other man stood as he shot at the oncoming vehicle...

As the investigation continues, the various shreds of this convoluted tale coalesce to form a picture of remarkable detail. Investigators, scientists and other specialists will continue to probe until there are no questions left unanswered and no stones left unturned. Relying on their own skills and the tested precision of modern forensic techniques, they will follow the evidence *wherever* it leads. Mormon succinctly defines the ultimate goal of these experts, and of forensic science as a whole: "Everybody just wants to get closer to the truth."



Source: Bill Ketterhagen

From a footprint to DNA, every piece of evidence leads forensic scientists closer to the truth.

Author Bio: Ryan Sydnor is a freshman majoring in Biomedical Engineering—and presently operating on about four hours of sleep. He thinks it would be cool to run across the country like Forrest Gump, but he probably won't get around to actually doing that.

Source: Renee Weinberger

The Wisconsin & Southern passenger trains will face new competition from Amtrak's high speed trains.

This Isn't Your Grandma's Train Anymore

By Katie Maloney

Can you imagine traveling from Madison to Milwaukee in one hour, and at the same time bypassing a speeding ticket? Sound crazy? Well, this wild notion will become reality as soon as 2003, due to the arrival of high-speed trains to the Midwest.

The first steam locomotive, introduced in 1804, achieved a speed of five miles per hour, and the first passenger train, introduced in 1825, reached speeds of sixteen miles per hour. The new high-speed trains will far exceed those speeds. High-speed trains for the new rail network will travel at a maximum of 110 miles per hour, bringing rail travel in the Midwest into a new era of transportation.

The new rail network will cross nine states and spread 3,000 miles with the main hub at Chicago's Union Station. The total cost of the project is estimated to reach $4.1 billion total, $625 million of this going towards new train sets.

According to Ron Adams, director of the Bureau of Railroads and Harbors for the Wisconsin Department of Transportation, the new trains will either be Diesel Multiple Units (DMU's) or diesel locomotives. DMU's use much smaller diesel engines than the conventional locomotive, and each diesel motor is designated to an individual passenger rail car.

"A couple of years ago a subsidiary of Daimler Chrysler brought a DMU to the United States," Adams said. "They had three-car sets that were interconnected with two engines on the front car and then two on the back car. The four diesel engines were like bus engines and provided sufficient power to bring [the train] up to 110 miles per hour."

In contrast, the diesel locomotive contains a single engine that provides all power for the train. The locomotive engine is held in a single car not carrying passengers. The engine is responsible for pulling or pushing a train or individual railroad cars. "In Wisconsin, the locomotive will be 'push-pull,' where you don't have to switch cars or turn the train around," Adams said. "There may be an additional engine on the back of the train, or the conductor may have controls that can control the train in the opposite direction." DMU's also have the ability to travel in the opposite direction.

Whether the Department of Transportation will use DMU's or diesel locomotives is still undecided. At this time, the steering committee for the Midwestern Rail Initiative is in the process of putting together specifications for high-speed trains in the Midwest, such as desired speed and specific types of equipment. Adams said the committee will place these specifications in a proposal due out in May. Once the proposal is available, companies may bid for the project. "It's [the companies] decision what they want to offer to meet our specifications," Adams said, explaining that companies will vary in their decisions to propose DMU's or diesel locomotives.

There are advantages and disadvantages to both styles of trains. "The DMU unit is lighter and they don't need as much horsepower," Adams explained. "And the engines are lighter. Those three cars [brought by Daimler Chrysler] weighed less than the conventional locomotive."

'The difference between the two trains (DMU's and diesel locomotives) is kind of like the difference between a Cadillac and a Honda...They both have air bags to protect you, but some people just feel safer in a Cadillac'

DMU's are more adaptive than diesel locomotives if there is a failure in an engine. Adams states, "With several engines, if one engine fails, another engine can compensate and the train will pretty much go at max speed." However, if there is an engine failure in a diesel locomotive, there is no other engine to compensate.

On the other hand, some people feel safer riding a diesel locomotive. "It's larger. Some people believe it is safer because if it hits another train, it hits on equal footing, so to speak," Adams said. "The difference between the two trains is kind of like the difference between a Cadillac and a Honda. They both have air bags to protect you, but some people just feel safer in a Cadillac."

The Federal Railroad Administration has a Crash Energy Management System that re-

quires certain safety requirements for trains in an attempt to protect passengers if a train did collide with another object. "Some parts of the DMU's will not have seating, so this part will crumple if the train collides," Adams explained. "Energy will be absorbed in this location instead of absorbed by passengers," he said, explaining that this will prevent passengers from being violently shaken on impact. The diesel locomotive also has crash energy components to prevent passenger injury. In this case, the component is located in front of the locomotive engine and in between each passenger car.

Despite the final decision to use DMU's or diesel locomotives, the train will include bogies, locomotive undercarriages with wheels that swivel in order to negotiate curves, that differ from traditional bogies. "The typical set of bogies have wheels on the outer edge that are always trying to derail on a curve," Adams explained. "Without a solid axel, those wheels are free to move at different speeds. Instead of rubbing against the rail, the wheel stays on the radius [of the curve]. Engineers are trying to design bogies like this because you can't have conventional bogies on a high-speed rail system. This is an option manufacturers can offer."

Track design will also contribute to the success of the high-speed train. "The equipment is just one side of things, but the creation of track structure is as important," Adams explained. "We want to be sure the track can be maintained at a reasonable cost and that it can support a train moving at high speeds."

In order to support a fast moving train and reduce maintenance, the tracks will consist of a continuously welded rail along with concrete ties laying on thick beds of ballast (gravel placed under the ties). Engineers will use concrete to increase the ties' longevity and will also use new fasteners to keep the track in place. "The conventional fastener is not designed to hold the track against the railroad tie. It is the weight of the train that keeps it from moving up and down," Adams explained. "The new fasteners put pressure on the rail and hold the tie in place." The new fasteners also eliminate the need for rail anchors, which are used in conventional rails to force the rail to remain stationary. The continuous rails will allow trains to operate more quietly with less vibration because of better ballast.

Again, specific details for all aspects of the project will depend on the manufacturers of the product who win the bid for production. "We will score the various proposals against certain criteria we put together to determine which manufacturer wins the bid," Adams stated. "Our goal is to sign [an agreement with a manufacturer] by August or September."

It will be a few years before the new trains come speeding into the area, but they are coming. And when they arrive it may be just the beginning of a new era of Midwestern transportation.

Author Bio: Katie Maloney graduated in May 2000 with a degree in life science communications.

Source: Renee Weinberger

Source: Renee Weinberger

Passenger trains have been evolving in the minds of engineers from the existing passenger trains to newer and faster passenger trains which will change the tempo of commuters.

Are You Ready for Some Baseball?

Miller Park: The New Home for the Brewers and a Stadium for the Future

By Tanim Hossain

The day that many Brewers fans have been waiting for is drawing very near. Miller Park, scheduled to open for the 2001 season, will be the new residence of the Milwaukee Brewers, who will bid farewell to County Stadium, their dependable abode of over 47 years. Travelers along I-94 can marvel at the masterpiece, indulging themselves in images of next summer, with the Brew Crew hitting home runs over a new wall and ushering in a new era for baseball in Milwaukee.

The $500 million project has been designed as a modern, state-of-the-art ballpark, while at the same time creating a familiar and nostalgic atmosphere. The brick façade reflects the traditional Milwaukee architecture of the late 19th and early 20th centuries, adding a homey, but sophisticated feeling. Miller Park has also been designed as a "ballpark within a park," which is another innovation. Picnic areas, natural landscape and a memorial to County Stadium, which is scheduled to be demolished, will surround it.

On the modern side, Miller Park will boast a fan-shaped retractable roof -- the only one of its kind in North America. It will weigh 12,000 tons and will take approximately 10 minutes to open and close. The ability to keep the roof open allows for a natural grass playing surface. Seating 43,000 fans, the stadium is designed to emulate a split-bowl with 5 different levels, bringing the audience closer to the action on the field.

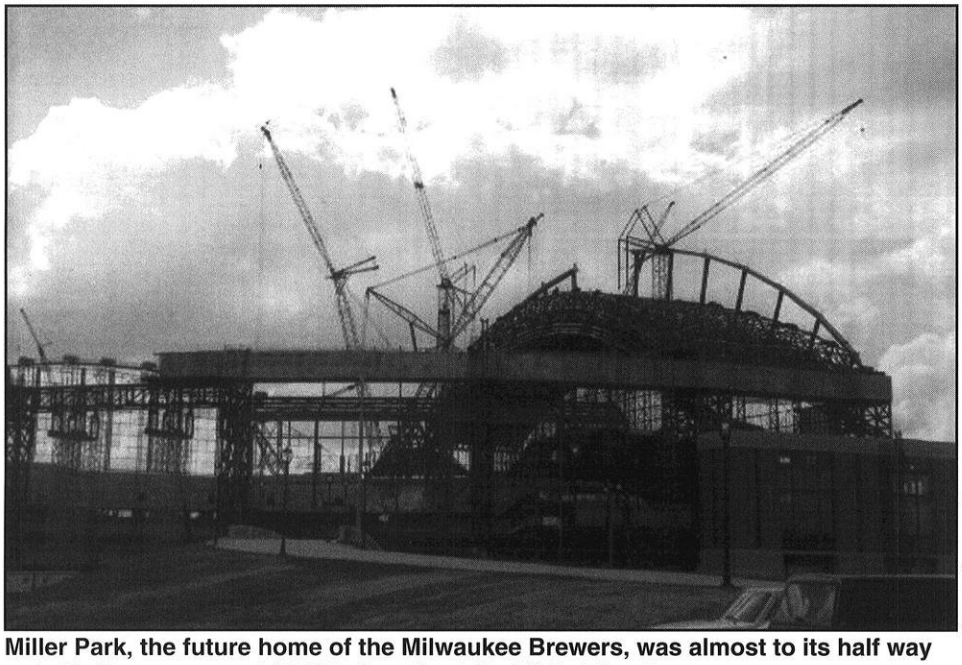
The construction process also includes infrastructure work, such as roads, bridges and parking lots. As a nice bonus, there will be a building for tailgating, so the rain (or snow perhaps) will never ruin plans for cookouts. But it doesn't stop there. There are also plans to make decorative improvements on the Menomonee River, by remodeling bridges and overpasses. The river will also be enhanced.

Those responsible for the making of the ballpark include the design teams of HKS Inc. of Dallas, NBBJ of Los Angeles and Eppstein-Uhen Architects of Milwaukee. These teams of architects will join the construction engineers of HCH Miller Park Joint Venture team, consisting of Clark Construction of Chicago; Huber, Hunt & Nichols of Indianapolis; and Hunzinger Construction of Milwaukee. This unification of different firms will give rise to a gorgeous finished product.

When completed, Miller Park will weigh 500,000 tons, making it the heaviest structure in Wisconsin. It will consist of 25 miles of deep piles, 70,000 cubic yards of concrete and 24,000 tons of steel. The roof will measure 10.5 acres, and the park itself will take up a whopping 1.1 million square feet.

Since groundbreaking on November 9, 1996, progress had moved at a steady pace, and Miller Park was set to open last April. However, on July 14, 1999, tragedy struck. "Big Blue," the crane used to set the roofing in place, collapsed, killing 3 workers and injuring 5 others. This was a devastating blow to the community and to the project as well. Completion was set back another year, and the federal Occupational Safety and Health Administration (OSHA) levied fines that totaled $539,000. In addition, the repair and clean-up cost $5.9 million.

These troubles were big roadblocks to the project, but with hard work, they have been cleared. The project is headed for completion without a hitch. With about 80% finished, Brewers fans can look forward to Miller Park in April of 2001. None of this would be possible if not for the collaboration of engineers, architects, politicians and taxpayers. This unification will definitely not disappoint; Miller Park will be a beautiful ballpark that the state of Wisconsin will surely be proud of.



Source: Grayson Harms

Miller Park, the future home of the Milwaukee Brewers, was almost to its half way point in the summer of 1999 before the fall of "Big Blue."

Author Bio: Tanim Hossain is a sophomore majoring in electrical engineering.

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Shake, Rattle and *Roll*:
New Technologies Make Structures Earthquake Resistant

By Amy Dohlman

It is pitch black and three o'clock in the morning. Your house is shaking, book cases are collapsing, pictures are falling off walls and dishes clatter to the floor. You wonder if your home will remain standing. Earthquake! In Wisconsin? Maybe not, but more than 20,000 fatalities in Turkey's 1999 quake shows the need for better designed buildings. How can such catastrophes be averted? The answer lies in structural engineering—using new technologies to make buildings earthquake resistant.

Why do structures collapse in the first place? Structural failure can be traced to several factors. Buildings most susceptible to collapse are those that contain "soft stories"—stories that lack enough supporting walls and have large areas of open space. Many of the buildings in Turkey were full of such soft stories. Another factor figuring into structural collapse is the foundation—surprisingly, buildings are sometimes built upon liquefied sediment that is more prone to settle during quakes. Other structures such as roads and bridges can be weakened by erosion and weathering.[1]

Source: Izmit Collection, Earthquake Engineering Center, Univ. of Cal, Berkeley

Picture of the aftermath in Turkey.

One method of reinforcing bridges involves fitting them with carbon composite jackets, reinforcing areas that need it. These jackets are comprised of carbon fibers continuously wrapped around supportive hoops and can be thought of as analogous to fiberglass, although much stronger. They wrap around bridge girders, correcting weakened areas. Such jackets are stronger than steel, more durable and less labor intensive than traditional steel jackets. Other advantages to carbon composite jackets are that they are unaffected by corroding agents such as water and alkalis and that they can provide greater flexibility during the intense shifting in earthquakes. This "jacket method" was used to retrofit six columns of Interstate 5 in California, strengthening them to withstand that area's frequent earthquakes. The historic Arroyo Seco Bridge in Pasadena also plans to make use of these jackets.[2] Wisconsin, a state plagued by road deteoriation due to salting and snow removal, could benefit greatly from this sort of technology as many of its bridges are damaged and in need of repair.

Source: Izmit Collection, Earthquake Engineering Research Center, Univ. of Cal,Berkeley

Scenes like this from the 1999 Turkey earthquake have given researchers more incentive than ever to develop better earthquake-resistant structures.

An approach to making buildings safer involves the use of pre-cast concrete structures. These structures involve the use of concrete modules that are poured and cast off-site, then transported and assembled through the use of bolts and steel rods. Although viewed as a "house of cards" in the past, pre-cast structures now gain stability due to high

Source: Izmit Collection, Earthquake Engineering Center, Univ. of Cal, Berkeley

Yet another picture of the treacherous aftermath in Turkey.

quality steel rods within the concrete that act as "capacitors," limiting the load to the system while maintaining structural integrity. Bolts holding the structure together also transfer any shear stresses through friction.

Another advantage to these buildings is that much of the work can be done off-site at the casting facility. Once the portions are cast, the structure can be quickly assembled on-site. Such technologies have been used to construct parking structures in California, with further applications for the high-rise building market.

More than 20,000 fatalities in Turkey's recent earthquake shows the need for better designed buildings

Since these buildings can be cast off-site and assembled quickly, they can eliminate much of the construction costs of site preparation and work. A parking structure using pre-cast technology was built in Los Angeles for $3.6 million, resulting in a very cost-effective structural price of only $14.10 per square foot, proving that these structures can be both safe and economical.[3]

A second method known as structural isolation can also be applied to buildings to keep them standing. Such methods have been used on the Parliament Buildings in Wellington, New Zealand. The process seems simple: the buildings were first removed from their foundations, shock absorbing rubber pads and giant springs or bearings were inserted into specially drilled holes, then the structures were re-settled and any gaps filled. These bearings allow the building to freely move several inches in the event of a quake, counteracting shaking movements and remaining stable.

Similar technology has also been used in the country's national museum, Te Papa, which was built for a mere $15 million, including costs of incorporating such earthquake-resistant technologies. Since the buildings are isolated from the ground, they are able to avoid much of the structural damage involved in earthquakes. Many buildings in Wellington are built upon a seafloor drained earlier in the last century. These buildings may be especially prone to sediment settling and could use similar structural isolation techniques.

Although all U.S. cities have strict codes to ensure that buildings are safe, other countries do not. Some of these countries, like Turkey, rely on Western firms for construction, calling into question these firms construction at home. Turkey's construction codes have mirrored those in the United States since the 1970s, so the damage there is doubly scary.

Could such catastrophe happen here? Even areas as technologically advanced as Taiwan are susceptible to building collapse—the September 21 quake there killed 2,300 people when approximately 10,000 buildings collapsed.[1] Since many buildings in both countries collapsed due to questionable construction techniques used by seemingly advanced construction firms, it is imperative that engineers find ways to build strong, safe structures that are still economical. Our lives depend on it.

[1]Hays, Walter W., Amar A. Chaker and Craig S. Hunt, "Learning from Disater," Civil Engineering, Dec. 1999, p. 28-35.

[2]Cercone, Larry and James Korff, "Putting the Wraps on Quakes," Civil Engineering, July 1997, p. 60-61.

[3]Englekirk, Robert E., "An Innovative Design Solution for Precast, Prestressed Concrete Buildings in High Seismic Zones," PCI Journal, July-August 1996, p. 44-53.

Author Bio: Amy Dohlman is a senior at the University of Wisconsin-Madison. She has also visited Wellington, New Zealand, and although she slept through a four-pointer there, she prefers to live where the earth doesn't move.

Chemistry and Art: Two Dueling Forces Bring Color Back to Our Lives

By Soma Ghorai

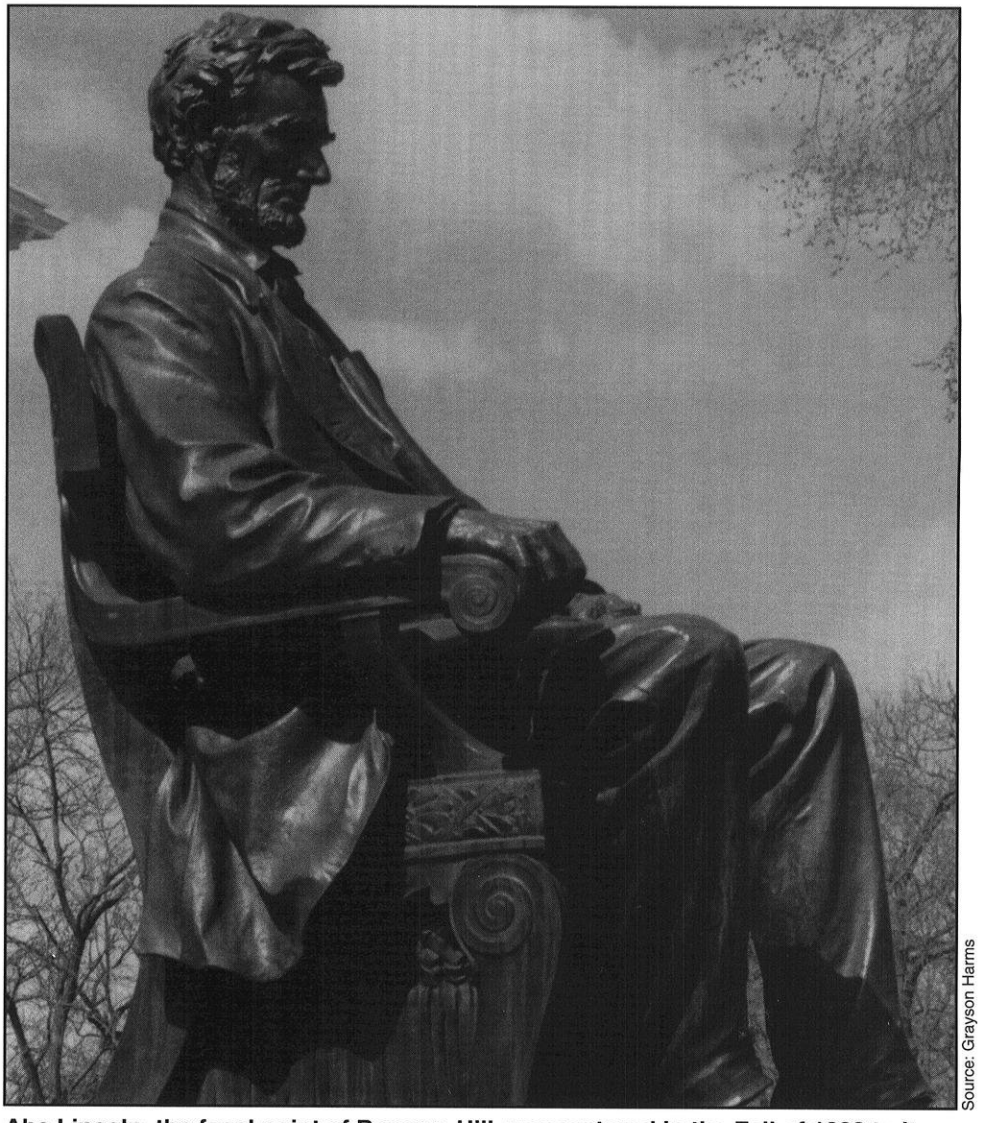
Aristotle once said, "Art takes nature as its model." Whether the art is an ancient Greek sculpture, Monet's impressionistic gardens or Jackson Pollock's crazy canvases, something in nature was the model. For this reason, we have been able to learn about the world's cultural history in other ways besides reading what a historian wrote. For example, researchers can learn much about the ways of ancient Greeks from studying their art. Unfortunately, ancient art may be reflecting too much of modern nature. With pollution a never-ending concern in many areas of the world, the life of art pieces is being reduced. Everyday weather also helps in speeding up the deterioration of art.

Fortunately, new research is being done on art restoration. One important group based in Italy, the University Consortium for the Study of Large Interface Systems (CSGI), has been studying supramolecular and colloidal systems in industrial applications. Their research has helped find ways to restore art, specifically frescoes, and has also been helpful in studying the chemical changes that take place on stone and fresco surfaces.

"We shape our buildings, thereafter they shape us." Winston Churchill referred to the lasting effects a building has on society. One way people brightened buildings was to paint pictures directly on the building's surface. These types of paintings are called frescoes. A fresco is made by first applying a layer of paste made of calcium hydroxide ($Ca(OH)_2$) to the building's surface. While the surface is still wet, the artist paints on it. Over the next few days, the $Ca(OH)_2$ will react with the CO_2 in the air and become calcium carbonate ($CaCO_3$). The paint pigments are trapped in the structure of the $CaCO_3$ crystals. Since frescoes are usually painted on a building's outside surface, the paintings are subjected to sunshine, rain, pollution and people everyday. This type of treatment speeds up the deterioration of frescoes.

Frescoes degrade because of the crystallization of nitrate salts on the building. The salt crystals form and press against the pores in the stone. This causes the size of the pore to increase, which weakens the stone. Large pores in stones make them more fragile and easy to break. These nitrate salt crystals further degrade the fresco by breaking the crystal lattice of $CaCO_3$. These salt crystals have a lattice that is twice as big as the lattice of $CaCO_3$. As the nitrate salt crystals grow, the $CaCO_3$ crystals burst to make more room for the salts. Since the paint pigments are trapped in the $CaCO_3$ crystals, when they burst, the colors are also lost.

"Art washes away from the soul the dust of everyday life." This is how Picasso explained the importance of art to many people. In the same way art washes the dust



Source: Grayson Harms

Abe Lincoln, the focal point of Bascom Hill, was restored in the Fall of 1999 to its original glory.

of everyday life from our souls, chemical engineers are researching ways to wash away the dust of everyday life from the frescoes. Before the 1970s, the fresco was very carefully removed from the wall and reattached to a polymer support. This worked fairly well, but art restorers wanted a method that did not involve removing the fresco from the wall.

In 1970, Enzo Ferroni developed such a method. First, Ferroni applied a saturated solution of ammonium carbonate ($(NH_4)_2CO_3$) on the surface of the fresco. A chemical reaction occurs that reforms the $CaCO_3$ and produces ammonium sulfate ($(NH_4)_2SO_4$). $(NH_4)_2SO_4$ is water-soluble and can be washed away. Then, a barium hydroxide ($Ba(OH)_2$) solution is applied to the surface. Barium sulfate ($BaSO_4$) and carbonate crystals are created. These crystals fill the holes that were created when the small $CaCO_3$ were reformed. Filling in the holes helps strengthen the fresco. The only disadvantage to this method is that it leaves behind $BaSO_4$, a component not present on the original fresco.

The researchers at CSGI are looking for another way that will restore the fresco to its original chemical composition. One method they have developed involves the use of an alcohol with a lower surface tension than water. A stable dispersion of $Ca(OH)_2$ is made using this alcohol and is spread over the fresco. The dispersion reacts with the CO_2 in air and converts $Ca(OH)_2$ to $CaCO_3$. The reaction also removes the nitrate salts from the fresco. Since this is the reaction that was used to create the fresco, the fresco is restored to its original composition. This method is still being tested before it is used on actual frescoes.

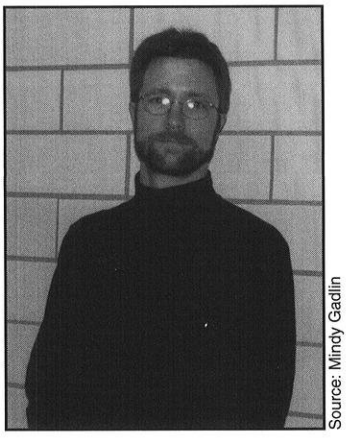
"Art is the appearance of an idea." Hegel-Schiller explained how a single piece of art can represent something large and vague. The University of Wisconsin-Madison, for example, has a statue of Abraham Lincoln. Since the early 1900s, this statue has represented the ultimate goals and values of this university. Unfortunately, these ideas have been obscured by weather, pollution and graffiti. For the past 90 years, acid rain has been corroding the statue of Lincoln. Small details and facial features were the first to go. The bronze color was also transformed into a streaky green and black color.

In September of 1999, Abe got a good cleaning. Cameron Wilson, a well-known art conservator, spent a week cleaning and restoring Abe. First, Wilson removed corrosion from the statue with detergent, mineral spirits and medium-pressurized water. This cleaned the statue, but did not strip the statue down to bare metal since some of the corrosion agents had become stable and actually will protect the statue from further corrosion. Wilson also applied chemicals to help rid Abe of his streaky complexion. To help Abe maintain his new clean appearance, two coats of hot wax with a corrosion inhibitor will be applied once a year.

"As the sun colors flowers, so does art color life." Now that Abe is back to his original appearance, everyone at UW-Madison can enjoy his color. Some people might not realize the importance of preserving old pieces or art, and instead focus on the new. But the old pieces of art bring integrity and cultural history to our lives. Hopefully, chemical engineers will continue to research ways to preserve art so the future will be able to enjoy what we have today.

Author Bio: Soma Ghorai is looking for more ways to express herself creatively. She has tried body art, interpretive dance, stand-up comedy and other such normal activities. Now, she just wants to sleep.

Being John Booske



Source: Mindy Gadlin

By Meena Vairavan

On Friday afternoon, you are sitting in your last lecture of the day. You weren't even planning to show up, but you happened to be in the general vicinity of engineering, and the good student in you could not be quieted. Have you ever thought about your professor having the same feelings? Is there an actual person behind that lecturer? There can't be! Wait, what if there is?

I had the opportunity to speak with John Booske, the person behind the electrical engineering professor at the University of Wisconsin-Madison. I asked him a few questions to introduce him to those who have not met him and to better acquaint him with those who have already had the pleasure. I fall in the latter of those two groups and feel that he is one of the most accomplished and talented professors here at UW-Madison. He has a lot to offer both as a mentor and as a teacher.

John Booske was born in Lancaster, Pennsylvania, where he led a lively childhood. He fondly remembers spending summer afternoons in pickup games of basketball, football and soccer with other children in the neighborhood. This interaction was important because it shaped his ability to interact with his peers. He feels mildly disappointed that today these activities are more often organized than spontaneous.

One member of his family that played a significant role in his childhood was his grandfather. Professor Booske has fond memories of fishing with him or joining him for long walks and meaningful conversations. There were times when he would mercilessly ask his grandfather questions until he had no more answers. Some words of advice from his grandfather that he still tries to live by are to never stop asking questions.

Currently, he enjoys many hobbies. When he is not working or involved in community activities, he prefers to spend quality time with his wife and two children. He also enjoys reading, listening to music, volunteer service (especially if it involves his children's activities such as coaching soccer teams), acting as a stroke-and-turn judge official in Wisconsin and swimming, although he claims that this is more of an attempt at sanity preservation than a hobby. Other hobbies include a little bit of gourmet cooking and traveling with his family.

He also has goals for himself. One of them is being the best that he can be without letting perfectionism overcome him to the point of compromising something that is of value to those around him. He wants to become as knowledgeable as he can in those areas for which he has a particular opportunity to gain unique insights.

Interesting Facts about John Booske

Favorite Color: Blue

Favorite Music: He likes all sorts like jazz, contemporary rock and classical. He could, however, do without heavy metal and rap.

High School/College Sports: In high school, he swam, played water polo and had the potential to go out for varsity wrestling and soccer but chose to focus on swimming and water polo. He continued his water sports in college but stopped when the constant practice time started to interfere with his engineering studies.

Source: Mindy Gadlin

Professor John Booske is busy, as usual, working on one of his research projects.

Also, he feels it is important to be a good husband and parent. Finally, he would like to be someone that people will look back on and be pleased to have associated with.

Along with the goals he sets for himself, he is concerned about the success of students.

Some of his advice is as follows: "It is an exciting time to be involved in the electrical engineering profession in particular, and engineering in general. Success in this field is a worthwhile goal. Success in engineering, however, requires a large time commitment, and some students have an unfortunate practice of underestimating just how much time this takes, until it is too late. In general, the field requires mastering not only a concept-based intuition, but also a fluency in one or more abstract 'languages,' usually mathematical in nature. In addition, it matters to acquire this mastery in a 'context' of thinking about the big picture— not only how to design something, but issues of cost, alternative ways of solving the problem, quality of life, ethics, designing to be manufacturable and safe, etc. And still there is responsibility to get the details precise, as well as the big picture and concepts, since the details often are what determine the success and safety of an engineering project."

Now that we have gotten to know Professor Booske, we can now see that he is not only a distinguished instructor, but also an invaluable resource to students here at UW-Madison.

Author Bio: Meena Vairavan is one of the three females majoring in electrical and computer engineering. Her hobbies include tennis, listening to music, hanging out with friends and basically anything that doesn't include studying. Hopefully, she'll graduate next May. Keep your fingers crossed!

The FutureTruck 2000 Challenge

By Lynn Weinberger

When you think of a sports utility vehicle or SUV, what comes to mind? For me, it's rugged durability, towing boats and camping. Certainly fuel efficiency doesn't come to mind, as SUVs are notoriously inefficient. But what if you could have all that rugged durability and get 25 or 35 miles to a gallon just like a compact car today?

That's just what Team Paradigm, a team of University of Wisconsin-Madison students and the winners of last year's FutureCar Challenge, are trying to do. Last year, they made a Ford Taurus get 65 miles to the gallon. Now they have a new challenge—to make a Chevrolet Suburban fuel-efficient. Team Paradigm nicknamed their Suburban the Moollneium Cow. They're trying to make the truck get 30 miles per gallon rather than the Suburban's current 12 miles per gallon.

The goal of the FutureTruck Challenge is to make SUVs fuel-efficient. The U.S. Department of Energy and General Motors are sponsoring the challenge. As part of it, fifteen schools are given a truck, which will be compared to an unmodified stock truck of the same model in competition. The truck is a year 2000 Suburban and the mileage goal is 35 miles per gallon.

The teams competed at a national competition in Mesa, Arizona, this summer. They went through a series of tests, including towing a 7000-pound trailer, and various speed and acceleration tests. The trucks were judged in terms of appearance and, most of all, fuel efficiency.

The members of Team Paradigm all feel that fuel efficiency will increase in importance in years to come, and they like being able to work on the problem. Team leader Jenny Topinka, a mechanical engineering student, said that when she got into the college of engineering she didn't really know what she wanted to do, so she decided to find a project to work on that would make her feel more involved. When she first started, she "didn't even know what a ratchet was." Now, she is the team leader and says that she can't imag-

Source: FutureTruck Team

This a Team Paradigm with the FutureTruck.

ine not being part of the team.

Ethan Brodsky, controls group leader and an electrical engineering student, said, "I get to see my work make a difference... You can go through school and do work in classes and you get grades but it doesn't mean anything to anyone because it's all been done before. When you do FutureCar [or FutureTruck], you're doing something that's never been done before and it's something that makes a difference and that's really satisfying."

Brodsky's original reasons for joining, however, were not as eloquent. His original motivation to participate in the FutureCar and FutureTruck Challenges was because the kickoff meeting had pizza. His other motivation was because he, "wanted to learn to weld," something that electrical engineers typically do not do. However, he still hasn't welded yet.

According to Topinka, there are two keys to making the Suburban fuel-efficient. The first is a hybrid electric drive train and the second is a lighter vehicle. Combined, these two keys will contribute to a better fuel efficiency.

The first key, a hybrid electric drive train, uses a diesel engine and an electric motor in combination. Whereas the typical diesel engine just uses one engine. The inefficiency in using one engine is that the engine is constantly running, even when the car is merely coasting. A truck needs two different levels of energy. One of these levels is a high-energy boost when it is accelerating to give it the power to go faster. The second level is lower energy for maintaining a constant speed.

That's where the hybrid drive train comes in. Rather than using one engine running at the same energy level, burning excess fuel when maintaining speed, a hybrid drive train uses two separate power sources for each level of power needed. When the truck is accelerating with that high-energy boost, it uses both the motor and the engine. When it maintains speed, it uses less energy and only the engine.

Since there is a motor to assist the engine, a smaller engine can be used rather than the V8 diesel engine found in a regular Suburban. Now, they can use a 2.4-liter diesel engine. This smaller engine uses less fuel than a full-sized one, contributing to the Suburban's increased fuel efficiency.

The assisting motor is electric, meaning that it does not consume any fuel. A straight electric vehicle would need to be plugged into a power source to charge its batteries periodically. In contrast, a hybrid vehicle would never need to be plugged in because it charges its own batteries. These batteries power the motor through regenerative braking.

Regenerative braking means that when the truck is braking, it takes the energy that the car loses by slowing down and translates that into electricity. That electricity charges the batteries that power the motor. When the driver decides to accelerate, the motor draws energy from the batteries to assist the engine. Eventually, the car brakes and charges the batteries. This works like a loop to keep the batteries charged and to reuse already present energy. Reusing energy also adds to the fuel economy of the vehicle.

Some of the electricity for charging the batteries is diverted to power the computer. This computer is in addition the truck's original built-in computer, and the additional computer tells the motor when to assist the engine. When the driver presses down on the accelerator, a wire attached to the accelerator sends a signal to the computer. The computer then turns on the motor to assist the motor.

The computer also runs a touch screen installed in the dashboard. The screen lets the driver monitor the truck's energy use. For instance, if the driver accelerates the vehicle, the screen tells him that the truck was using both the motor and the engine. If he brakes, the screen tells him that he was recharging the batteries. If he just drives along the highway at a constant 65 mph, the screen tells him that he was only using the diesel engine.

They're trying to make the truck get 30 miles per gallon rather than the Suburban's current 12 miles per gallon

Brodsky says that the computer "controls and assists in regenerative braking in response to driver inputs, manages battery state of charge and provides diagnostic information and data logging capabilities for the entire hybrid drive train."

In addition to the hybrid drive train, the FutureTruck achieves fuel efficiency weighing less than the typical year 2000 model Suburban. Last year, Team Paradigm managed to make the FutureCar, a 1999 Ford Taurus dubbed the Aluminum Cow, 600 pounds lighter than the stock car.

Using aluminum rather than steel in the frame can make the vehicle lighter. Most vehicles use steel for their frame. The frame is like the bones of the car. Steel is typically used in the automotive industry because it's so strong. However, steel is also heavy, and the heavier a car is, the more energy it needs to run. In contrast, a lighter car would use less energy and therefore be intrinsically more fuel-efficient.

On May 31st, Team Paradigm traveled to Mesa, Arizona, to compete in the FutureTruck 2000 Challenge. They placed 5th overall, taking home 1/3 of the individual awards. These awards are:

Best Technical Presentation
Best Design Inspection
Safety Award
Best Teamwork
Most Innovations in Aluminum
Best Workmanship

Jenny Topinka, team leader, said, "We had difficulties/failures of various components, and therefore missed many important events. Luckily, we got 1st place on all the design events, so we still got 5th place... not too bad for not running until the last couple dynamic events.

"In a nutshell, we had various problems, everyone stood together, we pulled through and did get our vehicle running for the last few dynamic (moving) events. Weplaced competitively in those dynamic events. We did very well on most of the static/design events.

"We will do testing throughout this year. We plan to perfect and test our design so we have a more reliable vehicle next year."

More specifically, for every hundred pounds you can take off the vehicle, it gains one more mile per gallon. While one mile may seem small, if you can take off hundreds of pounds, the difference adds up and you have a more efficient vehicle.

Since the FutureTruck must remain the same size in terms of length, width and height as the stock truck, they cannot make the truck itself smaller. However, they can use a metal that is lighter than steel in the frame construction and therefore reduce the truck's overall weight. Team Paradigm's alternate metal is aluminum.

Aluminum weighs half as much as steel; however, it is not as strong as steel. In order

to maintain the same strength of steel in the frame, the shape of the frame must be altered. A typical steel frame is made of c-channels. C-channel is the shape of the metal, and it looks like a square pipe that is bent with the top of the pipe removed. The aluminum version of the frame uses two c-channels that overlap each other. This is called a box channel. Along the sides of the frame, there are two layers of metal, whereas in the steel frame there would only be one. By altering the shape, the aluminum can be made to have the same strength in crash tests as steel.

Another way that aluminum is made stronger is by heat-treating it. Heat-treating means that the aluminum is heated up to a certain temperature and then cooled in a controlled manner. This process makes the aluminum more rigid and even stronger.

To make the truck weigh even less, lighter weight seats can be installed. In the FutureCar, dubbed the Aluminum Cow, the team installed lightweight seats that had black and white spots like a cow. This year, however, there will be no cow spots because one of the goals of the challenge is to make the truck look and feel just like any other truck so that the driver barely notices the difference between the hybrid truck and a standard truck.

By the year 2004, federal law mandates that all cars be more fuel-efficient. In response, the big three American car companies, General Motors, Ford, and Daimler-Chrysler, are all designing mid-sized cars that use the hybrid electric drive train and the technology developed by the FutureCar teams.

The next step in energy conservation is fuel-efficient trucks. Team Paradigm is working hard to do just that by making a Suburban

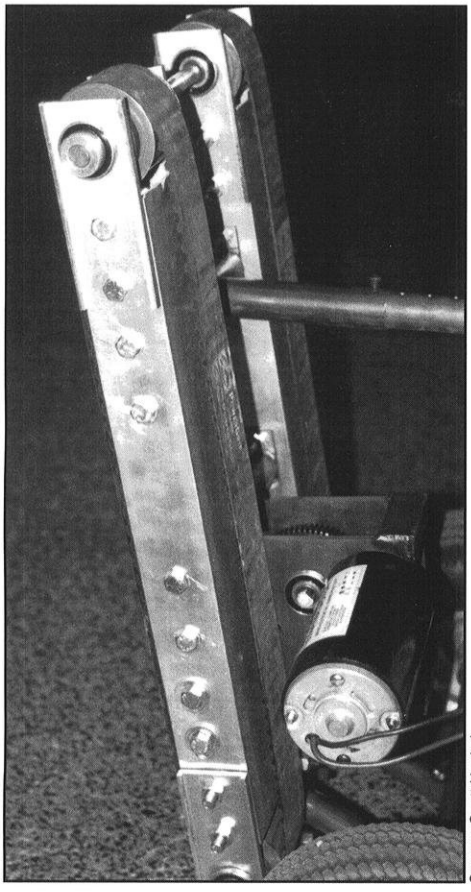
Author Bio: Lynn Weinberger is an English major who hopes for a cleaner environment. She would love to drive a more fuel-efficient vehicle. Thanks to Jenny Topinka, Ethan Brodsky and Julie Marshaus for interviewing with me for this story.

Contesting Engineer

By Dugan Holtey

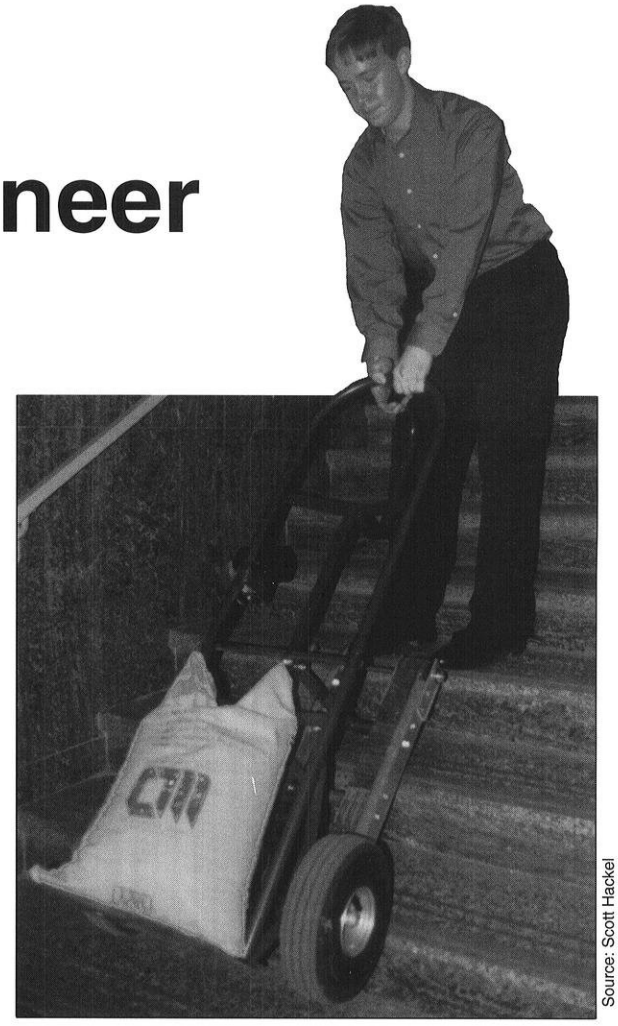
Over $150,000 has been given away at "The Schoofs Prize for Creativity" in the last six years of the contest. At the end the contest, judges award monetary prizes to the undergraduate engineering students who invent the most original, useful and marketable product. "The Schoofs Prize for Creativity" contest takes place every year around the celebration of Thomas Edison's birthday at the University of Wisconsin-Madison engineering campus.

Eric Wobig, a veteran contest winner and fifth-year senior in mechanical engineering at UW-Madison, won over $21,000 in the last three years from the Schoofs invention contest. This year, 24 inventions competed in the contest, and Eric claimed second place ($7,000) with his StairCrawler, a modified two-wheel hand truck used to carry heavy loads up stairs. Every year he competed, Eric's walked away with first prize in the Tong Prototype contest, a prize of $2,500, which is included with his $21,000 total.



Source: Scott Hackel

The mechanism that may someday put the StairCrawler on store shelves everywhere works like the tracks on a tank.



Source: Scott Hackel

Eric Wobig demonstrates his award winning, work-saving, StairCrawler.

The first time Eric participated in the Schoofs contest, he and his companions Brie Howley and David Waters won the first prize of $10,000 with their invention the Turbo Mule. The Turbo Mule was a human-powered vehicle capable of transporting up to 1,500 lbs. of material in industrial plants.

The following year, Eric took third place ($4,000) with his own invention called the AirLift. This device was designed to help those confined to a wheelchair to reach things in the house that would otherwise be impossible to retrieve. The AirLift is just a contraption made up of two metal plates "sandwiching an inflatable bladder and placed in the seat of a wheel chair." A control on the wheelchair's arm allows the user to inflate the bladder six inches allowing him or her the possibility to reach a can on a shelf.

How is an engineering student capable of creating three winning inventions in a row? Don't engineering students have enough homework and projects to do already? So for you future Schoofs inventors out there or those who just want to know how one goes about inventing award-winning creations in a limited time period, here is how Eric did it.

The contest is held every year at the beginning of February, and Eric's concept for the StairCrawler came to him the preceding summer. The StairCrawler concept stemmed from the $50 billion a year problem our country has with work-related back injuries. Eric thought of roughly 100 ways to approach the design of the StairCrawler. From those 100, he chose 20; and from those 20, he narrowed it down to three and then eventually to one. In narrowing down the design, Eric spent time talking to workers at industrial plants to get input from the possible users of his product.

In September, Eric had the conceptual idea of what his product was going to look like, so in the next several months, Eric then spent around 200 hours drawing the parts of his product down to every bolt and screw on AutoCad, a computer designing program. This part is optional, but it helps considerably when putting the final product together, or if one would want to patent the product. With the design done and Christmas break just beginning, Eric spent another 100 hours making parts and assembling the

StairCrawler, as well as organizing his presentation for the contest judges. If you think that sounds like a lot of work, that's because it was, and much simpler designs have won in the past. If Eric could have thought of a simpler design for the StairCrawler, he would have.

The design process of an invention may be hard work, but the payoffs are obvious. In the last three years during competition, Eric has been offered on-the-spot jobs just because these employers saw Eric's hard work and ingenuity in the form of a hands-on product. By competing in the Schoofs contest, three other contest participants all declared that it not only made them money, but also made them better students and engineers.

So if you're interested in a little more cash and an addition to the resume try giving the invention business a shot. After all, you're not just in school to take tests and to hand in homework, are you? The next Schoofs contest will be held February 15th, 2001, but the deadline for registration is October 1st, 2000. For more information see the Schoofs web page at *http://www.engr.wisc.edu/students/brainstorm/brainstorm.html*.

Author Bio: Dugan Holtey, a civil engineer and writer is completing his Technical Communications Certificate this semester at the UW-Madison and is happy in doing so.

Our Take on This and That

By Art Gibson, Soma Ghorai, Tanya Kosmo and Matt Nelson

Do we address a bunch of girls or a mixture of guys and girls as "guys" ?

YES, there just doesn't seem to be a problem with that.

Pudding skin...How does it get there? Do you like it?

"Yes I do. I like it better than the soupy pudding."

-Art Gibson

Is ketchup an appropriate breakfast condiment?

Some would say that it is reserved for dinner and lunch for food like burgers, fries and hotdogs. But what they don't know is that ketchup is a wondeful addition to scrambled eggs and a little tobasco. These same people could probably tell you they have never tried french fries with Ranch dressing.

Light beer...is it really that great for you?

No, because you are going to wind up drinking twice as much. Tell me this, is it worth buying a twelve-pack of light beer when you know you know you'll be satisfied with a sixer of something that tastes good.

Why do women go to the bathroom in multiple numbers? Do women deserve a couch in the bathroom?

Women go to the bathroom in multiple numbers simply because there is a need to borrow things like "chapstick." Granted, some women do not go to the bathroom in large groups but the vast majority do. We think this may be something to do with the fear of being seperated from the group.

The whole couch thing comes down to it's one of the perks being a female engineer. Think about it, where else on the UW-campus can a woman find a bathroom where they don't have to stand in line.

Male restroom rules:

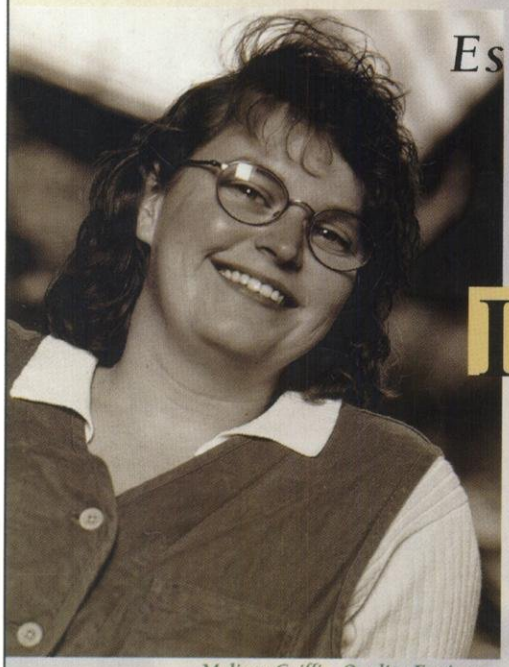
1. No going in groups
2. Please observe the one urinal space (although two is preferred)
3. NO TALKING!! We do our gossiping over the pitcher or who's buying the next.

Trouble Situations:

If someone talks--KILL THE CONVERSATION AT ALL COST!!

How are guys so fast:

1. We stand up
2. No make-up is applied
3. We REALLY have to go
4. No talking



Melissa Griffis, Quality Engineer
BSE, Industrial Engineering
University of Iowa, May '96

Melissa Griffis knows first-hand about Deere's long tradition as an outstanding employer. Her great-uncle worked for Deere, so she grew up hearing all about the company. But with all of the technological advances Deere has made, Melissa's not sure her great-uncle would recognize his old employer. Take the Deere prototype facility, for example. This is where Melissa and her Assembly Team develop new techniques for the manufacture of the company's latest products. This is also where they identify manufacturing issues and help implement quality processes. A lot of changes have taken place since Melissa's uncle worked at Deere. One thing that hasn't changed is the way Deere encourages growth and innovation.

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