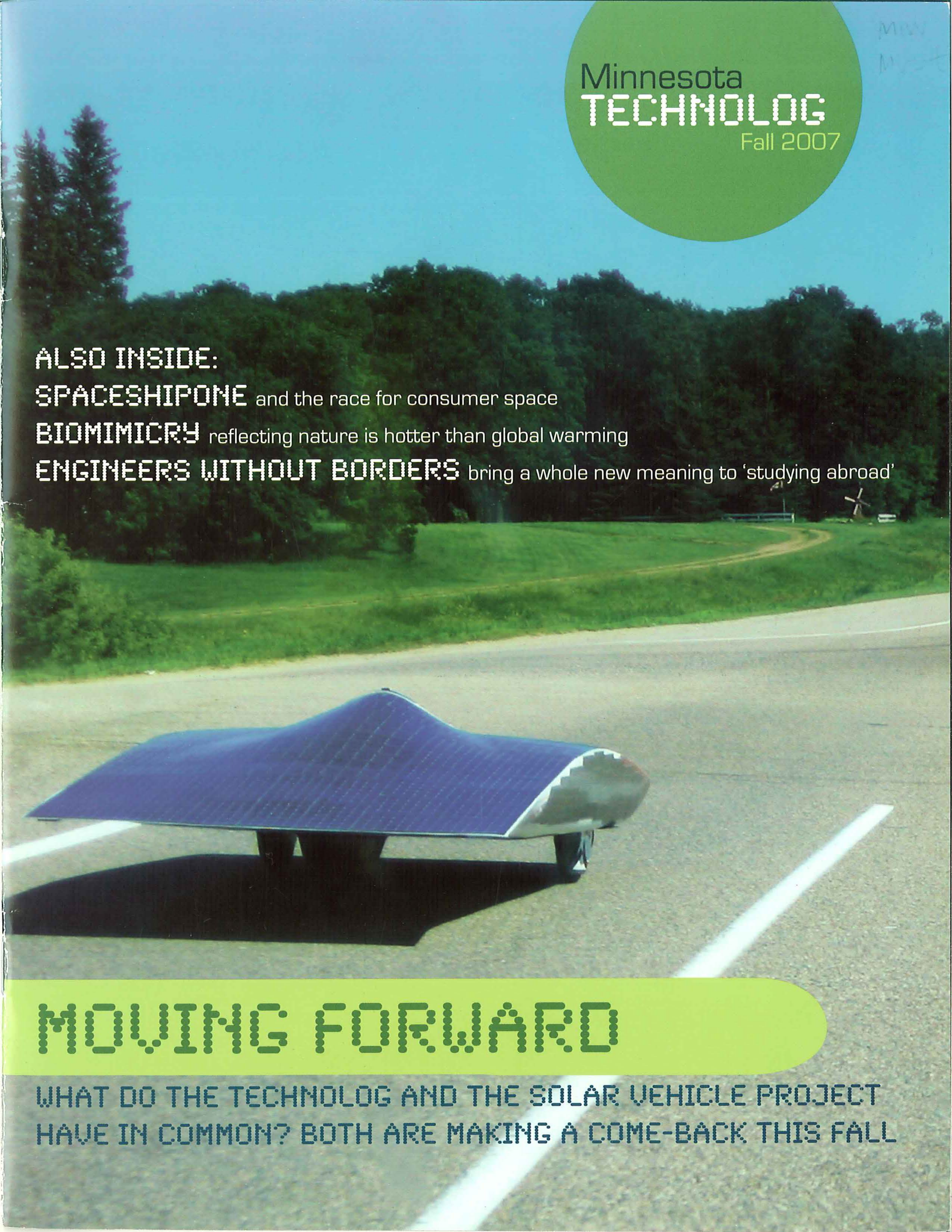
Minnesota
TECHNOLOG
Fall 2007



ALSO INSIDE:

SPACESHIPONE and the race for consumer space

BIOMIMICRY reflecting nature is hotter than global warming

ENGINEERS WITHOUT BORDERS bring a whole new meaning to 'studying abroad'

MOVING FORWARD

WHAT DO THE TECHNOLOG AND THE SOLAR VEHICLE PROJECT HAVE IN COMMON? BOTH ARE MAKING A COME-BACK THIS FALL

CONTRIBUTORS

ANDREW KIRCHMAN

Besides being the president and writer for the Technolog, Andrew is a member of the solar car project, spending his time designing a parking brake and finalizing details for the rear suspension of the new car. He is also busy trying to make Pro-ENGINEER work, a program that is excellent for turning a seemingly simple design into several hours of work and lots of swearing. When Andrew is trying to avoid his homework, he may be spotted playing his electric bass and hanging out with friends.

TAYLOR HILL

Taylor is the layout editor, graphic designer, and illustrator for the Technolog. She's caught somewhere between graphic design and mechanical engineering majors... and if she's lucky enough to have any time left over, she likes making posters and gadgets, swing dancing, learning new languages, and playing Xbox. She hopes to graduate in less than eight years, and then work somewhere like IDEO.

YOU?

The Technolog needs students in all majors to help write, design, publish, and distribute the magazine!

We need writers. Pick a topic that interests you, and share your enthusiasm by writing all about it. We need editors to look after the writers and give them useful feedback. We need some marketers, people willing to call up businesses and get them to advertise in your magazine.

Most of all, though, we need you. We need you to let us know how we're doing. We need to know what you think is good about the magazine, and what's bad. You've paid for this magazine whether you like it or not, so you may as well make it the best it can be.

EMAIL US! TECHNOLOG@UMN.EDU

EDITORIAL

As the board of this magazine sat around planning this first issue of the re-born Technolog, we started discussing what the audience of this magazine should be. And that led me to thinking...what's in a name?

Stephen Levitt, in his book Freakonomics, tells the story of two brothers. The parents named one Loser, and named the other Winner. Well, what happened to them?
Loser goes on to have a successful career as a police officer, and Winner, well, Winner had a rather unsuccessful career as a criminal. So names can't mean that much, can they?

But on the other hand, we identify products by their names. A car is a car is a car, but is it a Mercedes-Benz or a Ford? They both do the same thing- provide transportation, but have different images associated with buying each one.

That leads to the Minnesota Technolog. Looking through some of the archives we have in our office, I saw articles like "Calculator Comparison." Now, I am a nerd, but even I don't want to read articles discussing the benefits of a Gee-Whiz Adding Machine 2718 compared to an Oh-Boy Integration Station 3142. That's what Consumer Reports is for.

So, yes, our name may sound like "Technology," but this magazine is not going to be so technical in detail that you need a bachelor's degree in order to understand the articles. Our goal is simple. Publish a magazine that a large audience can relate to and understand. Yes, it will have technology in it. But it's going to be written and covered in such a way that the average person can understand what's going on. In order for us to succeed, we need your feedback.

Sound good? I hope so. Drop us an email, or check out our Facebook group for questions, comments, or just more information about who we are and what we want to do.

-Andrew Kirchman, President

WE'RE LOOKING FOR A FEW GOOD MEN AND WOMEN

As you read through this magazine, the first issue of the reborn Minnesota Technolog, we hope that you'll find some article that excites you, something that makes you stand and shout "YES!". You may also find some article that just irritates you, or you think this entire magazine is a waste of your money.

That's right, your money. You may have picked up this magazine for "free", but as a student group, we are supported by student services fees. That means when you pay your tuition bill, you put money into this magazine. So if you don't like what we print, or you think it's great, tell us. It's like Congress spending your tax dollars, except your voice will actually be listened to.

Simply put, The Minnesota Technolog is your magazine, and what will be covered will reflect what you want. Which is why we need you.

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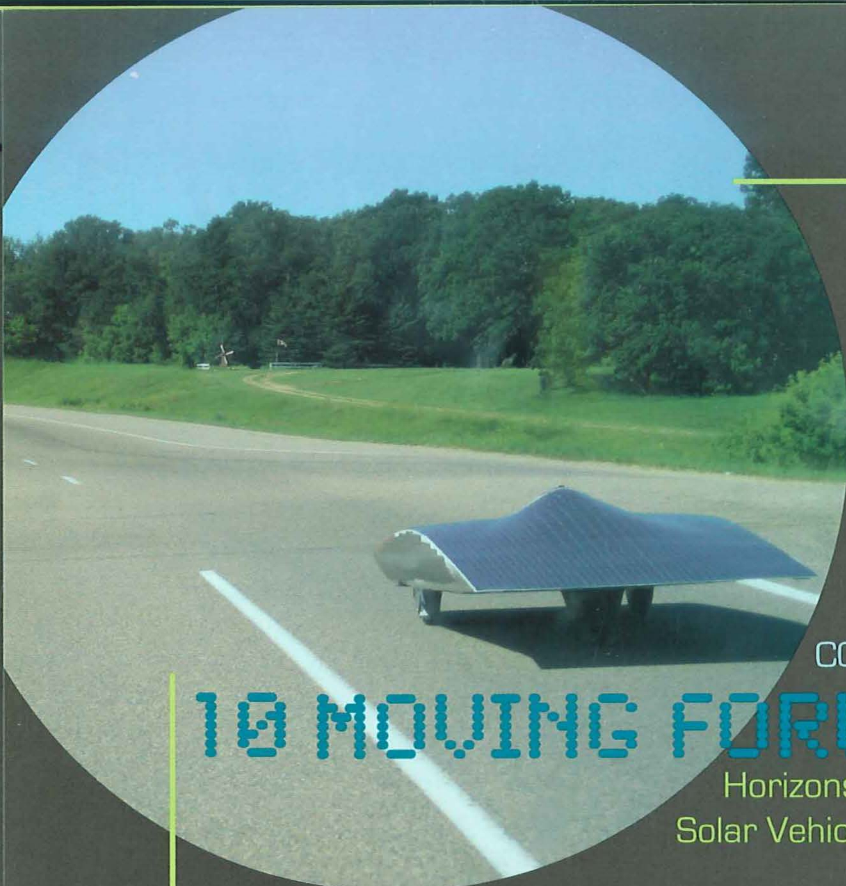


THE RIGHT BRAIN

Poetry in an IT magazine? You betcha! The Right Brain is where Technolog takes a right-brained look at left-brained subjects.

Feel free to send us your own science, math, or engineering-related creative works! Photos of photovoltaics, odes about cathodes... whatever you've got!

THE WAY TO REALLY LOVE IT
Eirann Lorsung

Touch the edge of salt pond with a finger. Maps
don't show the taste of water.
You can know

what cows eat by tang in butter, and here
what swims, what stays away

tells saltiness. If you wade
hip-deep in these ponds, maybe
something will begin

or something will stop happening
(you know what this means). Places like this

are dying off. Between land & ocean,
you stop thinking of it and it's gone.
Sudden

lack of birds. Pitch pine. A bog quaking
to life, with life, you had better

listen to this disappearing land, you had better
be quick, keep it trimmed,
burning—

LETTER TO THE ASTRONAUT
Eirann Lorsung

When the early stars come out into all that blue
It's like a prayer, one I memorized
Without ever paying attention. I realize sometimes
That I am only waiting. The path of the satellite
Eclipses me, so many hours removed from you.
And in the waiting, the sound of water moving.

What is gravity? Anything that could keep me
Here, I can't refuse. So I find someone
Who has the slender hands that you do,
Hands I see everywhere. So I find someone
For when you are so far away from me, breathing
Through tubes and doing rocket math, freeze
Drying your laundry. And I am like mulberry, he
Is nightshade and by landing time
The branches are all tangled in vine. And then
You land, wearing all the darkness you could gather
Out in the starred night. And I have to pretend
My heart has forgotten you.

If I ask you, do you look for me, across those lightyears,
What then? I know your eyes don't catch
But break in shards of blue that splinter light
Almost to whiteness near the edge, immersed
In radiation, deep buried. With what device
Will you find me? This body is a faulty sextant
Now, instrument no one uses. Our age of global
Positioning, of cursors sweeping across the Arctic
Circle—you keep everything you know tied
In bundles of zeroes. And back here it is growing
Dark, and humid the heat rises from the edge
Of the street, and where I am walking
The chamomile comes to me dense and citrus.

And in a million years, when you find
Notes in a ruined language circling
Some black, collapsing star, I wonder
Will you focus lenses to catch the light of this blue
Place, will you remember how cut grass
Overwhelms a lung in summer, how asphalt
Burns from the ground up, what I mean is,
After so many flights and landings,
Will you remember, will you come back?

[bio: life] + [mimesis: to imitate] = BIOMIMICRY

by Olivia Richardson

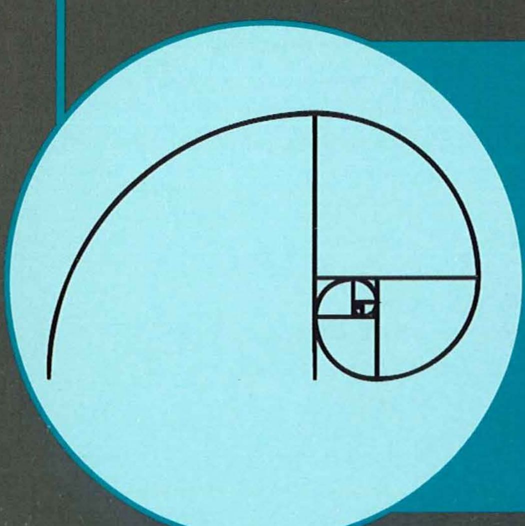
INTRIGUED BY the burrs stuck to his dog's coat, George de Mestral, Swiss inventor of Velcro, further examined the microscopic shape of the cocklebur, and crafted the handy "hook" and "loop" fastener we use today.

TO EXPLORE Mars, our "breezy" fourth planet from the sun, scientists conceptually modeled the large and light-weight Mars Lander on the tumbleweed.

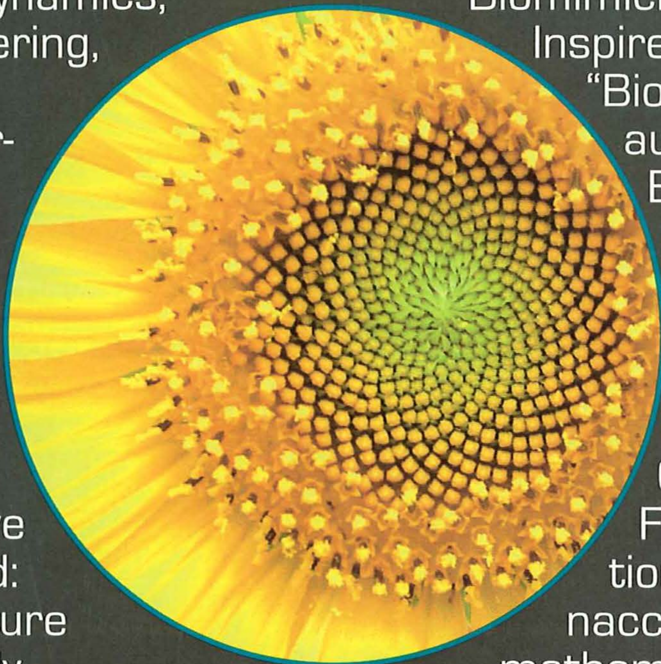
LET'S NOT FORGET how seeds are scattered in various ways by water, wind, gliding, exploding, and other means; the aerodynamics of botany is quite impressive in itself.

HONEYCOMB PRISMS provide a fascinating, yet simple waxen structure. Beyond the use of pollen and honey-holding, similar hexagonal figures are utilized in math and science from tessellations in geometry to organic chemistry's six-membered rings.

THE FIBONACCI SEQUENCE is a dynamic example of mathematics illustrated in nature. For example, the number of petals per flower, tree branching, sunflower seed arrangements, pinecone shape, leaf arrangements on apples and pineapples, and even how growth literally spirals outward to prevent overcrowding for optimal spatial packing can be exemplified in the spiral-shapes and numerical sequencing patterns named after Pisa native and mathematician, Leonardo Fibonacci.



Nature freely displays its examples. Studies in medicine, electronics, aerodynamics, hydraulics, engineering, materials science, optics, robotics, architecture, mechanics, and beyond can advance by using nature's efficient processes, designs, and methods in creative ways. Keep in mind: if something in nature seems fascinatingly applicable, it very well could work. Think about how a flagellum moves, the importance of camouflage, or the efficiency of multi-functional concepts like our skin. Try something new! Mimic a natural process; harvest a biological brainstorm.



Want to learn more? Try Janine M. Benyus' book, "Biomimicry: Innovation Inspired by Nature," or "Biomimetics," co-authored by Yoseph Bar-Cohen. Also, various bio-inspired elective courses are offered at the University of Minnesota in the College of Design. For more information about The Fibonacci sequence and the mathematical elegance of our world, I encourage you to read more about mathematics in nature – or give Darren Aronofsky's movie "Pi" a look.

BIOMIMICRY-RELATED COURSES:

The Design Institute has many courses focused on designing for environmental and human factors. Their courses can go toward a Design Minor, or simply add new perspectives to other areas of study. Check out DESI 3050 and 3061 this spring to learn about urban planning or materials design, respectively.

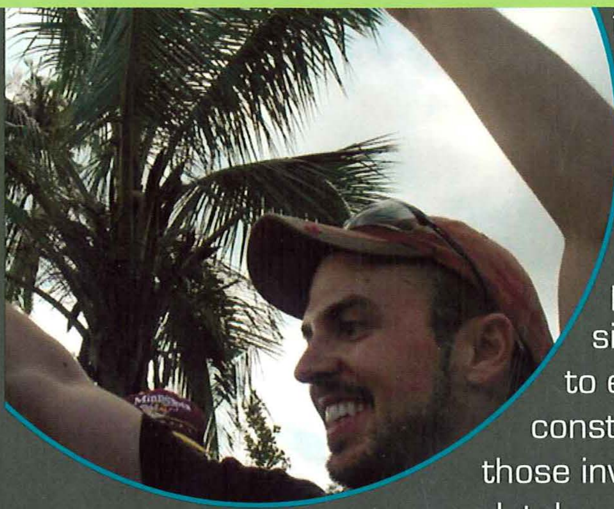
ENGINEERS WITHOUT BORDERS

by Mark Ryan

The typical engineering student rarely does much more than solve problems, using the math and science that form the basis of the undergraduate engineering curriculum. Learning the fundamentals is clearly important. A student must learn to adjust to various situations and respond to the array of practical problems that he or she will have to solve in a professional career. Still, it is beneficial, some may say necessary, for a student to work on a practical engineering project to truly get a feel for what real-world engineering work is all about. Luckily, there are a number of student groups at the University that can help round a student's experience, such as Engineers Without Borders (EWB). Even though our University of Minnesota chapter frequently advertises its existence, the Institute of Technology student body remains largely unaware of the incredible real-world problem-solving opportunities that EWB members get to work on.

By forming partnerships with communities in developing countries, EWB designs and implements projects that can help fulfill a community's greatest needs and improve its standard of living. Locating communities that are in need of engineering assistance is most assuredly not the difficult part of the process. Forming a partnership based on the promise of fulfilling one need often leads to the discovery of a handful of different requests for help with other deficiencies in that community alone. For example, applying a new method of collecting water could lead to an even more challenging project centered on making the water potable. This sequence of discovering new projects repeats itself in essentially every community lacking basic amenities throughout the world.

Clearly, there is no shortage of possible projects. Apart from finding the money to fund these projects, the difficulty exists in a project's design. In order to efficiently construct a design, those involved must completely understand the circumstances of the project site. While the idea of completely understanding the problem before attempting to solve it seems elementary, it is necessary with these projects to ensure that the design is appropriate for the surrounding environment and that its maintenance will be affordable for the community. Understanding the site, its needs, and any existing local technologies that may be used in the solution is therefore essential to a project's success.



It is usually straightforward to assess a site's needs, because actually visiting the site and talking to the people who live there is about the only way to do it. Survey trips are the precursor to design and implementation of a project, and they typically consist of a few students accompanied by a mentor or representatives of a partnering organization. In addition to identifying problems that a community wishes to have addressed, the team focuses on acquiring physical data for use in design. The trips also allow for the participants to orient themselves to the culture and surroundings and to learn where and how to find various objects or services they might need for implementation. Understanding the pace of work in a given culture makes the successful project.

Over the last year, the University of Minnsota EWB chapter has taken two survey trips that have both successfully led into the design process. In March 2006, civil engineering undergraduates Kris Langlie and Andrew Sander traveled to Comalapa, Guatemala with associates from the Minnesota Professional chapter of EWB. They stayed at Long Way Home (LWH), a youth organization that provides, among other things, nurseries, gardens, and a soccer field. Establishing contact and finding out the wishes of LWH were a major part of the trip, but the students also took water samples and compiles land survey data that has enabled the design of the first phase of the project, which includes a new water pump, a concrete basin to house the pump, and plumbing to an existing water tank. An implementation team of eight students is set for January, 2007, who will also survey for future phases that will focus on further cleaning of the water, irrigation systems, and sanitation.

Continued on page 20

SPACE ENTREPRENEURSHIP

by Justin Hausauer

In October 2005, SpaceShipOne, the first private manned space vehicle, was installed beside Lindbergh's Spirit of St. Louis at the National Air and Space Museum in Washington, D.C. The pioneer spacecraft had reached a suborbital altitude of 100 km for the second time in two weeks in October 2004, snagging the $10 million Ansari X Prize, an award intended to encourage private spaceflight. After some 40 years, space travel is no longer the exclusive domain of governments but is gradually becoming accessible to the multimillionaire and even the mere millionaire. Perhaps in twenty years, you may book a window seat to the moon.

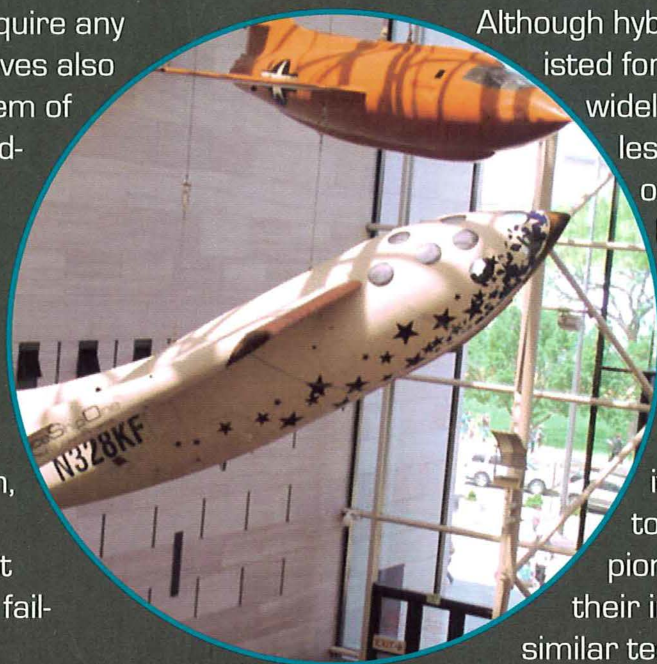
Burt Rutan, designer of SpaceShipOne, and British entrepreneur Richard Branson are leading the nascent space tourism industry. Branson's Virgin Galactic company, in conjunction with Rutan, is now taking reservations for a series of 3 ½-hour, $200,000 flights beginning in 2009. Among the 7,000 people who have already signed up is William Shatner, Star Trek's Captain Kirk. The $200,000 price tag seems like a bargain compared to the $20 million that American scientist and businessman Greg Olsen paid for a trip aboard a Russian Soyuz spacecraft in 2005.

Now, Rutan and Branson are seeking the $50 million prize sponsored by billionaire Robert Bigelow which will be offered to the first company to complete two full orbits with a crew of five passengers twice in two months. The $10 million Ansari X Prize that Rutan's backer, Microsoft co-founder Paul Allen, claimed with SpaceShipOne offset only half of the $20-million costs incurred by the project. But the private space industry is not just a few billionaires who are willing to pour money into sheer thrill-seeking. "People are figuring out how they can possibly make money out of the concept of affordable, reusable access to space," says James A.M. Muncy, a space consultant. Less-costly space travel services would be attractive to research universities and to the government. One company, SpaceX, already has eight government and commercial contracts, and no plans to put people into their vehicles.

Rutan believes that it is the private space industry, not NASA, which will foster the next generation of advancements in space. NASA recently announced it would phase out the shuttle program and return to the moon by 2020; with this back-to-the future approach, don't look to them for innovation anytime soon. Critics believe NASA cannot operate with the same level of efficiency as a private venture. Their plan to revisit the moon will cost an estimated $100 billion. A private company, Virginia-based Space Adventures, announced in August that it will send people to the moon for a cost of only $100 million per seat. Rutan also disagrees with NASA's approach to space exploration: "We'll go back to the moon by not learning anything new."

Private enterprises have already made innovative contributions to space vehicle engineering. An interesting combination of materials propelled SpaceShipOne to its pioneering flight: a polybutadiene rubber fuel and nitorus oxide oxidizer. SpaceDev, the rocket motor sub-contractor, developed this hybrid rocket engine.

All rocket engines require a fuel and an oxidizer. Traditionally, rockets use strictly solid or liquid systems. In solid-fuel rockets, both the fuel and the oxidizer are pre-mixed into one composite material. In solid-fuel rockets, both the fuel and the oxidizer are pre-mixed into one composite material. This fuel-oxidizer premixture is very dangerous and can sometimes explode during shipping. The advantage of a solid-fuel rocket is its simplicity; it does not require any plumbing. But its lack of valves also poses the significant problem of controlling the thrust. Liquid-fuel rocket systems separate the fuel and oxidizer and then use a complex system of valves and turbopumps to control the mixing of the reagents. The fuel used in liquid rockets, typically liquid hydrogen, is dangerous to begin with, and the complexity makes it more prone to mechanical failure.



SpaceShipOne's hybrid engine takes a different approach. The thrust chamber contains a solid rubber fuel. But the liquefied nitrous oxide, a powerful oxidizer yet much safer to handle than liquid oxygen, is piped into the combustion zone as desired, providing easy control of thrust all the way down to zero.Unlike solid-fuel motors, the fuel and oxidizer are not premixed, so it presents no shipping hazards. Nitrous oxide also has the useful property of having a boiling point high enough that it can be stored as a liquid at room temperature, unlike oxygen, but a boiling point low enough that its vapor pressure at room temperature is a strong 750 psi, which makes an expensive pumping system unnecessary. Mechanically, a hybrid propulsion system is very simple, requiring only one valve to allow to oxidizer to flow onto the fuel.

A rocket engine with a self-pressurized reactant does have its drawbacks; to withstand the storage pressure, it must have strong, and therefore heavy tanks. More than in any other engineering endeavor, weight is the enemy of the rocket builder. A pound more of fuel tank is a pound less of useful payload, or, to keep the same payload, twenty more pounds of fuel.

Although hybrid rocket engines have existed for decades, they have not been widely used because they develop less specific impulse than solid or liquid systems. Traditionally, NASA has favored liquid-fuel motors for their thrust, and the military likes solid-fuel motors because they are easier to store and handle. It took private enterprise, with its singleminded focus on cost, to opt for a hybrid system. The pioneers of space travel hope their industry will continue to make similar technological advancements, like aviation did a century before.

So what is in store for the future of astronautics? Some experts predict an unprecedented boom. Patrick Collins, economics professor and founder of www.spacefuture.com, envisions a 5-million-passenger-per-year tourism industry, with an orbital population of 70,000 people, and 60 space hotels in place by 2030. Although this may seem far-fetched, Collins believes it is totally feasible. "I don't think it's unreasonable in view of the space industry's extraordinary economic stagnation for half a century," he wrote. "The full implications of breaking out of that are going to be a revelation."

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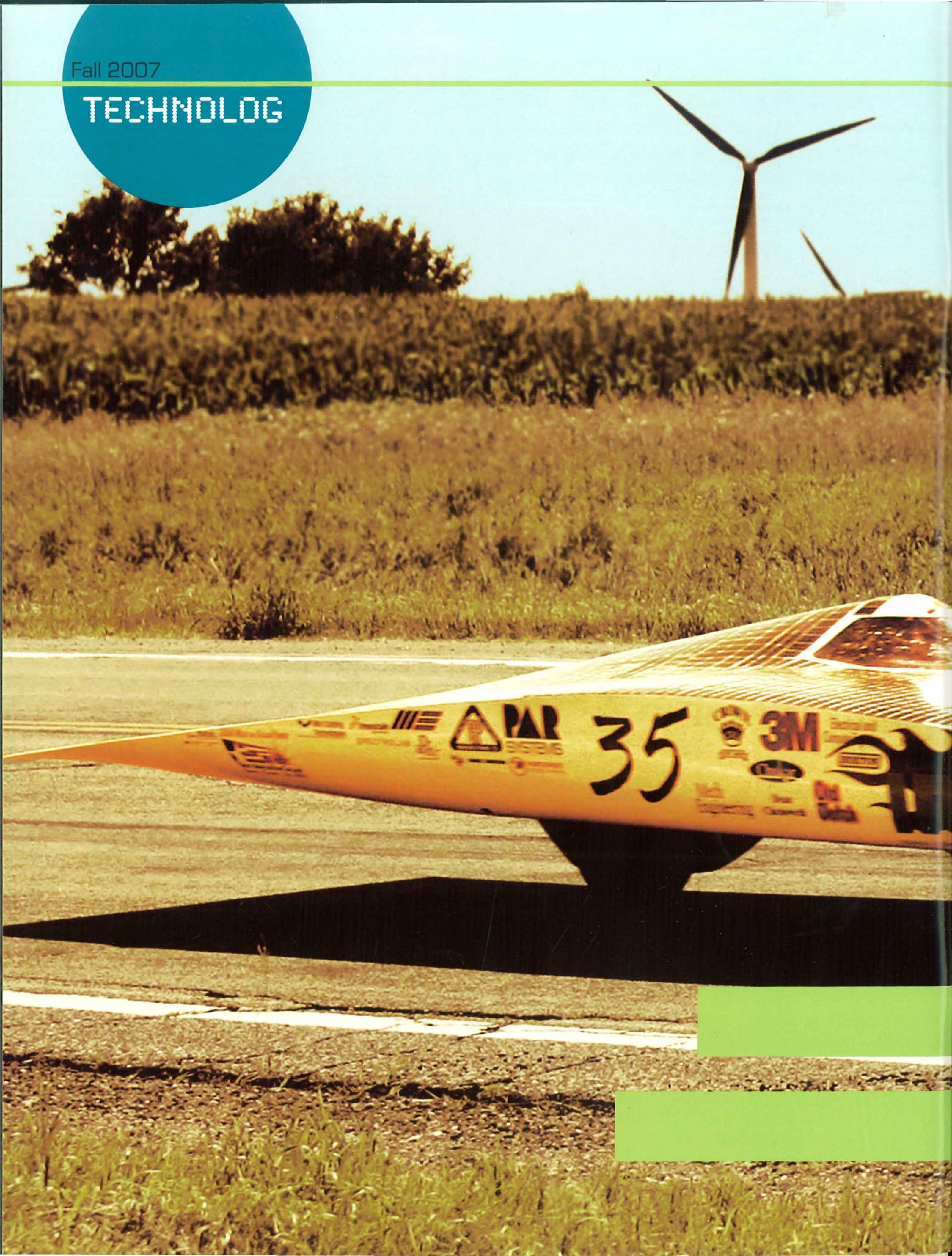
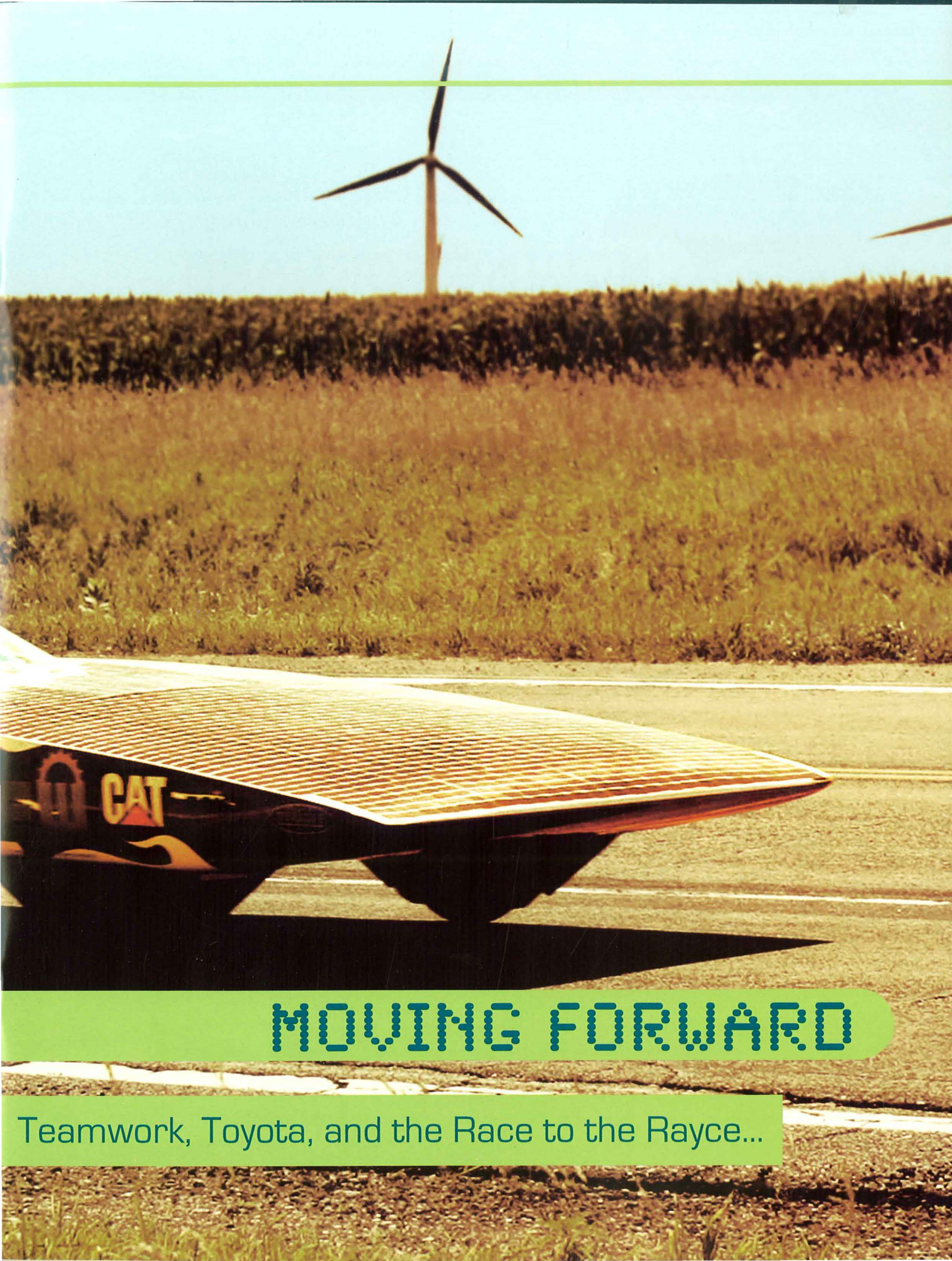
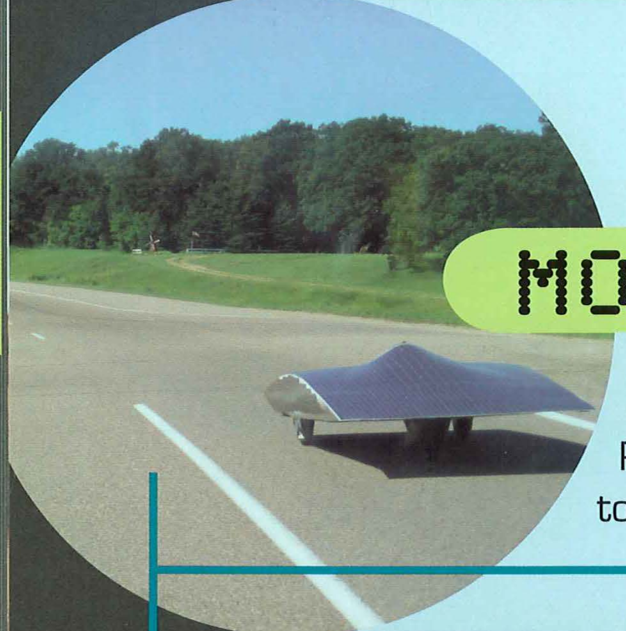




MOVING FORWARD

Teamwork, Toyota, and the Race to the Rayce...



by Andrew Kirchman

MOVING FORWARD

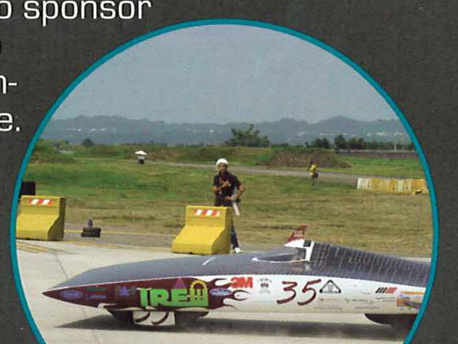
With funding back on the table, members of the U of M Solar Vehicle Project go back to the drawing board to get the car in gear for raycing

Several years ago, the 2007 North American Solar Challenge (NASC) was canceled when the U.S Department of Energy withdrew its sponsorship. The University of Minnesota Solar Vehicle Project (SVP) was left hanging. Undeterred, the project pushed forward anyway with its ongoing work on a two-seater solar car design. In the summer of 2006, the SVP raced Borealis III in Taiwan, the car originally built for NASC 2005. Coming back from Taiwan, the team started working with other universities' solar car teams to try to put on a North American Solar Challenge 2008, with or without DOE support.

ONE MAJOR HURDLE REMAINED: FINDING A SPONSOR WILLING TO COUGH UP ROUGHLY HALF A MILLION DOLLARS.

Schedules were set, rules were drafted, and everyone looked forward to racing in the summer of 2008. An organizer stepped forward, the same one formerly contracted by the Department of Energy. Design began on the new SVP car, with a blend of experienced and novice members of SVP working on it. But one major hurdle remained: finding a sponsor willing to cough up roughly half a million dollars, the cost of organizing the race.

A deadline was set: July 31, 2007. If no sponsor appeared by this date, there would be no race. This deadline came and went: no sponsor. It looked like there wasn't going to be a race. The questioning began: What could SVP do?



Several alternatives were thought of. One was to make a proposal to the Dean of the Institute of Technology to approve racing overseas, possibly in Japan. Another was to scrap the solar vehicle project, and instead participate in the Solar Decathlon, an event that involves designing a house completely supported by renewable energy.

A month passed, with little or no work being done on the new car, and no decision made regarding SVP's future. Then word came from the organizer- Toyota had stepped forward to pick up the tab. Taking their new sponsor's motto to heart, SVP was Moving Forward, and the future looked bright.

A sponsor had been found for the race, but the delay had brought a new problem. Scheduling. Would SVP have enough time to finish designing and building the car? After careful consideration by the faculty advisors Professor Jeff Hammer and Dr. Patrick Starr, and several team leaders, the answer was yes.

The team had time, yes, and a race for a car to go to. But membership in SVP had dropped from the previous school year. Several team members had graduated, and others were unable to continue due to more time tied up in their studies. That meant there were fewer people to do the same amount of work in less time than had originally been planned.

But SVP took these membership changes in stride. Several new members joined, and were paired with experienced team members. Other team members stepped up and took leadership roles and responsibilities they hadn't had before. Fortunately, several alumni had left behind designs that were well on their way to completion, and just needed some finishing work done.

SVP has weathered this unintentional downsizing and is well on its way to building a solar car that will be finished with enough time to test before the North American Solar Challenge 2008. The team looks to improve on their second place finish at the North American Solar Challenge 2005. The future again looks bright for the members of the Solar Vehicle Project.

for more info and pictures: SVP.UMN.EDU

WHAT IS THE U OF M SOLAR VEHICLE PROJECT?

The University of Minnesota SVP is one of the most successful university level solar car racing teams that participates in the North American Solar Challenge. The SVP designs and builds a solar car from scratch to participate in this race, which is scheduled to run every other summer. The team is split into several subteams: Aero, Array, Electrical, and Mechanical. An Executive Team is in charge of making sure the teams are communicating with one another and that the project stays on track. Team members are all undergraduates, with faculty advising and support. The SVP is rare among college solar car teams in that it designs nearly all of the car's components itself.

e THE STORY OF A NUMBER

Book Review by Scott Larson

It is reasonably safe to assume that anyone studying in a scientific or mathematic field has at least a vague understanding of the significance of the number e. If you are a practitioner or student of one of the many scientific disciplines studied at this university, you have used the number e frequently in your career or course of studies.

Eli Maor teaches history of mathematics at Loyola University of Chicago and is the author of two other texts on the history of mathematics. The intended readership of this text is are those moderately inclined to mathematics and technically literate. At the same time, Maor hopes to overcome the fear of or distaste for mathematics in some of his readership. Maor believes that many are put off by the subject matter because of an authoritarian approach that lacks historical perspective. His aim is to help provide a technical understanding and an appreciation of mathematics by providing the historical view.

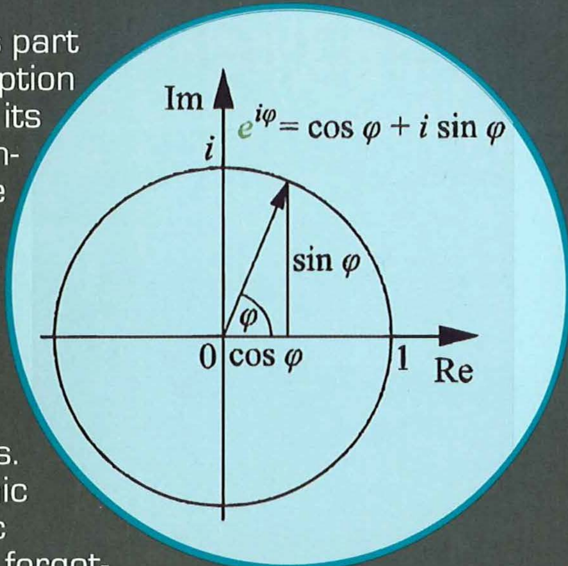
In keeping with this historical approach to the understanding of significant concepts of mathematics, Maor begins his history with John Napier's work on logarithms in the seventeenth century and traces the development of logarithm tables.

Maor moves on to the financial world and shows how some of the earliest intimations of the number e may have been in the mathematics of compound interest. Maor demonstrates how the number e is found in the compound interest. It may interest those inclined to science and mathematics that the first person to discover the number may well have been some moneylender whose only interest in mathematics was to squeeze the maximum usury from borrowers.

For the next several chapters, Maor covers a vast territory of mathematical history with some very interesting stops at historical vistas to view interesting developments in calculus, analytical geometry, and linear algebra.

Maor clearly relates the number e and the natural logarithm in a discussion the hyperbolic functions. He also does a respectable job of explaining the Euler identity. For some who still shudder at the thought of the meaning of $e^{i\theta}$ and other related concepts, take heart, for Maor removes some of the shroud of mystery surrounding these often challenging concepts. He explains the Euler identity so simply by using a power series that one has to wonder why it is not explained this way in undergraduate linear algebra and differential equations courses more often.

Perhaps the most wondrous part of this book is Maor's description of the logarithmic spiral and its relationship to many phenomena in the natural world. One of his side notes describes the existence of the logarithmic spiral in art and nature.



The book contains many side notes explaining interesting points of mathematics. An example is the logarithmic graph. Reading a logarithmic graph is a skill probably long forgotten by many who have ever learned it, and one most likely never learned by most who began college after the demise of the slide rule. Other side notes involve other interesting formulas related to e, including the expression of e as a power series expansion and an infinite continued fraction. There is also a chapter that demonstrates how e^x is its own derivative.

For all its merits, the book is not entirely clear, concise, and to the point. Many of Maor's points are either not clear, not well demonstrated, or merely distantly related to the object of the book. There is, however, much to be gained by a student of engineering picking up this book and gaining some additional insight into the mathematics behind his or her studies. For some, it may provide just the spark of understanding needed to integrate some important concepts of mathematics to their fields of scientific study.

e: Story of a Number
by Eli Maor, 1994
Princeton University Press

IMAGE CREDITS

PHOTOS

Biomimicry and Space Entrepreneurship photos are public domain (http://www.wikipedia.org, 2007)

Engineers Without Borders photos are the property of EWB-UMN, and were submitted for use in the Technolog from a trip to Ghana

Solar Vehicle photos used in the cover. title page, and table of contents are public domain (http://www.wikipedia.org, 2007)

All other Solar Vehicle photos are from the World Solar Rally in Taiwan, and are property of the U of M Solar Vehicle Project, retrieved from their website (http://www.svp.umn.edu, 2006)

ALL ALONE WITH EVERYBODY

by Jen Idziorek

I had a question about the ongoing lecture in class the other day. I looked around me for aid. I realized that I did not know the names of any of my fellow microbiology students. That did not stop me from talking to them, but it gave me pause; why don't I know the names of these people I sit next to every day? My answer: technology is stranding us on myriad desert islands.

I'm not going to say how long I have been a part of this magnificent university, but when I started undergrad here, cell phones were actually the exception, not the rule. Only true geeks had laptops, and no one had heard of the Blackberry or VCast. During breaks in long lectures or between classes, one would chat with classmates, do the crossword, or head out onto Northrop Mall to look for an ultimate Frisbee game. Today, people check their text messages, and rush to the nearest computer lab to look for new e-mail. The real people swarming all around them are mere obstacles. Virtual reality is here.

Music can now spill into our ears twenty-four hours a day. CD and MP3 players allow us to hear only what we want, when we want. People wear their earphones during and between classes. Some of the rather less enlightened even listen to tunes while biking or skating to campus. I have personally seen someone with ear buds channeling music into his head, biking with no hands, smoking a cigarette. How long will it take natural selection to weed out that guy? Nor do I especially enjoy hearing people shout their life stories to their friends over their poorly-connected phones. But has walking around these beautiful grounds with 55,000 others become so utterly boring that we must entertain ourselves on ten-minute walks? The half of the people who are walking down the street with headphones on cannot hear but for the other half who are talking on their cell phones!

We now have the technology to keep close contact with the important people in our lives. Very, very close. Everyone and their grandmothers have e-mail. If that does not work, you can call them on their cell phones. If it is urgent, you can even instant-message them, so that they can respond to you even if they are in class. Our established social circles are now very tight circles indeed. I only have one friend who does not yet own a cell phone. Some of her other friends and I are seriously thinking of chipping in on one for her because we can not get hold of her whenever we want, and we cannot stand it.

Ten years ago, everyone rolled their eyes when vandals cited boredom as the reason for their hijinks. With video games and cable TV, how could one ever be bored? Idle hands are the devil's playthings, and the over-stimulation to which we are subject, over the course of a normal day, has made many hands newly idle. If it is not new, if it does not speed our pulses or relax our minds, we do not want it. We have come to find company agonizing and silence deafening. Through our electronic devices, humanity has become less human.

But what can I say? I am part of that

mass. My personal video recorder tapes all of my favorite TV shows so that I can speed through commercials and watch far more of the boob tube than I would without it. My iPod goes with me to school and back again. It goes to my boyfriend's house, and sits out in the yard with me while I study. On shopping trips, my car's satellite radio channels me 200 stations. My cellphone goes everywhere with me. If I leave it in the fruit basket, I feel naked without it. I'm listening to a recorded radio show on my computer while I write this.

The siren of technology sweetly sang that it would give us more time to spend as we please–more time with friends, loved ones and for ourselves. As we progress, we are able to communicate with each other more often and much faster. Somewhere along the way, something went awry. Instead of saving time, we try to create more, and faster in the same amount of time. We can now do many times the amount of work that our parents were able to do, but work the same hours. We find ourselves dealing more and more with machines and less and less directly with people. The element of human interaction is slowly slipping away.

In Psych 1001 our professor told us a disturbing tale. Back in the ethical dark ages of the early 1900s, they used to experiment with the effect of human contact on newborn orphans. In one famous experiment, a cohort of children was divided into two groups. One group of children they held and played with and talked to. The other group of children had their contact kept to a bare minimum, only as much as was necessary for survival. Within months, there was a noted difference in health between the two groups. The fatality rate of the children who received no contact skyrocketed, while the socialized group enjoyed higher body weight and better development. Humans thrive when we spend time with other humans. We are social creatures. It is why we release relaxing hormones when we see someone we like and feel the reward chemicals when we touch someone. This doesn't work the same way when you are chatting with someone over AOL Instant Messenger.

Your cable TV might amuse you. The internet may keep you informed. Your cell phone might keep you connected. But it is people that make you happy, and people that you need, not gadgets.

FACULTY SPOTLIGHT:

PROFESSOR FRANK BATES, CHEMICAL ENGINEERING DEPARTMENT HEAD

by Nangah Tabah

His surroundings speak volumes for him– shelves of personal publications dating back to the 1980s, colorful molecular models, and a diverse collection of interesting artifacts. Like every great person, Frank Bates is a living paradox. The intersection of his personal life and academic success is curious. How could a man of his intuition not know where he was going, and then have so much academic success? Knowing the man, his students would tell you, it is no surprise. He succinctly puts it this way: "Chance and fate brought me to become a leading expert in polymer science today."

Born and raised in Queens, New York, Bates obtained his bachelor of science in mathematics from State University of New York at Albany, but he was always intrigued by science and mathematics. Reflecting on that time of his life, he recalls he had always known he was not going to be a pure mathematician.

STUMBLING INTO CHEMICAL ENGINEERING

With bachelor's degree in hand, and time to contemplate the future, he moved to Boston. On his first visit to the Massachusetts Institute of Technology campus, the first building he walked into, the chemical engineering building, would become one in which he would spend many long hours in the five years that followed. As he says, he stumbled into graduate school in MIT. He took a polymers course, which he enjoyed, and to this day he carries out landmark research in the field of polymers. He obtained his doctorate in chemical engineering from MIT in 1982. Professor Bates says, "By serendipity, I ended up in the field I am in today."
He then worked for Bell Laboratories for seven years. Bell Laboratories, which had once been the home of the scientists who were in the forefront in the discovery of the transistor, was still in its glory days. Professor Bates' research publications from this period gave him leverage to pursue his long-time ambition to become an instructor. He was offered the position of Associate Professor at the University of Minnesota in 1989 and was soon promoted to Professor in 1991. Along with forty other faculty members, he was later named a Distinguished McKnight University Professor, an honor given to exceptional midcareer faculty.

IN THE CLASSROOM

The department of Chemical Engineering and Materials Science at the University of Minnesota has a reputation for excellence and rigor. Lectures are delivered with timeliness and accuracy that is difficult to find elsewhere. These admirable standards are set by subject matter experts who possess a mastery of material that could only come from brilliance and years of hard work. These instructors offer an effortless and sometimes entertaining delivery that flourishes from practice and pure talent.

As head of this department, Bates

understands his role as one of recognizing and harvesting this talent. He has hired unique individuals like Satish Kumar, an instructor of limitless faculty and focus, who is making tremendous advances in the fabrication of complex devices having characteristic sizes of nanometers to microns.

As an instructor, Bates sets the ultimate standard for excellence. It suffices to attend one of his lectures to attest to this. During an Introduction to Materials Sciences lecture in the fall of 2004, he went over the steps for calculating the maximum shear stress for a piece of metal. The class followed, in silent amazement, a flawless performance. And even as the students thought the discussion was drawing to a close, he stylishly reminded them that calculations alone meant little, by saying "I always feel excited and smart when I do a calculation like this. But the engineer in me says, let's compare these calculations to experiments." He continued his presentation with just that.

Bates' every lecture in some way makes an argument for the extraordinary importance of materials science to every branch of science. He says, "it is hard to find a discipline that is not impacted by this field."

The issue of ethics is also something no engineer can ignore. Bates makes sure his students take this essential lesson, if nothing else, when they leave his classroom. He drove this point home by discussing one of the most spectacular engineering failures. On January 25, 1986, the space shuttle Challenger, a three-billion-dollar aircraft, took off from Cape Canaveral in Florida. The seven astronauts on board were just over a minute into their flight when Challenger exploded . Millions of people saw one of the world's worst space disasters on television. It had been cold that fateful morning, and watching the launch on television himself, Bates noticed icicles that formed around the base of the craft before it took off. The results of an independent investigation traced the cause of the explosion to a leak past an o-ring on the solid rocket booster. This o-ring was made of a rubber which had behaved very unrubberly in the low temperatures. "Temperature influences time response when dealing with polymers," says Bates, a vital lesson that was overlooked by NASA that day, a lesson every student sitting in that classroom was urged to take home with them. "You have an ethical responsibility to make yourselves knowledgeable about all aspects of a problem you are going to be working on. Materials Sciences and Engineering will always play a critical role in modern day technology and development."

For most people the world of science and experimentation is all facts and no fun. Like the mighty paradox that he is, Bates is a rare combination of both. Being an avid supporter of the Vikings, Twins. and Timberwolves, these names make frequent appearances during lectures. Sports talk would hardly constitute a materials-science curriculum, but an update on how the playoffs are going is a welcomed tradition in his class. Playful bets on baseball games usually turn into much appreciated ice-breakers for many of his lectures.

RESEARCH

Bates has an underlying philosophy that connects all his work. The first and perhaps most fundamental is to generate knowledge for its own sake. In other words, to simply grasp a commanding understanding of scientific issues is important. But no less important is the development of materials with practical applications.

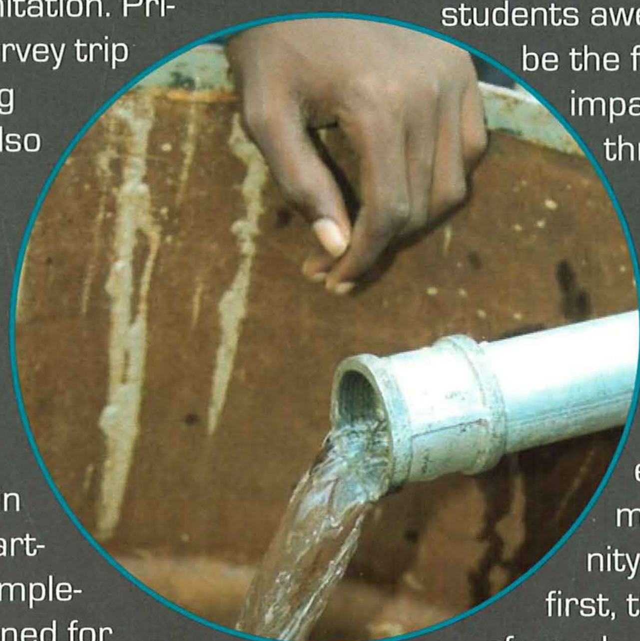
His research group studies the thermodynamics and dynamics of polymers and polymer mixtures. Polymers are very widely used. Every year in North America, $100 billion is spent on polymers.

CONTINUED ON PAGE 21

ENGINEERS WITHOUT BORDERS

Continued from page 07

The second survey trip took place in July and August 2006, when chemical engineering graduate student David Gasperino traveled with colleagues to the Agona-Swedru region of Ghana. They visited the Minnesota Academy and learned about the organization and the town's need for potable water and improvements in sanitation. Primary objectives of the survey trip were water quality testing and surveying, but they also spent a lot of time learning about the region's culture. Design steps for water collection and managing water quality have been incorporated into a project within the capstone design course in our civil engineering department this semester. An implementation project is planned for either spring break or early summer, and additional designs could become a part of future capstone design courses.



The students' work, that of locating of a project site, the survey trip, the elements of the design, and the implementation process, is very much the same as the work they will face as employed engineers: locating a problem, identifying all of its aspects, designing the methods and systems to solve the problem, and finally, following through with the solution. When asked about how working with EWB impacts a student, Gasperino responded:

"Using these skills to design structures and systems that will provide clean water and sanitation for entire communities really inspires a sense of respect in these students towards their skills, and the engineering profession." To build thing that people will actually benefit from can almost leave students awestruck because it may be the first time they realize the impact that they can have through their profession.

From a student's standpoint, these are definite positives to working with EWB, but clearly the benefits are appreciated even more by the host community and its organizers. At first, the prospect of a group of people coming from nowhere and promising to help must not feel like a sure thing. Then, with a little displaying of commitment to the project, they are open to anything. Essentially, they realize how exactly their work benefits the host community and can see their gratitude. To go from using barely operational hand-pumps and crude latrines to having clean, running water and sanitary toilets is nearly unimaginable. "This change will be night and day for the school and community we are working with in Ghana," says Gasperino. "They will be both shocked and delighted to see such a positive change to their daily lives."

His group has developed three broad areas of investigation to address this issue. They include: polymer synthesis, chemical modification, and molecular characterization.

Polymer synthesis involves the chemical manufacture of block copolymers. Block copolymers allow one to connect two different polymers. For instance, combining a hard polymer with a soft rubbery polymer would yield a stiff yet elastic polymer. This synthesis produces polymers that are in everyday use. An example is the adhesive on packing tape, which is sticky and yet does not flow.

Chemical modification, his second area of investigation, involves studying the resulting properties of polymers, such as their flow behavior, stiffness, structure and optical clarity. Some of the techniques used here include x-ray scattering, neutron scattering and electron microscopy.

Molecular characterization entails designing new materials for various purposes such as polymers with biomedical applications. As a work in progress with workers at the University of Pennsylvania, Bates is undertaking research on imaging vesicles. An imaging vesicle is made of a polymer vesicle into which a dye is planted. Tentacle-like protrusions of polyethylene oxide increase the sensitivity of the vesicle. It is used to locate and identify tumors. While also working with Dow Chemicals, he is helping develop polymers to make epoxy tougher, thus less brittle. This could improve on robustness of electronics devices, whose yields can suffer losses when the circuits are packaged in epoxy.

THE FUTURE

Bates prides himself in achievement and excellence–his and that of his students. When asked how he feels about the department's future, confidently, without a moment's pause, he says "This is a very good department that has a very bright future." Bates identifies two problems the world faces today: energy and health. Not surprisingly, he adds, "Both of these are greatly influenced by materials sciences and engineering."

He recognizes a big future in energy for chemical engineers and materials scientists. His research and that of his colleagues plays a crucial role in medicine.

"As department head I have to help coach us in that direction." He understands the importance of hiring faculty that will decide the research direction in which this department is going. And above all, faculty that take teaching seriously.

Finally, when asked what makes him so good at what he does, and more important, what motivates him to do what he does, Bates' response comes quickly and with a smile, "I like to see things work."

It is with this conciseness and deliberateness that this distinguished professor has kept the Chemical Engineering and Materials Science department of the University of Minnesota number one for half a decade.

IT Student Publications
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TECHNOLOG
Spring 2008

CLEAN AND GREEN

SOLAR DECATHLON, CLEAN COAL, ALTERNATIVE FUEL VEHICLES

ALTERNATIVE ENERGIES AND ENGINEERS IN ACTION

EDITORIAL

Over this past Winter Break, I was privileged to be able to travel to Costa Rica with a group and there I was able to experience an environment that we cannot find in the U.S. During my trip, I came in contact with some unique technological systems, or lack thereof, that I found intriguing.

One of the systems that I saw implemented in Costa Rica is called a biodigester. This consists of a large inflatable plastic tank (approximately 15 feet long and 3 feet wide) in which feces are washed into with water. In this bag, the feces are allowed to breakdown and after a while, methane gas forms. The methane gas is then piped to a house, ignited, and used to cook food. On average, this system saves approximately $20 a month and can last for approximately five years. Even though there is the initial purchase and installation totaling close to $150, it can more than pay for itself during its lifetime.

This system was implemented on a farm where pig feces were washed into the biodigester. It was explained to me though that the type of feces is not unique at all, so human feces could work as well. If this system were to be implemented in a large metropolitan area, say the Twin Cities for example, it would have several positive ramifications. One of these is that the methane gas could be used to heat homes during the winter, which would reduce our oil consumption. Since the process is all natural, the price to heat a house would also drop significantly, but I imagine it would not be eliminated. The downside though is that there would need to be a large area for the tank, which is something most metropolitan areas, such as the Twin Cities, lack.

Another aspect that I observed in Costa Rica is that all the farm work, or at least the work I saw, was done by hand – no technology or machines were used other than a vehicle used to transport the produce, animals, or what be it. We toured a dairy farm and all of us were astonished to find out that the farmer milked over 40 cows twice a day all by hand – no machines used at all.

Many construction projects such as road construction or mixing and pouring cement are also done by hand. During my time there, the group I was with mixed cement by hand and manually moved it into the form with shovels. In the U.S. most people cannot imagine doing and for many people in the group, it was a learning experience. Because of the intensive manual labor required for construction of roads, several roads are left unpaved or are in poor condition.

All of this made me think of what life would be like without the conveniences of technology. I grew up on a family farm of approximately 250 acres in rural Minnesota where we raised beef cattle and produced corn and soybeans. We use machines to plant, harvest, store, and transport our crops. Even with these machines, it is a lengthy process; now imagine it without it. We grow crops on approximately half of our land and without machines such as a combine, it would require us to manually cut each plant and separate the corn from the cob or what be it, which would be a major disadvantage for then productivity decreases.

At the same time though, without these machines, there would be positive effects. No electricity or oil derivative would need to be supplied in order to run the machine. This would lead to a cleaner environment. If farmers chose to not use machines, they would have more money, for farming equipment is rather expensive. Ultimately though, the funds saved would have to be allocated elsewhere – into hiring employees for example.

CONTRIBUTORS

The big question with all of this is what to do. Each side has stark pros and cons, which make both sides appealing. No matter what is chosen, there will be a negative consequence that is unappealing, but with time we will be able to adapt to it. So, for example, if major metropolitan areas were to implement biodigesters, there would be the inconvenience of occupying space, though it could significantly reduce our oil consumption and dependence. Not using farming machines would create a "greener" environment, though productivity would significantly decrease. The choice here is not easy.

Making a greener environment is a good thing, but at what cost? Converting to biodigesters would be an amazing alternative, though I think they need to be explored a little more. However, not using machines for farming, or whatever, is entirely different. In my opinion, we need these machines in order to be able to sustain the level of production that we are currently at. Though detrimental to the environmental as they are, the machines are the only thing currently in our array of options. "Greener" options would be better, but until they are developed, this is all we have. For each option we must consider it on an individual basis; we cannot simply lump the greener options together and others together.

-Jered Bright

Minnesota
TECHNOLOG

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ANDREW KIRCHMAN

Besides being the president and writer for the Technolog, Andrew is a member of the solar car project, spending his time designing a parking brake and finalizing details for the rear suspension of the new car. He is also busy trying to make Pro-ENGINEER work, a program that is excellent for turning a seemingly simple design into several hours of work and lots of swearing. When Andrew is trying to avoid his homework, he may be spotted playing his electric bass and hanging out with friends.

TAYLOR HILL

Taylor is the design editor for the Technolog. She's caught somewhere between graphic design and mechanical engineering majors... and if she's lucky enough to have any time left over, she likes making posters and gadgets, swing dancing, learning new languages, and playing Xbox. She hopes to graduate in less than eight years, and then work somewhere like IDEO.

JERED BRIGHT

In addition to being the chief editor (well, the only one really) for the Technolog, Jered also enjoys participating in SPACO (Spanish and Portuguese Across Cultures Organization), which designs cultural events for people to participate in. If he has any time after these or doing homework for his Spanish Studies and Mathematics Education degrees, he likes to try to get people to go salsa dancing with him or simply relax at home by watching movies or playing PS3.

CAITLIN CRANDALL

Caitlin is a sophomore majoring in Bio-Medical Engineering. She is from Yankton, South Dakota and does not understand city life. She loves riding her bike and eating glazed carrots.

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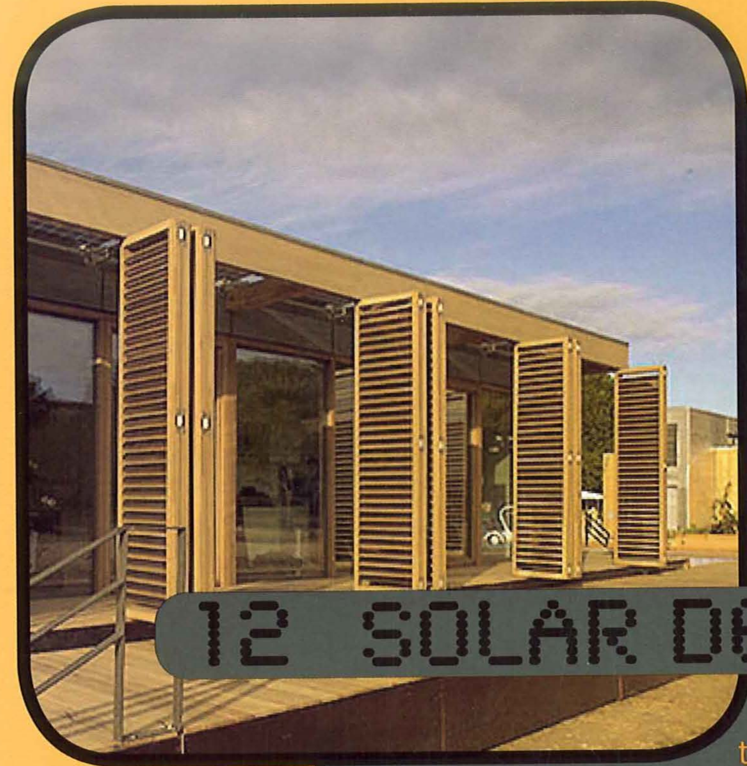
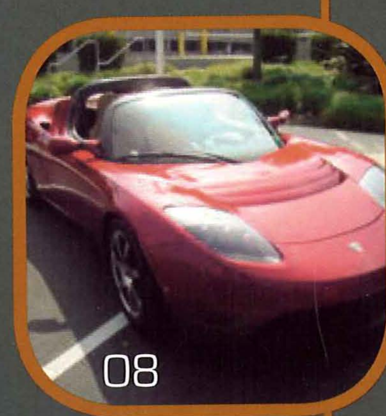


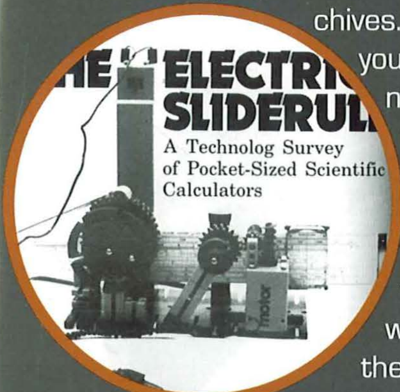
COVER STORY



VINTAGE TECHNOLOG: THE ELECTRIC SLIDERULE

compiled by Taylor Hill

In the last issue, Andrew's editorial mentioned articles such as calculator comparisons found in the dusty pages of the Minnesota Technolog archives. I believe he promised that you wouldn't see such nerdy nonsense in the new and improved, modern Technolog. But wait just a second...



The calculator comparison wasn't just a recent rant on whether or not to shell out the extra money for the silver edition of the TI-84+, or if you really need the engineering-oriented TI-89. The article was printed in the October, 1973 issue of the Technolog, just as scientific calculators started to make their way into the educational scene. These were the days when IT students wore sliderules on their belts, when programmable calculators with more than a line or two of display were futuristic dreams akin to jet packs, and when Texas Instruments didn't have the corner on the calculator market.

The debate was about whether or not professors would, and should, allow calculators into classrooms and quizzes, whether more complex problems would become a normal part of homeworks and labs now that calculations could be made in an easy 38 steps on a calculator that required three hours to charge from an outlet.

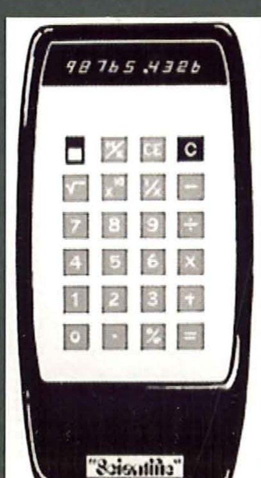
How many of you could imagine going to class without a calculator? Do you get frustrated when you have to put away your quick, easy TI-83 with its multi-line display, back-up battery, and plethora of functions, and use your feature-poor, exam-approved TI-30xa for quizzes? These days, many students own more than one calculator, often because the $10 scientific calculator allowed on tests just isn't powerful or fast enough for everyday homeowrk calculations.

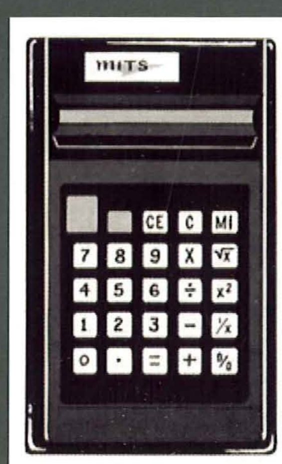
In 1973, the cheapest scientific calculator cost about $150, the same as the best available today. And the writers of the Technolog were wondering how the calculator would affect the future of science and engineering.

> At $149 it is quite a steep price to pay for a pi key. It would be cheaper to use the old sliderule trick of dividing 355/113.

Who knows... maybe this generation of IT students will look back in thirty years and think the TI-84 is just as obsolete as the sliderule seems today.


Hewlett-Packard HP-35

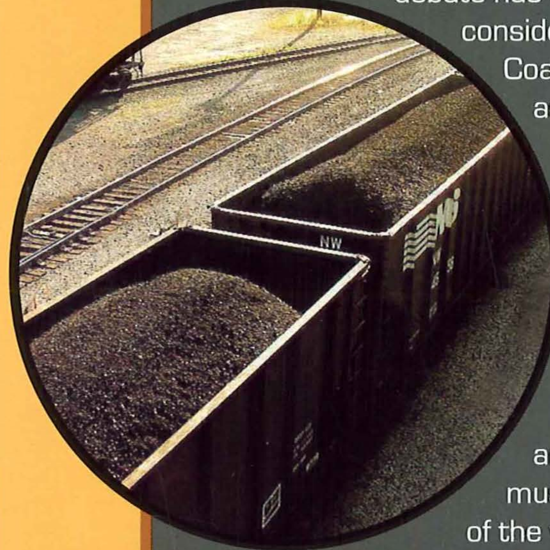



MITS 150 (kit)

IS CLEAN COAL A CLEAN ENERGY TECHNOLOGY?

by Bridget Ulrich

The emission of greenhouse gases such as carbon dioxide and methane through the combustion of coal is a principle contributor to anthropogenic climate change. A topic of recent debate has concerned the consideration of new Clean Coal Technology (CCT) as a solution to climate change. In an age where green washing has been used to mislead the public regarding the environmental benefits of obscure practices and products, one must question the use of the word "clean" in reference to a fossil fuel. A better understanding of the processes that CCT entails will provide a more substantial comprehension of the issues prevalent in this debate.



Coal.

CCT is composed of processes that remove impurities from coal and neutralize pollutants such as sulfur dioxide nitrogen oxides during the generation of energy. During preparatory phases, mineral impurities are washed and expelled from the coal through a process called gravity separation. In gravity separation, coal is crushed and fed into barrels containing a liquid of selective density. This allows the organic matter that is to be utilized for gasification to float to the top, while the heavier minerals sink to the bottom for removal. The resulting matter is collected and subject to further grounding in preparation for gasification.

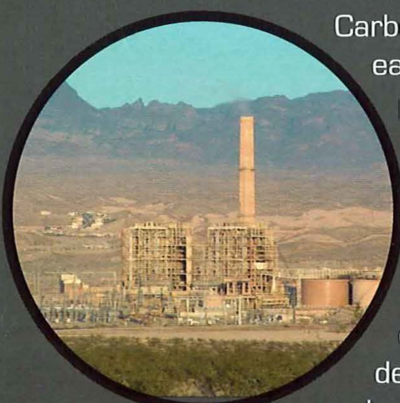
Organice material from coal is converted to a syngas which can be utilized in the production of electricity through gasification. Within a gasifier, high pressure and steam separate the matter into char and volatile products. A stream of oxygen is fed into the gasifier, causing the volatile products and a portion of the char to undergo combustion to form carbon monoxide gas. Gasification occurs when the carbon matter of the char reacts with the water from the steam to produce hydrogen and carbon monoxide gas. The gas phase then undergoes the water gas shift reaction, where the concentrations of carbon monoxide, steam, carbon dioxide, and hydrogen pursue equilibrium. The resulting gas mixture is the syngas that directly utilized for energy in its ability to drive the turbine of a power generator.

Pollutants including sulfur dioxide, nitrogen oxides, and particulate matter are removed through additional processes. During flue gas desulphurization, "wet scrubbers" remove up to 99% of the sulfur dioxide from the gaseous mixture. The syngas is fed into a scrubbing chamber, where limestone and water are sprayed over the gas. This mixture reacts with sulfur dioxide to form the solid calcium sulphate gypsum, which is collected and removed from the chamber. The generation of nitrogen oxides is diminished through the use low nitrogen oxide burners. These burners function by preventing oxygen from flowing into the hottest part of the reactor in which the coal is burning, where conditions for the formation of nitrogen oxides are most favorable. Up to 99% of particulate matter is removed by Electrostatic Precipitators.

"ORGANIC MATERIAL FROM COAL IS CONVERTED TO A SYNGAS WHICH CAN BE UTILIZED IN THE PRODUCTION OF ELECTRICITY..."

The term "clean" in CCT is attributed by its capability beyond traditional coal processing to curb certain pollutants. CCT prevents acid rain through the removal of sulfur dioxide, prevents damage to the ground level troposphere through diminishing nitrogen oxides, and avoids harmful respiratory symptoms by capturing particulate matter. Though CCT has been cleaned up in a sense, this does not necessarily constitute CCT a clean energy technology. To be considered a clean energy technology, the energy being generated must be derived from renewable starting material, emit zero net pollution, and have minimal impact on surrounding ecosystems.

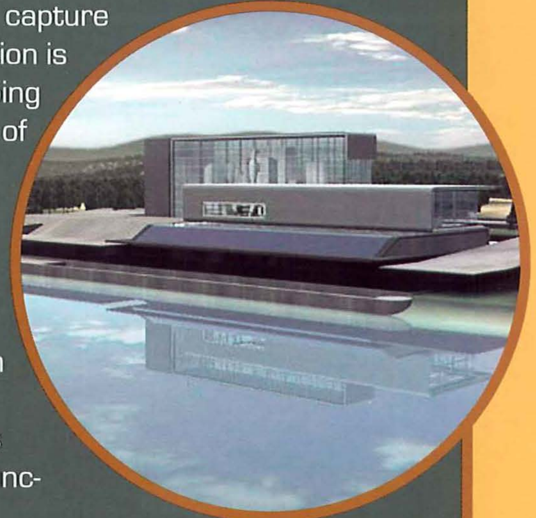
Though various pollutants are eliminated by CCT, it fails to prevent the emission of greenhouse gases that contribute to climate change. Energy is harnessed through the combustion and gasification of organic matter containing carbon material that has been withheld from the atmosphere for centuries. The product of this combustion and gasification is carbon dioxide, which fundamentally causes a net increase of carbon in the atmosphere.



Mohave Generating Station, an as-yet unretro-fitted coal plant in Nevada

Carbon dioxide is not as easily removed as other polluting products. Carbon capture and sequestration technology attempts to mitigate this pollution through storing carbon dioxide underground rather than releasing it into the atmosphere.

However, capturing and compressing carbon dioxide for storage has been shown to increase the fuel demand of a coal plant by 11-40 percent, and increase the cost of the energy generated by 21-91 percent. Though carbon capture and sequestration is capable of curbing 80-90 percent of carbon dioxide emissions, it is not economically feasible to apply these technologies on the large scale that coal plants are currently functioning.



Futuregen, a proposed clean coal plant slated for Illinois, pending funding

CCT is essentially given the buzzword "clean" because it processes coal in a way that curbs acid rain, damage to low level ozone, and potential respiratory symptoms. It cannot be considered a clean energy technology because it requires the utilization of nonrenewable fossil fuel resources and is incapable of curbing the generation of carbon dioxide. Technology to mitigate the carbon dioxide emitted through these processes is available, but lacks economic feasibility. CCT ultimately generates a net increase of greenhouse gases in the atmosphere, which eradicates and contradicts its potential as a solution to climate change.

ENGINEERS WITHOUT BORDERS: FOSTERING THE FUTURE ENGINEER

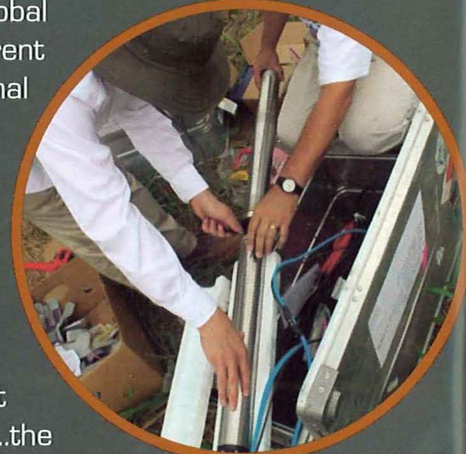
by Kevin Huselid

Sustainability. The word evokes images of an indefinite continuity. It has become the hottest buzzword in government, academia and industry. Sustainability has become the focus of any forward thinking engineering project. At the University of Minnesota, the Engineers Without Borders student chapter is educating students and preparing young engineers to confront the challenges of sustainable engineering in the 21st century. The focus on sustainability in international development exposes students to the fundamental objective of engineering: improving people's quality of life. Engineers Without Borders contributes to a more sustainable, just, and equitable world by solving local-scale environmental development problems.

"SUSTAINABILITY HAS BECOME THE FOCUS OF ANY FORWARD THINKING ENGINEERING PROJECT."

Engineers Without Borders - University of Minnesota Chapter (EWB-UMN) has completed projects in Guatemala and Ghana and presently has projects in Uganda, Haiti, and Guatemala. The problems are often posed in terms of clean water supply and sanitation, but true engineering solutions encompass both technical and nontechnical approaches. The enrichment of the student's education from exploring these engineering solutions attracts the future leaders in the engineering profession to this program.

Why do these low-tech solutions have such importance? The place and role that engineers will take in the global economy is different than the traditional role of the past century. A 2001 NSF-funded conference on interactions between natural systems and the built environment concluded that "...the engineer of the future applies scientific analysis and holistic synthesis to develop sustainable solu tions that integrate social, environmental, cultural, and economic systems (Amadei)." The interaction between these systems - natural and man-made - can be difficult to predict; yet it is an important part of understanding an engineer's role in society.



During the assessment phase of the project in Mulobere, Masaka, Uganda in August 2007 two students and a professional mentor travelled to Uganda. The eight student project team will be returning summer 2008. During the assessment, one of the main objectives was to identify how the partner organization, Uganda Rural Fund, interacts and mobilizes the local community to organize and declare what are the community's needs. The best way to start this investigation was to call for a community meeting to ask the people which issues were important to them.

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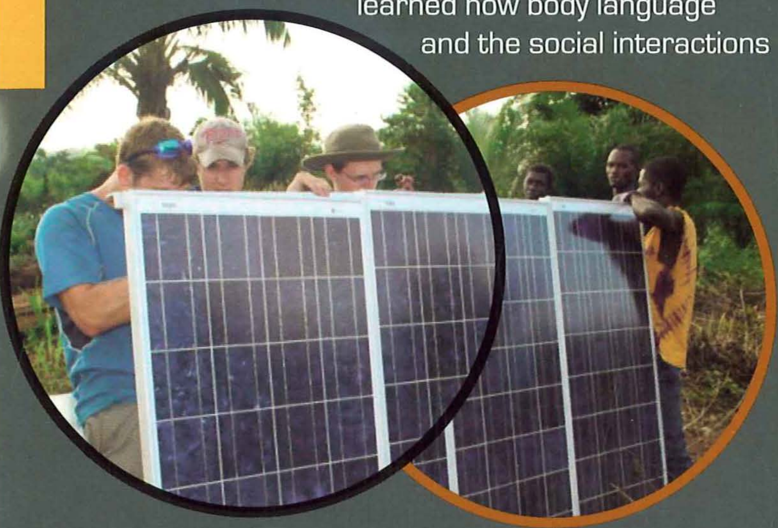

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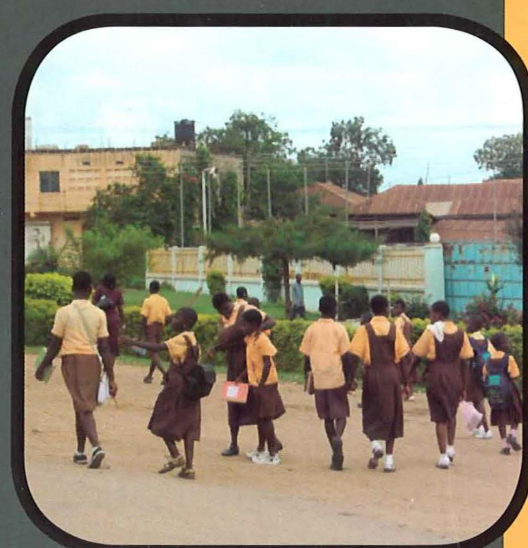

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ALTERNATIVE FUELS: OPTIONS FOR TODAY AND TOMORROW

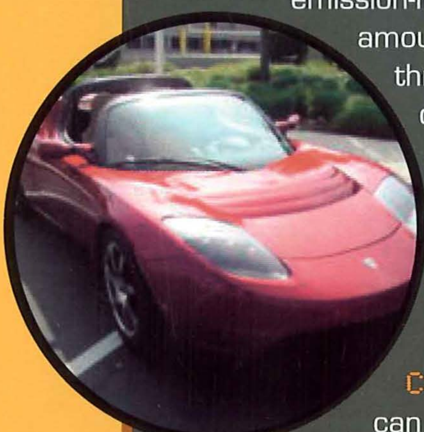
SOME ALTERNATIVE FUELS AT A GLANCE

by Andrew Kirchman

ELECTRIC CARS

HOW IT WORKS: The car is run by a battery pack which supplies power to the electric motor and can be charged in one of two ways. One way to charge the battery pack is to connect it to a household circuit or electrical grid. Generally, electric vehicles also include a process called regenerative braking, which converts some of the kinetic energy from the wheels spinning and heat from the application of the brakes to electric power which is then routed to the battery.

PROS: Electric cars have the potential to be emission-free; however, the total amount of emissions produced through running the car is dependent on the electrical power source. Additionally, electric cars have the most research behind them of all the gasoline alternatives.



CONS: The range the cars can travel is the largest issue facing electric vehicles. The Tesla Roadster, a lightweight sports car that weighs 1,000 lbs less than an average car, can travel approximately 220 miles on a completely charged battery pack, compared to 300-400 miles a gas or diesel car can get on a full tank of fuel. Battery life is also another concern. It would take approximately 3.5 hours to fully charge the battery for the Tesla Roadster, although that is from a completely dead battery. The battery pack in the Tesla will last for approximately 100,000 miles.

OUTLOOK: It is a viable option and will be available in the near future. Battery technology has improved dramatically over the past decade - lithium ion battery packs are the new standard. General Motors has built several prototypes of E-Flex vehicles - vehicles that run on electricity, but can also run on gasoline when the battery is depleted. On average, E-Flex vehicles cannot travel as far on electricity as pure electric cars, but they have greater overall range. Tesla Motors Corporation has started production of a high-end sports car (the Tesla Roadster) that runs completely on electricity, with plans to eventually offer sedan models. Additionally, several companies are starting to modify existing cars to run on electricity.

PRODUCTION: Tesla Motors Corporation and General Motors, though focusing primarily on experimentation with electric vehicles, are at the forefront of this alternate fuel with other companies also exploring this option.

HYDROGEN FUEL CELL

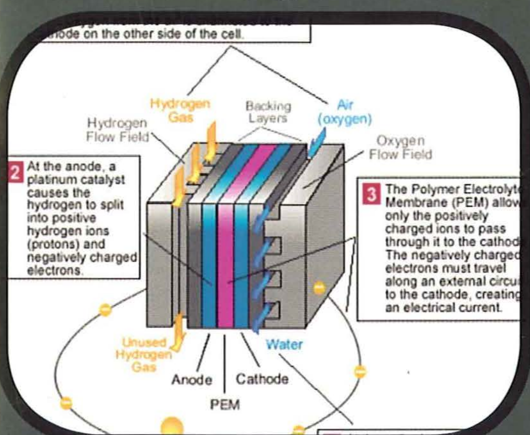
HOW IT WORKS: Hydrogen, stored as a compressed gas or liquid, in a metal hydride, or in carbon nanostructures is fed into the fuel cell, which contains a catalyst, an anode, membrane, and cathode. The hydrogen atoms split into electrons and protons, with protons passing through the membrane, and electrons going to the cathode. The electrons flow from the cathode to the anode, creating an electric current which powers the electric motor in the system. From here, the electrons leave the cathode, where they are reunited with the hydrogen protons that passed through the membrane. The protons and electrons are then united with oxygen to form water. This water is the only "emission" produced by the system, along with some heat. Each fuel cell produces approximately 0.7

volts, meaning that hundreds of fuel cells have to be in stacks (in series with each other) in order to produce a usable quantity of current.

PROS: Water is the only emission of the system, making it a very environmental friendly option. Another positive consequence is that hydrogen is an abundant element that can be taken from many sources.

CONS: The main pitfall of hydrogen fuel cells is the cost of implementing hydrogen on a nationwide basis. Converting filling stations and storing the hydrogen also create issues that need to be resolved.

OUTLOOK: It is a viable option, but companies are running into troubles. According to an estimate from the Gasoline Marketers Association, it would cost approximately 2 billion dollars to outfit 10% of all gasoline stations in the US with hydrogen-capable equipment. However, both Honda and General Motors have done research into developing a home-based filling station that would also produce electricity and heat for the home. Besides infrastructure, on-board storage of hydrogen remains the largest hurdle for mass produced hydrogen cars. When stored as a gas, hydrogen is normally at a pressure of 5,000 or 10,000 psi. For safety reasons, the burst strength of these tanks has to be twice that level. Metal hydrides, which are metals that "capture" hydrogen, need high temperatures before they release that hydrogen. Liquid hydrogen, which is used by a small BMW 7-series experimental fleet, has to be stored at -253 degrees Celsius, or 20 Kelvin. Even so, liquid hydrogen has a tendency to bleed off roughly 3 to 4 percent of its volume per day in the form of hydrogen gas.



Carbon nanostructures have proven to be unreliable in terms of consistent production, and can only store approximately 10% of predicted hydrogen storage capability.

PRODUCTION: Though numerous companies are researching this method, BMW, Ford, General Motors, Honda, and Toyota are leading the research in this alternative fuel.

DIESOTTO/HCCI

HOW IT WORKS:

The DiesOtto (Mercedes-Benz) and HCCI (General Motors) engines are essentially a combination of a diesel and gasoline engine. Traditional gasoline engines ignite the gasoline, while diesel engine have their fuel compressed. DiesOtto/HCCI engines operate like a gasoline engine when starting and at full load, and operate like a diesel engine at other times.

PROS: The main benefit is the improved fuel economy over traditional gasoline engines. Also with this method there is no need for NOx filters, which are needed for clean diesels.

CONS: The most detrimental aspect of these systems is that they still run on gas and produce emissions.

OUTLOOK: Technology included in these systems is too new to see if it can succeed in marketplace. Additionally, the technology would not have the green image such as that enjoyed by hybrid cars and hydrogen fuel cell cars, which is an important factor in marketing of green technology.

PRODUCTION: It is still in testing stages though prototypes have been built by Mercedes-Benz and General Motors.

E85/ETHANOL

HOW IT WORKS: The engine operates like a normal gasoline engine; however, hoses and other connections are upgraded to handle ethanol, which can eat through traditional materials. Another difference is that there are sensors in the combustion chambers in order to deal with the octane difference between gasoline and ethanol. Perhaps the most important difference is the fuel. The fuel for this type of engine is E85 which consists of 15% gasoline and 85% ethanol (an alcohol often made from corn) mix.

PROS: One benefit of this type of fuel is that the majority of it is a U.S.-grown fuel. E85 also produces fewer emissions at the tailpipe than traditional gas cars. Since E85 is often derived from corn, it is a political favorite for it supports farmers.

CONS: There is still the issue of the amount of fuel consumed and emissions produced during the production of corn, which is the current primary source for ethanol in the US.

OUTLOOK: Numerous vehicles on the market now are E85 compatible. These vehicles are often marketed as FlexFuel vehicles due to their ability to run on pure gas or E85.

PRODUCTION: Most companies are producing E85 capable vehicles, though Ford and General Motors have the most models.

HYBRIDS

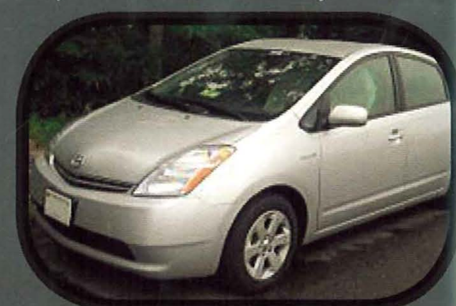
HOW IT WORKS: There are two primary categories of hybrids: mild hybrids, and full hybrids. Both have an electric motor as well as a traditional gasoline engine. The gas and electric motors are run simultaneously when under acceleration and heavy loads. Both categories of hybrids generally shut down the gas motor at stoplights in order to conserve fuel and feature regenerative braking, which converts the heat generated by the brakes working into electrical power. The difference is that full hybrids have the capability to run solely on the electric motor at city speeds.

PROS: Hybrids have better fuel mileage than traditional cars and also display the green image.

CONS: At current gas prices, the price of a hybrid as opposed to a similar car more than offsets the amount of money saved on gas. Additionally, their fuel economy can be matched by non-hybrid vehicles using existing gasoline or diesel engines.

OUTLOOK: Hybrids are enjoying success with their green image, and that success is likely to continue as long as there are no viable replacements for gasoline.

PRODUCTION: Companies that currently have hybrids on the market include Ford, General Motors, Honda, Nissan, and Toyota. Many other companies are planning to bring out hybrids of their own in the near future.



THE AUTOMOTIVE X-PRIZE

Run by the same organization that created the Space X-Prize for private space transport, the Automotive X-Prize seeks to jumpstart high efficiency vehicle research. Among the requirements for design entries in the Mainstream class are: 100 mpg, 4 passengers, 10 cubic feet cargo space, heater, air conditioner, and all the other elements of a normal everyday car. Entrants also have to design a business plan to successfully market and sell such a vehicle. The main prize will be awarded in mid-2009.

CALLING ALL LADIES (AND MEN TOO)! SWE NEWS AND OPPORTUNITIES

by Katheryn Hope

The Society of Women Engineers (SWE) is a nation-wide nonprofit organization that is comprised of professional and collegiate chapters. SWE provides educational seminars and opportunities to network with fellow women engineers. The chapter here at the University of Minnesota is all that and more, providing leadership positions, exciting events to participate in, a chance to get advice from older girls, and an overall sense of community. Many people do not know that men are also welcome to join SWE!

Since the beginning of the school year, SWE members have had their hands full with a variety of events. More recently, 18 SWE members from the U of M attended the SWE Region H Conference at Bradley University in Peoria, IL from January 25th-27th. Here, SWE members were able to partake in a career fair, networking lunch, and a several different workshops including Managing Effective Meetings, Professional Presence: What Not to Wear, Dining Etiquette, and What They Didn't Teach You in College, as well as many other events.

Last fall, SWE partnered with Eta Kappa Nu to host the Institute of Technology Career Fair. From 10 a.m. to 4 p.m. on September 17th and 18th, students could come to the Great Hall in Coffman Memorial Union to meet with representatives from over 110 U.S. companies and ask about internships, co-ops, and part-time and full-time opportunities they had available. During the day, SWE members helped distribute information on companies, register company representatives, and answer questions.

Besides these, SWE members participate in other volunteer and club activities. During this past fall semester, members went to the Ronald McDonald house in Minneapolis and raked leaves. Once they were finished, Ronald McDonald himself appeared and gave them a barbecue lunch to express his gratitude. SWE members also held an Ice Cream Social to allow the members of SWE to get to know each other. Members have also knitted scarves, made holiday cards for military men and women overseas, held Halloween events, and held programs for high school girls who are interested in math, science, and technology.

There are SWE members in 25A Lind Hall throughout the day during the week. If you are curious or thinking about joining SWE, stop by and talk to the girls about their experience!

APPLIED ENVIRONMENTAL SOLUTIONS: A NEW "GREEN" GROUP ON CAMPUS

by Caitlin Crandall

Several environmental groups already exist on campus, dedicated to finding ways to fix the world and changing mankind's detrimental habits, so why start yet another? What's different about Applied Environmental Solutions (AES)? A small group of students started the group last semester with a mission in mind - reduce CO2 emissions through researching and applying technology. Made up largely of engineers, AES involves work which seeks to actively design and apply solutions to environmental issues through research, discussion, technology, and work.

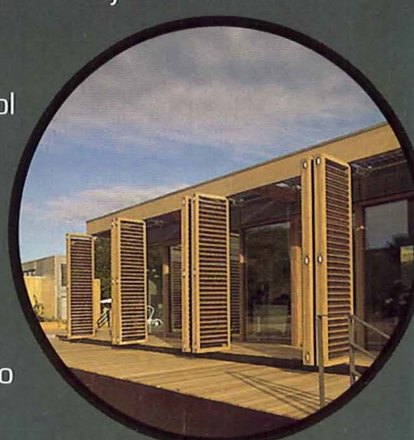
AES is split into two major divisions: one division works on sustainability while the other focuses on transportation. According to group president Hans Lillevold, "We concentrate on the technical aspects of designing and building efficient systems that everyday people can use." The sustainability group works on houses, with the ultimate goal of developing a zero carbon house, as well as implementing renewable energy technology such as solar panels into existing homes. A work in progress is an alliance with several colleges and other groups on the Solar Decathlon. The transportation group converts vehicles to electric and takes on other vehicle-related projects.

"WE CONCENTRATE ON THE TECHNICAL ASPECTS OF DESIGNING AND BUILDING EFFICIENT SYSTEMS THAT EVERYDAY PEOPLE CAN USE."

The Solar Decathlon project began in the fall when a group of students from AES and Greenlight traveled to Washington D.C. to attend the 2007 Solar Decathlon competition, where they gained information about the competition from participating teams and checked out the technologies used and how teams implemented them into their house designs. After returning to the University of Minnesota, the travelers shared pictures and information with the rest of the group and began planning for the 2009 competition. Since the second semester began, the Solar Decathlon team has had two large group meetings to generate interest on campus among students, faculty, and other professionals, and to focus energies toward meeting specific goals.

The Solar Decathlon is sustainability group's biggest undertaking and the project that AES is well-known for around campus. As one of only twenty teams world-wide accepted into the competition, the University of Minnesota's Solar Decathlon team has a lot of work ahead of them.

Lillevold states that, "This (the Solar Decathlon) is the same type of project as anything else. The responsibility of AES will be to provide technical know-how and expertise for energy production and management schemes such as home efficiency automation. Things under our control consist of lighting, appliances, and load management. Ideally, the team would like to eliminate phantom loads, possibly by designing a small outlet device which can plug into a regular wall outlet, and could then be controlled by a master control system."

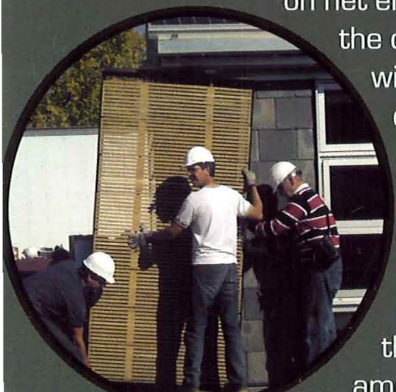


This theoretical control system might have incredible capabilities, including online or Bluetooth access. One practical use for this would be if a home owner forgets to turn off the lights at home before going to work. He or she could simply log on and manage the house from afar, hopefully maximizing energy savings. AES will also be responsible for integration of photovoltaics, solar-thermal, and control systems.

The Solar Decathlon team, being under the sustainability portion of AES, is split into several smaller divisions, each with responsibilities based on competition scoring. Solar Integration and Energy Management (SI/EM), being one of these divisions, will be responsible for generation of energy all the way through master controls and end use. Several of the sub-contests fall under these responsibilities. The sub-contests are meant to simulate regular living conditions and household energy use. For example, the team needs to be able to successfully wash several loads of laundry and dry them back to their original weight, as well as run other typical household and kitchen appliances to the satisfaction of judges and competition regulations. The house should produce energy to support various cooking, lighting, home entertainment, and other tasks.

"THE HOUSE SHOULD PRODUCE ENERGY TO SUPPORT VARIOUS... OTHER TASKS."

Perhaps one of the most important sub-contests to successfully complete will be the net metering sub-contest, where teams receive points based on net energy production during the contest week. Each team will be connected to a local electric grid, so when not producing energy during cloudy times or at night, the house has the option to buy electricity back from the grid. At the end of the week, the amount of electricity bought from the grid will be subtracted from the amount sold to the grid during high-energy producing hours of the day, and points will be awarded accordingly. The goal here is to have a net energy use of zero, and ideally to sell more electricity to the grid than the team buys back.



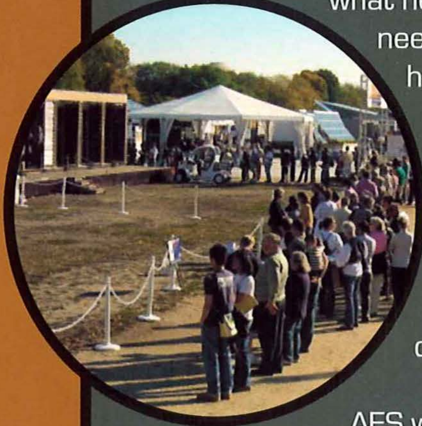
Weekly meetings are underway for the SI/EM team. Each meeting involves discussion of what needs to be done that week, and assignments are given out to fulfill weekly goals. So far, this has mostly included research about energy loads, houses from past competitions, competition rules, and strategies for the 2009 competition. Although most members joined the group knowing little about the work involved and implementation of solar technologies into houses, the team is working hard to gain well-rounded knowledge about solar technology, ranging from how it works to how to integrate it into a home.

The transportation division of AES has several undertakings as well. One of the first undertakings of the transportation group is the job of converting a mini-bike to run on electricity. Currently, they are assembling the conversion by mounting two electric motors, the battery racks, and a motor controller designed and built by the group to the bike.

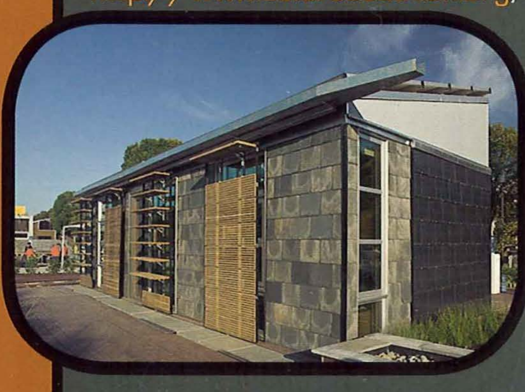
This division also has a proposal for an AES vehicle conversion. The group hopes to convert a Chevy S-10 truck using purchased parts as its first complete automotive conversion. The end product would be a truck that runs entirely on batteries, and an S-10 was chosen for its ability to lift the bed and showcase the electric setup.

Transportation has also obtained a prototype electric vehicle from the 1970's which needs repair. The owner bought it without batteries and has not been able to get it working since he bought it a few years back. He has allowed the transportation group to bring it back to the U of M from his house in northern Minnesota. The electric car will allow the group members to see how others envisioned and designed an electric car to work and pick apart the design.

According the transportation group's leader, Adam Malovrh, "We are on the verge of testing the circuitry on the car to see what works, what needs to be fixed, and what needs to be replaced. We have a bunch of the original technical documents which were used when designing the car, and we will be using these as a roadmap through all the outdated analog circuitry on the vehicle."



AES welcomes all who are interested in learning about renewable energy, helping the environment, and working to solve problems. Students currently in AES are majors from many different areas ranging from engineering to economics. Most members joined the group with little knowledge about renewable energy, but everyone works hard to learn as much as possible, and expertise is constantly growing. Members have all entered AES with loads of energy and excitement about its many projects, and their energy helps the group continue to grow and become more successful. More information about the group and meeting times can be found at http://aesumn.org. Information about the Solar Decathlon can be found at http://www.solardecathlon.org, and information about the U of M's student group is located at http://solardecathlon.umn.edu.



THE SOLAR DECATHLON

The Solar Decathlon is a competition in which 20 teams of college and university students compete to design, build, and operate the most attractive, effective, and energy-efficient solar-powered house. The Solar Decathlon is also an event to which the public is invited to observe the powerful combination of solar energy, energy efficiency, and the best in home design. More information can be found at www.solardecathlon.org.

WHAT DOES ZERO CARBON MEAN?

A zero carbon home uses less energy than it generates over a set period of time. A carbon footprint is calculated for the full life of the home, including the CO2 emissions created during the build of a house and its day-to-day energy needs. This figure is then offset by the property's ability to produce the energy it needs itself – through wind turbines, solar panels and other renewables.

PHANTOM LOADS

Phantom load is the electricity consumed by a device when it is turned off. Phantom loads make up about six percent of national energy consumption. These extra energy costs can be avoided by unplugging appliances when not in use, using power strips that can be turned off, and buying appliances created especially with the goal of being energy efficient.

PHOTOVOLTAICS

PV for short, photovoltaics convert energy from light directly into electricity. Commonly known as solar electric systems, these arrays are a hot topic for researchers who want to maximize the efficiency of solar cells. According to the U.S. Department of Energy, efficiencies as high as 40% have been achieved, which means more of the energy collected from light can be converted into usable electricity.

Sources:
Solar Decathlon Inset/Pictures: http://www.solardecathlon.org/about.html
Zero Carbon Inset: http://www.energysavingsecrets.co.uk/ZeroCarbonHomes.html
Phantom Load Inset: http://www.ocf.berkeley.edu/~recycle/ssec/download/Phantom%20Load.pdf
Photovoltaics Inset: http://www.energy.gov/news/4503.htm

EWB... CONTINUED FROM PAGE 07

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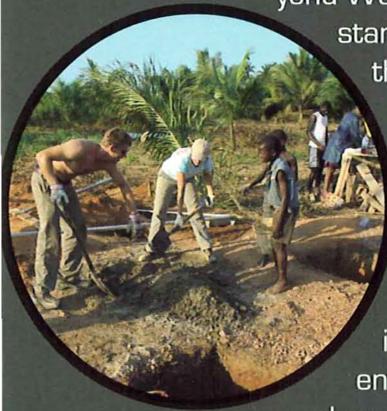

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As young engineers, we must ask ourselves how we are going to influence society, through our actions and through the technologies we design, build, and operate. If the education you receive does not prepare you to work as a professional engineer in the global economy, it becomes your responsibility to educate yourself and seek the experiences that will give you the skills to grow and understand your influence. Our actions as professional engineers will likely have important and widespread impacts on society, regardless of whether we are aware of those impacts. So the question I now pose is not how will you learn to do what you do, but rather, how will you learn to predict what you do does?

Amadei, Bernard. Engineering for the Developing World. Grand Challenges for Engineering. February 25, 2008

USE THIS SPACE FOR LECTURE NOTES, DOODLES, SCRATCH PAPER FOR CALCULATIONS...

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