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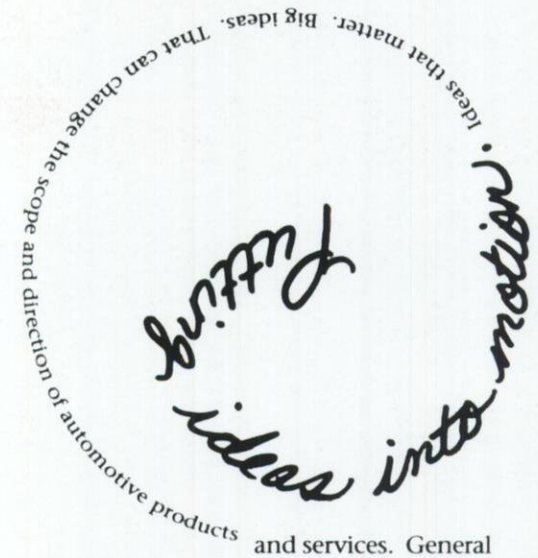
NOVEMBER 2001
VOLUME 106, NUMBER 1

WISCONSIN ENGINEER

Garden Engineering?

Aesthetics meets Technology



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WISCONSIN ENGINEER

Published by the Students of the University of Wisconsin-Madison VOLUME 106, NUMBER 1 November 2001

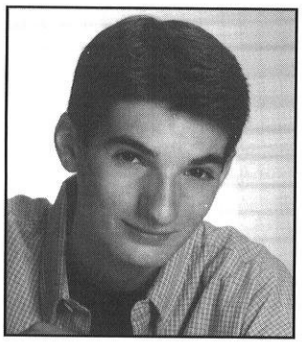
FEATURES

DEPARTMENTS

On the Cover:

Rain gardens, which touch many facets of life from wildlife to groundwater supplies, provide surplus water control and flood prevention technology in a manner that is aesthetically pleasing.

http://www.wisconsinengineer.org wiscengr@cae.wisc.edu 608-262-3494 1513 University Ave. Madison, WI 53706



Headaches & Earthquakes

As I sit here late at night attempting to think of something relevant, I find myself instead wondering what dinner tasted like. It looked pretty good, but everything tastes like the back of a postage stamp. I am in the final stages of a cold that must be distantly related to the Black Plague. For two solid weeks, I was incapable of doing anything beyond attending classes, and even that was too much to handle on a few occasions.

[Just to prepare you, this message will eventually become meaningful, yet perhaps a bit farsighted and geezerish.]

After spending a few days sniffling and whining a lot, I started to warm-up to my miserable state. After all, I finally had a valid excuse for being lazy. It was actually to my *benefit* to avoid being ambitious at all costs. I took advantage of this situation to the best of my ability. I found the time to wash and match all of my socks, watch the news, call my mom, and even clean the mystery gunk off the kitchen counter. Of course, my head felt like it was about to explode, but I recognized the value in being wrenched away from my precious routine. It allowed me to see how much of each day I usually roll through like a robot stuck to a track.

That brought me to think about the more serious setbacks in life, the real earthquakes that make even the worst head cold look like a walk in the park. At least once or twice in every lifetime comes a tragedy or hardship that causes everything once considered "certain" to collapse like an elaborate house of cards. Many of us make it through our younger days without any life-shattering disasters. Some of us aren't so fortunate.

Such devastating times cannot be considered good in any light; they are far too grave to be labeled mere clouds around which any silver linings can be drawn. They do, though, provide each person with the rare opportunity to pause and catch a glimpse of that illusive big picture. When you do this, you'll notice some of the essential things, both good and bad, that "life" has been blocking from view.

Much of the nation—in fact, much of the world—was derailed from its trustworthy track on September 11, and some of the most important elements of life became strikingly clear. Millions of people remembered to call their loved ones that day. Parents left work early to be with their children. Drivers thought twice before slamming on the horn and flipping off that old guy that always wastes the green arrow, and making time to watch "Friends" suddenly ceased to be a top priority. People from all walks of life proved themselves to be heroes. Countless others vowed to make a real difference in their lifetimes.

You can determine for yourselves the moral to be drawn from all of this. The message I'm fumbling with is that disasters and unforeseen changes, although tragic, may bring into view some of the most extraordinary aspects of your life. These are not the "good" results of "bad" events. They're things that always have been—and always will be—all around you, whether or not you choose to look at them.

And no, *geezerish* is not technically a word.

The College of Engineering
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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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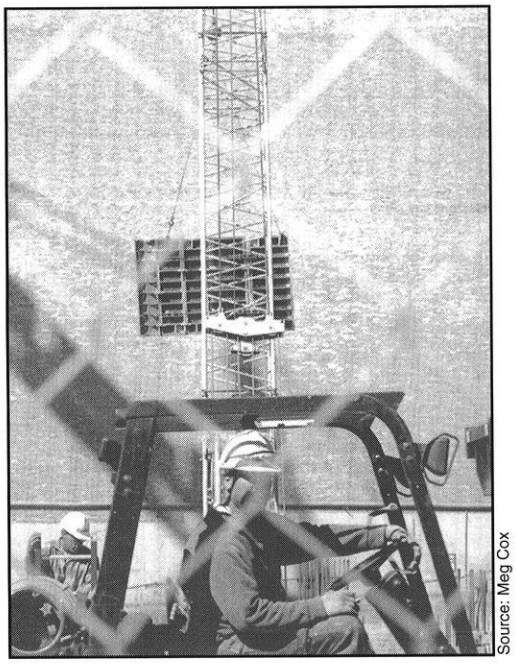
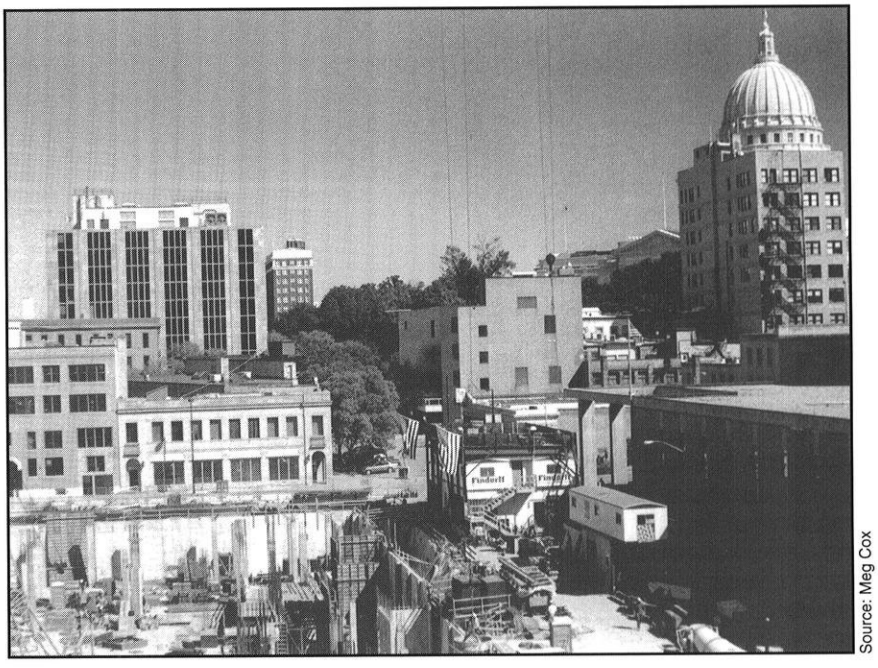
A Glimpse Of the Overture Project

By Meg Cox & Jen Rowland



Source: Meg Cox



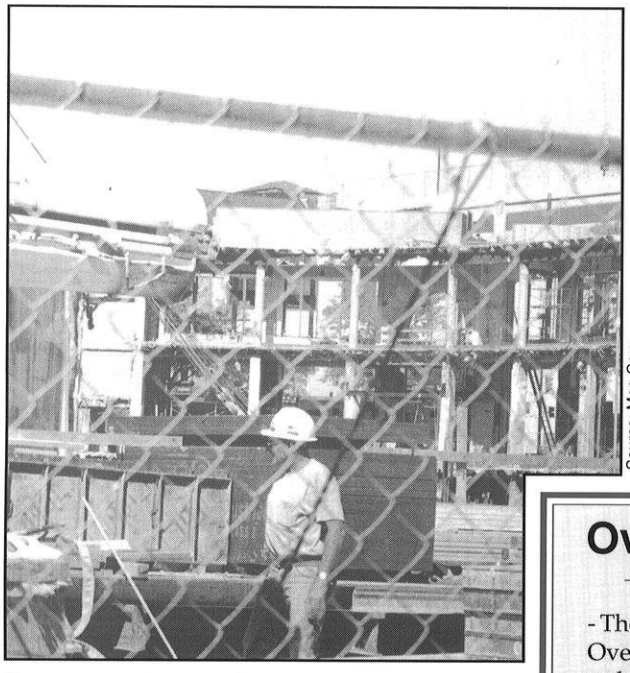
Source: Meg Cox

Source: Meg Cox

Above: The capitol can be seen in the distance overlooking the Overture Center from Henry Street. J.H. Findorff and Son, Inc. is the construction manager and Cesar Pelli is the lead architect.

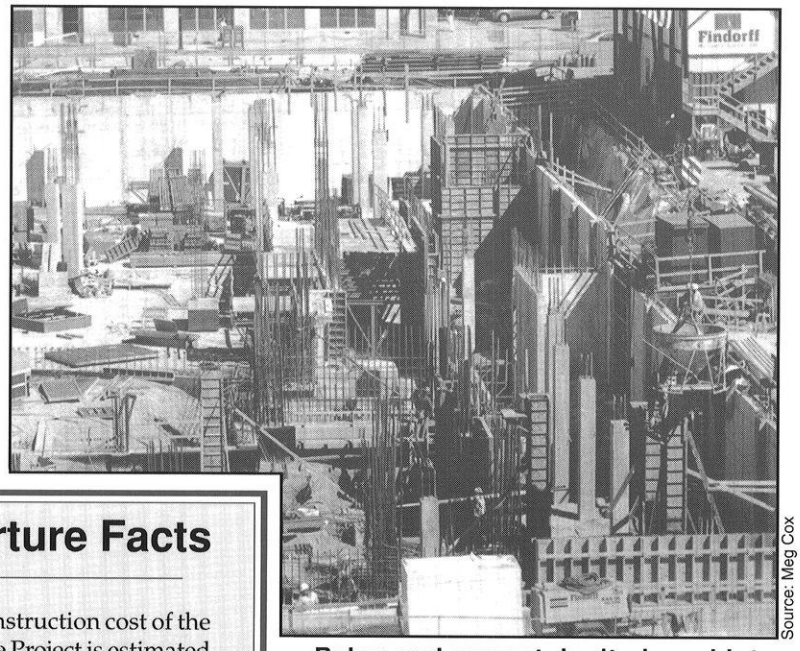
Above Left: A construction worker uses a hydraulic lift to move building materials behind the fence alongside the public library.

Left: The gutted Yost-Kessenich store front can be seen from the observation window on the third floor of the Civic Center.



Source: Meg Cox

A construction worker can be seen through the fence surrounding the Overture Center construction area.



Source: Meg Cox

Rebar and cement don't give a hint that by 2005 an orchestra will be tuning up here in the future orchestra pit.

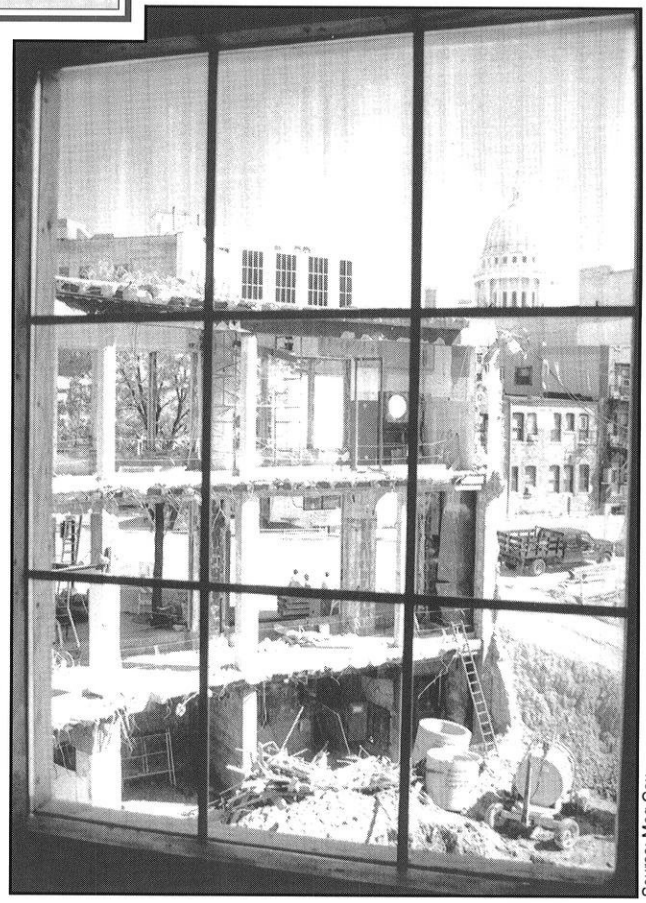
Overture Facts

- The construction cost of the Overture Project is estimated to be in excess of $100 million.

- The Project is expected to be completed by the end of 2005.

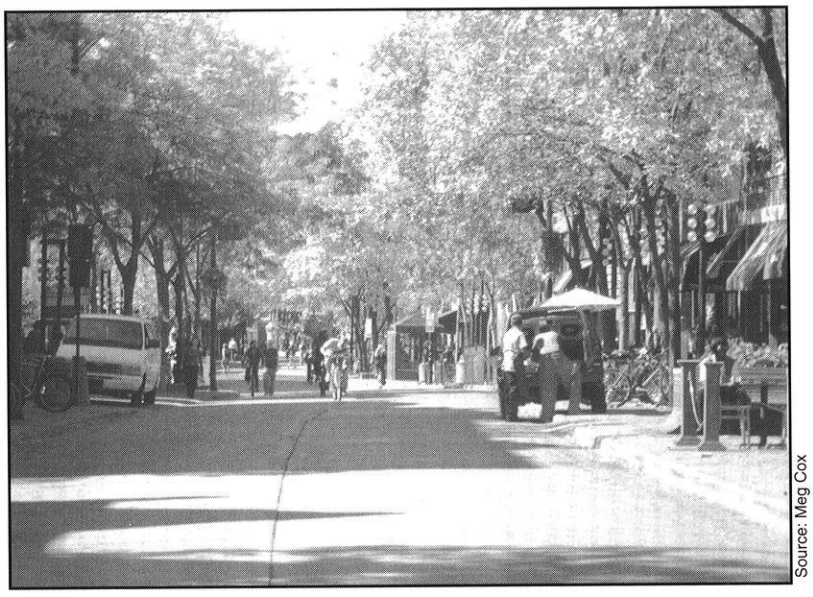
Source: Meg Cox

The cranes are in motion in a view from Henry and Mifflin Streets. The larger buildings of the Overture Center will be back here, away from State Street.



Source: Meg Cox

Madison's most noteworthy landmark, the capitol, keeps watch over the construction of what will become another beautiful Madison landmark: the Overture Center.



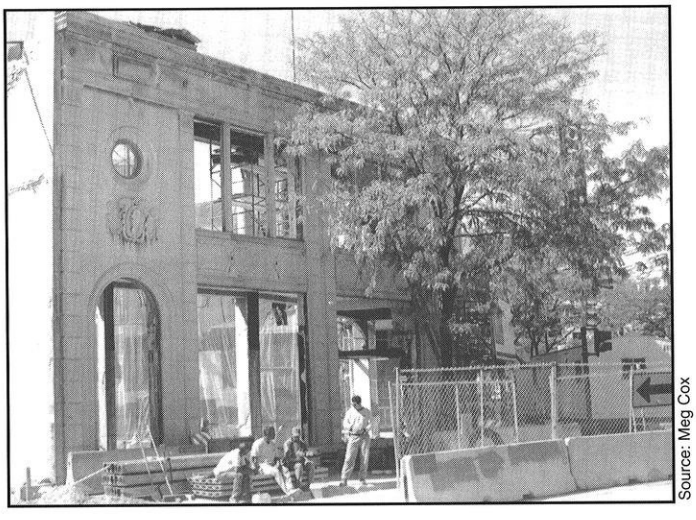
Source: Meg Cox

Left: State Street exudes a warm local atmosphere during the daytime. The people's art district worries that State Street will become gentrified as the Overture Center begins to bring in mainstream talent.

Overture Foundation

"The Overture Foundation was created in 1996 by W. Jerome (Jerry) Frautschi, who serves as its Chairman. Mr. Frautschi created the Foundation with the primary purpose of supporting the arts and culture in Madison and Dane County. The development of the (Overture Project) will be the Foundation's major focus."[1]

Construction workers take a lunch break in front of the preserved historical Yost-Kessenich store front. The main entrance to the Overture Center will be here at the corner of State and Dayton Streets.



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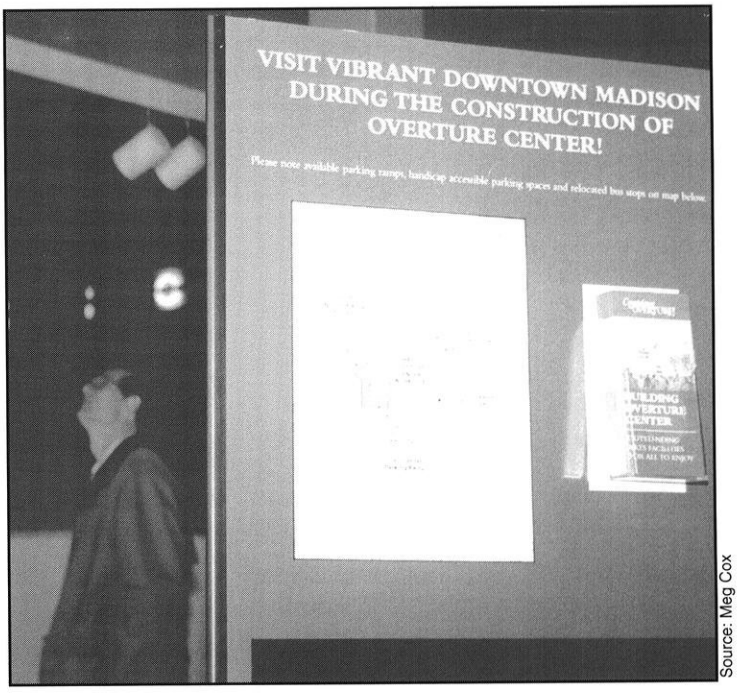


Source: Meg Cox

Cesar Pelli

Cesar Pelli is the design architect for the Overture Project. Below is some background information into the architectural career of Mr. Pelli.[1]

- Pelli graduated from the University of Tucuman in Argentina with a degree in architecture.

- In 1977, Pelli became Dean of the Yale University School of Architecture.

- In 1977, Pelli founded Cesar Pelli & Associates.

- In 1995, the American Institute of Architecture awarded Pelli the Gold Medal, recognizing a lifetime of outstanding contributions and distinguished achievement.

Above: A citizen checks out the current Civic Center, where construction maps and scale models are displayed and pamphlets are available.

Reference:

[1] *http://www.overturefoundation.com*

Ocean Floors Reap Massive Energy Resource

By Joel Wagner

Have you ever thought about how much natural gas the United States consumes in one year? Considering that, have you ever predicted when our current supplies of natural gas would be exhausted? A Department of Energy (DOE) workshop was held recently to discuss the status of the world's post-2020 natural gas supply, and almost all of the attending organizations concluded that a new source of natural gas would most likely be needed by 2030.[1] Fortunately, experts believe there is a new source available to fulfill our natural gas needs: methane hydrates.

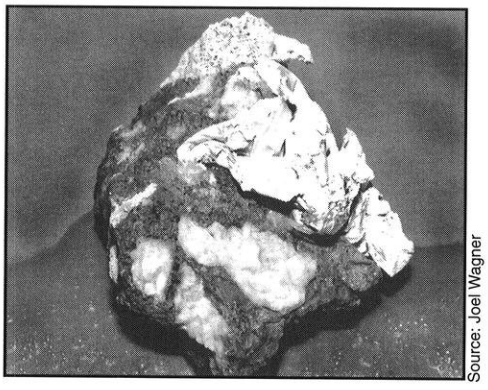
Methane What?

Methane hydrates are a member of the family of gas hydrates—crystalline solids whose building blocks consist of a central gas molecule surrounded by a cage-like lattice of water molecules, but without chemical bonding.[2] Therefore, gas hydrates are similar to ice, except that the water molecules enclose a central gas molecule.[2] Many gas molecules, including carbon dioxide, hydrogen sulfide, and numerous low molecular weight hydrocarbons can form gas hydrates, although most marine gas hydrates are methane hydrates.[2]

"Methane produces 40% less carbon dioxide than other fossil fuels, so, from the environmental point of view, it's a lot cleaner."

Dr. Bill Dillon, Project Chief of the U.S. Geological Survey (USGS) Gas Hydrate Project explains, "Methane hydrate is located in ocean sediments at water depths exceeding about 500 meters. The sediment layer in which gas hydrate is stable commonly extends from the seafloor to several hundred meters below the sea bottom." Methane hydrates are also found, less commonly, beneath arctic permafrost.[1] One of the primary benefits of methane is, as Dillon notes, that it "produces 40% less carbon dioxide than other fossil fuels, so from the environmental point of view, it's a lot cleaner."

The DOE is concerned with methane hydrates for three primary reasons: 1) the amount of energy contained within methane hydrates is immense and could have enormous effects on global economic and energy policies; 2) the presence of methane hydrates in sea floor sediment greatly alters the sediment's physical characteristics, which presents dangers to seafloor stability, especially during drilling operations; and 3) tapping into hydrate reservoirs could potentially release large amounts of greenhouse gases into the atmosphere, thereby affecting global climate.[1] The study of methane hydrates will focus on two key energy supply goals: 1) the DOE will support work that will increase the safety of deep-water oil and gas exploration and production operations that require drilling through marine hydrate deposits that exist above current oil and gas supplies; and 2) the DOE hopes to ensure the long-term supply of natural gas by improving the knowledge and technology base of methane hydrates, which will allow for commercial methane production from U.S. hydrate deposits by the year 2015.[1] Currently, these energy supply studies have encountered two primary problems. First, hydrates are found in remote arctic and deep-water locations. Another difficulty is that hydrates quickly dissociate when removed from their natural temperature-pressure conditions.[1] To overcome these problems and reach the project's goals, researchers will perform laboratory studies of pure hydrate and hydrate-sediment mixtures along with coordinated fieldwork to observe and obtain hydrates from their natural environment.[1]



Source: Joel Wagner

Gas hydrate samples have been recovered from 20 of 80 known sites worldwide, such as this Class II gas hydrate (ethane and carbon dioxide hydrate) from the Gulf of Mexico.

Dillon suggests that vast amounts of microbial methane in marine sediments around continental margins allows for the formation of methane hydrate anywhere that sufficient pressure is combined with low water temperatures, which are typically found near the seafloor.

To illustrate the amount of energy potentially available, the United States' total domestic in-place natural gas resource is near 25,000 trillion cubic feet (Tcf), while the total domestic in-place methane hydrate resource could top 200,000 Tcf.[1] As Dillon points out, "Gas hydrate has a huge amount of methane tied up in it."

Research & Development

To fully harness these resources, there is still much to be done. DOE's National Energy Technology Laboratory (NETL) is focusing on several key directives for studying methane hydrates. These are being carried out in association with the USGS, the Naval Research Laboratory (NRL), the Monterey Bay Aquarium Research Institute and several universities nationwide. These study efforts include laboratory characterization of pure hydrate and hydrate-bearing sediments, field studies of hydrate occurrences, remote sensing of the hydrate reservoirs, modeling of hydrate behavior and reaction to numerous natural or man-made processes and the establishment of a national hydrate database.[1]

The key element of methane hydrate investigation and, in the end, further discovery is

a reliable and precise method of finding hydrate reservoirs below the surface through remote sensing technologies.[1] Field studies to observe, sample and characterize methane hydrates are underway in the Atlantic, Gulf of Mexico, the Artic, Alaska and offshore Japan.[1] By using 3-D multi-component seismic data to map the distribution of hydrates on the ocean floor, scientists hope to gain new insight into the structure and properties of hydrates, which will lead the way to future practical hydrate collection.[1]

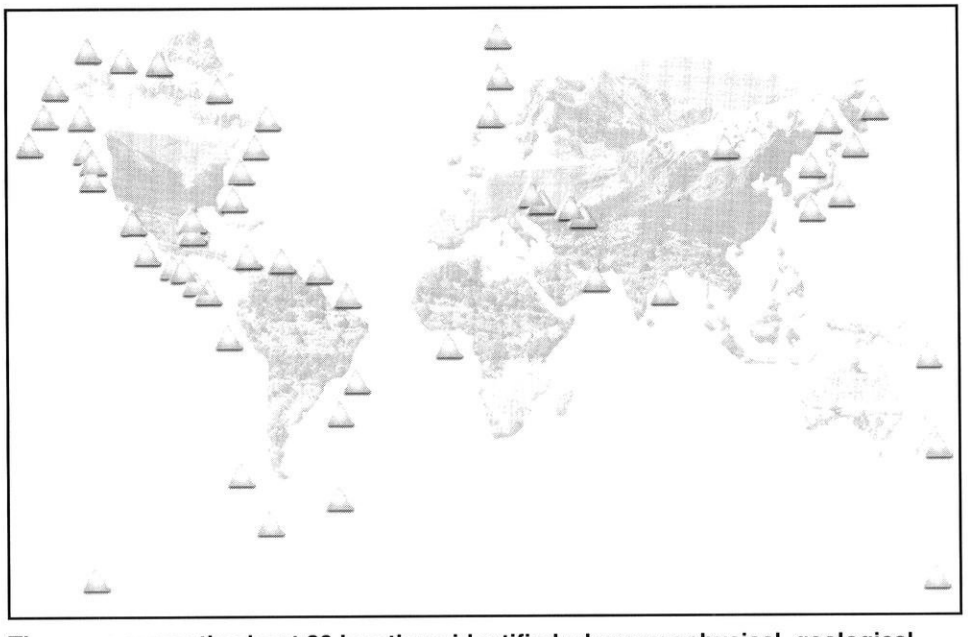
In May 2000, the "Methane Hydrate Research and Development Act of 2000" was put into law.[1] This bill authorizes a budget of $5 million in Financial Year 2001 (FY01), $7.5 million in FY02, $11 million in FY03 and $12million each in FY04 and FY05 for further methane hydrate research and development.[1] With this type of funding, NETL hopes to make significant advancements in the study and eventual implementation of methane hydrate resources.

Numerous developments around the globe are suggesting that the commercial production of methane hydrates may arrive much sooner than originally thought

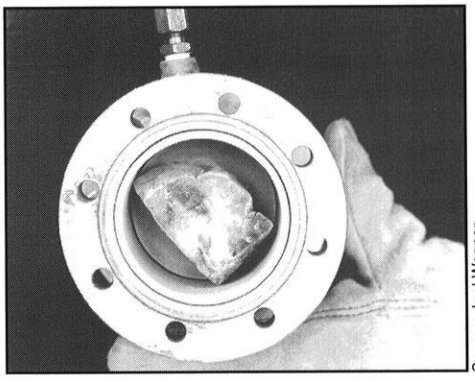
The Path Ahead

Along with tremendous energy resource implications, hydrates may also significantly affect the stability of the sea floor near hydrate reservoirs through hydrate dissociation and interaction with oceanic sediment. "The connection of gas hydrate to drilling safety is the most immediate issue," asserts Dillon. Also, hydrates may greatly affect long-term climate through potential periodic, possibly massive, release of methane into the oceans, and thereby potential release of greenhouse gases into the atmosphere through methane oxidation.[1] Dillon warns, "The release of methane into the atmosphere may be catastrophic, not gradual, because the release of a massive amount of methane from beneath the methane hydrate-stable layer can create a violent gas release. That also could release gas hydrate fragments that would float to the surface, as recent studies have shown, allowing the methane to be released directly into the atmosphere. Methane is a far more detrimental greenhouse gas than carbon dioxide. If large amounts of methane were to escape into the atmosphere, it would have a significant, immediate impact." To properly identify and address all issues concerning hydrates, scientists are continuing thorough analytic research.

Numerous developments around the globe are suggesting that the commercial production of methane hydrates may arrive much sooner than originally thought.[1] Using methane hydrates, the world may satisfy its oncoming natural gas shortage. Nonetheless, society must realize that even methane hydrate resources are finite.



There are currently about 80 locations identified where geophysical, geological, and/or geochemical evidence indicates the presence of gas hydrate, and at 20 of these locations samples of gas hydrate have been recovered.



Source: Joel Wagner

Retrieval of naturally occurring hydrates, like this Methane hydrate sample from the Middle America Trench off the Coast of Guatemala, is a vital component of hydrate research.

More Information

Go to the NETL website, *http://www.netl.doe.gov*, and the U.S. Geological Survey (USGS) website, *http://www.usgs.gov*. Visit *http://walrus.wr.usgs.gov/globalhydrate* to see details concerning all known gas hydrate occurrences worldwide. There are currently about 80 locations identified where geophysical, geological, and/or geochemical evidence indicates the presence of gas hydrate. At 20 of these locations, samples of gas hydrate have been recovered.[4]

Author Bio: Joel Wagner is a freshman in Chemical Engineering and Biochemistry. His interest in energy resources was sparked this July when he heard a lecture on methane hydrates while attending the National Youth Science Camp in Bartow, West Virginia. This is his first article for the Wisconsin Engineer.

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[1]Tomer, Brad; Guthrie, Hugh; Mroz, Tom; Boswell, Ray. "A Collaborative Approach to Methane Hydrate Research and Development Activities." Presented at Offshore Technology Conference, Houston. 2001. Available: *http://www.netl.doe.gov/scng/explore/ref-shelf/otcpaper.pdf*

[2]*http://woodshole.er.usgs.gov/project-pages/hydrates/hydrate.htm*

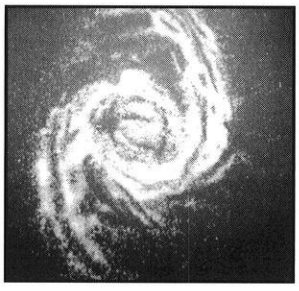
[3]Dillon, Bill, Ph.D. Telephone interview conducted Sept. 24, 2001.

[4]*http://walrus.wr.usgs.gov/globalhydrate*

UW-Madison Aims a New Eye to the Cosmos

By Matt Feirer

The UW-Madison Astronomy Department's long and productive history with telescope research is about to enter an exciting new chapter. A new telescope is being built in South Africa, which will be the largest in the Southern Hemisphere. It's a multinational partnership collectively called the Southern African Large Telescope, or SALT for short.



Perhaps the most noted UW-Madison telescope is at the Washburn Observatory, which sits sentinel on Observatory Hill, overlooking Lake Mendota. Built in 1881, the Washburn 15 inch was the first telescope constructed by the State of Wisconsin. By 1958, Washburn had been absorbed into the University, and the Pine Bluff Observatory was built 15 miles west of Madison to serve the increasing needs for astronomical teaching, research and testing. In 1994, UW Madison joined forces with Indiana University, Yale and the National Optical Astronomy Observatories in the construction of a new telescope situated on Kitt Peak in Arizona.

Source: Gene Chyou

The new telescope on Kitt Peak, known as the WIYN telescope (Wisconsin, Indiana, Yale, and the National Optical Astronomy Observatories), had a primary mirror measuring 3.5m in diameter. This was a vast improvement upon the Pine Bluff Observatory, whose largest telescope had a primary mirror measuring 0.9m in diameter.

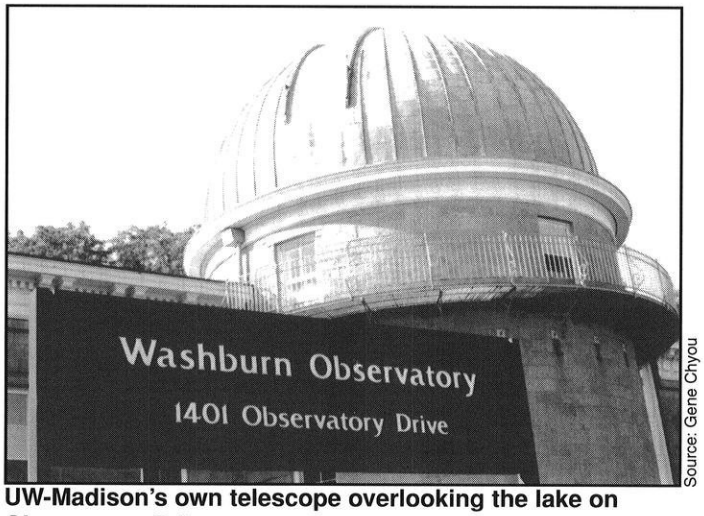
The new SALT telescope will boast a mirror 11m in diameter—but it isn't actually one mirror. It can be compared to the compound eye found on the common housefly. Instead of having two eyes, a fly has thousands of small eyes, which together provide a wide field of view. While not having thousands of "eyes," the SALT telescope will have a mosaic of 91 separate mirrors whose light rays converge to a single focal point. Unlike past telescope mirrors, which were very heavy and thick, these mirrors are thin and light. Each mirror is one meter in diameter, and is hexagonally shaped, unlike the traditional circular ones in older telescopes. One of the main reasons for keeping the mirrors small is that as you build larger and thicker glass mirrors, it gets harder to keep them at a constant temperature. Temperature fluctuations can greatly decrease the quality of a scope's image.

In another attempt to minimize this effect, engineers are designing elaborate ventilation systems, some of which rely on the surrounding area's natural winds. Although these small mirrors save weight, they require individual supports to keep each aimed at the central focus. The computer programming alone for this task is monumental. These individual mirrors are being manufactured in Leningrad, Russia. From there they'll be shipped to Kodak in the US for polishing. Then on to Africa, where they will be installed in the telescope.

The first mirrors are expected to be installed in 2003.

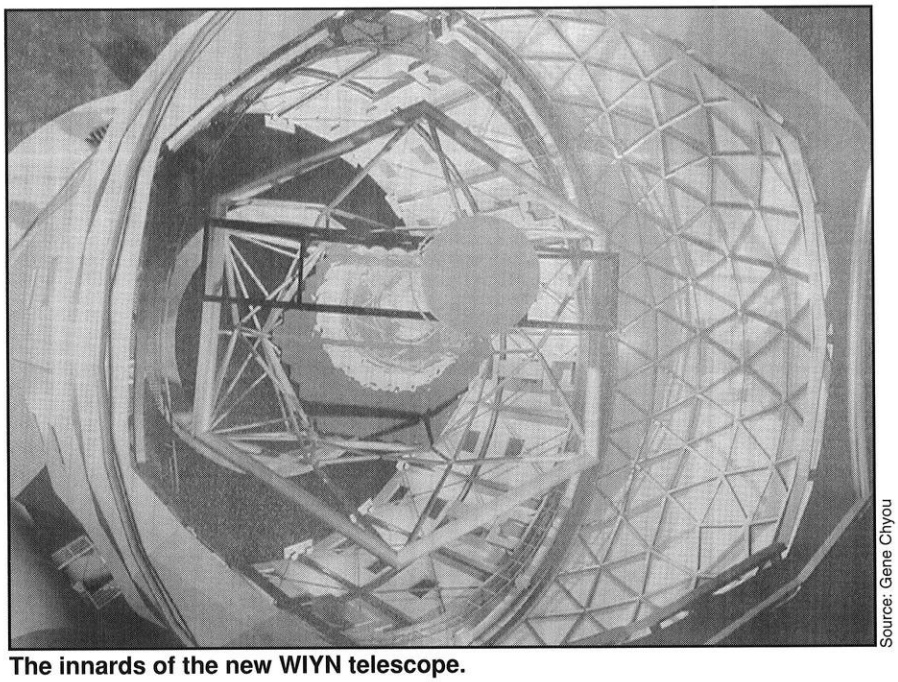
Another engineering innovation has been the restriction of the primary mirror's movement. It will be pointed at a fixed elevation and permanently fixed to a turntable, which will reduce the complexity of keeping the mirror focused and positioned. Unfortunately, with a fixed mirror you greatly reduce the amount of sky you can cover. Instead of being able to move the primary mirror to track the stars, the SALT will have its optical instruments follow the stars as they move. This assembly (which includes a spherical aberration corrector) will be able to move on and tilt around the x, y, and z-axes. A scaffold-like assembly will control the lateral movements, and fine-tuning will be controlled by a "hexapod," a device with 6 pneumatic legs.

UW-Madison is in charge of most of SALT's instrumentation and is planning on delivering it to South Africa in 2004. Upon completion, the scope will be open to observation. Unlike earlier telescopes, where you applied for several days of observing time, the SALT will have "queue"



Source: Gene Chyou

UW-Madison's own telescope overlooking the lake on Observatory Drive.



Source: Gene Chyou

The innards of the new WIYN telescope.

scheduling. This method will get rid of formal schedules, requiring researchers to instead submit a list of desired objects on which to have the telescope focused.

As mentioned earlier, the SALT telescope is a multinational partnership. The U.S. contingent includes UW-Madison, Rutgers, Carnegie Mellon, the University of North Carolina and Dartmouth. Overseas, South Africa, Germany, Poland, the United Kingdom and New Zealand are contributing. UW-Madison's share in the project is about 16%.

The telescope is being built on the site of the Southern African Astronomical Observatory, which is a six-hour drive from Cape Town. This area is dry and far from a major urban center, which provides the clear, dark conditions necessary for deep astronomical observation. As an additional incentive, the majority of the world's large telescopes are in the Northern Hemisphere. Having a telescope this large in the Southern Hemisphere will permit observation of a completely "new" realm of stars.

Once finished, the SALT telescope will sow its rewards for years to come. Professor Kenneth Nordsieck is the director of the Space Astronomy Laboratory here on campus, which is in charge of making the instruments that will be installed in the SALT telescope. "With its engineering challenges and potential scientific payoff," Nordsieck said with enthusiasm, "the SALT project has been one of the most exciting projects I have worked on." It's clear that the SALT telescope will add an immeasurable value to astronomy education here at UW-Madison.

Author Bio: Matt Feirer is currently a sophomore majoring in Biology.

The Future of Blood Preservation

By Sam Strom

The devastating events of September 11, 2001 demonstrated the worst, but also brought out the best, in human nature.

With all the injured people the blood supply grew sparse in New York and Washington, D.C. and help was needed from the entire country. People in Madison and around the country did not hesitate to donate. These acts of kindness illustrate the compassion of our country, but it is unfortunate that we should have such a shortage in a desperate time rather than simply having the resources to deal with it. Thanks to new research, these resources may be readily available in the future.

Due to our current expensive and insufficient storage techniques, we cannot preserve enough blood to keep a satisfactory supply for a situation like this. Basic storage of blood yields a shelf life of 28 days. Cryopreservation, currently our best system of preservation, yields a life of ten years, but this comes at great cost and risk. Cryopreservation, which involves stabilizing cells at cryogenic (very cold) temperatures, is used to preserve anything with living cells, including organs, tissue, sperm and embryos.

The first step in cryopreservation involves the cryoprotective agent, which is added to the sample to preserve it. Glycerol and dimethyl sulfoxide (DMSO) are the two most commonly used agents. An effective agent can enter the cell wall and delay the inner freezing of the water. The two aforementioned agents are generally considered the most effective, but they do not work with every type of cell. The correct agent must be used before the cell can be preserved. It is difficult to separate and preserve each of the many types of cells within a blood sample.

Basic storage of blood yields a shelf life of 28 days

Source: Carl Calhoun

The storage temperature of the cells directly affects the length of time they can be kept alive. The lower the storage temperature, the longer they will survive.

Researchers face the challenge of improving this process.

Next is the equilibration process, when the cryoprotective agent is allowed to penetrate the cells. Equilibration lasts anywhere from 15 to 60 minutes, depending on the cell type.

Once the agent has been given ample time to penetrate, the sample may be cooled. Professor William E. Brower of the Department of Mechanical and Industrial Engineering at Marquette University, a researcher in the field of cryopreservation, indicated that cooling is a critical point in the preservation. Since all cells contain water, much care must be taken in this step. If ice crystals form, the cell will be killed, rendering the sample unusable. If researchers were to refine this cumbersome process, both our ability to preserve blood and the amount of blood stock would increase.

Storage of the blood is very important. The stored amount of blood in hospitals and clinics is too low. The storage temperature of the cells directly affects the length of time they can be kept alive. The lower the storage temperature, the longer they will survive. For ideal storage, the cells should be stored at liquid nitrogen temperatures, but this process is difficult due to the nitrogen vapor, which may cause the sample to become toxic.

When the blood is needed, it must be recovered in the correct process. Cells can be damaged if subjected to liquid nitrogen vapor or to quick temperature changes. If done incorrectly, this critical step can be responsible for lowering amounts of stored blood. The more error there is in recovering the frozen cells, the more of the supply must be used.

It is clearly difficult to use cryopreservation with a high degree of success. This is why researchers like Brower and Professor James H. Southard of the Department of Surgery at the University of Wisconsin Clinical Sciences Center are working towards improvements.

Along with the preservation of blood, researchers are attempting to improve the preservation of organs. Currently at UW-Madison, Southard and his team are researching organ preservation and transplantation. Southard created a solution to store organs in the late 1980's and has become a leader in the field. Organs the team are researching include the kidney, liver and heart. "Our objective," said Southard, "is to improve organ transplantation for clinical applications."

The events of September 11, 2001 demonstrated to the world that we need a better way of storing blood and other critical organs for the long term. In a great display of patriotism, the nation came together to help those in need. Only through improved blood preservation will we be able to give ample help for a situation of this magnitude in the future. Improved techniques would not only have national and global implications, but also personal implications. The best blood for someone in need is his or her own. With a better, less expensive way to store blood, people could, in effect, donate to themselves in case of an emergency. Some already do this, but as previously mentioned, this process is expensive and therefore unavailable to many people. Larger organs could also be saved for the long term. Currently, kidneys are good for 48 to 72 hours, leaving many people waiting and oftentimes deprived of needed surgery. New technology can change this.

For ideal storage, the cells should be stored at liquid nitrogen temperatures

Source: Carl Calhoun

Thousands of blood donations were made across the country in response to the September 11 terrorist attacks.

The tragedies of September 11 drew numerous people to blood donation centers. In fact, the turn out was so good that centers have been requesting that people come back in a month or two. This generosity is nice to see, but it would be even nicer to see the day when the blood will already be there due to superior preservation techniques. That day might not be far away.

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Interview: Dr. William E. Brower. Conducted over telephone on September 14, 2001.

Author Bio: This is Sam Strom's first time writing for the Wisconsin Engineer magazine. Sam is a freshman at UW-Madison who is currently pursuing a bachelor's degree in Computer Engineering. Sam graduated from Brookfield East High School last spring, which is located in his hometown of Brookfield, WI.

Rain Gardens:
Something for Everyone

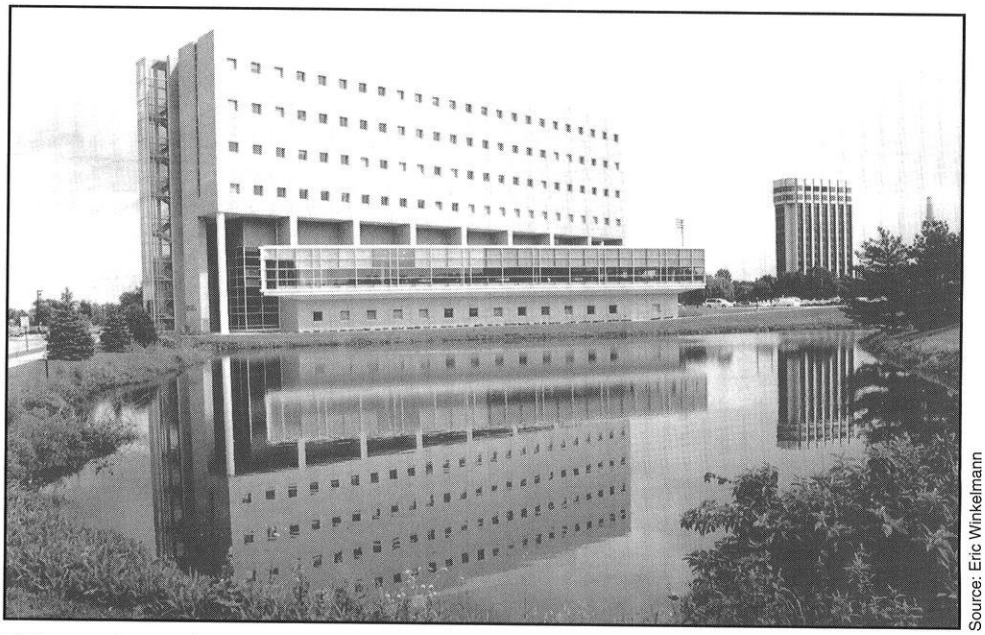
By Ellen Considine

Do you remember the Fresno State game, when kickoff was delayed several hours until the rain let up? If you, too, were driving that afternoon, you know what I'm talking about. Like it always does, University Avenue flooded over. Not only is this flooding frustrating for drivers, but it is also costly for Shorewood and Spring Harbor residents. Moreover, this stormwater pours into Madison's lakes, which destroys their natural ecosystems.

Fortunately for future Madisonians, UW-Madison, citizen groups, and the state government are working to alleviate these stormwater problems. But first, a review of the water cycle—it's more intricate than you think.

It rains. The water can either run off into streams and lakes as surface water or infiltrate down through the soil to become groundwater. This groundwater saturates the underground sand and rock, turning the strata into aquifers. When we operate wells, we're pulling groundwater out of aquifers. An interesting situation arises when the groundwater in an aquifer is under enough pressure to make the water rise naturally to the ground surface. Most people call this a spring; geologists like to call it an artesian well.

Professor Kenneth Potter of Civil and Environmental Engineering (CEE) points out that groundwater and surface water are not independent of each other. Earth has a constant volume of water. If there is excess runoff (i.e., surface water) then there will be less infiltration (i.e., groundwater). These translate into higher lakes, flashier streams, and lower groundwater tables. But can a human population really change a region's hydrology? Yes. Two hundred years ago, near-west Madison probably didn't flash flood like it does today. Incidentally, south-central Wisconsin used to be overrun with quality trout streams. Are the two unrelated? No, says Potter. Here's why:



Source: Eric Winkelmann

This pond near the new pharmacy building has been designed to capture excess rainwater to prevent flooding.

As Madison has grown and developed, humans have built more and more impervious surfaces. Roofs, roads and parking lots are all examples of impervious surfaces. Rain hits these surfaces and runs off into street gutters. Look at all the roof and concrete area around you; these create severe runoff. When it rains, water that used to infiltrate now goes into storm sewers and streams, which just cannot handle these volumes.

Not only is this quantity of stormwater unmanageable, but also the quality of stormwater is unacceptably low. Imagine the chemicals and debris that gather in gutters and run into lakes with the stormwater.

These are the obvious effects of urban development on the water cycle. But how is groundwater affected? As stormwater runoff increases, aquifer recharge decreases. In other words, water doesn't soak in and groundwater levels drop. Half of Wisconsin's population gets its water from aquifers. According to Potter, urban Dane County uses groundwater two times faster than it is recharging. Since groundwater flows in from the undeveloped area around greater Madison, our wells don't go dry. This does, however, explain our disappearing trout streams.

Trout thrive in spring-fed streams. These cold streams run year-round at a nearly constant temperature. When water tables drop, springs start to dry up and their constituent streams' conditions fluctuate more dramatically with rainfall. Streams that are fed by stormwater exhibit irregular flow and higher temperatures. Since warm water cannot hold as much oxygen as cold water, the trout disappear.

Clearly, we need more infiltration and less runoff. Urban sprawl won't slow down, and developers are reluctant to experiment with unorthodox environmentally sensitive solutions. In the past, planners have reverted to a solution of the 1930's: infiltration basins. During the 1930's, Long Island, New York was experiencing the same water management crisis that midwestern cities face today.

Its springs were drying up, and flooding was growing more severe. Long Island is made of glacial till, which is a mixture of silt, sand and gravel through which water easily percolates. Given this geology, city engineers introduced the infiltration basin, which has been effective in that terrain. Infiltration basins may be several feet deep and up to hundreds of feet long. Runoff flows into the hollow and soaks into the ground. Since one infiltration basin may serve a large area, this simple solution appeals to planners and engineers.

Why not use infiltration basins here? Wisconsin's soil contains much more silt—a very fine, small soil particle—than that of Long Island. Runoff carries this material into the infiltration basin, and the silt eventually forms an impervious layer on the floor of the basin. This seal prevents water from soaking in. Wisconsin's organic topsoil inhibits infiltration as well, since bacteria colonies in the soil can also form an impermeable layer. Infiltration basins have been used with some success in this area, but they can be costly to design and maintain.

Perhaps the key to an effective infiltration basin is to catch the water before it runs over soil and picks up sediment. Roger Bannerman of the Wisconsin Department of Natural Resources (DNR) puts it best when he says: "Store the water as close as possible to where it fell." In essence, contain the stormwater immediately after it runs off the roof, sidewalk or parking lot. Potter and Bannerman have figured out this piece of the stormwater puzzle: rain gardens.

Rain gardens, which are sunken plots of native prairie plants, may be seen on Bannerman's west side lawn. A closer look reveals something different about these gardens. They lie a few inches lower than the surrounding lawn, are surrounded by berms and are level across. Their giveaway is the gutter drainpipe, which leads directly into the depression.

While the rain that hits your roof probably feeds into street gutters, rain that falls on Bannerman's house is directed into a rain garden. The trapped stormwater is forced to infiltrate. This replenishes the groundwater system and diverts stormwater away from lakes. Bannerman says that his rain gardens rarely overflow and drain quickly: A few inches of runoff in a 10' by 12' rain garden will soak in within hours.

The hidden beauty of the rain gardens is its low cost. Potter states that rain gardens can be installed at new developments at costs comparable to conventional stormwater conveyance systems. Professionally built rain gardens at pre-existing homes run in the $2000 range, but with proper guidance and a shovel, a homeowner can build his or her own rain garden for only the cost of plants, which generally starts around $200.

In addition, rain gardens require less space than one might expect. Bannerman and Potter's research indicates that a rain garden's optimum area is 10% of the contributing impervious surface's area. That means that an effective rain garden only needs to be one-tenth the size of your roof!

Will Bannerman's single-family-home rain garden make a difference in Madison's hydrology? It may. The rain garden concept only came to Wisconsin from Maryland four years ago. Thanks in part to the proven success of Bannerman's lawn, communities such as Middleton, Poynette, Fitchburg and Minoqua are considering investing in rain gardens. At the St. Francis development near Madison, a new deed restriction requires a 300 square-foot rain garden at each home.

Keep an eye out for the forthcoming rain garden information pamphlet to be put out by the United States Geological Survey (USGS) and Wisconsin DNR, in cooperation with UW-Extension. Also coming soon is a rain garden how-to book, edited by Bannerman (Wisconsin DNR) and Judy Wierl (USGS). In addition, local landscapers and environmental firms such as Applied Ecological Services can point rain garden enthusiasts in the right direction.

Author Bio: Ellen Considine is a senior in Geological Engineering. Since her current housing circumstances prevent her from constructing her own rain garden, she can only covet everyone else's.

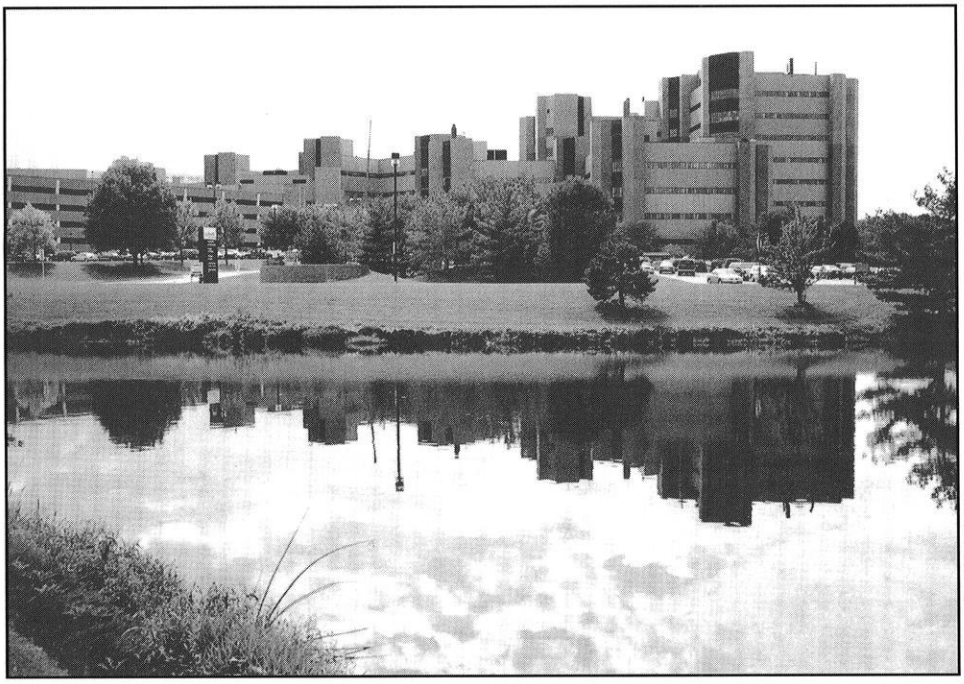


Photo by: Eric Winkelmann

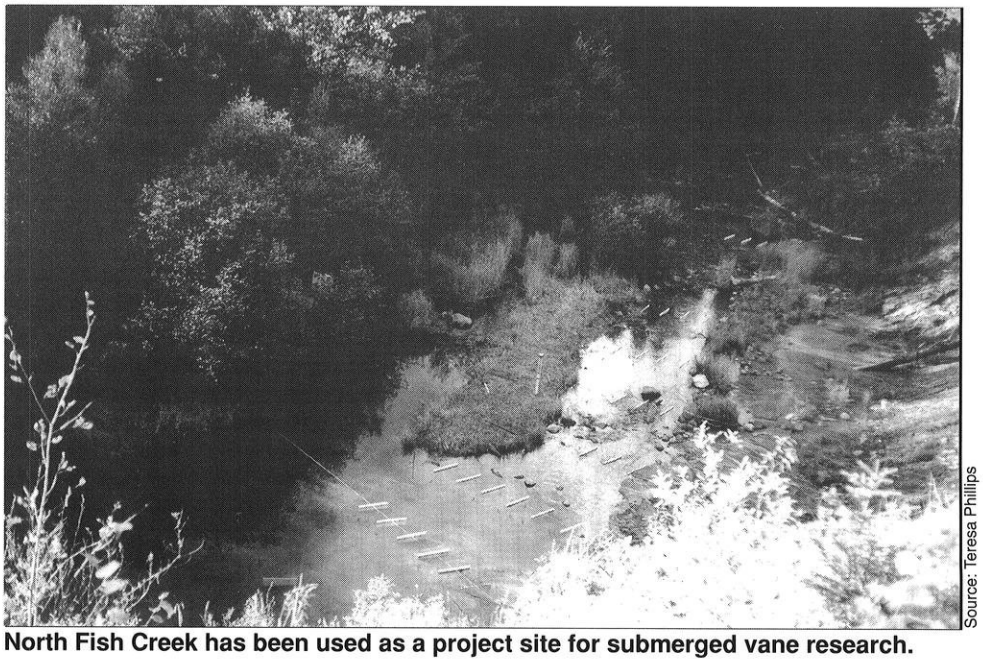
This pond should serve a dual purpose: water storage and aesthetic scenery.

Streambank Stabilization

By Eric Vieth

Every young angler dreams about his or her once-in-a-lifetime catch. Most (like me), are still waiting for that moment to come. Growing up in northeastern Wisconsin, I've been fortunate to have had the opportunity to explore the waters of the Great Lakes region. Freshwater game fishing is a part my life that will never fade away, yet I wonder if my "prize catch" will be driven away by the diminishing freshwater quality of the Great Lakes.

Lake Superior is well known for its variety of game fish. Chequamegon Bay, at the southwestern end of the lake, produces some of the nation's largest smallmouth bass. While most species within the bay are flourishing, some species in North Fish Creek and other tributaries to the Bay are in serious jeopardy. Fisheries in these streams are threatened by aquatic habitat loss due to high levels of upper stream bank erosion and lower stream sedimentation. The main sediment sources in North Fish Creek are 17 large bluffs that are eroding and depositing heavy sediment loads upon spawning beds of brook trout, brown trout, Coho salmon and steelhead.



Source: Teresa Phillips

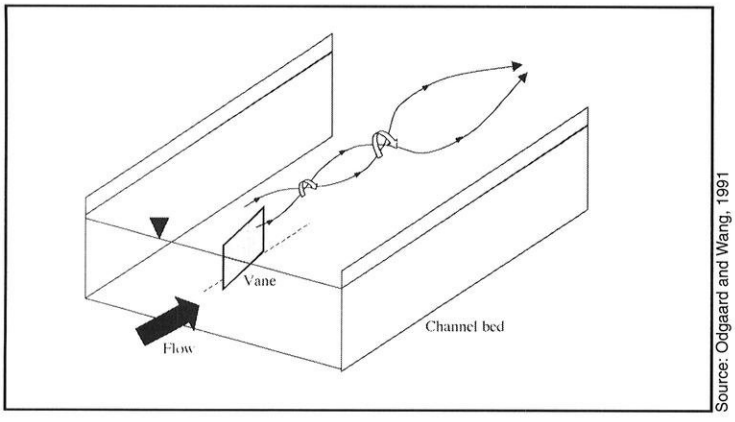
North Fish Creek has been used as a project site for submerged vane research.

According to a 1999 U.S. Geological Survey (USGS) report, the change in land cover (mainly clear-cutting) and agricultural development by European settlers is what promoted unfavorable geomorphic alterations in North Fish Creek. Some of these changes are associated with increased run-off and precipitation, rising lake levels and floodplain loss. This once-stable stream has been drastically affected by these changes.

The channel instability and erosion problems at the North Fish Creek site prompted the Wisconsin Department of Natural Resources to fund a research project by a team of researchers at the University of Wisconsin-Madison and the USGSMiddleton Office. UW-Madison Civil Engineering professors John Hoopes and Ken Potter, two graduate students (Heather Whitman and David Poggi) and USGS research hydrologist Faith Fitzpatrick are conducting this investigation to demonstrate the effectiveness of submerged vanes for streambank protection. Submerged vanes are flat plates or foil-shaped structures that are anchored to the streambed and angled into the flow. The research team examined a number of bank stabilization techniques based on cost-effectiveness, environmental concerns, feasibility and operational history.

Submerged vanes were evaluated for their effectiveness in preventing further bluff erosion. The vanes are distributed in arrays along the length of the channel.

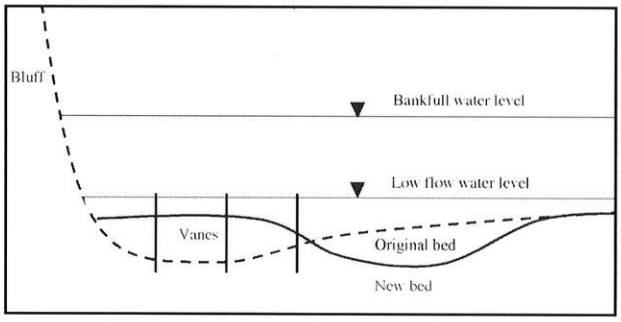
The three-foot-long vanes act like airplane wings and induce a tip vortex (helical motion). This vortex induces cross-channel stresses that cause scour on the channel side and deposition on the bank side of



Source: Odgaard and Wang, 1991

Schematic of flow situation showing vane-induced circulation.

the vanes in each array. Under high flow conditions, submerged vanes apply a torque to the flow that opposes the torque due to the centrifugal force of the flow in the bend. This moves the faster-flowing water away from the outside bank. The induced whirling motion causes the channel to scour the point bar (inner bank in the bend), which moves the channel toward the inner bank and stabilizes the outside bank. Due to the sediment load of the stream, the vanes will become buried by deposition along the outside bank.



Source: Whitman et al, 2001

Schematic showing vane-induced change in channel bed profile.

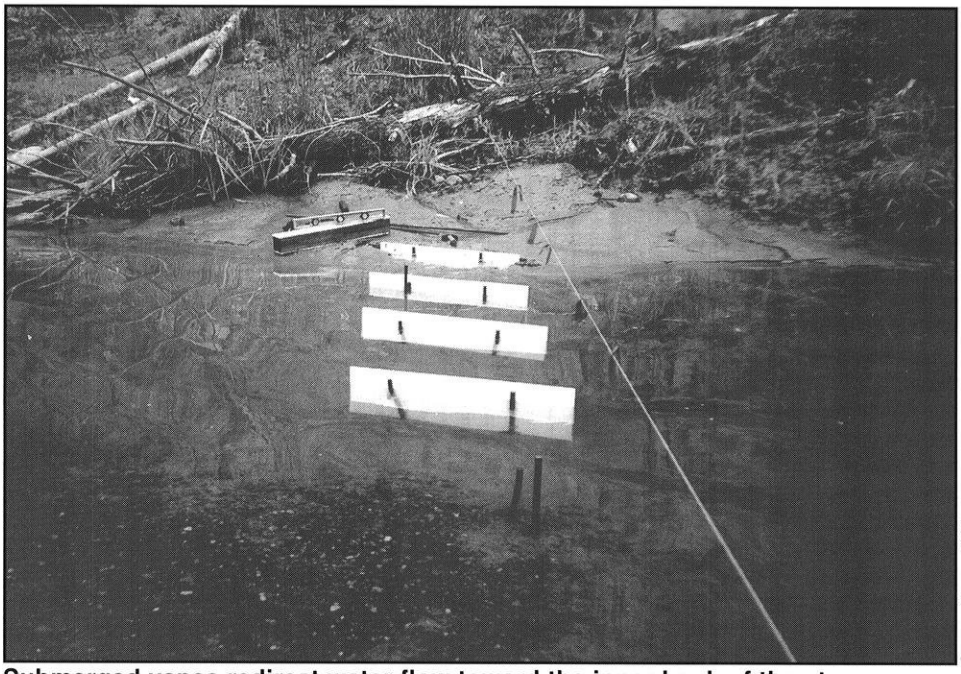
This design permits the vanes to be buried over time because of local sediment accumulation and has been shown to be effective in causing desired geomorphic changes

This technique was chosen after previous soil bioengineering efforts proved unsuccessful in bank protection. Common structural reinforcement methods (e.g., riprap, gabions, sheet piling, dikes) were not considered, as they require site access by heavy machinery. The application of submerged vanes allows for low-cost hand installation that minimizes ecological disruption.

For this project, a site was chosen along a bend on one of the 17 eroding bluffs. The layout consists of 45 vanes arranged in 15 arrays, six upstream and nine through the bend. The vanes are oriented at 20 degrees to the local stream flow. The vanes are composed of high-density polyethylene and fastened to rebar at the channel bottom.

This design permits the vanes to be buried over time because of local sediment accumulation and has been shown to be effective in causing desired geomorphic changes. Recent surveys, including channel cross-sections, have shown promising evidence of point bar retreat and island erosion opposite to the bluff side. The UW-Madison study will continue to monitor the stream flow and channel conditions in order to assess the performance of these vanes. A second bluff location has been selected along North Fish Creek; plans for installing vanes there this fall are underway.

Modern Civil Engineering practices involving submerged vanes for preventing bank erosion are being used frequently throughout the world. In the North Fish Creek case study, UW-Madison researchers are experimenting with this method to stabilize an eroding streambank that is affecting precious aquatic habitat. Other alternatives, such as the addition of detention basins to reduce upstream flood flows, are still being considered. It is possible, however, that submerged vanes will be installed along the whole stream (and perhaps other streams in the region) if this demonstration project is a success. The inhibition of productive spawning in this tributary arouses questions and concerns about the future well being of our Lake Superior recreational fisheries. Hopefully, streambank stabilization using submerged vanes is the right answer.


Source: Teresa Phillips

Submerged vanes redirect water flow toward the inner bank of the stream.

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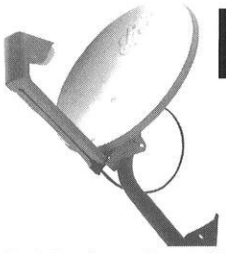
Author Bio: Eric Vieth is a junior majoring in Civil Engineering. Eric enjoys fishing, hunting, and playing basketball. If his engineering career aspirations fall short he plans on learning to play the guitar and moving to Nashville!

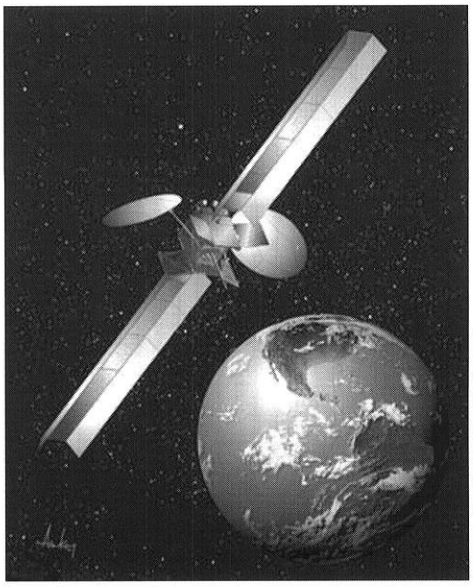
Satellite Radio: An Emerging Media Technology



By Matthew Gorajski

Imagine going on a long road trip and never changing the radio station. Now imagine not hearing a single commercial for that entire time. Sound like a fantasy? Well, it may soon be possible, thanks to the new media concept of satellite radio. In much the same way that "small-dish" satellite television enhanced home-viewing upon its emergence in 1994, satellite radio promises to change the way we tune-in to audio, boasting a number of enticing features to potential customers. Hundreds of stations, CD quality sound, commercial-free music stations and availability across millions of square miles are some of the benefits for customers willing to pay a monthly fee and the cost of satellite-compatible stereos. Two companies, XM and Sirius, will be offering audio via satellite to the United States by the end of 2001. To those who would like the service specifically for the driving experience, car units are already available for purchase, and within the next few years, automanufacturers will begin pre-installing them.

The process of transmitting satellite radio broadcasts to home or mobile listeners consists of three components. A broadcast studio where production takes place uplinks the programming to satellites orbiting the earth, which beam the signal back down onto the entire United States. This eliminates the need to change stations as the listener moves around the country. Ground-based radio broadcasts begin to fade at only about 30 miles from their signal source. Ground repeaters are the third component; they amplify and relay the signals in urban areas, where tall buildings block satellite line-of-sight.

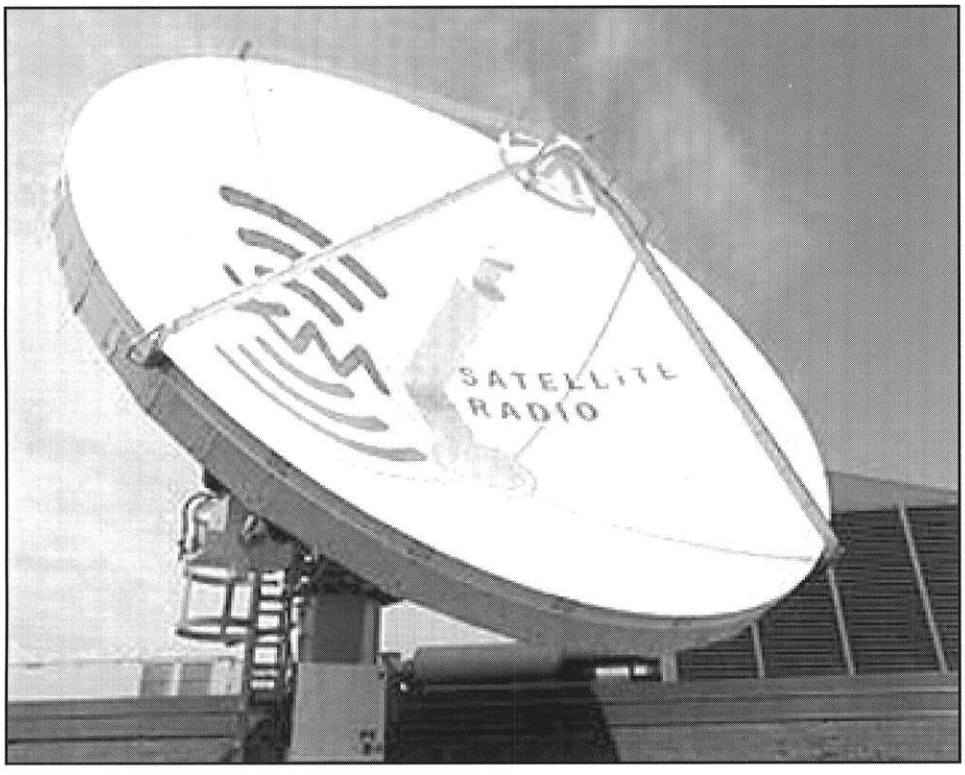


Source: http://www.xmradio.com

Above is an artist's rendition of one of XM's two Boeing 702 satellites.

In March and May of 2001, XM launched two ten-megawatt Boeing 702 satellites into geostationary orbit (i.e., orbit above the equator) 22,000 miles above the earth. Named "Rock" and "Roll," the pair of satellites will broadcast 100 channels of audio. Seventy-one of the channels will be music, of which at least 30 will be commercial-free. The remaining 29 channels will be talk, news, sports and other entertainment. Broadcasting has already begun in San Diego and Dallas/Fort Worth, and it will be available in the southwestern United States by October 15. The service will cost $9.99 per month and is scheduled to be fully operational by November 15, 2001. XM has agreements with General Motors, American Honda Motor Co., American Isuzu, Suzuki, Freightliner and Peterbilt to pre-install AM/FM/SAT radios in their vehicles. Home radios from Sony, Alpine, Panasonic, Sharp and Pioneer are already available at major electronics retailers. The XM website *(www.xmradio.com)* offers information on every channel, searchable by category or number. Channel numbers are conveniently grouped together by content. For example, channels 40 to 52 are rock music, and channels 120 to 134 are news.

Seventy-one of the channels will be music, of which at least 30 will be commercial-free



Source: http://www.xmradio.com

One of XM's two seven-meter uplink satellite dishes is located at the company's Washington D.C. headquarters.

Sirius Satellite Radio

Sirius *(http://www.siriusradio.com)* uses a system of three satellites for its broadcasts. The satellites were all launched last year, and they orbit directly above the United States (as opposed to geostationary orbit). This increases line-of-sight with the satellite and is claimed to provide better reception. Sirius will broadcast 100 channels of audio, 50 of which will be commercial-free music. Agreements with Ford (which includes Lincoln, Mazda, Jaguar and Volvo), DiamlerCrysler (which includes Chrysler, Dodge, Jeep and Mercedes-Benz) and BMW promise exclusive installation of satellite radios for the Sirius service in their automobiles. These radios will also be AM/FM compatible, so that listeners can tune-in to their favorite local stations. Panasonic, Kenwood, Alpine, Pioneer, Sony and several other stereo manufacturers have released satellite-compatible models for Sirius. They will soon be available at major electronic retailers. Sirius will charge $12.95 per month for their service and is expected to begin broadcasting by the end of 2001. All three satellites have been tested in orbit and are operational.

Sirius will broadcast 100 channels of audio, 50 of which will be commercial-free music

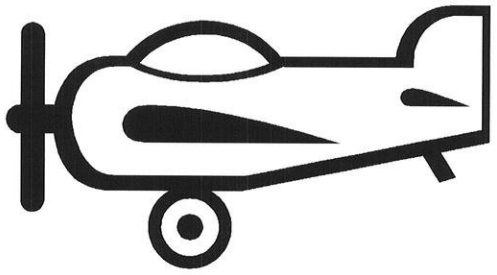
Just as satellite television has not rendered cable and ground-based broadcast television obsolete, satellite radio is unlikely to overthrow the current radio infrastructure. XM and Sirius do not have plans to broadcast local stations. They will broadcast their own programming as well as the audio programming of national networks, such as CNN and ESPN.

Sources:

All information obtained from *http://www.siriusradio.com* and *http://www.xmradio.com*

Author Bio:
Matthew Gorajski is a junior majoring in Engineering Mechanics and Astronautics. This is his second Wisconsin Engineer article.

AIAA Students Take To the Skies

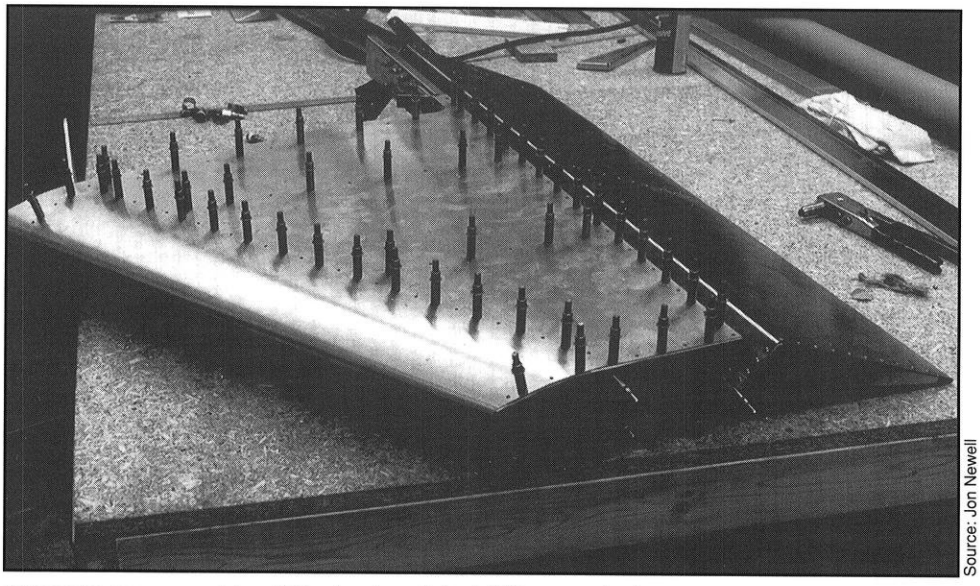


By Aaron Bock

Traditionally, the Department of Engineering Mechanics and Astronautics (EMA) does not receive the same level of attention and recognition as many other engineering departments at the University of Wisconsin-Madison. The EMA department is outnumbered in members by at least three-to-one when compared to larger departments, such as Electrical Engineering and Mechanical Engineering. Sheer numbers alone allow these larger departments to sponsor many extracurricular activities, primarily oriented around automobile building (e.g., Future Car, Future Truck, Formula One). EMA students have only recently had an opportunity to undertake a similar project oriented around their typical aerospace interests.

Last spring, the UW-Madison student chapter of the American Institute of Aeronautics and Astronautics (AIAA) announced the launch of a plan to construct a lightweight aircraft, the first project of its kind on campus. In charge of the project is Dr. Mark Anderson, who is involved in the Department of Engineering Physics as well as the Fusion Technology Institute. Anderson serves primarily as an advisor to the students involved in the project. Since EMA students deal primarily with design concepts and theory rather than actual construction, Anderson provides machining and production concepts to supplement their knowledge. "Most EMA students don't get much experience with actual hands-on building projects in the course of their studies," Anderson says. "This project provides them with that experience and at the same time gives them something aerospace-related."

"Most EMA students don't get much experience with actual hands-on building projects in the course of their studies," Anderson says. "This project provides them with that experience..."



Source: Jon Newell

Above is an assembly of the horizontal stabilizer and elevator.

To some, the concept of constructing one's own personal aircraft may seem like a foreign concept. However, such an undertaking is actually quite a common hobby among many aerospace enthusiasts. Evidence of this can be seen in the annual Experimental Aircraft Association (EAA) air show in Oshkosh, WI, every summer. This event usually involves hundreds of these people flying in small aircraft they built, and occasionally designed, themselves. It is Anderson's hope that the project will be finished in time to fly the airplane into next summer's exhibition.

As with any project of its type, design concepts are key issues in building this airplane. It is by no means a 'model airplane' where you simply take the pieces out of the box and follow the assembly instructions. Anderson stresses that, although the students have blueprints and flowcharts, intuition is still involved. "Even though we've got a lot of information at our disposal, it's still by no means a simple process," he claims. "There are still a lot of things the students have to figure out on their own." Indeed, the project members have often found themselves consulting the EAA for assistance with the design process. The only component of the craft that the students will not be building themselves is the engine, which they will purchase from BW.

Design details are but one of many aspects that make the airplane construction challenging. In addition, this is also a first-time-for-everyone type of project. While Anderson has experience in machining and manufacturing techniques, and many of the students involved have participated in aerospace related classes and co-ops, none have ever assumed the task of the actual building of an aircraft. "It's something new to all of us, so it's naturally more difficult the first time through," Anderson remarks. Additionally, because of the relatively small size of the AIAA student chapter and the $20,000 budget the project carries, extensive fundraising is needed. Since making the project and its goals public, the AIAA has received generous monetary support from several organizations and businesses. These include Boeing, Sonnex, Quartus, Pointwise and the AIAA professional chapter and the UW-Madison College of Engineering.

The funds generated have been used to purchase not only raw materials for the initial stages of the building process, but also to buy tools and testing equipment for the airplane. The construction site in the basement of Engineering Hall is being slowly converted to a virtual aerodynamics lab, according to Anderson. In addition to housing the airplane materials and the tools necessary for construction, a wind tunnel and a developing Zero-G Project also reside there—all property of the AIAA.

"Even though we've got a lot of information at our disposal, it's still by no means a simple process"

Student involvement is another factor that is key to the project's success. When it began last spring, over a dozen students worked on the airplane for one or two nights a week. Over the summer, many of these students left the area because of summer internships or co-ops, which left only two who regularly attended building sessions. Even so, these two students were able to complete the vertical tail stabilizer. Following its completion, the students began work on the side stabilizers and are currently working on it.

Source: Jon Newell

Project leader Mark Anderson holds the unfinished horizontal stabilizer next to the vertical stabilizer of the sonex plane

It is Anderson's hope that the fall semester will yield the same number of members that worked on the project in the spring. Since there is no one best path to follow to the airplane's completion, multiple components of the craft could be worked on simultaneously. Given a good turnout throughout the academic year, it is possible that the aircraft will be completed sometime this summer and perhaps make an appearance at the Oshkosh air show in July.

Author Bio: Aaron Bock is a senior in the EMA department, and is also involved in the AIAA.

Energy at the Madison Children's Museum

By Meena Vairavan and Shana Scheiber

Lessons learned in childhood are often carried into adulthood. Recognizing this, the University of Wisconsin-Madison College of Engineering, in conjunction with the Madison Children's Museum, organized an instructive and enjoyable exhibit to help children aged two to nine understand energy and energy conservation. "Making Electricity without Making Smoke" was available to the public from September 11th to the 16th. Displays covered various energy production techniques along with the advantages and disadvantages of different energy sources, including combustion, wind power, solar power, nuclear power and hydroelectric sources. These displays attempted to communicate complex issues concerning traditional and renewable energy to young children.

In addition to the displays, several special programs were organized to target different age groups. One of these programs was a puppet show called "The Wizard of Watt." The show mostly attracted children from ages three to six. Puppet characters Judy and Jody helped children understand the importance of energy conservation through their adventures in the Land of Watt. The performance allowed audience participation through songs and question-and-answer sessions that instilled the importance of energy conservation.

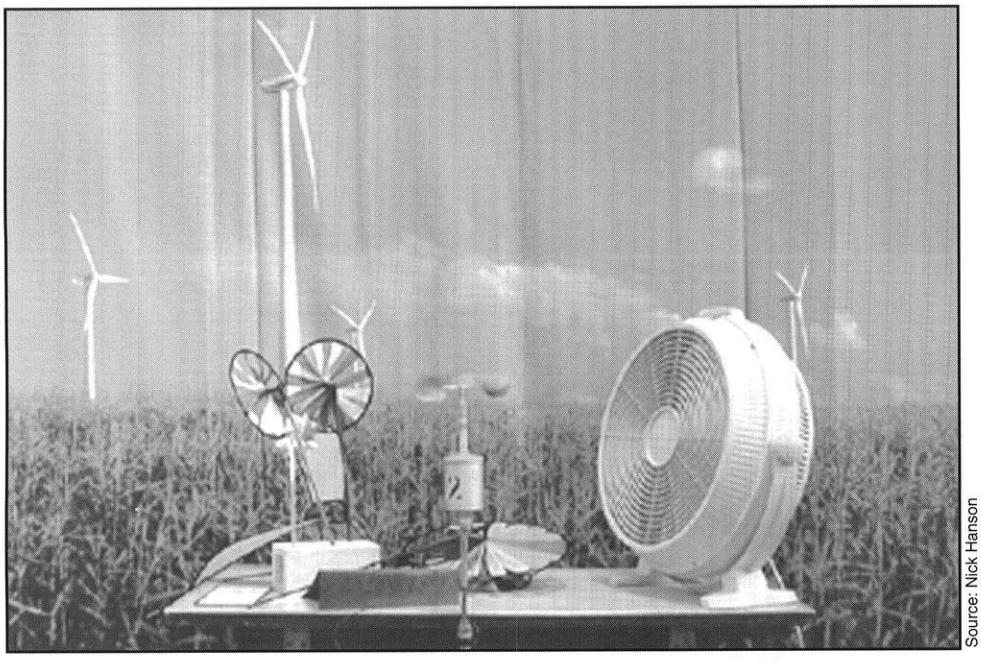
Another program taught children ages seven to nine about electromagnetic energy through the construction of a simple electromagnet consisting of a small nail, a battery, paperclips and copper wire. The nail was magnetized by electricity running through the coils of wire wrapped around it. Children really enjoyed putting the electromagnet together and were able to learn about yet another type of energy with the help of parents and other adults. Other programs included constructing solar ovens and wind machines.

According to Rebecca Smith, head of Engineering External Relations at UW-Madison and head of publicity for the event, there were three major goals for the exhibit: Increasing science literacy in the Madison community, promoting research projects underway at UW-Madison and encouraging young people to choose a career in engineering. With the help of parents and other adults, children were able to learn very important ideas about a variety of energy production and conservation methods. The exhibit encouraged people to think about how energy is used and which forms of energy production are best for the future.

John Robinson, exhibit coordinator, says the Madison Children's Museum would like to develop a more thoroughly researched, long-term energy exhibit. The museum has requested the help of UW-Madison students enrolled in EPD 160: Introduction to Engineering. For their semester design project, some students were responsible for observing the exhibit and conducting interviews to discern what children knew about energy and how much they learned from the exhibit. Students were also asked to make recommendations for the more permanent exhibit. The results of this survey will be presented to the museum at the end of the Fall 2001 semester. Future EPD 160 students may be asked to use these ideas to build exhibits for display in the museum.

Puppet characters Judy and Jody helped children understand the importance of energy conservation through their adventures in the Land of Watt

The Madison Children's Museum is a valuable asset to our community. Its dedication to educating our youth is admirable. The UW-Madison College of Engineering actively supports the organization and aims to help the museum with its future exhibits.



Source: Nick Hanson

A display of numerous devices that stimulate air movement and either use or create electricity.

Author Bios:
Shana Scheiber is a Mechanical Engineering major graduating this coming December. Her plans after graduation are still not determined.

Meena Vairavan will be graduating in December with degrees in Electrical Engineering and Computer Science. In spite of this, she has managed to have a life that involves a few friends (if she remembers to pay them).

Information about the Madison Children's Museum and its upcoming events can be found at *www.kidskiosk.org/*

Source: Nick Hanson

An exhibit at the Madison Children's Museum contemplating the uses of electricity.

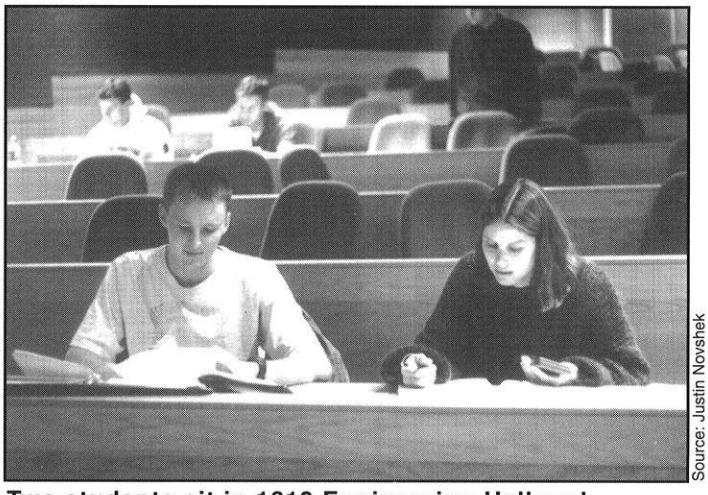
Opportunities Abound For Engineers

By Andrew Wentland

With layoffs, cutbacks and disparity, where do you fit in? Many students and professionals are inquisitive about the job market for engineers during this time of economic freefal. The city of Madison, unfortunately, lacks the industry needed to support all the engineers coming out of UW-Madison.

Rockford, IL, however, holds many opportunities for engineers. Years ago, Rockford was booming with industry, containing a large job market for the engineers that UW-Madison produced. Although Rockford still supports several Fortune 500 companies, such as Newell-Rubbermaid, Textron and United Technologies, it has seen several economic lulls. The most severe was in 1981, when unemployment topped 20%and again in 1991 when unemployment skyrocketed. During the most recent downsizing, many manufacturing companies within Rockford reduced their staff or postponed hiring new engineers.

Despite this, there are still opportunities for those that continuously improve their engineering skills. Sherilyn Anderson (B.S.,'82 Metallurgical Engineering, UW-Madison) is a Senior Quality Engineer with Amerock, a division of Newell-Rubbermaid. She was Corporate Metallurgist with Textron Fastening Systems when she was laid-off in February 2001. "In today's economic downturn, no one can be assured of keeping their job. Layoffs occur despite how hard working or ambitious a person is," Anderson explains. "The only way to protect yourself is to take advantage of educational opportunities and keep current on recent technological developments in your field. Remaining stagnant increases one's difficulty in finding a different position."



Source: Justin Novshek

Two students sit in 1610 Engineering Hall and discuss engineering topics.

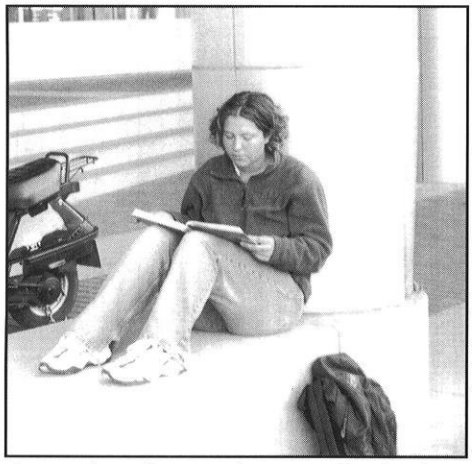
In an engineering career, an employee is required to do several tasks in multiple fields for success. In Anderson's case, she not only has to keep up in metallurgy, but in quality, customer service and mechanics as well.

Anderson states, "It is important when choosing a company to work for that the company is diverse. Companies that are dependent upon a specific market division, such as aerospace or automotive, experience stronger repercussions during economic downturns. These companies are more likely to reduce their engineering departments."

A recent example of such an economic repercussion was when Ford Motor Company laid off 5,000 white-collar workers, primarily engineers, in mid-August. Another example is Textron, who has laid-off a total of 4,600 workers this year.

According to the Department of Labor, of the 1.5 million engineers in 1998, nearly half of them were employed in industries related to transportation and electronic equipment, and 166,000 were employed by Federal, State and local governments. Another 50,000 engineers were self-employed, mainly in consulting firms.

The Department of Labor Statistics states that engineering employment opportunities are expected to be solid until 2008.



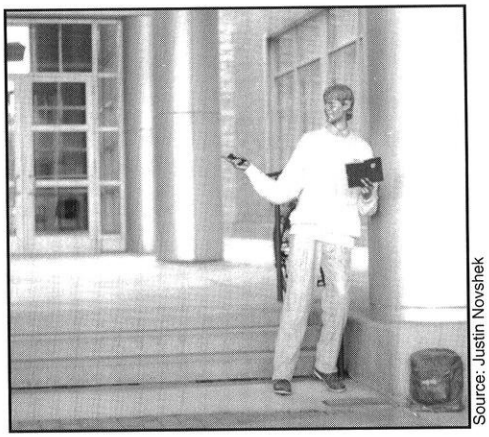
Source: Justin Novshek

An engineering student studies in the hope of getting a good job.

Opportunities for engineers will be stable through the coming years, as turbulent as they might be

Since most engineers work on long-term projects, it is rare for corporations to layoff engineers before their other workers, even during economic slowdowns.

With the threat of war, the economy may worsen, but engineering jobs will likely increase. Government contracts lead to the growth of big business in not only research and development, but also in manufacturing supplies and parts.



Source: Justin Novshek

College Guy welcomes students to the world of Engineering.

Efficient parts and materials are engineered for the most effective military weapons. Engineers with degrees in the mechanical, electrical, metallurgical and biomedical fields are commonly hired for government positions.

William Wentland (M.S., '82 Metallurgical Engineering, UW-Madison) is the Principle Materials Engineer at Hamilton Sundstrand, a division of United Technologies. Wentland states, "The amount of government contracts has dropped significantly within the past decade. Our business in 1982 consisted of two-thirds of government contracts, while today that amount only reaches about one-third." United Technologies recently hired both electrical and mechanical engineers but laid-off some mechanical engineers, depending on their field of specialty.

Secretary of Defense Donald Rumsfeld proposed cutbacks that worried Wentland. Wentland once believed that the field of engineering was doomed with these cutbacks, but the impending war eliminated that anxiety. The increase in defense spending will retain many jobs for engineers, likely creating some along the way.

For instance, Lockheed Martin, a missile developer for the government, will get more business as a result of U.S. military actions. Currently, only at the dawn of a war, there are more than 150 mechanical engineering jobs available within Lockheed Martin nationwide.

On the other hand, Wentland observed that large corporations have acquired competitors. With the merging of companies, many duplicate departments occur. One of these is often scrapped, putting many engineers out of work.

No one can ever be sure of the stability of a job market. Despite the declining economy and recent incidents, rest assured that opportunities for engineers will be stable through the coming years, as turbulent as they might be.

Author Bio: Andrew L. Wentland is a freshman, currently in biomedical engineering. This is his first time writing for the Wisconsin Engineer.

- There were around 200,000, unemployed engineers in 1997.
- Engineers held one-and-a-half million jobs in 1998.
- Employment opportunities for engineers are projected to be good through 2008.

Reminiscing About Engineering III

By Nicholas Mueller

The latter half of this year's "History of Engineering" conference was devoted to "pulpit," where various attendees rose to the occasion and spouted off what they had learned in their years of study, research and professional practice. What follows is a brief summary of their most interesting comments. Many names have been withheld to protect the speakers from public exposure.

Experimental/Professional Practice Advice

♦ Any circuit design must contain at least one part which is obsolete, two parts which are unobtainable, and three parts which are still under development.

♦ Anything cut to length will be too short.

♦ Measure with a micrometer. Mark with chalk. Cut with an axe.

♦ We are all agreed that your theory is crazy. The question which divides us is whether it is crazy enough to have a chance of being correct. My own feeling is that it is not crazy enough. — Niels Bohr

♦ Weinberg, as a young grocery clerk, advised the grocery manager to get rid of rutabagas, which nobody every bought. He did so. "Well, kid, that was a great idea," said the manager. Then he paused and asked the killer question, "NOW what's the least popular vegetable?" Law: Once you eliminate your #1 problem, #2 gets a promotion.
— Gerald Weinberg,
"The Secrets of Consulting"

♦ Heed the warnings of all electronic equipment. When the computer tells you that: "Warning! You are in error: 2+2=5.273," immediately recalibrate all of your equipment.

♦ God runs electromagnetics by wave theory on Monday, Wednesday, and Friday, and the Devil runs them by quantum theory on Tuesday, Thursday, and Saturday.
— William Bragg

Homework Advice

♦ In any formula, constants (especially those obtained from handbooks) are to be treated as variables.

♦ Every nonzero finite dimensional inner product space has an orthonormal basis. It makes sense, when you don't think about it.

♦ I have yet to see any problem, however complicated, which, when you looked at it in the right way, did not become still more complicated. — Poul Anderson

♦ If mathematically you end up with the wrong answer, try multiplying by the page number.

♦ It is not that polar co-ordinates are complicated, it is simply that Cartesian co-ordinates are simpler than they have a right to be.
— Kleppner & Kolenhow,
"An Introduction to Mechanics"

♦ Mathematicians often resort to something called Hilbert space, which is described as being n-dimensional. Like modern sex, any number can play. — Dr. Thor Wald,
"Beep/The Quincunx of Time", by James Blish

♦ You can not get anything worthwhile done without raising a sweat.
— The First Law Of Thermodynamics

♦ What ever you want is going to cost a little more than it is worth.
— The Second Law Of Thermodynamics

♦ You can not win the game, and you are not allowed to stop playing.
— The Third Law Of Thermodynamics

Historical Perspective

♦ Before Xerox, five carbons were the maximum extension of anybody's ego.

♦ "As an adolescent I aspired to lasting fame, I craved factual certainty, and I thirsted for a meaningful vision of human life — so I became a scientist. This is like becoming an archbishop so you can meet girls."
— Matt Cartmill

General Knowledge

♦ Artificial intelligence has the same relation to intelligence as artificial flowers have to flowers. — David Parnas

♦ Heisenberg may have been here...

♦ Heisenberg may have slept here...

♦ Heisenberg may have left the building...

♦ Moebius strip: See reverse side for instructions.

♦ Klein bottle for rent — inquire within.

♦ Murphy's Law, that brash proletarian restatement of Godel's Theorem.
— Thomas Pynchon,
"Gravity's Rainbow"

♦ The following statement is not true. The previous statement is true.

♦ The use of "spurious" logic is more than allowed in the practice of engineering; it is in some cases required.

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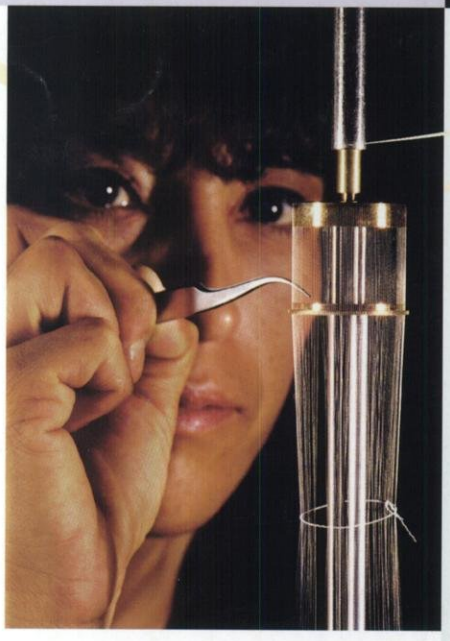

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