Wisconsin engineer. Volume 100, Number 3 April, 1996

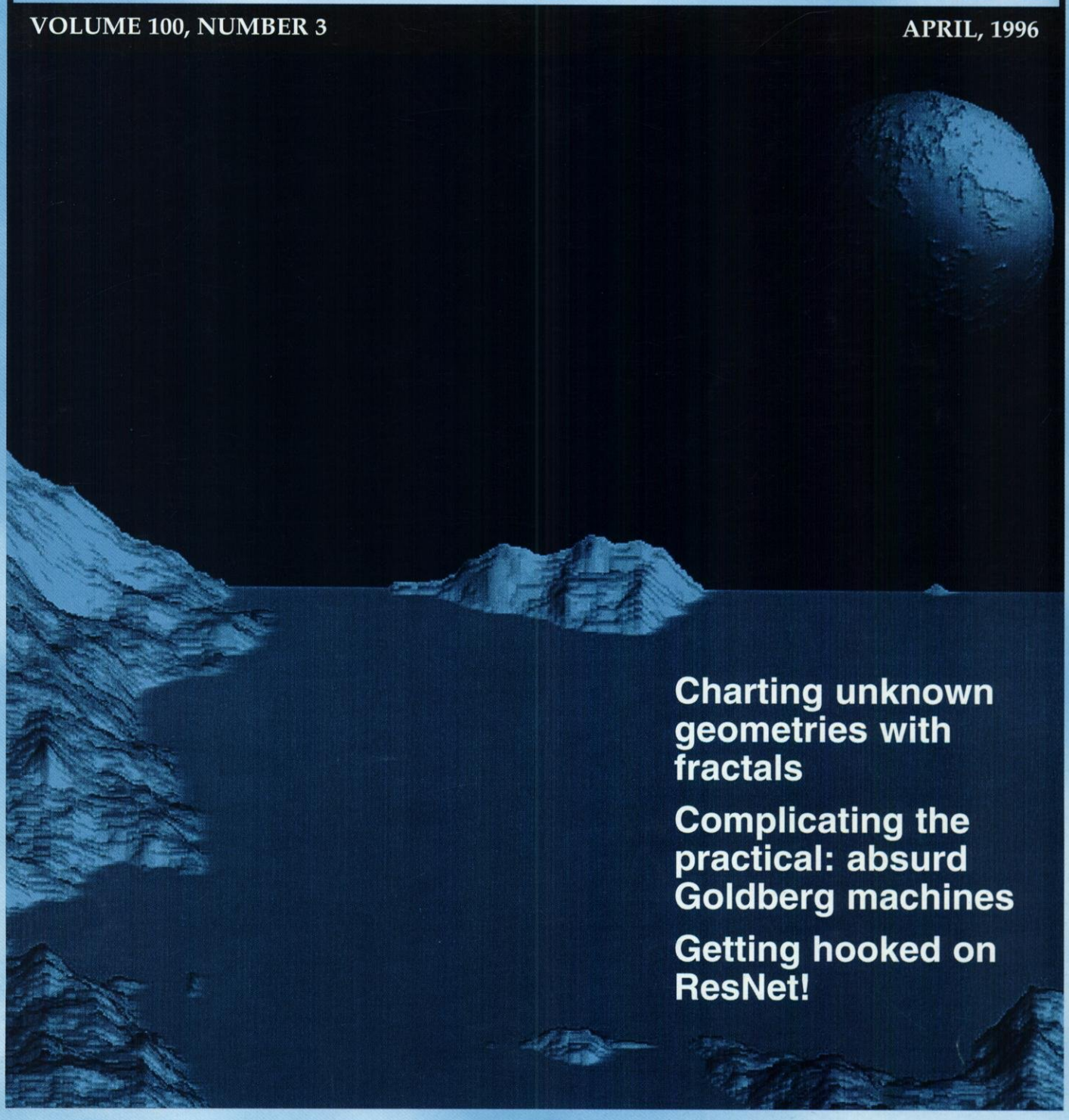
Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I

100th Anniversary

WISCONSIN ENGINEER

VOLUME 100, NUMBER 3 APRIL, 1996



Charting unknown geometries with fractals

Complicating the practical: absurd Goldberg machines

Getting hooked on ResNet!

Celebrating Our 100th Year

WISCONSIN ENGINEER

ON THE COVER: *Lunar Landscape*. This fractal image, produced by the program FractInt, utilizes an iterative process to represent natural phenomena. Image copyright 1993-1996 Melissa D. Binde.

Published by the Students of the University of Wisconsin-Madison

Visit our new Web Site!

http://www.engr.wisc.edu/~wiscengr

FEATURES

DEPARTMENTS

Faculty Advisor: Steve Zwickel
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.
Publisher: Community Publications, McFarland, WI.
Correspondence: Wisconsin Engineer Magazine, Mechanical Engineering Building, 1513 University Ave., Madison, WI 53706. Phone (608) 262-3494. The **Wisconsin Engineer** is published four times yearly in September, December, February, and April by the Wisconsin Engineering Journal Association. Subscription is $10 per year.

Source: Vince Rose

Jeremy Marwil

Editorial

Challenger: A Retrospective

"Dear friends, your loss has meant that we could confidently begin anew."

These words were spoken by mission commander Captain Frederick Hauck on the first flight of space shuttle Discovery nearly 32 months after the Challenger disaster.

This year is the ten year anniversary of this tragic event, but some of the people involved have not come to terms with the magnitude of this tragedy.

I vividly remember where I was and what I was doing the moment I heard about the explosion. As a 13 year-old kid, the images of the explosion left me in disbelief. It was a defining moment for a generation of youngsters like myself.

But who was to blame for the loss of six highly skilled astronauts and an American teacher? Who was to blame for the choice by NASA to launch the shuttle despite the warnings by engineers? Who was to blame for not heeding then Morton Thiokol engineer Bob Ebeling's foresight that the Challenger mission would result in a "super colossal disaster?" Who do we blame that NASA felt pressure from the White House to launch since then President Reagan wanted to mention it in his state of the Union address that evening?

These questions are nearly unanswerable and I don't think blame can be assigned arbitrarily to NASA or the US government. However, if we don't confront the aftermath of this tragedy carefully, then we ignore the memory of the ultimate screwup in space flight history.

Some stories in the media have responded to the 10th anniversary as a celebration of the heroic efforts of those involved. The headline of a USA Today article about the 10th anniversary reported that "the deck was stacked" against the engineers from scratching the mission since NASA management wanted to launch. It's too easy in hindsight to view the engineers as "right " and NASA as "wrong." We all watched as the house of cards fell and the astronauts became immortalized in a cloud of white smoke.

We cannot blame a single person or a group of people for the Challenger explosion, but we can ask how the ultimate space calamity reflects on our American ideals and values. It has always been the American way to be pushing forward and striving to do better, but maybe we have moved so fast that we have glossed over some of the important lessons.

We have not come face to face with some of the terrible human attributes that are connected with this tragedy—neglect, fear, guilt and bitterness. Roger Boisjoly, an engineer with Morton Thiokol at the time, testified before a presidential commission that the company ignored evidence that the O-rings (which caused the crash of the Challenger) would fail. He subsequently lost his job and was forced to move to another state in fear for his life from other coworkers in the company. For Judson Lovingood, a former NASA deputy manager, the guilt runs deep. In the USA Today article, he admitted that "people should hold us collectively responsible as a group."

The families of the astronauts settled with the US government and Morton Thiokol for more than $1.5 billion dollars. But the animosity and loathing continued for Christine McAuliffe's father who wrote, "(they) deliberately neglected to make corrections to the O-rings and are, therefore, as guilty as if they planned a deliberate criminal act." We have glossed over the hatred and bitterness that those closely involved with the space shuttle program felt and still fear.

As Captain Hauck said two and a half years after the Challenger accident, NASA had "confidently begun anew," but even at the ten year mark, the loss is still tremendous.

by Jeremy Marwil

They're Lean, Mean, Goldberg Machines

Would you like the chance to design a wild and wacky machine that nobody believes will work? Do you have a great time playing with toys you should have given up years ago? Are there piles of old knickknacks or junk sitting around your basement or attic? If you answered yes to any of these questions, you might be ready for the Rube Goldberg™ Machine Contest.

Rube Goldberg was a talented cartoonist in the first half of the 19th century. He created drawings of incredibly complicated machines that would supposedly do things like peel the shell off a boiled egg or brush lint off an old coat. He labeled every part of the machine with a letter and explained the actions of the contraption by the side of the drawing. Goldberg's name is often used in writing as an insulting description for some unlikely method of solving a problem that seems to be way too complicated for its own good.

The objective of the Rube Goldberg™ Machine Contest is to build a complicated machine that accomplishes a simple task such as turning on a light bulb or toasting a piece of bread. The ultimate goal of this year's machines is to put a coin into a bank, using twenty or more distinct mechanical steps. The teams are judged on their use of a theme, how many steps they take to put the coin in the bank (the more the better) and whether their machine actually can do what the team members claim it can.

Talk to any of the students on campus who have taken part in the Rube Goldberg™ Machine Contest and they will tell you, "It's the hardest thing I have ever done...The heavy machinery...."

One question often asked is, what do winning contraptions of the past have in common with each other? What made them better than the others? The answer is hard to define.

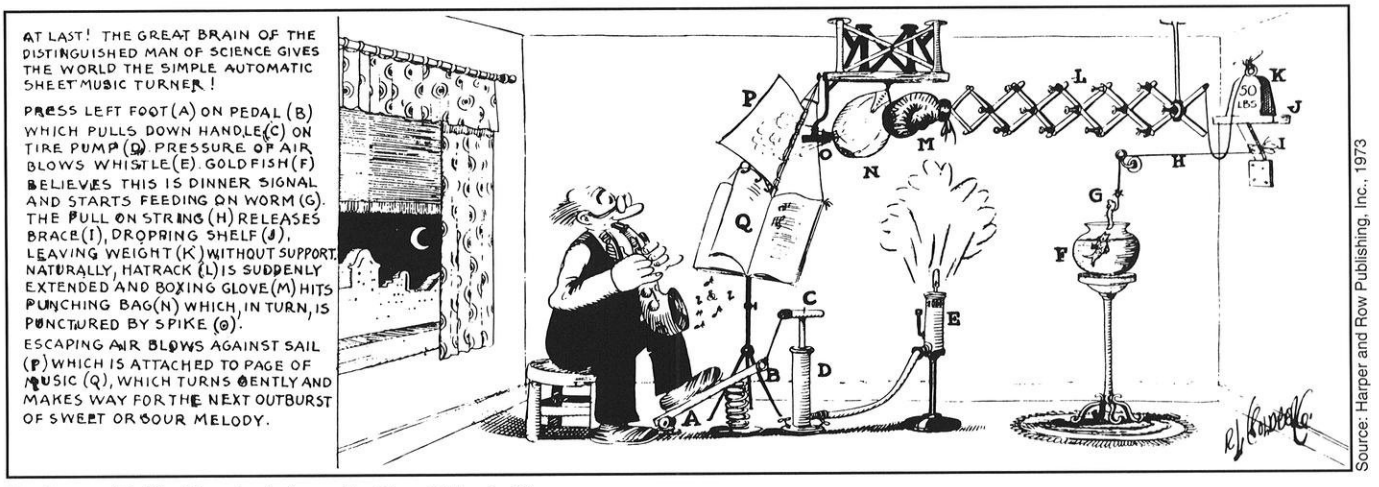
One past machine contained a toilet seat that had a copper wire stretched across it. A toy troll was hanging from the wire by a length of fishing line. The fishing line melted when electric current, started by a previous step, surged through the wire, and caused the troll tumbling down, triggering yet another step.

The objective of the Rube Goldberg™ Machine Contest is to build a complicated machine that accomplishes a simple task

According to Jessie Corbett, the chairman of this year's local Rube Goldberg™ Contest, anybody can be involved, even if they're not in engineering.

Another machine incorporated 22 steps and used objects such as a heat lamp to heat water, an electric drill, a baby bottle, a mechanical clock and a golf ball. The

Cont. on page 11



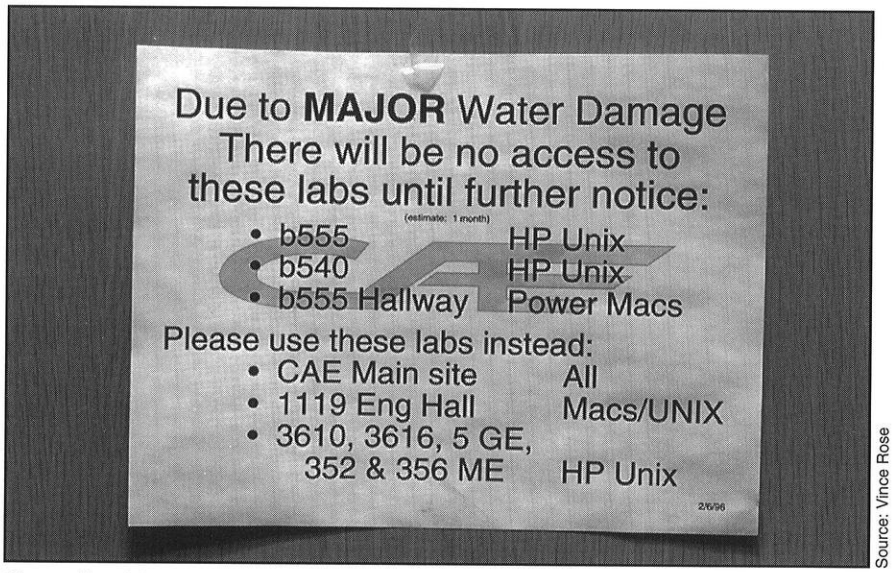
Source: Harper and Row Publishing, Inc., 1973

Professor Butt's Simple Automatic Sheet Music Turner

Familiar Hazards

How is calamity contained on the COE campus?

How many times in the last few months have you been walking across the engineering campus and noticed a fire truck outside of CAE or Engineering Hall? Several, right? Did you wonder what the heck was going on? Because, chances are, you probably didn't find out much of anything at the time. Many students were frustrated not only by not knowing what was going on, but by the fact that they had to be evacuated. They were just told to leave without ever receiving any explanation as to why. Given these circumstances a question that could potentially be raised is, "Well, is this really necessary?" Did the entire building really have to be evacuated? Were safety procedures being followed? Who was handling all of this?



Source: Vince Rose

Signs, like this, are hastily put up to redirect students after an accident.

Near the end of last semester many students may recall that there were a couple of chemical spills at CAE within about a month and a half of each other. In each case, everyone was evacuated from the building. Many students recall being forced to leave all of their belongings in the computer lab until the "all-clear" was given. It was later determined that a meter's warning light had gone on in an area of the building where chemicals were being handled. The containment facilities used for the chemicals are equipped with hoods and a type of alarm system that indicates when even the smallest amount of the chemical has leaked from the area. When this occurs, standard procedure is to evacuate the building. The chemical spills, in both instances, were contained.

Hundreds of thousands of dollars worth of damage was done to over 80 computers, including HP workstations, DOS machines, and Macs. An unprotected pipe seemed to be the cause

More recently, a water main burst in the basement of Engineering Hall. On February 6, Mary Baldwin, CAE department manager, was in B555 working on one of the computers when she and another student noticed standing water in the room. There was even water dripping onto many of the workstations. She says now that her first course of action may not have been the most rash. She immediately began unplugging the computers in the room. Initially, the hardware maintenance staff and other staff members were called to the "scene" to assess the situation. During the course of all of

this, a fire alarm was sounded, and everyone was asked to leave the building. After the alarm went off, she returned to one of the rooms to try and cover some of the machines. When the fire department arrived, she was told to leave - no questions asked. Looking back, things could have turned out worse than they did had she not taken action. In fact, they probably ended up saving a couple of machines. According to Baldwin, no one from the police or fire departments would give any of the faculty any information about the status of the situation.

Many students were affected because they were scheduled to have interviews that day. Some of the companies that were there posted signs on the outside of the building saying that they had relocated to Union South. Other students and faculty, upon hearing that it was contained to the northwest corner of the basement, did re-enter the building if they had been working elsewhere.

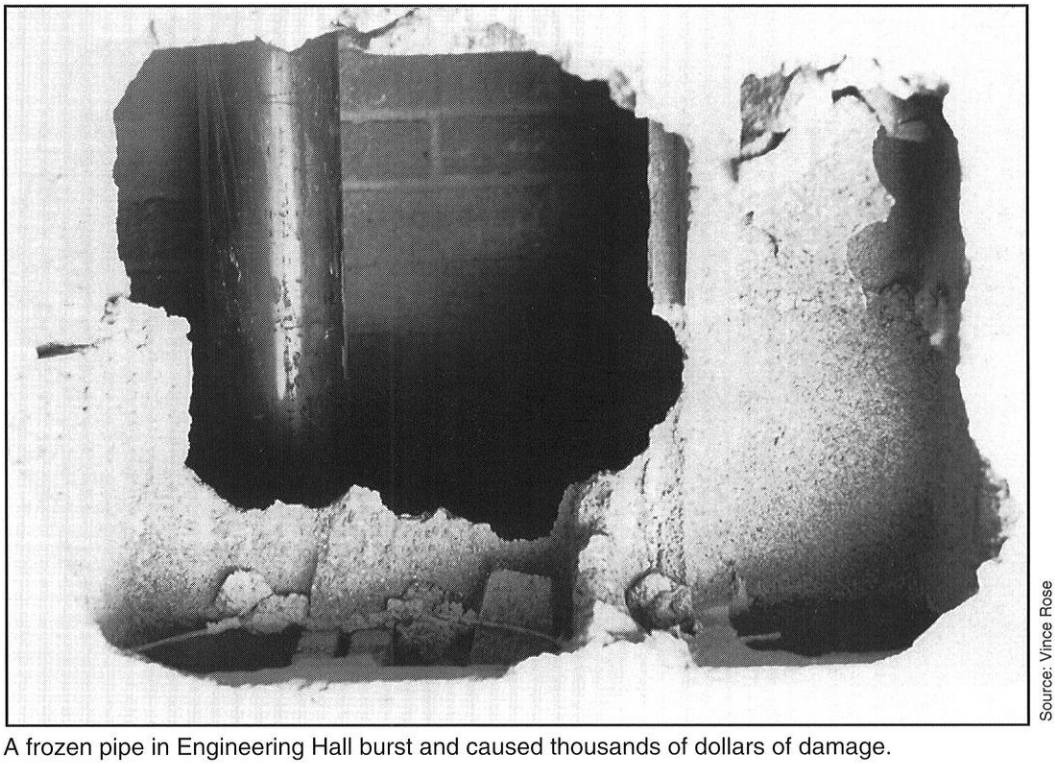
The result of the water main braking was the flooding of the computer labs in the basement of Engineering Hall. Hundreds of thousands of dollars worth of damage was done to over 80 computers, including HP workstations, DOS machines and Macs. An unprotected pipe seemed to be the cause.

Currently, Mary Baldwin and others are desperately trying to find more machines to make available to the students. "It's devastating because it affects all of (the students) who are trying to do homework," said Baldwin. They are in the process of trying to repopulate Room B540 with some computers, but Room B555 will have to be completely gutted, and may not even be operational this semester. One decision that just went through is that as of Monday, February 26, General Engineering will be open 24 hours a day, Mondays - Fridays. This will provide 13 more HP workstations, 13 more DOS machines and about 15 additional Macs for students to use.

What seems to be most important in each of these cases is that safety procedures throughout engineering are strictly followed. Regardless of how much information is available at the time of the incident, the safety of the students and faculty is the number one priority. Nothing is left to chance. So, the next time you should happen to run across a fire truck on your way to class, rest assured that, although you may not have a clue as to what is happening, everyone is safe.

Regardless of how much information is avaliable at the time of the incident, the safety of the students and faculty is the number one priority. Nothing is left to chance

Author Bio: Bridgett Marsh is an engineering student who is new to the Wisconsin Engineer. She enjoys playing the clarinet in the UW-Marching Band.

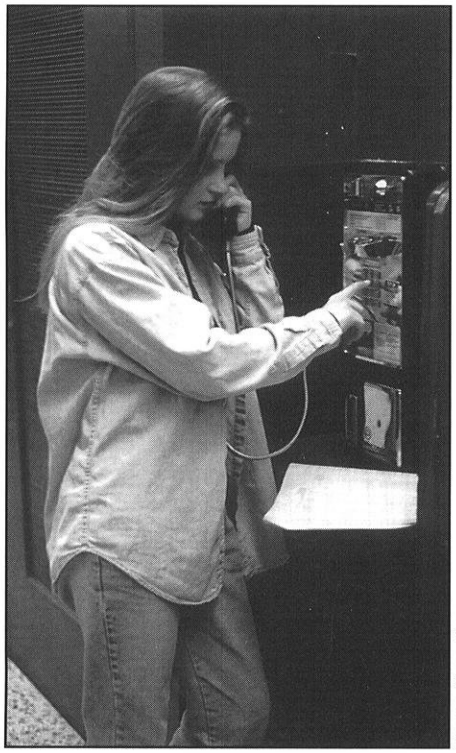


Source: Vince Rose

A frozen pipe in Engineering Hall burst and caused thousands of dollars of damage.

Administrative Mysteries Solved

The engineering campus may sometimes seem like its own little island in the big ocean of what is the University of Wisconsin. However, every school and college - engineering included - is touched by the waves sent out by the University's administrations. For the most part, students don't ever think about the administrative side of the University, but there are exceptions. At least once every semester, all students stop to wonder (as they are trying to fit one more EPD class into their schedules) about the University's registration system a.k.a. "the touchtone lady." Perhaps the most frequently asked question to spring from the lips of frustrated students is, "why isn't the touchtone system open twenty-four hours a day?" After all, she is a computer, so it's not like she needs to sleep.



Source: Vince Rose

Author Michelle Truscott familiarizes herself with the registration process.

Questions like these from the curious minds of the *Wisconsin Engineer* were taken to Rosemary Gall at the Peterson Building. According to Gall, the computerized touchtone system was first used in the fall semester of 1988, and the program was developed here at the University. Before the touchtone system was in place, students had to go to the Stock Pavilion on the Agricultural and Life Sciences campus and pick up a registration form. Then they had to go to individual departments and stand in line to sign up for each class they wanted to take.

With the installment of the touchtone system, students can not only register but also access grades, schedules, official University information and change their PIN's all from the comfort of their homes. That is, as long as the system is open. The reason the system is shut down at night and on the weekends is because the same computer that runs the registration program also contains the University's records system and does batch printing jobs. These other programs are run at night and on the weekends when the registration program is closed. During registration periods, however, the touchtone system has extended evening and weekend hours.

Let's do a poll!

Based on her voice, would you go out with the touchtone lady?

And where would you two go?

Email responses to:
wiscengr@caelab1.cae.wisc.edu
Reponses due by May 1st

Now that we've unraveled the mystery of the "touchtone lady," there's one other question concerning the administrative side of the University that students sometimes ponder. How in the world do they decide where to put each class? Granted, your Chemical Engineering class is not going to be taught in Bascom Hall, but still with around 6,000 classes being offered each semester, how does the University keep everything running smoothly?

Once again the answer is a computer program. According to Sharon Pereo, Director of the Timetable and Classroom Scheduling Office (formerly known as

the Instructional Space Assignment Office) a computer program was developed here on campus to make classroom assignments more adequate, efficient and fair. While there are pockets of space not scheduled by the Timetable and Classroom Scheduling Office, each semester the program places between 5,000 and 7,000 sections in approximately 380 classrooms.

The process starts with each department on campus sending in their requests for building space by class period. Classes are assigned in the home building of the department if possible (Mechanical Engineering for IE classes, for example). If it is impossible to schedule a class in that department's home building, it gets put in whatever building the department designates as first priority, second priority and on down the line. In most circumstances, classes can be scheduled in a building near by, if not in, their department's home building. When assignments come out, if an instructor is not satisfied with the assignment, he or she can request the location of the class be moved.

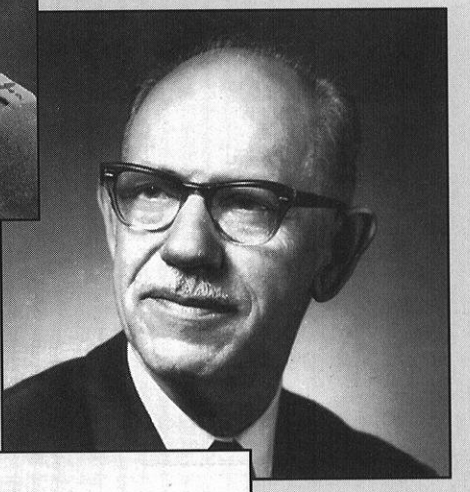
For the majority of students at the University of Wisconsin, administrative duties and decisions are never given much consideration. Most of what goes on behind closed doors in places like the Peterson Building and the WARF building will always remain a mystery, but next semester when you are registering for your required engineering courses, at least you will have the satisfaction of knowing that you do not have to stand in line to sign up and that your engineering class will not be in Vilas.

Author Bio: Michelle Truscott is an English major who dares to venture forth onto the engineering campus to work on the magazine. What a brave soul.

Glory Days

University faces of the past century

Unknown
(circa 1918)



Kurt F. Wendt

Dean John Bollinger

Donna Shalala

It's Alive!

Biomed program slowly rises from planning table

What do neighboring universities like the University of Iowa, University of Illinois and Marquette University have that UW-Madison does not? The answer is an undergraduate biomedical engineering program (BME), but perhaps not for long. Through the efforts of Electrical and Computer Engineering Professor Willis Tompkins, Industrial Engineering Professor Robert Radwin and Orthopedic Surgery and Mechanical Engineering Professor Ray Vanderby as well as others across campus, an undergraduate biomedical engineering degree may soon be a reality at UW-Madison.

Biomedical engineers use engineering tools to solve problems in biology and medicine and use engineering principles to understand and repair the human body

Fastest-Growing Fields	Ph.D. Recipients 1982	1992	Increase
Geology	25	166	564%
Cell Biology	41	188	358%
Computer Science	220	789	258%
Nursing	112	337	201%
Aeronautical Engineering	86	234	172%
Mechanical Engineering	334	856	156%
Industrial Engineering	79	197	149%
Biomedical Engineering	59	147	149%
Materials Science	147	365	148%
Computer Engineering	72	174	142%

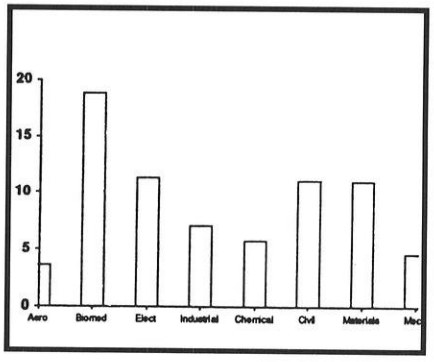
*Source: US News & World Report

In general, biomedical engineers use engineering tools to solve problems in biology and medicine and use engineering principles to understand and repair the human body. Among their many responsibilities, BME's may design medical instruments and devices and use engineering tools for medical decision making and cost containment.

Previously, the philosophy of the faculty and administration on the College of Engineering has been that it is better to first become good engineers and to later specialize in biomedical engineering. Students were advised to earn a traditional undergraduate degree in Chemical Engineering, Electrical Engineering, Industrial Engineering or Mechanical Engineering and focus their electives on the numerous engineering courses specializing in biological or medical applications.

Why the change in philosophy? According to Professor Tompkins, "the planets are aligned right at this time so that it may be possible for us to start a real biomedical engineering degree program." More specifically, it has been reported by US News and World Report that Biomedical Engineering is one of the fastest growing fields in America with a growth of 149% from 1982 to 1992 (see Figure 1). In an informal survey conducted by Assistant Dean Donald Woolston, approximately 50 of the pre-engineers currently enrolled at UW-Madison would be interested in earning an undergraduate degree in BME. These data establish a demand for a BME program with students already enrolled, even though UW-Madison has no doubt been losing potential students to other universities that have undergraduate biomedical engineering degrees.

A biomedical engineering program is also likely to attract female faculty and students to the College of Engineering. According to American Society of Engineering Education (ASEE) statistics, females are awarded more PhD's in Biomedical Engineering than any other

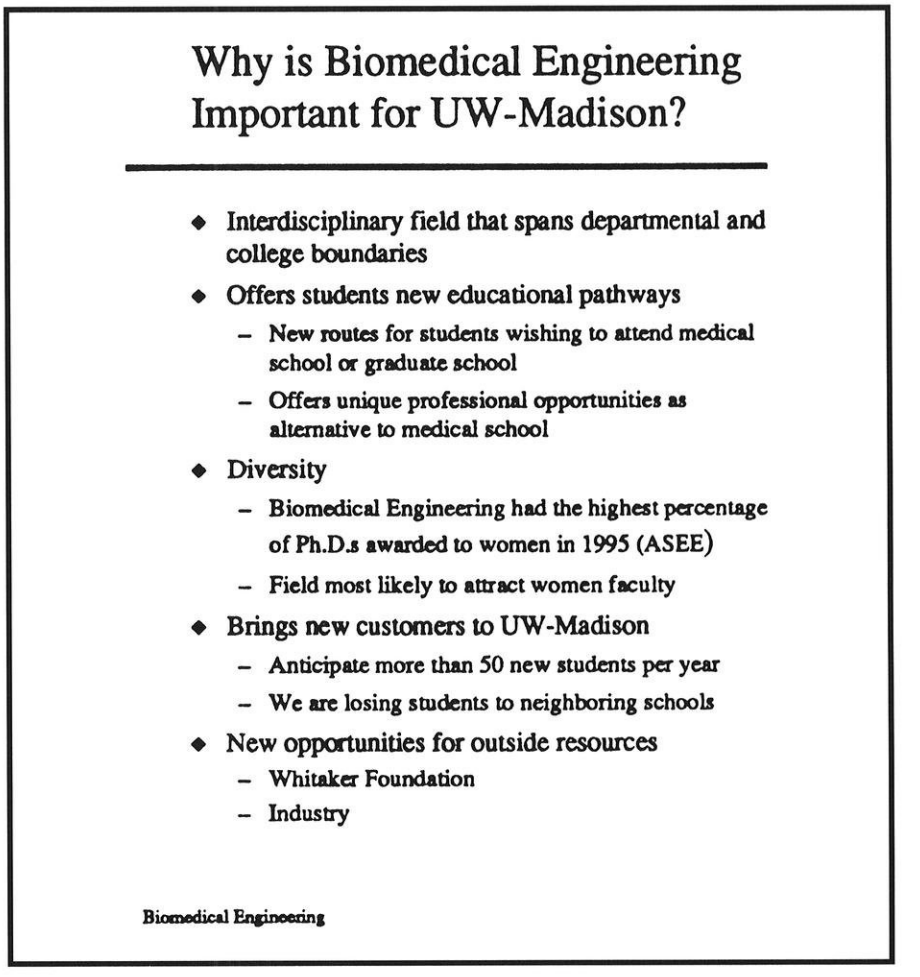


engineering discipline (see Figure 2). This means that a program in biomedical engineering could increase the percentage of females in the College of Engineering which currently has about 5% female faculty and about 18% female students.

Finally, a BME program would cross university boundaries and offer new educational pathways to students. Faculty in at least eight of the schools or colleges on this campus are qualified and would be interested in teaching classes in such areas as biomechanics, biomedical instrumentation, biomaterials and biochemistry. Previously, students who were interested in medicine and engineering took many extra credits to fill the requirements for medical school in addition to their engineering classes or just gave up on engineering. An undergraduate degree in BME would offer a new route to students wishing to attend medical school or graduate school.

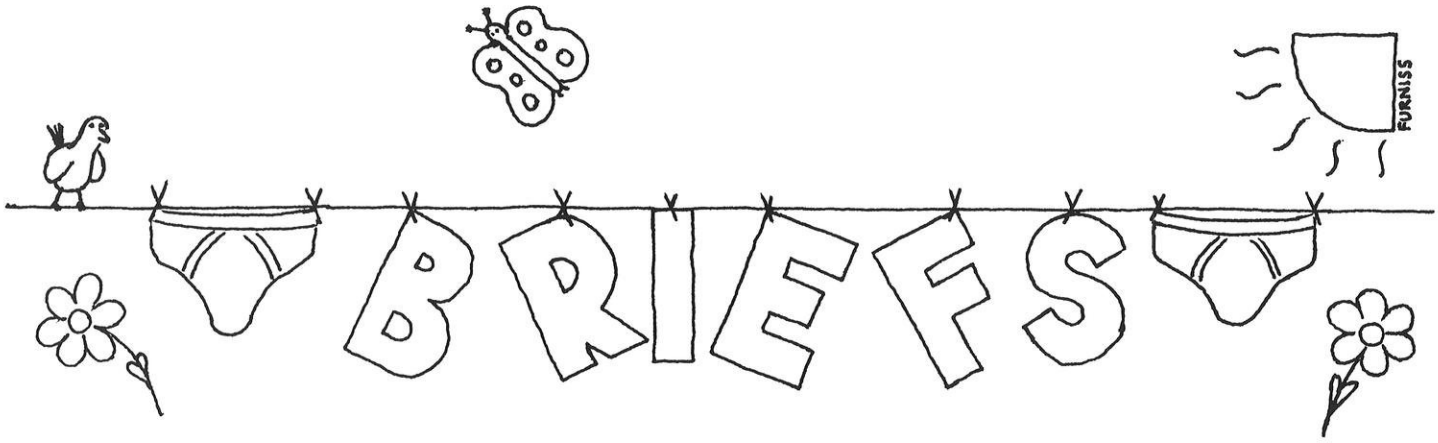
What an undergraduate curriculum in biomedical engineering should look like is the question that is now being debated. To be competitive with degrees offered by the College of Letters and Science, it would be necessary for a BME degree to require a maximum of 120 credits. This is a stringent constraint. Out of the nine engineering degrees currently offered, all but two, indstrial and mechanical, exceed this requirement. After the 16 credits of liberal studies required to be accredited, the 28 credits required for medical school, and the approximately 30 credits of basic courses such as math and physics required by the College of Engineering are built into a curriculum, there is little room to fit fundamental biomedical engineering classes. Therefore, a person earning her or his undergraduate degree in BME would not be qualified to enter industry after four years as a biomedical engineer. One solution would be to offer two different tracks, one leading to medical school and one to professional biomedical engineering. Those choosing to go to medical school would benefit from having basic engineering skills as well as the required knowledge to enter medical school. Those choosing the biomedical engineering career path would be able to earn a masters degree in BME in one additional year.

What is the outlook of an undergraduate biomedical engineering degree at UW-Madison? The enthusiasm of the faculty and students involved is very high. If this is any indication that there will soon be an undergraduate biomedical engineering program, the outlook is good. Who knows, maybe the planets are aligned correctly.



An undergraduate degree in BME would offer a new route to students wishing to attend medical school or graduate school

Author Bio: Sheri Schneider is a junior at the University of Wisconsin. This is her first semester working on the Wisconsin Engineer and she has recently joined our advertising staff.



EXPO NEWS

The Engineering Mall Project

Engineering Mall is an important gateway to the College of Engineering and there has been much interest in designing and improving it. Many ideas have been introduced ranging from coordinating the fountain with the clock chimes to adding a laser light show. The Executive Committee is interested in learning about your interest in designing Engineering Mall. Please consider the following questions and contact EXPO if you, or your group, are interested in these ideas or would like to express your opinion on the subject.

1. Should EXPO host a contest to determine what group of students get to work on the Mall?
2. Would you be willing to work during the summer on the Mall?
3. How would you feel about participating for independent study/design credit?

Correction

The February 1996 article "The Stueber Prize for Excellence in Writing" incorrectly spells Mr. Steuber's name in the title of the article. The Wisconsin Engineer apologizes for this error.

Congratulations!

The Wisconsin Engineer would like to congratulate the finalists of the 1996 Steuber Prize for Excellence in Writing. The finalists and their winning essays are:

Rick Giallombardo - "Old Man River, Past and Present: Technology's impact on the Upper Mississippi River"
Travis King - "Locked Out"
Yaniv Lazimy - "Defusing the Population Explosion: Is Humanity Up to the Challenge?"
Joel C. Moser - "The Art of Noise: Designing Sound Characteristics Into a Motorcycle"
Michael Scholz - "Landmines: A Global Crisis to Challenge this University"
Svetlana E. Zilist - "A Glimpse of Culture From the Eyes of an Engineer"

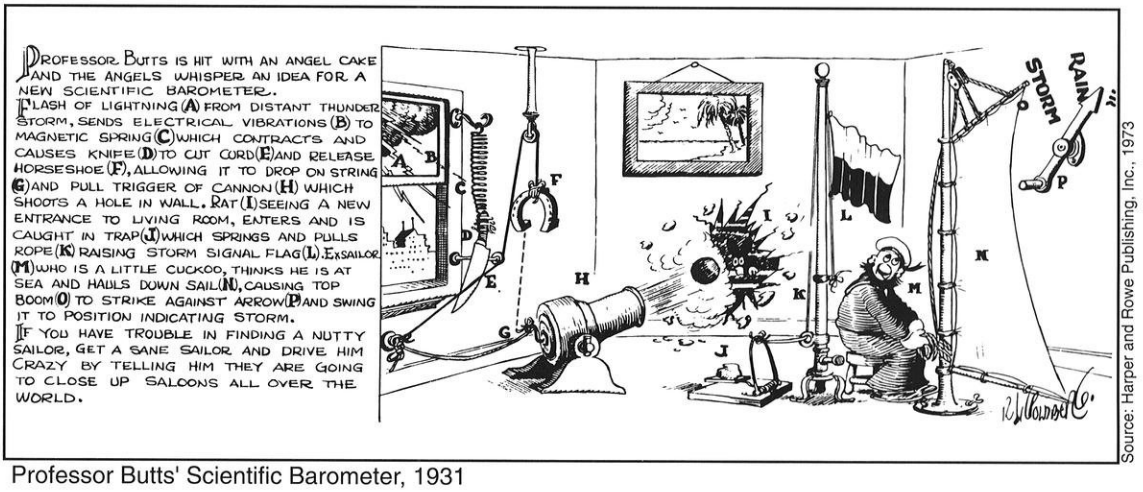
The winners will be announced at this years Polygon Banquet. To find out more about the contest and to read these winning essays, check out the Steuber Prize Webpage at http://www.engr.wisc.edu/epd/syllabus/Steuber.html.

Cont. from p. 3

machine to make a drinkable cup of coffee, in the most complicated way possible, in less than five minutes using at least 20 steps. The winning design included four flavor options of coffee, plus a choice of cream and/or sugar.

The Money Grubbers, one of this year's teams, were inspired to their name by the fact that, true to the spirit of the contest, their machine would be made entirely from cardboard, duct tape, string and other assorted junk. Their plan was to use no extra money to build it. Tom Mayer, the organizer of the Money Grubbers, is most proud of a pulley system that dumps B.B.'s as one of its main steps and is started off by a bowling pin. The eight members of the Money Grubbers spent many hours of mental planning and 4 days of hard physical labor preparing for the February 24th contest.

How does a team win the contest? One definite bonus is being able to actually complete the task, without human intervention. Also, many teams win by the way they play with a certain theme such as toys, or things from the 1960's.



Professor Butts' Scientific Barometer, 1931

Source: Harper and Rowe Publishing, Inc., 1973

You may be wondering why engineers would actually go so far as to set up a contest to emulate the crazy ideas of Rube Goldberg. Engineers, for the most part, try to design machines that are efficient, use as few materials as possible, have no unwanted side effects and which work consistently. Rube Goldberg's ungainly contraptions seem to be the exact opposite of that engineering ideal.

Building a machine can be quite fun and gives you a chance to let your imagination run wild. According to Jessie Corbett, this contest is, "engineering gone mad," because Rube Goldberg machines are obviously not very efficient machines. This contest lets people from engineers to music majors have fun making up wacky machines that totally disobey the "laws" of engineering.

So how did a contest of this nature get started, and by whom? It all started at Purdue University as a contest between the Theta Tau and Triangle fraternities, but it died a few years later. Many years passed until some members of the Theta Tau chapter at Purdue found some old pictures from the contest and decided to research its history. Soon after that they started up local contests on their campus and opened it to everyone who could build a machine. The contest eventually caught the attention of the National Theta Tau Fraternity who opened it to anyone from a school that had a Theta Tau chapter.

The contest has changed through the years. There is now a Rube Goldberg, Inc. and the Rube Goldberg name is copyrighted. One of these changes is at the local contest level. The national contest is now open to all universities and high schools in the country. The Madison contest is open to all students, Engineering or otherwise. Contestants have the chance to win a trip to Purdue University where they will compete at the National Rube Goldberg™ Machine Contest for the traveling trophy.

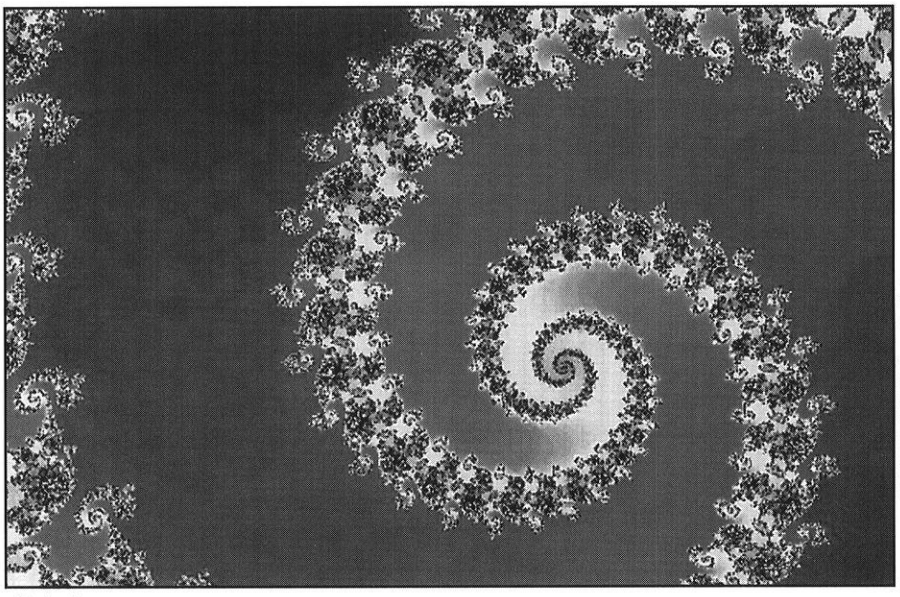
So, in the future, save those artistic doodles in your lecture notes. You may have the plans for a supreme Rube Goldberg™ Machine.

Author Bio: Dan Hanson is a freshman in pre-engineering who enjoys writing, running and playing hacky-sack, in between sleeping and studying.

Fractals

Mapping the Natural World

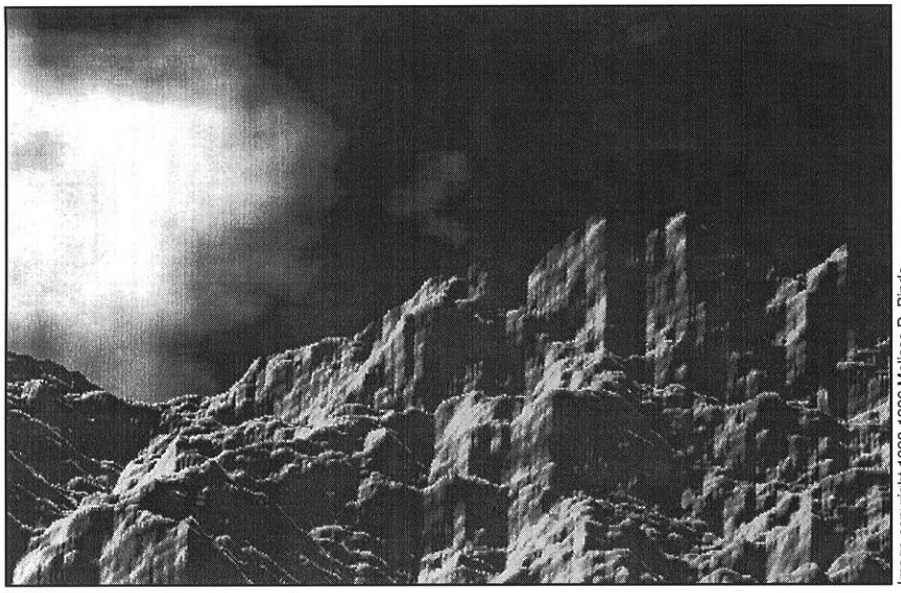
Anyone can describe the shape of a building, a lamp or a car using simple shapes like a square, line or circle. In fact, anything built by humankind can be described using such shapes and figures. But how can we describe the structure of a fern or a mountain range? In 1975, Benoit Mandelbrot discovered a geometry that he called a *fractal*. "Mandelbrot's fractal geometry provides both a description and a mathematical model for many of the seemingly complex forms found in nature."[1]



Spiral

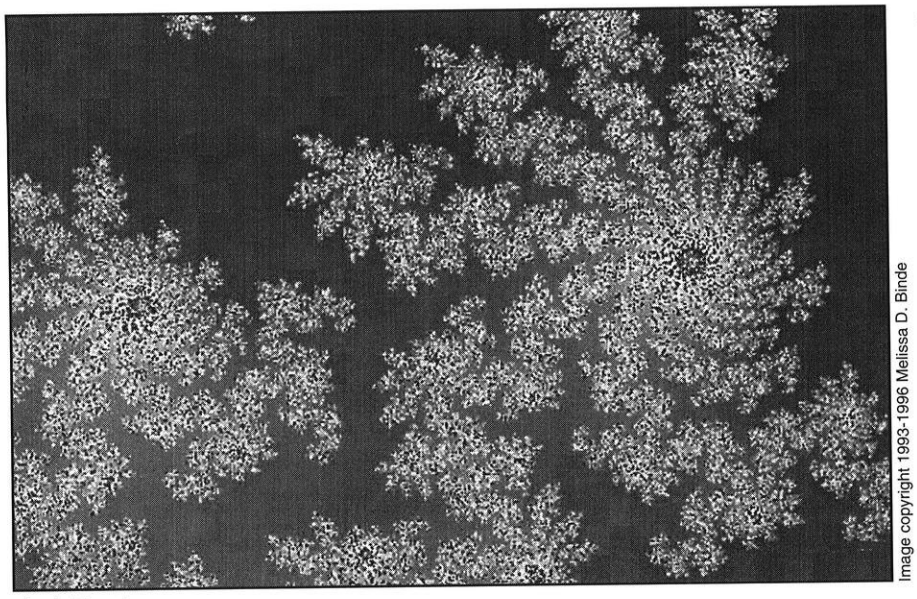
What is a fractal image? Some of you may have seen a poster or news story about chaos and fractals. They are those posters with seemingly infinite and wild shapes that sometimes do not look like anything familiar, but nonetheless create a beautiful structure. Many of the works of M.C. Escher, such as *Circle Limits IV*, show fractal properties. A fractal has properties unlike any of the traditional shapes people are familiar with. Basically, a fractal geometry is a structure that exhibits a similar shape exhibited over all scales. An example of a fractal structure in nature is a cauliflower. If you were to look at a whole cauliflower, as well as at a small but magnified section, they would look very much alike.

There are several properties that make a fractal geometry different than a traditional *Euclidean* geometry. Euclidean geometry contains structures like the square, line and sphere. Where Euclidean geometry is good for representing man-made objects, fractals are appropriate for representing natural objects and phenomena. Traditional geometry can be described by a certain characteristic size and formula (i.e. slope of a line, radius of a circle). A fractal geometry has no specific size or scale and cannot be described by a single formula. Fractals are constructed by a mathematical method called *iteration*. Iteration is the process of performing on operation over and over to come to a solution of a certain desired accuracy.



Cloudy Day in The Mountains

Unlike most Euclidean geometry, fractals have the property of *self-similarity* or *scaling*. This self-similarity is the property of an object or shape that looks similar on all scales. Examples found in nature include the fern or the cauliflower. If you were to look at a whole fern as well as a small section, they would look strikingly similar. This self-similarity can be seen in many natural structures like



Jack Frost

mountains, coastlines, snowflakes and clouds. It is one of the central concepts of fractal geometry.[2]

Many of the mathematical concepts that are used to create these fractal images were discovered around the turn of the 19th century. The mathematicians who came across these fractal objects considered them "monsters of uncompromising irregularity."[3] They were then ignored until Benoit Mandelbrot coined the term fractal in 1975. With the aid of computers, Mandelbrot recognized some of these "monsters" as the basic structures in the language of nature's irregular shapes.[4] The new mathematical language of fractal geometry now allows the description of many of the complex forms of nature.

How are fractals created? At the very root of a fractal is usually a simple equation. Using a computer, successive iteration of this equation is then used to create the fractal image. For an example of iteration, consider the function $f(x) = x^2$. To iterate this equation, start with an any initial value for x, and solve. Use this solution for the new value of x and solve f(x) for this value. Iteration is the continual repeating of this process. The equation for five iterations would look like this: f(f(f(f(x)))). This type of iteration is one of the methods used to create fractal images.

Another method for the creation of fractal images is the *line replacement method*. An example of this is the Koch Curve created by Helge von Koch in 1904.[5] This curve is also called the snowflake curve for obvious reasons. This is also created from an iteration process, but with lines instead of equations. An initial line, the *initiator*, is drawn. This line is then replaced by a series of connected lines called the *generator*. Each new line is again replaced with the generator. Depending on the resolution that is desired, this could be an infinite process. The creation of the Koch curve, as with all fractals, is a sequential construction process.

Because so much of nature follows a fractal structure, these mathematical models may lead to a deeper understanding of the complex natural world

Why are fractals important? "The computer rendering of fractal shapes has left no doubt of their relevance to nature."[6] With the aid of computers, fractals have allowed the creation of mathematical models that are, for the first time, close to the complexity of nature. Fractal geometry and its concepts have become the central tools in most of the natural sciences: physics, chemistry, biology, geology, meteorology and materials science.[7] Also, fractal geometry has been found to relate to many dynamic systems in the world. It is probable that these methods will allow us a deeper understanding of such dynamic systems as the climate or the ecology.

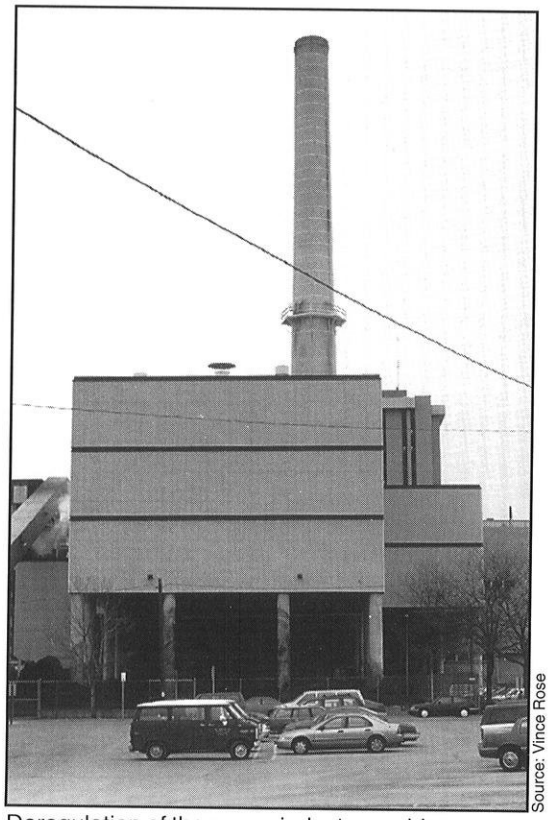
"Fractal geometry is not just a chapter of mathematics, but one that helps everyman to see the same old world differently."[8] Fractals have brought about the ability to create stunning mathematical models of the natural world. Fractal structures are seen in such things as the mountains, trees and even in the behavior of the stock-market. Because so much of nature follows a fractal structure, these mathematical models may lead to a deeper understanding of the complex natural world. Although fractals may help us to see a simple process behind a complex pattern, it cannot be assumed that an understanding of its consequences can be found.[9]

References:
[1] Peitgen, Heinz-Otto; Saupe, Dietmar eds. **The Science of Fractal Images** (Springer-Verlag, 1988), preface
[2] Peitgen, Heinz-Otto; Saupe, Dietmar eds. **The Science of Fractal Images** (Springer-Verlag, 1988), p.28
[3] McGuire, Michael, **An Eye For Fractals** (Addison-Wessley, 1991), p. 30
[4] Peitgen, Heinz-Otto; Saupe, Dietmar eds. **The Science of Fractal Images** (Springer-Verlag, 1988), p.25
[5] Peitgen, Jürgens, Saupe, **Fractals For the Classroom** (Springer-Verlag, 1992), p. 103
[6] Peitgen, Heinz-Otto; Saupe, Dietmar eds. **The Science of Fractal Images** (Springer-Verlag, 1988), p.25
[7] Peitgen, Heinz-Otto; Saupe, Dietmar eds. **The Science of Fractal Images** (Springer-Verlag, 1988), p.25
[8] Mandelbrot, Benoit B., forward in Michael McGuire, **An Eye For Fractals** (Addison-Wessley, 1991)
[9] Peitgen, Jürgens, Saupe, **Fractals For the Classroom** (Springer-Verlag, 1992), p. 20

Author Bio: Michael Sprague is a Senior in Mechanical Engineering. He will be graduating in May 1997, and plans to attend graduate school.

Fueling Progressive Change

In the near future, with less state control of the power industry, the typical Wisconsin electric bill may become as complicated as the telephone bill. Behind this is both a statewide and nationwide push for deregulation of the power industry, which has enjoyed a very long history of a guaranteed fair profit return in exchange for a protected market share. These pushes to change the power industry may be comparable to the breakup of AT&T in the 1980's, when everyone was offered more choice in long distance service.



Source: Vince Rose

Deregulation of the power industry could cause heat, from plants like this, to be less expensive.

In speculation, the push to deregulate may involve loosening controls on pricing, competition in power generation and distribution and far greater consumer choice. Directly affecting the most people, new consumer choice will allow consumers the ability to choose which power company best suits their needs. This may facilitate the need for separate charges for distribution and the actual power itself. In contrast, Wisconsin power companies and investors may find the important aspect to be the ability to set their own prices in exchange for allowing increased competition to enter the market.

This broad push in Wisconsin strikes chords with similar proposals in California and New York, where power is much more expensive than in Wisconsin. Wisconsin's rates are third lowest in the nation while California's rates are 137 percent of the national average. This is due to the large social costs in California, such as environmental protection.

Why are Wisconsin's rates so low? To answer this, Wisconsin Public Service, a Wisconsin power company, credits these low rates to both efficiency within the organization and the good relationship it has with the state. The power industry and the state continue to work together to keep these rates low. In addition, Wisconsin, being a leader in the national topic of power deregulation, is forcing its power companies to prepare for coming deregulation in a way that makes them more competitive by keeping costs down.

Since Wisconsin rates are so low, why should it pursue deregulation? First, since the idea of power deregulation is still in the embryonic stage in many states, quickly pursuing this process may allow the power industry in Wisconsin to compete more effectively in larger markets such as Illinois or Michigan. In addition, because Wisconsin already has very low rates, it should pursue every alternative to keep them that way.

Wayne Peterson, a system operating manager at Wisconsin Public Service (WPS) in Green Bay, WI says, "Wisconsin Public Service's view is that deregulation should result in lower prices and should provide many more services for our customers. We think that in the long run, it is the right thing for the industry to do...There are a lot of issues, this industry has been regulated for a long time. What we feel we should do is to gradually move into the deregulated environment." However, Wayne said the other power industries in Wisconsin, notably Wisconsin Electric and Wisconsin Power and Light, do not share this go-slow approach. This promises to be a hot issue as Wisconsin gets closer to breaking up its power monopolies.

What are some of the advantages to deregulation? Low rates and a stable workforce are two advantages. The stability of the workforce at WPS results from a bargain between the workers and the company. According to Wayne, the workers provide, "a flexible work force where people who are in one jurisdiction class or one type of work can move over and do another type of work without having to go through a grievance process. It has allowed us to have supervisory employees do some union work and union employees do supervisory work and put the emphasis on having the employees work in the most critical areas." In return, workers get a high level of job security. The contract signed by the union and the company guarantees a no layoff

clause for at least three years, of which they are in their second year.

Proudly noting the high moral of the workforce, Wayne said, "We have not had major layoffs and early retirement at this point and to compete in the unregulated environment, we're going to need all of the 2500 to 2600 employees that we have. Where as some of these other utilities are laying off 20 to 25 percent of their work force...For us we feel this is an advantage, since the moral of our employees is very high going through the deregulated phases."

On the downside, WPS is surrounded by larger utilities. In addition, WPS depends on these larger utilities for about 20 percent of their power needs. In a worst case scenario, competing utilities could seize control of the power transmission lines supplying WPS with power and force them to charge higher rates, by raising the price of this power. This might allow the competing utility to enter WPS's core territory and pick off their customers with lower rates. Of equal importance, the largest consumers of power might benefit greatly by opting for their own power distribution systems and generators, or use these alternatives to bargain for much lower rates than small consumers. This is already happening in Detroit where Detroit Edison Company signed contracts with the big three automakers that gave them 10 to 15 percent reductions in their present rates, which translates into a possible savings of up to 400 million dollars in the next 10 years. These contracts are at present being formed across the United States and could eventually threaten to raise rates for residential consumers and small businesses.

Through deregulation, Wayne said, the power supply industry may be split into three units: power generation, power transmission and power distribution. Power plants could be bought and sold on the free market. Along with this, smaller generators could be cheaply built, making the number of potential players in this market large. Next, power transmission allows power to be distributed across long distances. Since the existing transmission lines could be owned separately by another company, the company generating power would have to pay a fee to have their power transmitted. However, power transmission is often much cheaper than power generation and the extra cost may not be much of a factor. Also, the new power transmission companies might expand the present structure, allowing the capability to transmit more power across longer distances than today. Finally, a power distribution grid is needed to transmit power to each consumer. It is incredibly expensive to enter this market and involves building a network of connections to individual power users. It is expected that the existing power monopolies will compete well in this part of the business and as a result will tack on the final cost of power.

These three core businesses (like the phone network's separate long distance and local businesses), could very easily add more to the price of energy than what we have today. However, in the long run it is hoped that competition will ultimately lower these costs and perhaps even improve service. Along these lines, some power companies hope to improve their service by installing new computerized meters in each household to allow different rates to be charged at different times of the day. In addition, there is some talk of utilizing the excess phone line capacity (needed to transmit information between power facilities) to provide phone line capacity for businesses looking for cheaper phone service.

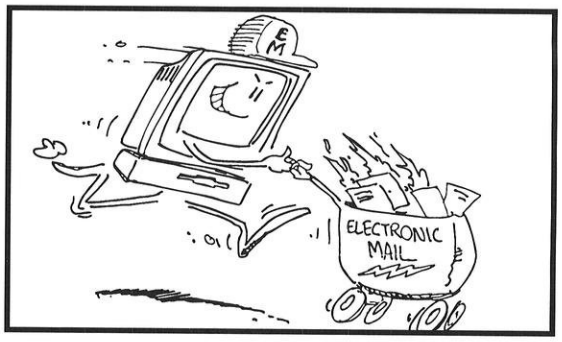
The struggle for power deregulation in Wisconsin poses many challenges. Perhaps, by using a go-slow approach which is carefully planned out, consumers, in the long run, might benefit greatly. However, many large businesses will more than likely benefit with the more choices afforded them and may prove to be the driving force to change the laws in Wisconsin and other states. Without a doubt, Wisconsin, with its strong position, is expected to stay competitive with other states as they eventually move to deregulate their power industries. In addition, while many utilities across the country face workforce cuts of 20 to 25 percent, WPS seems to be bucking this trend, to the benefit of Wisconsin workers. If

Cont. on page 22

Source: Wisconsin Public Service

Wayne Peterson, a successful engineer working for Wisconsin Public Service.

Getting ~ ~ Connected



"The server is busy." These four words that light up the computer screen can be really frustrating. Like many students in the dorm, trying to log onto the University system in the evening can take awhile. Most times, students in the dorms will have to wait until midnight or one in the morning to send an email message or look for information on the World Wide Web.

The advantages of having a com puter in your dorm room diminish when access is virtually impossible during the waking hours. To help resolve this problem UW-Housing is working on installing ResNet (Residential Network) in all student's residence hall rooms. ResNet allows for new telephone lines, basic cable TV service and computer data jacks. UW-Housing hopes that ResNet will provide a system for "future interactive, and distance, learning initiatives while delivering unparalleled information and communication services today." The anticipated completion date is the end of the 1996 fall semester.

ResNet uses ethernet, a networking scheme which is about 100 times faster than a 14.4 kilobaud modem

ResNet uses ethernet, a networking scheme which is about 100 times faster than a 14.4 kilobaud modem. A 14.4 kilobaud modem transfers data at 14,400 bits per second. Since ethernet uses hundreds of miles of cable that will soon be installed into the residence halls, the current method of logging in over your personal phone line is eliminated. The new cable will be for your computer connection and the existing phone lines will be strictly for the telephone. The complexity and size of the task of installing all these lines is enormous and this project will take time.

Each room will be wired with two high-speed ethernet connections allowing for full Internet access. House dens and study areas will also have the option for connecting a laptop computer to the network

In the meantime, residents will have to endure construction noise. The construction will not begin before 9 a.m. Housing staff will inform residents on what to expect and how to prepare their rooms for the installation. Installations consist of one inch pipes in rooms and two and one-half inch square pipes in the halls for all rooms leading to storage rooms and then to the basement.

ResNet will make access to the University computer system for residents very convenient. Each room will be wired with two high-speed ethernet connections allowing for full Internet access. House dens and study areas will also have the option for connecting a laptop computer to the network.

When ResNet is available, each computer will need an ethernet card and the appropriate software. DoIt will be selling ResNet Connection Kits which include an ethernet card, cable, drivers and WiscWorld software. An Installation Fair, given by DoIt, will be held in or near each hall when ResNet is running.

UW-Housing and DoIt are working to help the transition to ResNet. DoIt will provide a 24-hour Help Desk which students can call at 4-HELP. Also, if the problem can not be solved over the phone, a member from an ARCH center will contact you for an appointment.

If you are curious about the progress of ResNet or want more information, access the ResNet World Wide Web site:

<URL:http://www.wisc.edu/resnet/>.

Author Bio: Jennifer Schultz is a freshman interested in Geological Engineering. She can't wait for the ResNet so that the server will never be busy again.

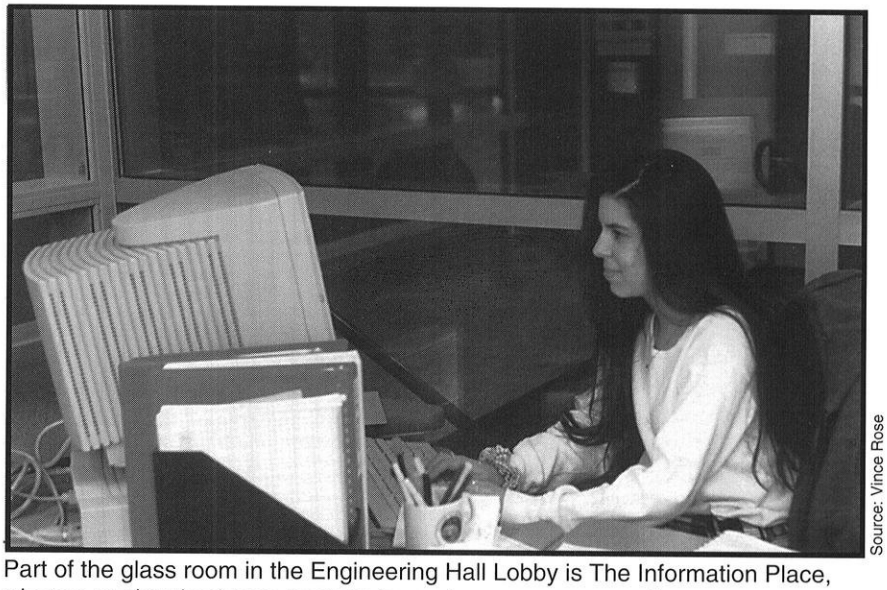
A Room with a View

Potted plants. People growing potatoes in outer space. Students hovering over a computer. The Information Place. Just what is going on in that glass booth, anyway???

The glass booth in the Engineering Hall lobby has evolved since it was built during Engineering Hall's renovation three years ago. Except for some potted plants, the glass booth remained relatively empty until fall of 1995. At that time, the Wisconsin Center for Space Automation and Robotics (WCSAR) moved in. They used the glass booth to monitor the potato spuds that they recently sent into orbit. However, when the shuttle mission was over, WCSAR moved out.

The students can do many different things with the fountain from the computer in the glass booth. They can control lights, music, and the pattern of water flow from the fountain

Currently, the glass booth is used for two purposes. Professor Richard Marleau's electrical engineering (ECE) students use one half of the glass booth to monitor the Máquina fountain's activities via computer. Dean Don Woolston set up the other half of the glass booth as "The Information Place," which provides information from an easy-to-find location to anyone visiting the engineering campus.



Source: Vince Rose

Part of the glass room in the Engineering Hall Lobby is The Information Place, where a student is always ready to try and answer your question.

Controlling Máquina

A computer is set up in the glass booth which controls the Máquina fountain on Engineering Mall. Professor Richard Marleau's ECE 468: Digital Computer Control Projects students, as well as ECE students taking independent studies credit, use the glass booth for this purpose.

Professor Marleau explained that the fountain is linked to a series of computers, some of which were donated by Allen-Bradley. These computers are located in various places, including a tunnel underneath the fountain and a room in Engineering Hall. The computers are also linked to the computer in the glass booth, which is used to control the fountain.

The students can do many different things with the fountain from the computer in the glass booth. Dan Anderson, an ECE student receiving independent study credit for his work with the fountain, said that they can control lights, music and the pattern of water flow from the fountain. In the winter, for example, they used the computer to control the water flow to

create the designs on the fountain. When summer arrives, giant speakers above Engineering Hall will play the Westminster Abbey chimes and the fountain will shoot bursts of water along with the music. For example, at two o'clock, two chimes will be heard as two bursts of water spray from the fountain. This display will be controlled by students working at the computer in the glass booth.

Anderson explained that the glass booth is used for convenience. He said, "we used to be in back of Professor Marleau's [ECE] 468 lab, and when you made changes to the program, you had to come out of the lab and walk to the front door [of Engineering Hall] to see if what you did was working. [Now,] you can just look out the window and see if [your changes] worked."

The Information Place

The other half of the glass booth in Engineering Hall's lobby is used as The Information Place. Dean Woolston said that "the main purpose of The Information Place is to bridge the information gap... between anybody who comes to Engineering Hall and those people who know the answers." He said The Information Place exists to serve all people, from students to professors to campus recruiters to alumni.

Conception

Dean Don Woolston created The Information Place in January, 1996. He said it was formed for two reasons. The idea first came about as a result of the 1990 College of Engineering Survey conducted by Polygon, the engineering student council. One of the survey's conclusions was that there is an information gap on the engineering campus. Information that students need in order to get through college is available, but is widely scattered and can be difficult to find. Therefore, a centralized, easy-to-find information place could help alleviate this problem.

The Information Place was also created to reduce student frustrations stemming from the poor layout of the Academic Affairs Office. Dean Woolston explained that once a student reaches the hard-to-find Academic Affairs Office, they "walk up to a counter that's like a bank, and is not really meant to be a place that you feel welcome. Then, if you're lucky, you find a place to sit, and almost always you have to make an appointment. Its like going to see a loan officer at a bank," said Woolston, "and that's not always what students want to do. They want to make a transaction with a teller and they're happy."

"I think the idea [for The Information Place] really stems from what students wanted all along, not anything that I wanted," Woolston explained. "It is puzzling to figure out all the stuff you are supposed to know."

Information Available at The Information Place

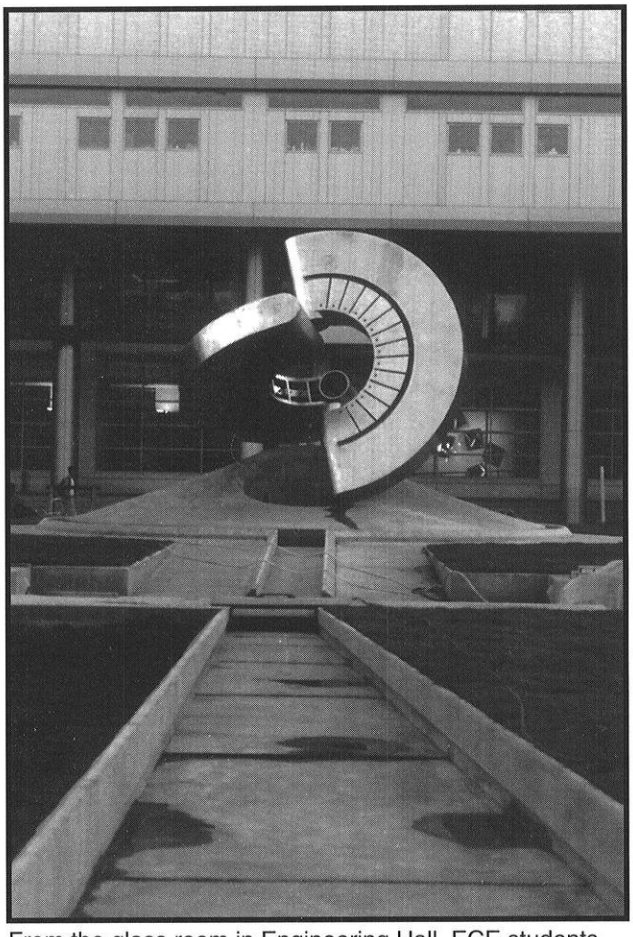
Students who work in The Information Place are prepared to answer all sorts of questions. Currently, the main focus is to provide two types of information: geographical information and information about current events.

The geographical information is available to help people find things, from classrooms to bathrooms, both in Engineering Hall and on the engineering campus.

The Information Place also strives to keep people informed about student events, such as club meetings and seminars.

Dave Sekowate, an Information Place worker, said that they also have information about lodging, social events and computer facilities. Karina Shook, who also works in The Information Place, said that they have a book listing all the student jobs available on engineering campus. "It will be one place that people can come and look, instead of having to go around to each department and

Students who work in The Information Place are prepared to answer all sorts of questions



Source: Vince Rose

From the glass room in Engineering Hall, ECE students hope to keep the fountain from running dry.

look on bulletin boards for student jobs," said Shook.

Right now, traffic through The Information Place is relatively slow, as people are still discovering what it is. When asked what the most frequent question in The Information Place was, Sekowate said, "It's, 'What is this place?' When people find out what we're for... they'll come in more and more."

The Information Place's Future

Recently, Dean Woolston said The Information Place is, "not quite the branch bank with tellers that I think of it as, but I think that will evolve." He hopes that in the future, students will be able to go to The Information Place to pick up pass/fail forms, major declaration forms, and pamphlets on engineering disciplines.

Woolston emphasized, "I certainly don't have any goal of making advising just a [process of] handing a pamphlet and sending [students] along... but students have an interest in getting things quickly, and if they have big questions, they can come and talk to me.... I am always happy to talk to students."

The Information Place could also evolve into a full fledged information referral office, according to Woolston. He said that it could become similar to the Campus Assistance Center, but for engineers. "At some point," said Woolston, "a student might go to The Information Place and say, 'I'm looking for an apartment close to the engineering campus, and they'd be given the information."

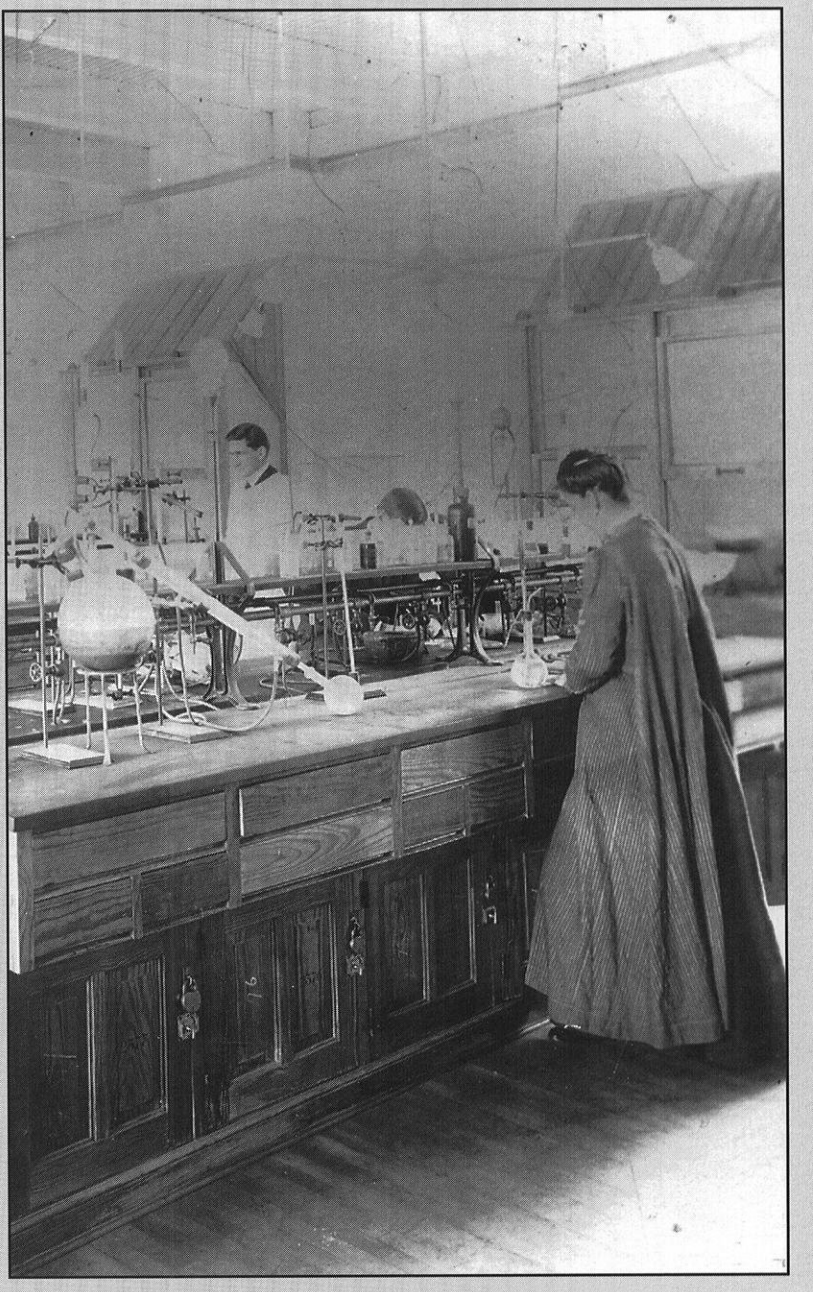
As ECE students think of more creative uses for the fountain, and as visitors to Engineering Hall discover the benefits of using The Information Place, the glass booth will no longer exist as a mystery. Instead, it will be known as a center for creativity and technical wonder, as well as a much needed place in which to gather the information that students need to make it to graduation.

Author Bio: Jen Hattan is new to the Wisconsin Engineer, but has already played a big role.

A Blast From the Past

Thanks in part to WWI and WWII, women broke the mold into the work force

(circa 1920)



Press Release

The *Wisconsin Engineer* magazine, published by the students of the University of Wisconsin-Madison, won six awards at this years annual Engineering College Magazines Associated (ECMA) national convention in Minneapolis, Minnesota.

The awards were as follows:

Best All Around Magazine - Honorable Mention
Best Single Issue - Honorable Mention
Best Layout - All Issues - Second Place
Best Article for a General Science Background - Second Place
Best Non-Technical Article - First Place
Most Entertaining Feature - Honorable Mention

The issue that won for 'Best Single Issue' was the February 1995 issue, Volume 99, Number 2. The author and article for 'Best Article for a General Science Background' was Jeremy Marwil for the article 'Desperately Seeking Fusion' in the April 1995 issue, Volume 99, Number 2. The author and article for 'Best Non-Technical Article' was Jason Och for the article 'Jump-Starting the Electric Vehicle Industry' in the September 1995 issue,Volume 99, Number 4. The author and article that won the 'Most Entertaining Feature' was Jason Och for the Just One more in the April 1995 issue, Volume 99, Number 2.

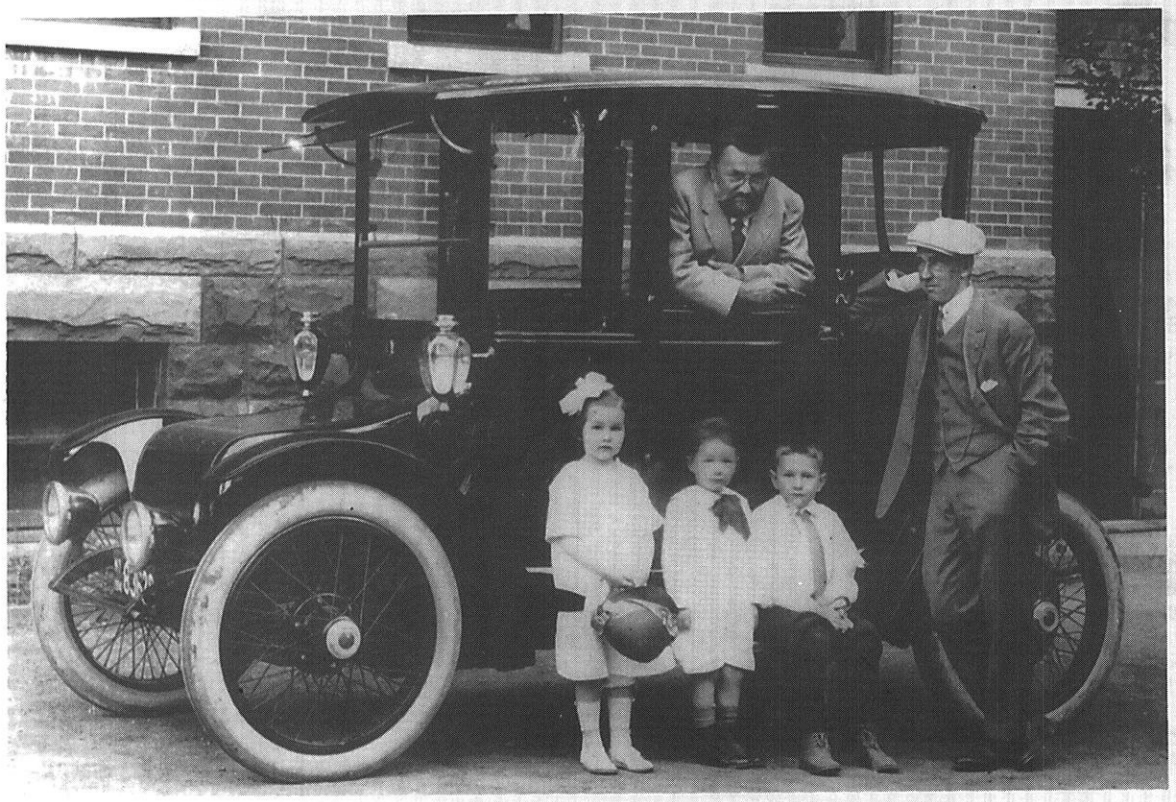
We would like to congratulate everyone who worked on the magazine and thank them for doing a terrific job! If you would like to find out more about the *Wisconsin Engineer* please contact us in any of the following ways:

E-mail: wiscengr@caelab1.cae.wisc.edu
Phone: 608/262-3494
Web Site: http://www.engr.wisc.edu/~wiscengr

Cont. from p. 15

anything,happens because of deregulation, the new ideas that will result because of competition will be sure to add value and thus ultimately benefit all consumers of power.

Author Bio: Rob Nelson poses as an ECE major at UW-Madison and has a few thoughts for the future. I hope someday that music, computers and ideas will one day meld into a common understanding. This will take a lot of work, overcoming harsh social barriers, barriers of different languages and understanding of mathematics, so that we can "Just all get along".



Faculty Profile: Michael Corradini

When I first met Mike Corradini, he took the time to sit down and talk with me. That was a few years ago, and he still makes the time to talk about whatever's going on in my life. So when I was waiting in his office to interview him, I wasn't surprised to see four or five other students shuffle in and out. His main concern is the students at this university.

Mike Corradini completed his undergraduate education at Marquette University with a Bachelor of Science in Mechanical Engineering. He then proceeded to graduate with his Ph.D. in Nuclear Engineering from MIT. For the next three years, he got a taste of the real world working at Sandia Labs in the Reactor Safety Division. In 1981, He came to the University of Wisconsin to be a professor in the Nuclear Engineering and Engineering Physics department.

In July, he became Associate Dean of Academic Affairs. He applied for this position to increase his interaction with students. In other words, students are the most fun. He said, "The students are our customers, and we are here for them."

Now Mike spends about 80% of his time being a Dean. He is responsible for the Engineering Career Services, International Engineering Studies Program, Pre-Engineering Office, and the CAE among other various services. The other 20% of his time he spends teaching and researching with his graduate students.

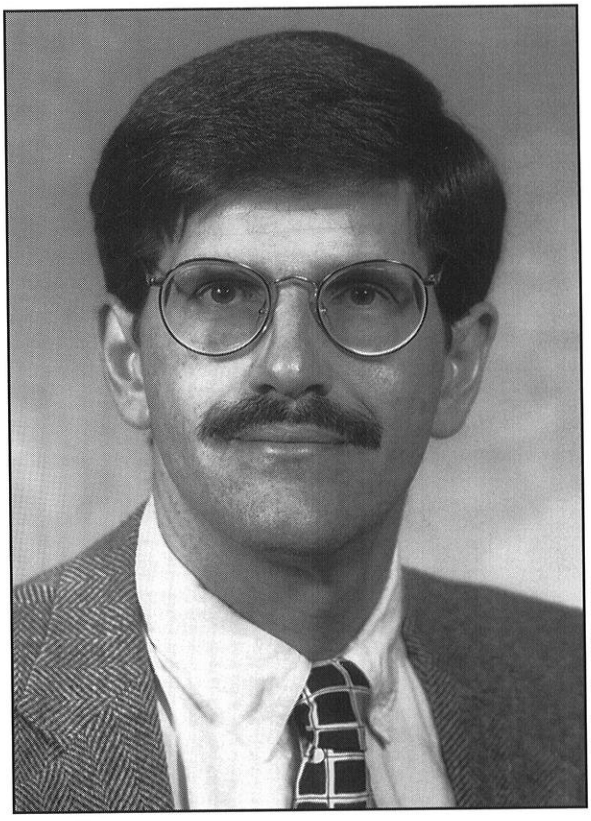
Dean Corradini is involved in many committees on campus and off. He is on the Assessment Council, which takes the curriculums of different majors and decides whether or not they are sufficient. He is also the UW System representative to the Technical Advisory Council of the State Radioactive Waste Review Board. This committee deals with the technical and political aspects of waste disposal siting. Another committee is the Administrative Council. This council deals with various changes on campus as a whole. A few examples are general education requirements and UW student transfer policy. Finally, he is the Director of the Nuclear Reactor Research Center.

His list of achievements includes the American Nuclear Society Young Members Achievement Award (1990), The Presidential Young Investigator Award (1984), and Fellow of the American Nuclear Society.

His research interests include thermal hydraulics and multiphase flow with specialties in reactor operation, reactor safety, waste disposal siting, and risk assessment. He currently has a dozen graduate students who assist him in his work.

In the little free time that he has, he likes to play basketball at the Shell and attend his boys' basketball and soccer games.

When asked what he thinks of the University today and its future, he said, "The University is at a crossroads. With respect to down-sizing, a unique opportunity for reorganization is upon us. In an engineering sense, we need to optimize our resources."



Source: Engineering Publications

When not spending time with his graduate students, Professor Michael Corradini finds time to be the Associate Dean of Academic Affairs.

Author Bio: Sara Steinhardt is a chemical engineer graduating in December. She is hoping to get a job someplace warm.

Just One More

Ahh spring! It's about that time when students throughout the college of engineering start scratching their heads and pulling their hair. Every year it's the same. Tensions are running high and engineering students start asking themselves the undeniable question, "Am I meant to be an engineer?"

We at the the Wisconsin Engineer thought this was a good question. Are you meant to be an engineer? Is anyone? Thus, in the interest of student well being, we have concocted a comprehensive study to answer this question once and for all. The following is a simple little test. It consists of 20 statements and if you can honestly say that five of these apply to you, then you my friend, are meant to be an engineer. If you can't say this then feel lucky. Get out while the getting's good. Go and never look back. Who needs you anyway!

You might be an engineer...

1. If you have no social life, and you can prove it mathematically.
2. If you enjoy pain.
3. If you know vector calculus but can't remember how to do long division.
4. If you've actually used every single function on your graphing calculator.
5. If it is sunny and 70 degrees outside and you are working at a computer.
6. If you frequently whistle the theme song to "MacGyver."
7. If you always have to do homework on a Friday night.
8. If you think in "math."
9. If you've calculated that the world series actually diverges.
10. If you hesitate to look at something because you don't want to break down its wave function.
11. If you have a pet named after a scientist.
12. If you laugh at jokes about mathematicians.
13. If you can translate English into binary.
14. If you can't remember what's behind the door in the computer lab which says "Exit."
15. If you are completely addicted to caffeine.
16. If you consider any non-engineering course "easy."
17. If, when your professor asks you where your homework is, you claim to have accidentally determined its momentum so precisely, that according to Heisenberg it could be anywhere in the universe.
18. If you'll assume a "horse" is a "sphere" in order to make the math easier.
19. If the fun center of your brain has deteriorated from lack of use.
20. If you make a hard copy of this list and post it on your door.

The above list was compiled by Jon Furniss with help from Matt Vokoun.

Wisconsin Engineer Magazine
Mechanical Engineering Building
1513 University Avenue
Madison, Wisconsin 53706

Nonprofit Organization
U.S. Postage
PAID
Madison, WI
Permit No. 658