Wisconsin engineer. Volume 120, Number 4 October 2016

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

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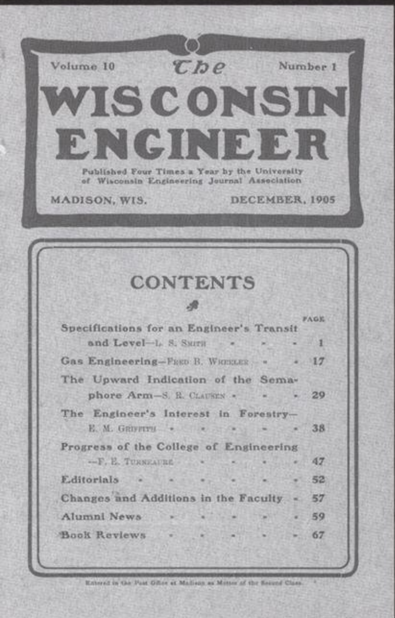
wisconsin engineer

OCTOBER 2016 VOLUME 120, NUMBER 4



Volume 10 The Number 1

WISCONSIN ENGINEER

Published Four Times a Year by the University of Wisconsin Engineering Journal Association

MADISON, WIS. DECEMBER, 1905

CONTENTS

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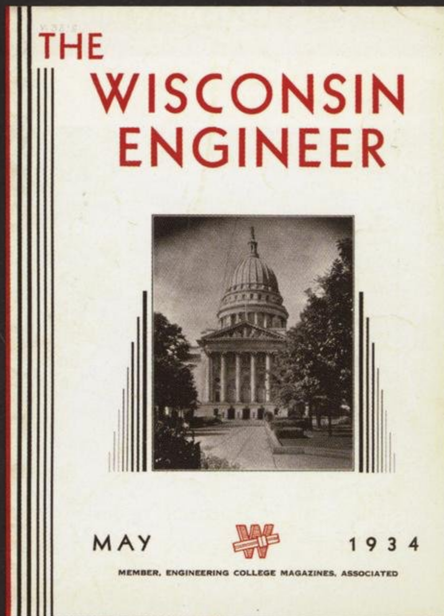
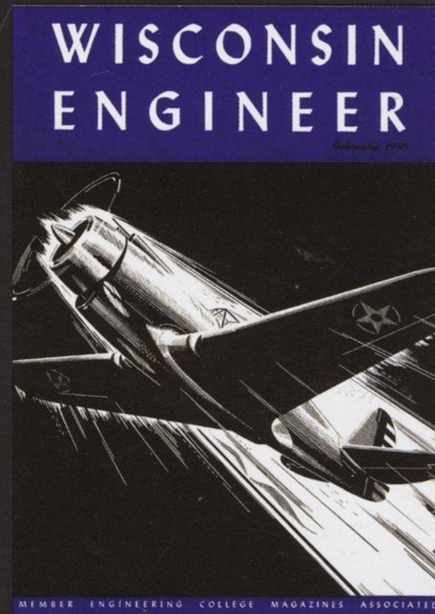
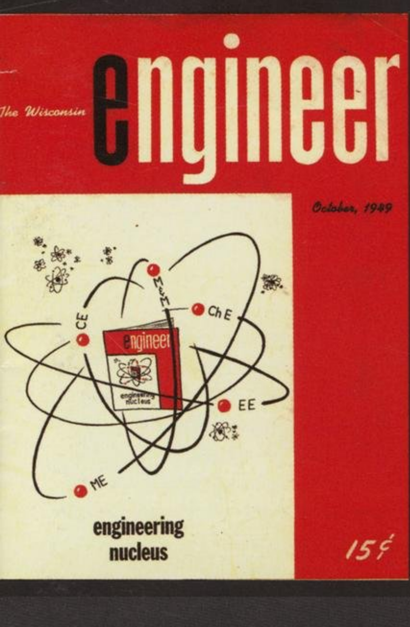
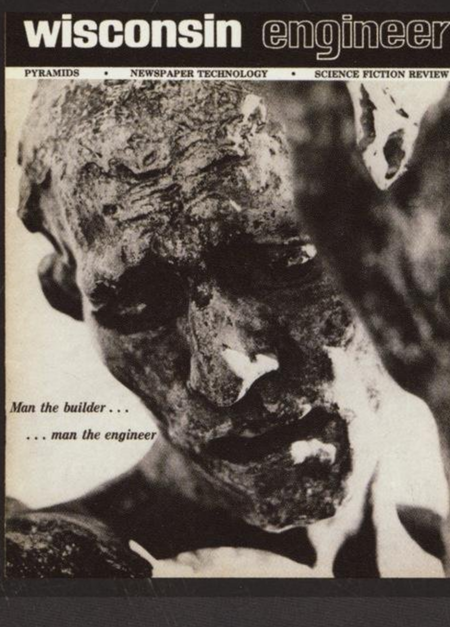
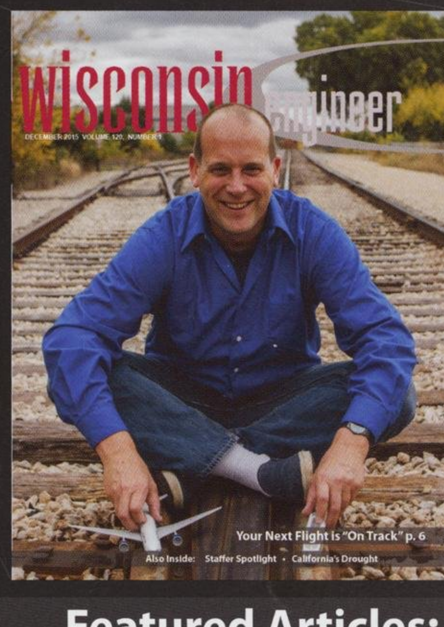




CELEBRATING 120 YEARS:
THE EVOLUTION ISSUE







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Faculty Advisor: Steven Zwickel **Publisher:** American Printing Company, Madison, WI **Web address:** http://www.wisconsinengineer.com

Correspondence: *Wisconsin Engineer* Magazine; 1550 Engineering Drive; Madison, WI 53706 **Phone:** (608) 262-3494 **email:** wiscengrmagazine@gmail.com

The *Wisconsin Engineer* is published four times yearly in October, December, March and May by the Wisconsin Engineering Journal Association.

Wisconsin Engineer

Published by the students of the University of Wisconsin-Madison VOLUME 120, NUMBER 4 OCTOBER 2016

General

COVER: Our cover features illustrations from the following Wisconsin Engineer issues:

December 1905
May 1934
February 1945
October 1949
February 1975
December 2015

Visit the archive link on our website for more historical issues!
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Evolution:
A Celebration of 120 Years in Publication

Times they are a-changin'. And faster than ever before, if the vast wisdom of the internet is to be believed. While I'm not sure if "change" is something that's even quantifiable, it certainly does seem to the casual observer that technology and society are evolving at an unprecedented rate. And for my generation, one that's never known anything different than this whirlwind of change propagated by a constant, rapid-fire exchange of information, it's easy to take for granted how far we've come since, say, 120 years ago.

Why 120 years, you ask? Well, in case you haven't yet noticed the proclamation so shamelessly emblazoned on the front cover of this very issue, this year, 2016, marks the Wisconsin Engineer Magazine's 120th year. Yes, that does indeed make us the oldest continuous publication on the UW-Madison campus. And yes, some objective third-party sources of particularly refined taste might also say that makes us the best publication on the UW-Madison campus (sources have asked to remain anonymous). In all seriousness though, let's not continue without giving this some further contemplation. 1896, the year that our very first issue was published, was also the year of several other notable historical events:

What happened in 1896?

- *The first ever car accident occured in New York City.*
- *The US Supreme court declared racial separation to be perfectly legitimate with their ruling in Plessy vs. Ferguson.*
- *The radio and the dial telephone were first patended.*
- *The first movie theater in the US was opened. Tickets were sold at ten cents apiece.*
- *X-rays were discovered and the first ever x-ray images were taken.*
- *The last Czar of Russia was crowned.*
- *The first official intercollegiate basketball game was played, with a sound defeat delivered to Yale. The riveting game resulted in a final score of 4 to 3.*

Ever since then, the Wisconsin Engineer Magazine has been around to write about happenings such as these and many, many more. We've made it from the first dial telephone patent to smart phones and virtual reality. We've made it from the first x-ray image to MRIs and high-resolution neuroimaging. We've made it from Czar Nicholas II to whatever it is that Russia is doing today (okay, so evolution maybe doesn't always move in a forward direction). Regardless, we've made it a long stinkin' time, and we're certainly a much different publication than we were when we started.

One thing hasn't changed: through it all, we engineers have always been (predictably) at the forefront of the evolution of technology, and this has always put us in a very interesting position. At the same time as we propagate technological evolution, we must rapidly adapt our present and future work to the societal changes that our own innovations inevitably bring about. It's this delicate, never-ending balancing act, this process of constant adjustments that has brought technology and engineering to where it is now. And it's certainly something I appreciate more and more as I continue to peruse the 120-year-old archives of the Wisconsin Engineer Magazine.

For this issue, we're paying homage to those who came before us by taking a look back at how our industry and our society have changed over the years. Since we, as a conglomeration of 18- to 23-year-olds, are certainly no experts on anything that came before the Back Street Boys, we've talked to people who have been around for a bit longer and can shed some light on the topic of evolution. We hope you enjoy these chronicles of our ever-evolving world.

W/E

Written by: Alyssa Hantzsch

Design by: Suzanne Kukec

The Path of Human Evolution

An extinct species of hominid lends a new perspective to past and future human evolution

From ancient history to the distant future, from The Flintstones to Star Wars, we have always been a species fascinated with both how we got here and where we will be years from today. It is a topic with a constantly expanding base of knowledge, which covers a wide variety of disciplines including anthropology, genetics, science fiction, and many others. Three years ago, two amateur cavers in South Africa made the initial discovery of the bones of a new species of hominid, Homo naledi. This extinct ancestor not only provides new insight into how we became modern Homo sapiens, but also helps guide our understanding of how our species will continue to evolve and adapt.

The cavers were exploring the Rising Star Cave System, a popular series of caverns and tunnels near Johannesburg, when they stumbled upon a narrow passage that led to a new chamber with a veritable treasure trove of fossils. Soon after, Dr. John Hawks, a UW–Madison paleoanthropologist, was on his way there to help with the excavation. As the fossils were excavated and examined, the team of scientists discovered an unusual contrast of characteristics. "Their hands are good at manipulating and making tools… their skulls are shaped in many ways like a human skull, they have small teeth that seem to indicate a higher diet quality," explains Hawks, "but they have traits that are related to climbing, and they have a very small brain. They have that mixture of features that really puts them at the very beginning point or base of our genus, potentially."

Additional evidence of this contrast can be found in the strange manner in which the bodies were discovered. The isolation of the cave and the large quantity of bodies seemed to suggest that these beings, which became known as the Naledi, might have been deliberately depositing their dead. This is a behavior that traditionally is associated with large brained, more modern species such as Neanderthals and humans. "If this all pans out, what Naledi tells you, maybe more than anything, is that the ways that we think intelligence is important to our evolution didn't all require a larger brain," says Hawks. "We have large brains as humans today, maybe that means something different than what we expected . . . It's showing that the way that we became human was more oriented towards what we were doing with our hands, how we were moving on the landscape, and less oriented towards larger brains."

Studying the ways that these kinds of traits come about helps scientists make predictions about the effects evolution will have on our future. "We're trying to understand where people come from," explains Hawks, "and our work is to understand how we were different in the past and what has caused us to become the humans that we are today." Gaining this understanding of our past leads directly to an understanding of what the future may hold. The importance of this ability to predict how such changes take place cannot be overstated, as it is inextricably linked to every aspect of human life.

Species have always undergone natural evolution due to changes in their surroundings. For humans this will only be accelerated due to the increasing pervasiveness of technology in every facet of life. One effect of this that can already be seen is how humans are more globally connected now than ever before. It is not uncommon nowadays for someone to be able to trace their recent ancestry to origins on multiple continents, creating totally new genetic combinations. This level of exposure to genetic diversity would never have been possible for the Naledi or similar extinct hominid species, whose remains typically are found only in very specific regions of the world, often only at one or two different sites. However, global connectivity is a double-edged sword as it also is slowly creating homogeneity in our species. "We have lost hundreds, maybe thousands of cultures in the last 100 years," says Hawks. "We are becoming more uniform behaviorally, culturally, linguistically, and in biological terms our populations are mixing at a faster rate than ever before."

That being said, the natural course of evolution the Naledi sheds light on is no longer the only way species can evolve. Genetic manipulation to preselect certain traits in future offspring is already an existing field of study. Many researchers such as Hawks assert that this will soon be an option for the general public, citing the commonplace industrial manipulation of genes in crops, livestock, and garden plants. It can be assumed that this so-called "artificial evolution" will soon take advantage of such methods. Accelerating and altering natural selection in this manner will likely work to eliminate harmful human traits and maybe even introduce new, desirable ones that would not otherwise have existed.

Of course, changes such as these occur over a long period of time. As this process takes place, we can continue to search for clues to better understand our own story. Homo naledi fills in some pieces of the human evolution puzzle, but it's just not yet clear which pieces – only further studies will reveal the answer. The influences of the past can be seen in modern humans, and the future of humanity is similarly dependent on the environments we live in now. Exciting changes are on the way and technology is ushering in a new age of human advancement that will shape the course of our species forever.

Written by: Ben Zastrow

Design by: Jason Wan

Voting: There's *not* an app for that

Why voting is staying the same when everything else is going digital

These days, most people expect to be able to do anything and everything on their smartphone. Apple's famous 2009 refrain "There's an app for that" has quickly transformed from a selling point into an expectation. Almost every conceivable task has been moved to the internet, and subsequently to the mobile phone. People use smartphones to bank, shop, pay bills, and find a soul mate. This has left many people asking the question "Why can't I use my phone to vote?" However, the voting process in America has evolved slowly, often lagging behind current technology. As a result, it may be a long time before Americans are able to exercise their most fundamental democratic right while waiting in line at Starbucks.

Though the voting process may change slowly, it's certainly not stagnant. Originally, votes in America were cast orally; that is, by publically announcing who you were voting for. The idea of a secret ballot came from Australia and wasn't completely implemented until 1892. A lot of different methods for casting and counting ballots have come and gone since then, but the common theme among them is that they have lagged behind current technology, often by several decades. In the early 1900's, mechanical lever machines began to be used to handle the rapidly increasing number of ballots. These were used in some areas of the U.S. into the 2000's. Punch card voting systems were developed in the late 1970's and adopted by Wisconsin in 1980, but this development came over twenty years after the technology began to be used in computer programing in the 1950's. The successor to punch cards, optical scan machines, were similarly dated, being adopted in the 1980's despite having been used for standardized tests since the 1950's.

A potential voter filling out the forms necessary to prove his eligibility to vote.

More recent advances include touchscreen voting machines and optical scan machines that save a digital image of the ballot. This ability to access digital images of scanned ballots has been immensely important in increasing confidence in the voting process by allowing easy auditing. Overseeing these recent changes in the voting process in Wisconsin as well as enforcing laws related to campaign finance, ethics, and lobbying has been the responsibility of the nonpartisan Government Accountability Board. The board's director, Kevin Kennedy, acknowledges the slow pace of voting technology advancement. "The technology was always several steps behind what people were using," says Kennedy, "People are reluctant to change the mechanisms that have an impact on how we chose the leaders of various levels of government".

Many states, including Oregon and Washington, have transitioned to a mail-in ballot system. This is one of the first steps that demonstrates an interest in and the viability of a remote voting process. Yet, physical mail is not the cutting edge technology one would expect to be transforming the voting process. As Kennedy points out, "Most people no longer rely on the postal service to get their bills, to get their communications, and yet we have an increasing number of states going to all-mail voting." These absentee ballots, which are mailed in or dropped off at designated locations, are just simple paper ballots. However, some forms of absentee ballots for people in the military and overseas have now been moved online.

> **"People are reluctant to change the mechanisms that have an impact on how we choose the leaders of various levels of government."**
> **– Kevin Kennedy**

The obstacles to making online voting universal, rather than just for overseas absentee voters, are significant. The first major concern is authenticating the identity of a voter. A person must only be able to cast a vote if they are eligible, and they must only be able to vote once. Remotely authenticating a user with the level of confidence required for voting will not be easy and will require more than just a username and password. In-person voters are currently verified using identification documents, signatures, affidavits, and checks on biographical information, depending on the state. These verification requirements may be difficult to replicate in an online system.

A second concern is maintaining the secrecy of the ballot. The system needs to be set up in a way that each vote can be verified without revealing to anyone in the process how an individual voted. This is where a fundamental difference exists between online voting and other online transactions that require security. Banking, shopping, and other secure online transactions all tie and individual's identity to their actions. But with voting, a fundamental part of the process is removing this tie in order to maintain the secrecy of the ballot.

The largest concern with online voting that remains is the vulnerability to attack. With cyber security experts and hackers in a constant arms race, it may be difficult to maintain a digital voting system that is undoubtedly secure. Election fraud has always been a risk in America, even with paper ballots, but online voting potentially scales up the risk. If all of the votes are part of one connected system, a single attack could have a much larger impact than an attack on a single ballot box would now. Additionally, malware on a voter's computer could change their vote as it is sent. Voters would not be able to get verification that their vote was received correctly because having proof of how you voted is restricted in order to prevent coercion and vote buying. Therefore, even if the voting system itself is not compromised, the results can still be impacted by a virus in a voter's computer.

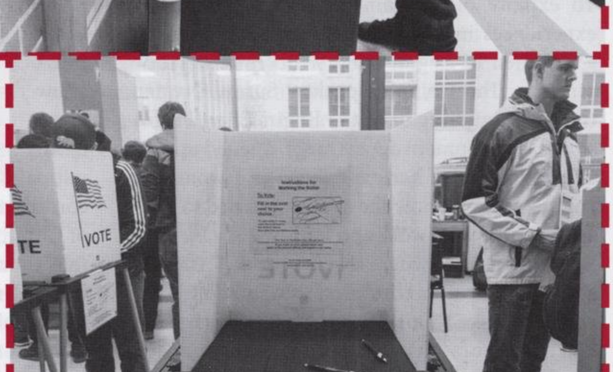
So how far away are we from overcoming these obstacles and beginning to implement online voting systems? "From a practical standpoint, I think very few people think it's a reality in the next 5 to 10 years," Kennedy says. However, Kennedy is more optimistic about the possibilities of online voting the long term. "It's not a question of can it be done, it's a question of can it be done cost effectively and can it be done with a confidence level that people are willing to accept."

So for the time being, it seems that we won't be able to vote from an app on our phones while waiting in line at the coffee shop. Instead, we'll have to spend time waiting in line at the voting booths. But, if while waiting in that line you feel the need to watch a movie, book a flight, or find a date, you're in luck – there's plenty of apps for that.

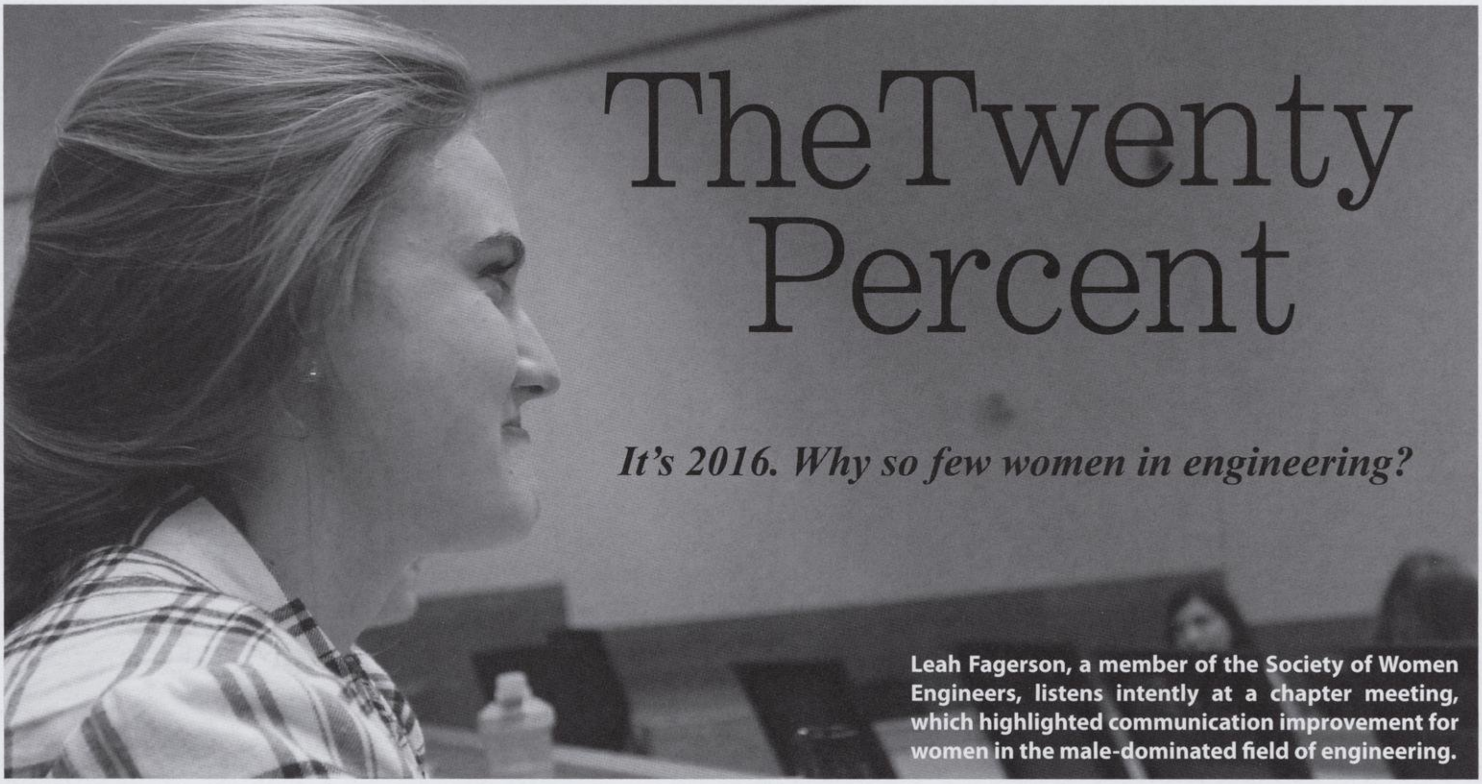
Written by: Eric Fleming

Photography by: Ben Chen

Design by: Suzanne Kukec



From top to bottom: Voters casting their vote on paper ballots at a polling place; It takes a lot of volunteers to make sure that voting day runs smoothly; People bringing their ballots to the optical scanning machine for auditing; The modern day voting booth, how will it change in the future?



The Twenty Percent

It's 2016. Why so few women in engineering?

Leah Fagerson, a member of the Society of Women Engineers, listens intently at a chapter meeting, which highlighted communication improvement for women in the male-dominated field of engineering.

Walking into an engineering class on the first day, I find it amusing to do a quick survey of my class, and without fail I find that only about 1 in 5 people are female. Depending on the class, that proportion can be much worse, as is the case in my computer science class - only 1 in 10 are women. These numbers, in fact, reflect the national average of female STEM major; the United States has an average of 18 percent women receiving bachelor degrees in engineering. Furthermore, there's an imbalance of pay within the field - statistics show that women in engineering receive 14 percent less pay than their male counterparts in the field. Beyond the classroom proportion issue, there is an issue globally.

To explore other women's stories about their experiences in the engineering field, I attended a "Women in Engineering: Work/Life Balance" seminar. The keynote speaker, Susan Ottman, the program director of the Engineering Professional Development department, opened up with a brief history of her experience as a woman in engineering and how she quickly learned to manage her time with work and family, and now finds herself in a place where she "has it all." After her speech, the seminar broke off into smaller groups where I spoke to a sales engineer for Schneider Electric, Laura Arnold, and a project manager for Findorff, Deana Turner. Both are married with children, and working full time in the engineering field. In response to Ottman's "having it all" comment, Arnold disagreed, saying that it never really works out that way. "There's always someone who is going to look like they have it better than you," Arnold says. "But at what cost? The twenties were the power dash, and my thirties saw a change in values. Going home to my kids is honestly amazing, it's really then when I truly feel like I have it all."

However, imbalance was very apparent in the field. Continuing the conversation, it was apparent that the men in the engineering field were unprepared for women "invading" the professional territory. Asking the women at the conference about the workplace culture, Turner laughed and said "When I was pregnant, I told my boss I had to take some time off, and he just pulls out a post it note and goes I am going to need to get back to you about that because I don't think we have a maternity leave policy — like it was that new to have women in the field, and men just were not familiar to the roles of a caretaker."

But a woman's role in society goes far past the role of a caretaker, and these women should be allowed an equal playing field when building careers in the field of engineering. This is apparently impossible in the real world - women are not paid equally as their male counterparts, according to a study done by the US Department of Commerce in 2011. In this study, it was found that though women held 48 percent of the jobs in the United States, 12 percent were in STEM fields, and within this field, women make 14 percent less than their male counterparts. This wage gap discrepancy could be due to a number of factors, which this study attributed to the different expectations and roles women have in society.

Dr. Jennifer Sheridan, executive & research director of Women in Science and Engineering Leadership Institute (WISELI), works to to identify and help mitigate the challenges women and minorities face in the academic field at UW-Madison, particularly ones that pertain to the work-life balance struggles and negative stereotyping. WISELI helps hiring committees and departments see through biases and stereotypes by holding seminars and looking through hiring data and surveys from departments to help identify whether a branch is truly allowing for equality. According to Dr. Sheridan, one major obstacle for women and minorities comes from unconscious bias. This phenomenon occurs while your brain quickly processes information, and if it doesn't have the full picture, it will fill in the gaps with information derived from stereotypes and personal experiences. WISELI sets up seminars that explain what unconscious bias is and how to avoid it. For example, to hiring committees, they recommend listing out the specific requirements of the position before interviewing candidates. This has proven to increase diversity in the staff. But women are still feeling lost in this academic field.

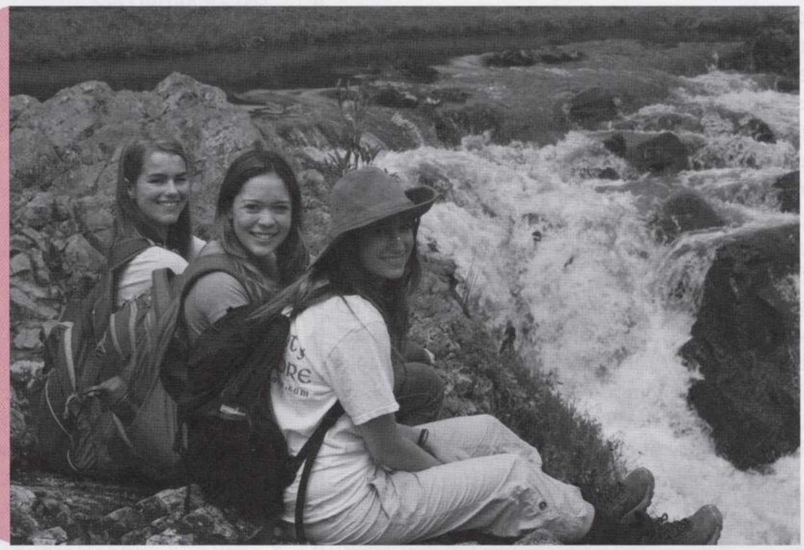
For example, when women and minorities enter academia to become an assistant professor, they are typically in their early thirties—about the same time people try to start families. "Women get a year extension for their tenure for maternity leave, it's not even up for discussion at this point," says Sheridan, "but I have received surveys back from women telling me they were uncomfortable taking this time for fear of not being considered dedicated enough to the program." WISELI helps women and minorities with this balance between work and life in other ways by providing grants for people (with a skew towards women and minorities, though men can apply for these grants too) who are struck with per-

In a similar article about women in engineering from a 1952 edition of the Wisconsin Engineer, it was highlighted that women in engineering should be regarded simply as engineers.

sonal tragedy. For example, the first person to receive a grant from WISELI was an assistant professor whose child developed leukemia. Her time was divided between being in the hospital supporting her child and in the lab trying to catch up with all of the tenure work. The grant allowed her to hire a technician to run the lab while she was away, allowing her to get tenure.

But not all is lost. In my conversations with Turner and Arnold, Arnold noted how there was a "boomerang effect" among men: "Men are asking me for time off to pick up their kids, and they're agreeing to lower paying jobs from their previous ones so that they can stay in a great city like Madison and not travel so much. There's obviously a shift from the men of the generation who hired me, to the men asking for time for their kids today." With a mindset change, there could be a call to action. Turner also noted the younger change in younger generations, saying "Honestly, I think it's the mothers who raised them – their mothers worked hard and kept them in check, and now they're respecting their wives' professional lives." All jokes aside, this idea brings Dr. Sheridan's unconscious bias into play. It shows how years of trained behavior to see through negative stereotypes can change the way respect is shown in society - whether it's being hired, paid equally, or simply being appreciated for your work.

"Women hold 48 percent of the jobs in the United States, 12 percent in STEM fields, and within this field, women make 14 percent less than their male counterparts."



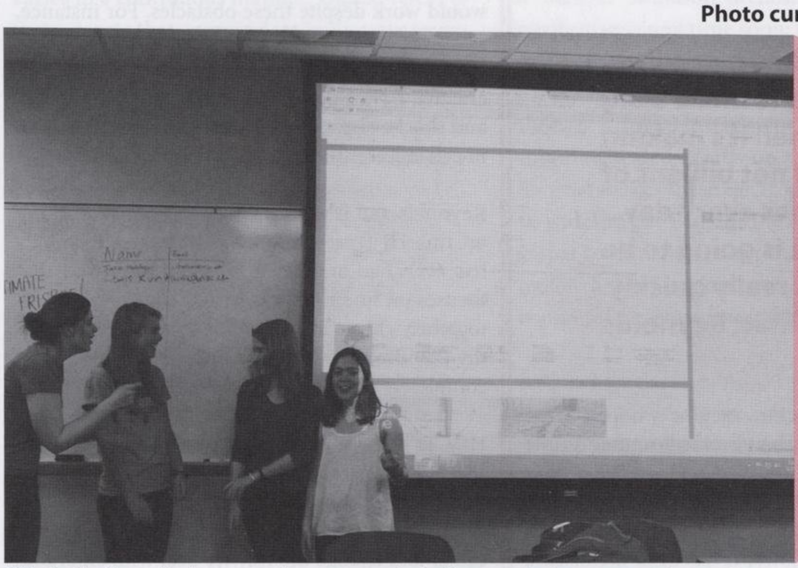
Giulia Mondin, Piper Rawding, and Katie Heitman traveled to Uganda this past summer to work on their Engineers Without Borders water project. • Photo curtesy of Jake Haefner.

Granted, this is anecdotal evidence. There are bigger problems than simply framing a mindset, since we must change the mindset of a whole society for women to start seeing equal results immediately. As equal pay is continually shut down in the government as a "bogus issue," we need to consider what that means to the nation as a whole. If women are continually paid less, will men continue to subconsciously see them as inferior? If a female undergraduate engineering student knows that her work will not be taken as seriously as an equally qualified male engineering undergraduate student, how do we expect women to continue to flood this field? If women are considered "undedicated" and "not serious enough" for attending to family issues after being considered the head of the household, how are we to expect them to stay in the field of engineering? For now, Turner gave this advice to females fending for themselves in a male-dominated field: "You just need to advocate for yourself, because no one else is going to pick up on it. It doesn't mean you're needy, it just means everyone is busy with their own work and won't ask you if you're okay. Who cares what the company thinks? Stay happy for yourself."

Written by: Anastasia Montgomery

Photography by: Beth Enright

Design by: Suzanne Kukec



While far from being equal, progress is being made for women in engineering. Pictured are project managers Piper Rawding (second from right) and Giulia Mondin (far right) along with other team members of UW-Madison's chapter of Engineers Without Borders presenting an update on their Ugandan project.

HIV: The Master of Mutation

Rapid viral evolution poses challenges to HIV research, but novel approaches show promising results.

A Viruses have been around for eons – possibly close to 3.5 billion years, according to many scientists. Some viral proteins even predate the divergence of life into the three domains: bacteria, archaea (ancient bacteria), and eukarya (plant, animal, and fungus cells). These ubiquitous microbes, which are not classified under any of the domains, have stood the test of time where a myriad of other life forms have long since gone extinct – this suggests rapid evolution has enabled viruses to endure all the challenges and catastrophic events in Earth's history. Viral evolution is essentially Darwin's theory of natural selection condensed into a much shorter time scale than what we typically imagine.

Humans have learned to prevent infection from dangerous viruses with the development of vaccines. Vaccines were first widely used to stop and eventually eradicate smallpox. An English physician named Edward Jenner observed that milkmaids would never get smallpox, however, since they worked with cows and often contracted a milder illness called cow pox. This led to the discovery that people who were inoculated with the cowpox virus became immune to smallpox. In fact, the word "vaccine" was derived from vacca, which is Latin for cow. Unfortunately, sometimes vaccines simply aren't enough in situations where the virus evolves at an absurdly rapid rate, changing at a fast enough pace to render the vaccine useless. This is the case with the infamous Human Immunodeficiency Virus (HIV).

Matt Reynolds, an associate scientist in the UW-Madison AIDS Vaccine Research Laboratory

Dr. Matthew Reynolds is an associate scientist in the School of Medicine and Public Health's Department of Pathology and Laboratory Medicine here in Madison. He specializes in HIV research and has received a $2 million grant from the National Institute of Health (NIH) to study prevention of the disease, which has proven to be an onerous task. To put this in perspective, think about the flu. Influenza is widespread and infects many different species. Genetic drift (the random fluctuation in genetic makeup of a population) forces us to get a new flu shot each year, and occasionally, when the virus jumps from one species to another in a genetic shift (as is the case with swine or avian flu), an entirely new flu vaccine has to be created. Although this seems like a pretty major nuisance, it pales in comparison to HIV. According to Reynolds, "Approximately the same amount of diversity occurs in one individual with HIV as occurs worldwide in influenza in a single year." This is astounding, and it means the virus is mutating extremely fast.

The culprit behind the frightening mutation rate of HIV is an enzyme called reverse transcriptase (which was discovered by Nobel Prize-winning scientist Howard Temin at UW–Madison, namesake for the Howard Temin Lakeshore Path). This enzyme is responsible for producing DNA from an RNA template as opposed to the ordinary transcriptase that makes RNA from a DNA template. Most life forms use transcriptase, but retroviruses such as HIV use reverse transcriptase. They integrate the new DNA into the host cell's genome while the cell translates and transcribes as usual, generating viral proteins along with its own. However, this is where HIV's signature variability occurs. "Going from RNA to DNA is very error prone…[the virus's replication process] makes a mistake about once every 10,000 base pairs while ours makes maybe one in a billion. It just turns out the HIV genome is about 10,000 base pairs long, so every new virus that's made has one mistake," Reynolds says. Most of these mutations will be detrimental to the virus, but some will be beneficial. "All it takes is one little change to make a big effect. When it's making millions if not billions of viral copies every day…evolution is going to be happening really quickly," Reynolds explains.

"All it takes is one little change to make a big effect. When it's making millions if not billions of viral copies every day... evolution is going to be happening really quickly.
– Matt Reynolds

Thus, traditional vaccines may be a hopeless endeavor against HIV. The virus will mutate so the immune system can no longer recognize it as it continues to infect the Helper T-Cells that facilitate attacks on pathogens. These immune system cells will dwindle to lower levels until the disease degenerates into AIDS.

With standard HIV vaccines out of the picture and antiretroviral drugs being met with more and more resistance from the virus, alternative methods must be pursued. The answer may lie with something called alloimmunity, or immune recognition of cellular proteins derived from the same species. An example of this type of immune response is an attack on a transplanted organ that doesn't quite "match" the patient. Researchers in the late 80s thought they had discovered a true HIV vaccine, but further experimentation revealed that their results were due to an alloimmune response against major histocompatibility complex (MHC) molecules. "It turns out there is more MHC from the [infected] cell on the virus than there are actual virus proteins," Reynolds says. Much like blood types, everyone has one of a few "flavors" of MHC molecules in their bodies. Antibodies will attack foreign MHC proteins, so different variants of MHC could be incorporated into the outer coatings of HIV as it buds off from infected cells.

Alloimmunization as a new prophylactic vaccine for HIV/AIDS provides a way around the incredible variability of the virus. "MHC is always going to be a part of us; it's never going to change… that's the attractive part of it," Reynolds says. Since the immune system would be targeting MHC proteins on the virus rather than the virus itself, it can essentially operate independent of any viral mutation. These vaccines would be tailored to specific regions of the world to accommodate the different MHC varieties that commonly appear there, and they could then be distributed to high-risk areas like sub-Saharan Africa. However, there is a drawback to this work-around; having a lot of anti-MHC antibodies would make it more difficult to receive organ transplants. Research regarding these alloimmunity vaccines is only in its beginning stages, but there is evidence that it would work despite these obstacles. For instance, pregnant women and people who have a lot of blood transfusions, such as those with sickle-cell anemia, have elevated anti-MHC antibody levels, and this has been linked with antiviral properties in cell culture studies.

Reynolds and his lab team are currently working on this HIV prevention research, and Reynolds has even had another NIH grant approved that focuses on finding a way to actually cure HIV altogether. This is based on the fluke case of Timothy Ray Brown, who is the only person ever to be completely cured of the disease.

HIV is an extraordinary example of evolution, and it is the most mutation-prone virus known. Finding a way to prevent and cure a terrible disease like HIV will improve global health significantly and change the way we deal with emerging deadly viruses.

Written by: Edwin Neumann

Photography by: Therese Besser

Design by: Suzanne Kukec

The Idea that Inspired a Nation

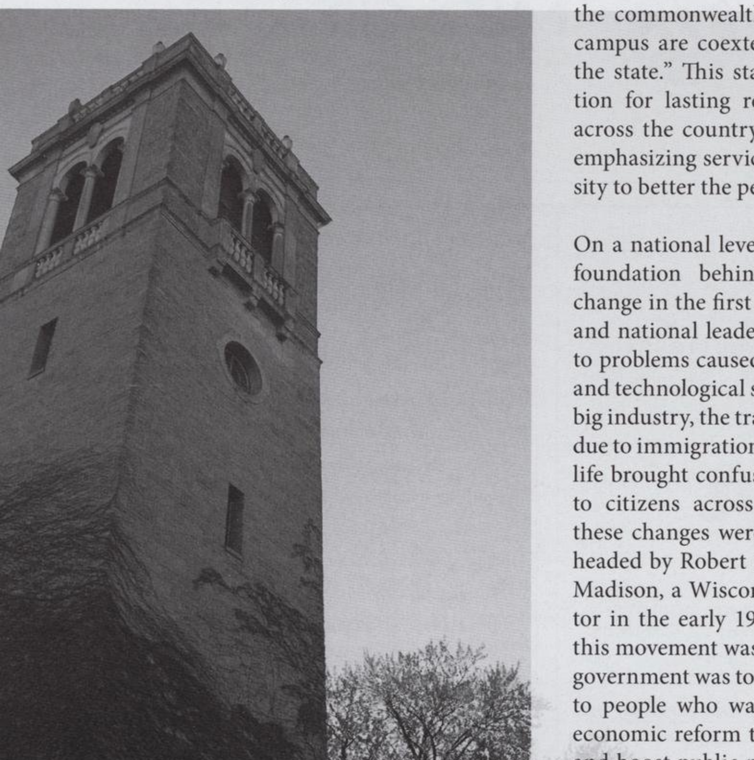
The Wisconsin Idea gives citizens of the state the power to think for themselves and the desire to seek out new information.

When you say Wisconsin, you've said it all: Home of Titletown and Cheese Days, America's Dairyland, Land of the Bratwurst, and leading exporter of cranberries, sweet corn and more. Wisconsin is known for a lot of things, but perhaps its greatest claim to fame is the Wisconsin Idea. Providing a vision for the University and the fuel to spur on the Progressive Era, it has played a crucial role in Wisconsin and the nation's history. At the core of this idea lies UW-Madison itself.

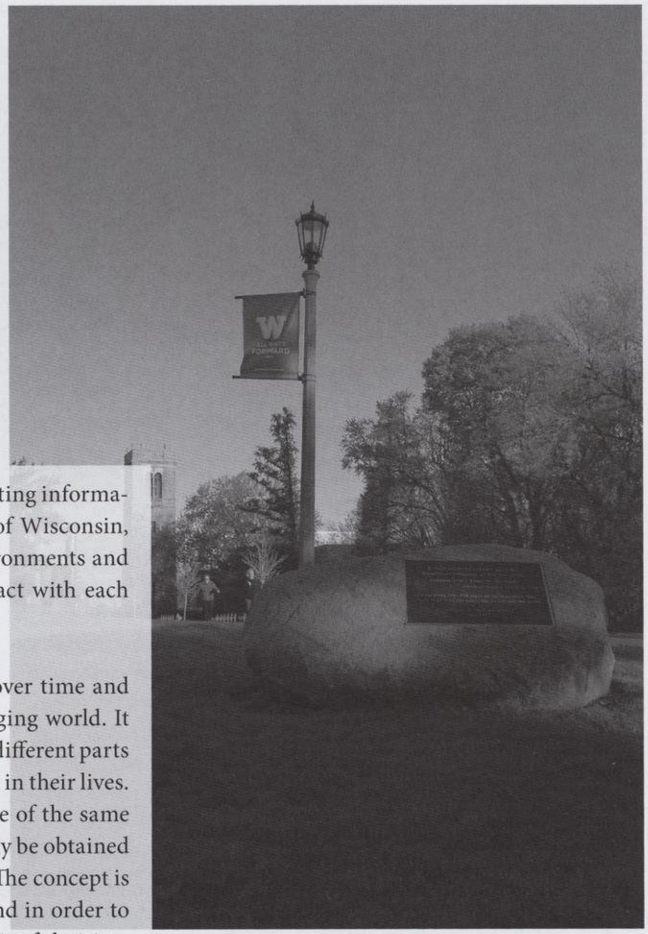
Since its conception in 1904 by UW-Madison President Charles Van Hise, the Wisconsin Idea has been the mission and vision of the university, guiding it for over a century. Van Hise stated: "I shall never rest content until the beneficent influences of the University reach into every home in the commonwealth, and the boundaries of our campus are coextensive with the boundaries of the state." This statement provided the foundation for lasting relationships within the state, across the country, and even around the globe, emphasizing service and outreach of the University to better the people of Wisconsin.

On a national level, the Wisconsin Idea was the foundation behind Progressivism and social change in the first half of the 20th century. State and national leaders were searching for answers to problems caused by an increasingly industrial and technological society. The new importance of big industry, the transformation of the labor force due to immigration, and the overall speed of daily life brought confusion, uncertainty, and distress to citizens across the country. In Wisconsin, these changes were addressed by Progressivists, headed by Robert La Follete, a graduate of UW-Madison, a Wisconsin governor, and a US Senator in the early 1900s. The guiding principle of this movement was the belief that the business of government was to serve its people. This appealed to people who wanted honest government and economic reform that would expand democracy and boost public morality. Progressivists sought to restrict corporate power when it interfered with individuals and their needs. As a result, reform swept across the state in the early 1900's, and progressive legislation was passed to regulate factory safety, to establish a state income tax, to limit work day hours for women and children, to create worker's compensation for those injured on the job, and to help protect natural resources.

This "power to the people" approach of government made Wisconsin a nationwide symbol of Progressive reform and ongoing Progressive research. Behind this movement was the idea that the inclusion of specialists in law, economics, and social and natural sciences would produce the most efficient government. This concept also came to be known as the Wisconsin Idea. As an effect of this shift in the political methodology of the time, faculty from UW-Madison played a substantial role in Progressive reform. They served as experts on government commissions, helped legislators draft laws, and advocated for a more efficient and scientific government. By the time the Great Depression came about, when the daily routine of American life was dominated by unemployment and turmoil, progressive ideals had become deeply ingrained into national politics, too. Much of FDR's New Deal legislation was, in fact, drafted by Wisconsin citizens who were taught here at UW-Madison. Edwin Witte, for example, was a Wisconsin-trained economist who is known as the Father of Social Security. The progressive ideals of La Follete and Wisconsinites even found themselves embedded in John F. Kennedy's New Frontier and Lyndon Johnson's Great Society policies.



Left: The sun rises over the Carrillon Bell Tower on campus. Like the idea of the music of the bell tower, former UW President Charles Van Vise envisioned the influence of the university to not be limited to the bounds of campus but to every home in the state.



In addition to encouraging government efficiency, many of the experts from UW-Madison involved with progressive reform also made efforts to expand educational opportunities for citizens. This is where Van Hise comes back onto the scene. During his time at the University, the Extension Division was created to provide all citizens of Wisconsin access to university research and other resources so that they could learn and grow as citizens. Another example of extending knowledge to the public came in the form of the Legislative Reference Bureau. Founded in 1901, the Legislative Reference Bureau provides legal, research, and information services to the Wisconsin Legislature. Services of this agency are emulated in countries around the globe.

At its heart, the Wisconsin Idea is about empowerment. The purpose of this concept, this vision, is to share knowledge with the citizens of the state by creating connections to spread that knowledge, that power, across borders. Its goal is to give as much power to the citizens as possible. The Wisconsin Idea emphasizes reaching out to the citizens of the state, giving them the power to think for themselves and seek out new information. But the power of this idea doesn't lie solely with cold hard facts and objective laws. At its beginning, leaders of the University placed a lot of importance not only on getting information to the students and citizens of Wisconsin, but also on helping to create environments and means by which they could interact with each other to develop as citizens.

The Wisconsin Idea has evolved over time and continues to alter in today's changing world. It seems that people are attracted to different parts of the idea depending on how it fits in their lives. Yet each version is a separate piece of the same puzzle, and the full picture can only be obtained by putting all the pieces together. The concept is very diversified and spread out, and in order to continue to be a useful and meaningful vision, the pieces must be put together again. The Wisconsin Idea that made this university a national leader among research institutions is the same Wisconsin Idea that made this state a national leader for honest and clean government. Today, the Wisconsin Idea has become a catchy slogan that rolls off the tongue without much meaning, but reading between the lines opens the door to the hidden achievements that make Wisconsin great. It unlocks the rich history of UW-Madison and its commitment to serving the public. It tells the story of citizens taking back power from big business. A lot came out of Wisconsin that many don't realize: entire economic schools of thought, New Deal policy, and government that gave power back to the people. And the Wisconsin Idea is behind it all.

Written by: Morgan Adkins

Photography by: Saager Paliwal

Design by: Patricia Stan

Above left: The Wisconsin Idea was the foundation behind Progressivism and social change in the first half of the 20th century having influence both in the state of Wisconsin and on a national level.
Above right: Simply passed by many, a plaque commemorating Charles Van Hise's mission and vision of the university on the northwest side of Bascom Hill.

"I shall never rest content until the beneficent influences of the university reach into every home in the commonwealth."
- Charles Van Hise

Physical Instruments in a Digital Age of Music

Music has changed drastically throughout the decades, perhaps more in the past century than in any other time in history. While genres and styles have been in constant development and evolution prior to the widespread use of electricity, the instruments being used by composers and performers were largely the same ones that had been used a hundred years before. A massive leap in music production occurred when electronic instruments and tools were incorporated into performances and recordings to make and augment sounds. Much of today's most popular music doesn't involve a single physical instrument at all, with computers providing entire albums worth of work through simulated sounds. While electronic music has shifted away from live performance, some artists choose to create their own instruments to play live, even when all the sounds are originally computer generated.

An important distinction to make when it comes to music and instruments is the difference between analog and digital. Analog, for our purposes, refers to instruments that express sound data that is continuous and defined by some physical variable. Violins, for example, are analog instruments because the sound they create is propagated through the air and they sound different as the frequency varies in a continuous manner. Digital refers to instruments that express data in discrete terms, such as the zeros and ones in binary code. A digital synthesizer, for instance, reacts when the artist presses a button on the keyboard. The button is either off or on, with no change in between. Even pitch-changing effects and various other seemingly continuous dials on digital instruments are most often discrete settings, having a limited number of states.

One of the earliest electronic instruments is the theremin, made popular by thriller movie composer Miklós Rózsa (and perhaps more recently by Sheldon Cooper from the Big Bang Theory). As a musician moves their hands through the electromagnetic field created by the theremin, disruptions are created. These disruptions are translated into sound. The whole instrument is still analog, but was nonetheless a pioneer in introducing new musical possibilities. One of the most significant leaps in bringing digital instrumentation into the mainstream of music was with the digital synthesizer. This device, most often set up as a keyboard, simply creates certain preset sounds when the keys are pressed and has built-in features to modulate pitch and volume or to loop sounds. Even once artists started using these instruments, at the core of the work was a skilled performance. A complex synth riff is as much of a challenge as playing a song on a piano.

While writing songs before a performance has always been standard practice in most genres, a critical change occurred when entire songs could be finished at an artist's leisure. Due to the nature of digital music, various sounds can often be recreated simply using a computer program. Many programs on the market today, such as GarageBand and Ableton, have thousands of sounds available, all able to be manipulated in limitless ways. This paved the way for DJ's to get away with standing in front of a turntable, or in recent years, a laptop, and simply pressing play. Recent breakthrough trends, however, are shifting the focus back into live performance and recording.

The gap between analog and digital instruments is still not something that is closed, and there is no way for a computer program to create a "natural" sounding orchestra or rock band performance any time soon; there are just too many variables involved in the sounds produced by physical instruments. Theoretically, though, a digital instrument can have every sound recreated exactly on a computer screen. So what makes these electronic instruments so widespread? Perhaps the best explanation is that some artists prefer the imperfection of an off-the-cuff performance piece, even when computer-generated sounds are involved.

Jeremy Morris, an assistant professor of Media and Cultural Studies at UW-Madison suggests that contemporary music innovation is approached from two sides. Not only is music itself being constantly changed and developed, but the technology side of it has become its own entity. There appear to be two approaches to bridging the gap between disciplines. "Some artists are so acutely aware of their own practice and their own way of making music that they design an instrument to do what they want to do," Morris says. Artists such as Imogen Heap are known for modifying their instruments to create unique sounds, and ever since the classical era, artists have been known to request their instruments to be made to certain specifications. What's arguably new is the development of technologies first, without clear musical demand for it. This interest has grown among developers and academics alike, leading to new movements and gatherings dedicated solely to music development.

An event dedicated to music technology is the Music Tech Fest. It is a traveling event that showcases new developments in music technology, with an emphasis on novel and unique ways to create and control sounds. Examples of devices from recent appearances include devices that scan brain waves and sensors that detect subtle movement of the fingers to create sounds. Morris characterizes these instruments by claiming that, "the tactility of performance is being put back into instruments." Technologies such as the Reactable allow multiple people to surround a table and use blocks to control the sounds, creating an entirely interactive musical experience not too unlike playing a piano with friends. As Morris describes, the festival's theme is "an approach to the instrument, as opposed to an approach to the music."

Music today stands in a unique position, where engineers are influencing music just as much as musicians are influencing the engineers. Technology is advancing at amazing rates in all fields, and perhaps it was only natural that technical creativity caught up with musical creativity. This could be seen as a complete upending of the source of innovation, but it is not something that musical engineers fear. Morris is a contributing thinker to the festival's manifesto, which describes how "Music technologies help us explore what it means to be human, to create, and to participate." Music is in a very confusing place in time, but perhaps the work that comes out of these modern collaborations between engineers and artists will come to define the cultural era in which we live.

Written by: Brandon Grill

Design by: Jason Wan

Moore No More

A Paradigm Shift in Computer Architecture

The end of an era requires new, innovative techniques to advance computing.

Computers drive the world, it seems, and with the rise of applications like self-driving vehicles, this is true more so than ever before. The intricacies involved in their development are vast and numerous. A modern computer processor can have more transistors (the basic building blocks of computer chips) than the number of blades of grass on ten football fields, all squeezed into an area half the size of a penny. Pushed by economic and technological forces for more than 40 years, the continued miniaturization of the transistor has finally hit the unyielding wall of physics. These limitations force computer architects to rethink their approach to modern design problems. By exploring the changes in computer architecture over the years, we can get a glimpse at what the future holds for computing.

One of the most important and well-known principles in computer architecture was Moore's Law. "Moore's Law isn't really a law of physics. It's more of a law of business, of economics," says Karu Sankaralingam, an associate professor of computer science at UW-Madison. Moore's Law, named after Intel co-founder Gordon Moore in 1965, proclaims that the number of transistors—the device which switches electricity on a computer chip—will double approximately every two years. Moore's Law goes hand-in-hand with Dennard scaling, which states that the amount of power a transistor consumes is proportional to its size. The transistor has been the fundamental component of computers for the last fifty years by its ability to switch electricity.

A transistor can be visualized as a light switch but with two key differences: (1) the switching is controlled by electricity rather than a mechanical arm, and (2) no part of the transistor moves when switching. As the size of transistors decreases, the energy needed to switch them decreases as well. This means the performance of a transistor per watt of energy used increases as the transistor shrinks, allowing for more transistors to be used on a chip without increasing the amount of energy needed. Also, the less energy transistors use, the faster they can flip on and off. Because smaller transistors can switch faster, computers can perform more work in a given amount of time. In the case of Moore's Law and Dennard scaling, the combination of an economic observation and a technological principle became a self-fulfilling prophecy – and has driven competition between computer manufacturers at Moore's projected levels for over 40 years.

> **"How do we think about transistors as precious resources even when there are a billion of them on a chip?"**
> **- Prof. Karu Sankaralingam**

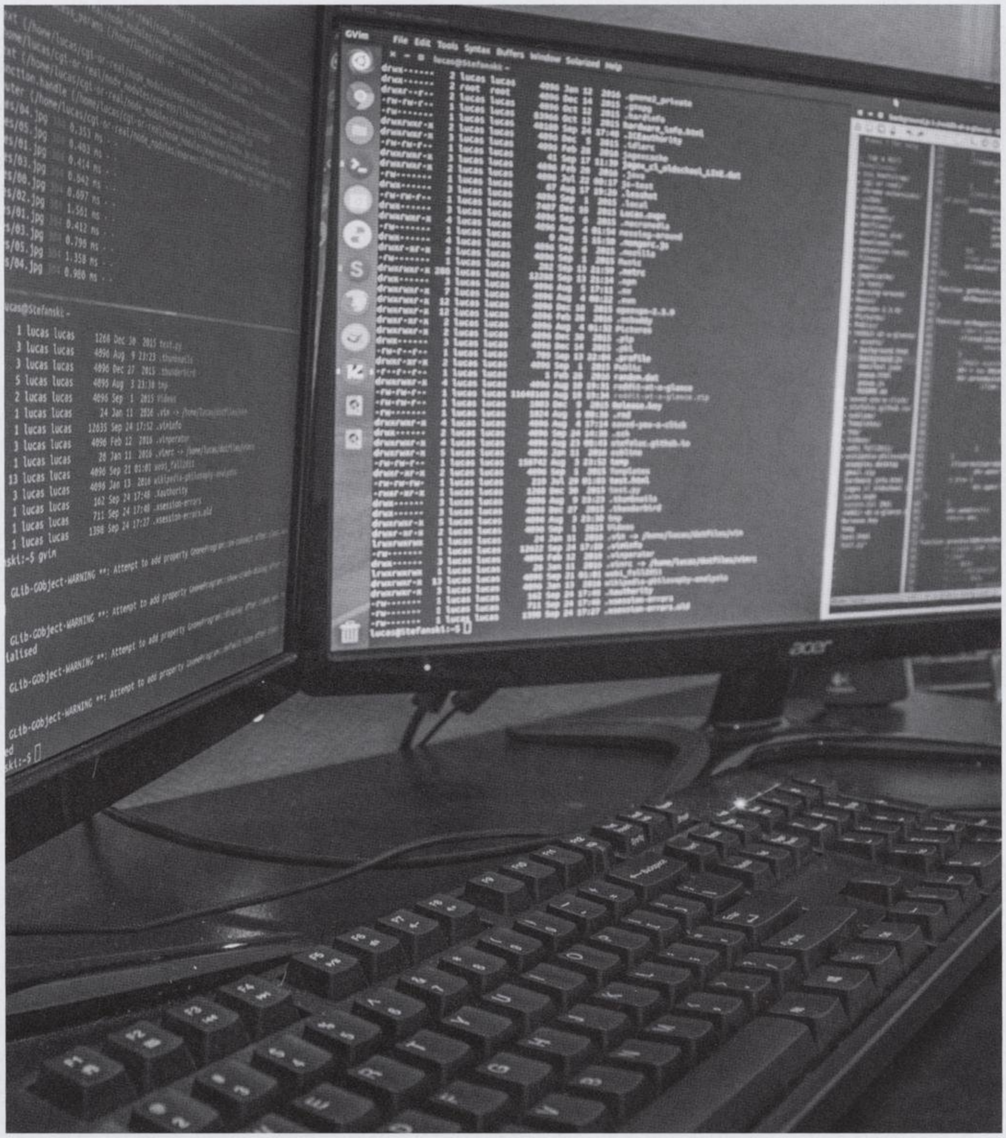
In the past, this trajectory was only attainable because of how relatively large transistors were. Ten years ago, the smallest transistors were 45 nanometers (nm) in length, whereas current transistors are now 10 nm. Each new generation of transistor shrinks both its length and width by thirty percent. This means the 10 nm-long transistor occupies five percent of the surface area of a 45 nm-long transistor. Lately, though, it seems the trend of miniaturizing transistors has encountered an impasse. "Moore's Law has been hit by the sheer economics of how much more expensive it is to make a transistor smaller than what it is today," says Sankaralingam. "Almost all technology projections suggest it will be harder to get the next generation of transistors to be cheaper than the current generation."

Since the advent of Moore's Law, the integrated circuit manufacturing process, known as photolithography, has allowed for low-cost scaling of computer chips because of how large the transistors were. However, the size of a silicon atom is near 0.1 nanometers, meaning only 100 silicon atoms span across a 10-nanometer transistor. Creating the tools to carve such minuscule features has become preposterously complex, driving the manufacturing costs of any transistor smaller than 10 nm by 10 nm through the roof. With the death of Moore's Law as well as Dennard scaling, new ideas and techniques are needed to keep the field of computing moving forward.

This is where Professor Sankaralingam steps in. "My research work is essentially this: how do we think about transistors as precious resources even when there are a billion of them on a chip, and build devices that are really energy efficient?" says Sankaralingam. "There's a lot of stagnation in hardware innovation because it's really, really expensive." One of his strongest efforts is to push open-source computer hardware into the mainstream. If something is "open-source," it means anyone can see what makes the product tick and can use the product for free. The open-source software movement took off in the late '90s as a result of a slowdown in software innovation from major software players at the time. One of the biggest success stories of open-source software is Linux, an operating system which, according to a global survey by W3Cook in March 2016, runs on over 95% of the web servers we interact with daily. Leveraging free software tools allows companies large and small to develop new products faster and cheaper while scaling their current technologies larger than ever before.

Open-source hardware development, however, is an entirely different beast. Efforts such as Open Compute Project create open-source servers for large-scale datacenters, but the chips running inside those servers are often still closed off. Sankaralingam is looking to help change that with the Many-core Integrated Accelerator of Waterdeep/Wisconsin, or MIAOW (pronounced me-ow). MIAOW is an open-source general-purpose graphical processing unit (GPGPU) implementing a publicly available specification from one of two companies currently producing mass-market GPUs. "A benefit of open-source hardware is establishing that you have a minimum-viable product," says Sankaralingam. If a small startup had a huge new computer architecture idea, they would need to gather enormous amounts of money because developing a processor from scratch is incredibly time-consuming and expensive. A tool such as MIAOW can drastically reduce the up-front costs of development, encouraging innovation by lowering the barrier of entry.

Turning conceptual circuitry into a physical device is an extremely costly endeavor. Fortunately, a tool exists to quickly bring concepts like MIAOW into the real world. A field-programmable gate array, or FPGA, allows one to take a bit of designed circuitry and program it onto this special device. Unlike a normal programmable chip, the uploaded design reconfigures the transistors of the FPGA so it "becomes" the circuitry. Due to the incredible savings in computing time and energy usage coupled with decreased manufacturing costs they bring, FPGAs are beginning to hit the mainstream. "I think it's the exact right thing for industry to do," says Sankaralingam. Intel is planning to integrate an FPGA onto some of their server processors in the coming generations. This would allow the processor to offload certain tasks normally handled by software to a hardware unit capable of performing faster and more efficiently. FPGAs will almost certainly play a big role in the coming years.



A computer running Linux, a very successful open-source operating system.

As crucial as a transistor is to making an FPGA work, there are new technologies coming down the pipeline promising to provide new, incredible functionalities. One such technology is known as the memristor. First theorized in 1971 by UC-Berkeley professor Leon Chua, the memristor is a single circuit element made of an advanced material which remembers the amount of electricity that has passed through it in each direction. Based on that historical value, the memristor will alter its electrical resistance. Designating high and low resistive states for the memristor allow for the storage of binary information without the need to store electric charge because the material properties of the memristor have been physically altered. Since no charge needs to be held captive, the energy savings wrought through this technology are immense. This type of memory is generally referred to as resistive random-access memory (ReRAM or RRAM), and is working its way toward widespread adoption. In July 2015, Intel and memory manufacturer Micron announced the pending release of a new information storage device called 3D XPoint. While the core underlying storage technology for the device has not been publicly announced as of April 2016, the publication EE Times received a statement from Intel stating "the switching mechanism is via changes in resistance of the bulk material," strongly implicating ReRAM or a close relative as the storage mechanism. This technology significantly reduces power consumption and increases memory access speed by an order of magnitude, laying groundwork for a huge shake-up of the computer memory market.

Digital technology is a field continuously experiencing flux. The speed at which computers evolve and change is unlike how the rest of the world works. Up until now, it's been relatively easy to achieve speedup in computers, but the death of Moore's Law ended that party. However, the amount of new technologies being developed and ideas being tested by Karu Sankaralingan will help ensure a steady beat for future generations of computing to march to.

Written by: Stephen Eick

Photography by: Brendan Hanke

Design by: Patricia Stan

THE WISCONSIN BADGERS, *Then and Now*

Explore the changes throughout the history of Wisconsin Badgers athletics

As a founding member of the Big Ten Conference, the Wisconsin Badgers athletic teams have a long and rich history dating back more than century. Proudly donning the iconic cardinal and white throughout the years, both men and women student athletes competing in a variety of different sports have historically earned national recognition and respect for their accomplishments. UW-Madison has produced over 100 Olympic athletes and has claimed more NCAA boxing championships than any other school prior to the sport's discontinuation, which demonstrates the level of excellence that has come to be associated with the institution. While these storied programs embody a modern day powerhouse in collegiate athletics, this wasn't always the case.

Andy Baggot, an Insider for UWAthletics.com who has been covering the Badgers for the last 35 years, explains that in order to appreciate the current state of Wisconsin athletics, one needs to look before 1990. During this time, the athletic department had more than a $2 million deficient, outdated facilities, and football, the sport that drives the department due to the revenue it generates, had been mediocre for years. "You had people leaving tickets on windshields hoping that others would take them off their hands," says Baggot, describing the general sense of apathy towards the football program in the 80s. That all changed when Pat Richter was hired as the new athletic director in 1989. Richter, who subsequently hired Barry Alvarez as the head football coach, completely revitalized an athletic department that was struggling to sustain itself. Under Richter's leadership, Alvarez turned the football program around and eventually posted the school's first winning season in years. By the time Richter stepped down to hand the reigns over to Alvarez in 2004, not only was the deficit erased, but a sizeable budget had been generated to sustain the department indefinitely into the future.

Discussion of this transformation would not be complete without mentioning Ron Dayne. As the 1999 Heisman trophy winner and all-time leading rusher in NCAA history, Dayne was, according to Baggot, "the most impactful student athlete," to have ever passed through UW-Madison. At a time when the football team posted their first losing season after going to the Rose Bowl under Alvarez, there were many questions about where the program was headed. Enter Dayne, who in his first season led the Badgers to a major victory in the 1996 Copper Bowl. His record-setting numbers generated genuine enthusiasm about the program, putting students and alumni alike back in the stands.


Left: Athlete Josh Gasser ready to fight for NCAA game in year 2015. Right: Athlete Sam Dekker in one of NCAA games in year 2015.

"It's not just football or basketball—everyone is involved, both men and women, and it's important to know how hard everyone has worked."
- Andy Baggot

Athlete Bronson Koenig in NCAA game against Oregon in year 2015.

While football and, more recently, men's basketball tend to steal the spotlight in terms of national recognition, that is not to say that the other sports teams have gone unnoticed. Wisconsin hockey, both men's and women's, has a long history of being one of the premier teams in the country. The most recent women's ice hockey world championship gold medalist team featured nine former Badgers. Track and Field boasts its own plethora of standouts, including Chris Solinsky, who won five championships at UW-Madison. Every sport on campus has had its exceptional seasons and athletes, and, as Baggot explains, "It's not just football or basketball—everyone is involved, both men and women, and it's important to know how hard everyone has worked."

Given the level of commitment these student athletes dedicate towards perfecting their game, it's only natural that competitive rivalries develop. The longstanding competition between Wisconsin and Minnesota is one of the fiercest in all of college sports and is one of significant historical importance. In football, it is the most-played rivalry in the country: the teams have met on the gridiron over 125 times in the same number of years. Starting in 1930, the annual game was played for the right to hold the Slab of Bacon trophy for the remainder of the year. Thirteen years later, this trophy was lost, only to be rediscovered 50 years later in a Camp Randall storage closet in 1994. In the meantime, the trophy was replaced in 1948 by the iconic Paul Bunyan's Axe, for which both teams still compete today.

With rivalries comes intense school spirit that manifests itself through extraordinary school traditions. Whether it's the marching band's unique Fifth Quarter or the many game day songs every Badger knows by heart, these traditions elevate the athletic experience to a whole new level. But perhaps no tradition has become more remarkable than Jump Around. This phenomenon, originating in 1998 because someone decided to play it on a whim, has evolved into a nationwide sensation. While Wisconsin athletics has had its ups and downs, traditions like this ensure its longevity and keep people coming back for more. As Baggot notes, "The students have always been the biggest catalyst for the Wisconsin

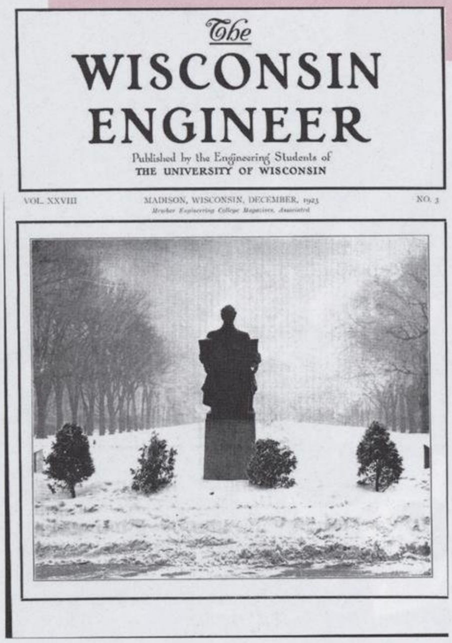
Written by: Stephen Schwartz

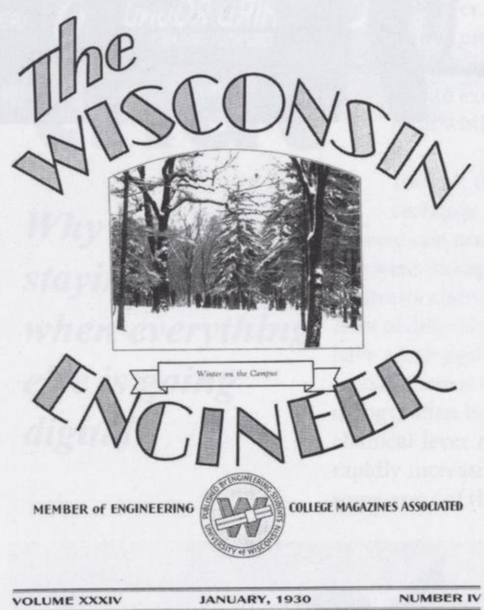
Photography by: Cong Gao

Design by: Patricia Stan

MAKING A MAGAZINE,
Preserving History

Looking back on 120 years of the Wisconsin Engineer Magazine





For 120 years, the Wisconsin Engineer Magazine has been a magazine with a mission to document engineering topics that are relevant to the students and alumni of UW-Madison. The Magazine published its first issue in June 1896 with the purpose of establishing a journal to share the knowledge and experiences of the students of what was then called the College of Mechanics and Engineering. The Magazine was first and foremost a method of communicating experiences before the time of social media.

Over the course of its long history, the Magazine has reported on groundbreaking technology from the boom of the automotive industry to the rise of commercial flight, and more recently, expeditions in space. In the 120 years that the Magazine has been in publication, the progress of technology and engineering has been tremendous. What is considered normal in our everyday lives today at one time was breaking news. In the very first issue published by the Magazine, many of the articles dealt with the then-relevant technology in the railway system with titles such as "A comparative test of a compound and single expansion locomotive," and "Storage battery auxiliaries for railway power stations."

Like any art form, major world events have shaped the Magazine into what it is today. When the United States entered World War I, the writing staff of the Wisconsin Engineer turned to topics such as submarine navigation, the technology behind the navigation processes, and other wartime technology. In the April 1917 issue, John G. Callan aptly titled his article "Submarines," which explained "The essential advantages of the submarine lie in its invisibility and in the extreme deadliness of the torpedo." To a modern audience, these facts seem particularly mundane, but at the time, the submarine was the pinnacle of military technology. The Wisconsin Engineer kept the public informed on the technology that was keeping our country safe.

After World War I, the Magazine continued to report breakthrough technology and issues important to the times. As the country descended into the heart of the Great Depression, the Magazine reported on the engineering projects across the U.S. that were essential to rebuilding the economy. In the November 1929 issue of the magazine, an article by Professor Daniel W. Mead focuses on the proposed construction of dams along the Colorado River. "The dam, if built, will be the highest dam yet constructed and will be more than twice the height of the Arrowrock Dam which is now the highest dam built," Mead explained in his article.

Moving ahead in history to December 1941, a letter from College of Engineering (CoE) Dean F. Ellis Johnson was featured in the Magazine following the attacks on Pearl Harbor. In his statement, he called for the men of the CoE to strive to achieve perfect grades because in a time of total war, competency in all areas was key. "It is only thus that we may leave to others after us the principles which shall make the freedom and opportunities we win for men worth the total war we must wage," wrote Ellis. As the Second World War continued, articles regarding the Army Corps of Engineers were featured in many issues. In the November 1943 issue, a piece titled "Engineers Behind the Guns," by P.F.C. Karl Wegener detailed how the outcome of a war is no longer determined by well-trained men, but rather that "modern war" calls for engineers to develop the best equipment and to be well-trained in combat. Men don't win wars, he claimed, technology does.

It was during this tumultuous era that the first trace of women's involvement in the Magazine appeared. In the April 1943 issue, Loella Niles wrote an article entitled "Women Workers," which documented how women were taking over traditionally-male jobs as more and more men left the factories for the war. This extended into all fields of work, including engineering. Following the publication of this article, women slowly became an integrated part of the Magazine's staff.

The Magazine is and always has been a product of its times, reflecting world events and capturing ideas and feelings permanently into text. Over the years, the Magazine staff has not only shared feats of engineering, but has also tackled social issues of the times. The Magazine even included obituaries, book reviews, jokes, and puzzles. During the Civil Rights Movement of the 1960s, there was a noticeable shift in the way articles were approached and written, as the magazine staff started to adapt to the changing social scene. Additionally, a "Feedback" section was added to the Magazine so the readers could voice their concerns about articles in the prior issues or provide ideas for articles.

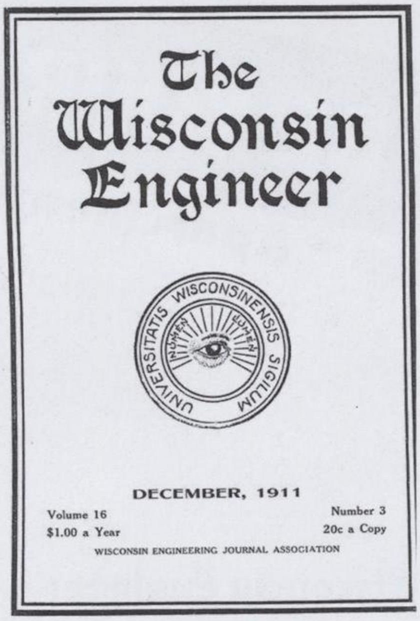
Not only has the written content changed over the past 120 years, but the visual content has changed as well. The earliest illustrations were simply drawings and sketches. As technology improved, photography became more prevalent in the Magazine. The advent of television and the internet also allowed the Magazine to progress. The Magazine now has a strong social media presence as well as a website. Media has transformed the way the Magazine has grown, yet it still holds true to the founders' intents: publishing material that matters to engineers.

Looking through the past articles it is evident this publication became much more than just a place to share engineering accomplishments, but a place to document life experiences. Each issue of the Magazine is a time capsule that captures the thoughts, ideas, and dreams of generations long gone. Those who came before the current staff of the Magazine carved a monumental path, and during the next 120 years, the Magazine will continue to report the evolution of technology, creating snapshots of the voices of our generation.

Check out the Wisconsin Engineer Magazine archives at http://digicoll.library.wisc.edu/cgi-bin/UW/UW-idx?type=browse&scope=UW.WIE to discover more of the history that the magazine has preserved.

Written by: Emily Morzewski

Design by: Jason Wan



The Wisconsin Engineer

UNIVERSITATIS WISCONSINENSIS SIGILLUM

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DECEMBER, 1911

Volume 16 — Number 3

$1.00 a Year — 20c a Copy

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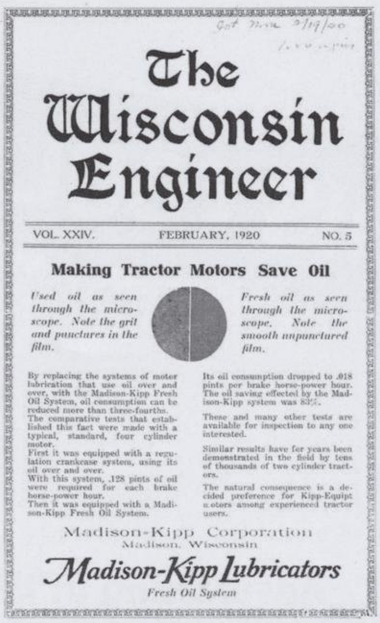

The Wisconsin Engineer

VOL. XXIV. — FEBRUARY, 1920 — NO. 5

Making Tractor Motors Save Oil

Used oil as seen through the microscope. Note the grit and punctures in the film.

Fresh oil as seen through the microscope. Note the smooth unpunctured film.

By replacing the systems of motor lubrication that use oil over and over, with the Madison-Kipp Fresh Oil System, oil consumption can be reduced more than three-fourths.
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