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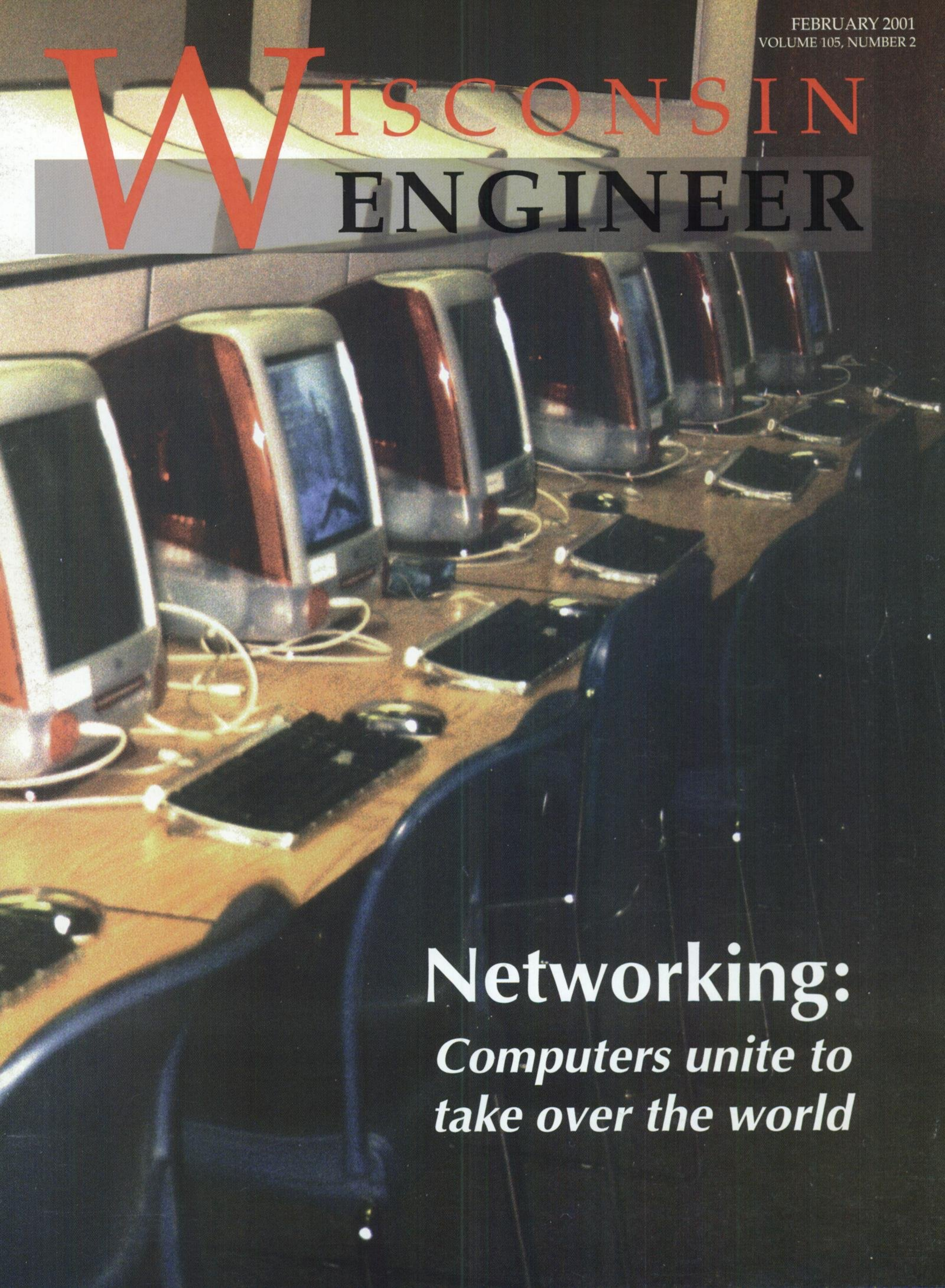

FEBRUARY 2001
VOLUME 105, NUMBER 2

WISCONSIN ENGINEER

Networking:
Computers unite to take over the world

WISCONSIN ENGINEER
Published by the Students of the University of Wisconsin-Madison
VOLUME 105, NUMBER 2
February 2001

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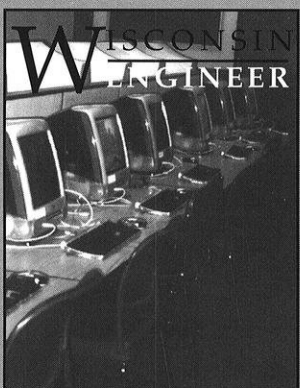

Computer Networks:
Linking it up in the DoIT lab with some of the many computers available to engineering students.

TO CONTACT THE *WISCONSIN ENGINEER:* 1513 University Avenue, Madison, WI 53706 — wiscengr@cae.wisc.edu — http://www.cae.wisc.edu/~wiscengr — 608-262-3494

Having Fun While I Can

I'll betcha that I have either seen or conversed with almost every student or faculty member on the engineering campus. No, I do not spend hours at CAE nor do I loiter at Engineering Hall. I work at the Quick Byte Deli at Union South.

It's amazing just how many people you can meet while working at this fine establishment. It's funny sometimes when I'm going to class and I see these students straining to figure out how they know me. The best most can come up with I'm sure is, "Oh, yeah, the Quick Byte girl." That's okay if they don't know my name because, at the same time, the only thing I can remember is "flavored coffee and a blueberry muffin."

Now, what does working at the deli have to do with my major? Nothing! Yes, I could've found a job that is in my field, but what fun would that be? I'll be "in my field" for the rest of my life. Here I can gossip with my boss Kara and my co-worker Rebecca about the weekend's events or if Cute Boy #1 or #2 has come into the deli yet. The most complicated part of my day is finding out if my customers want flavored or regular coffee or what kind of cone they would like with their ice cream.

Besides, I think I do a great service for the engineering campus. Not only do I get to pump engineers full of caffeine and sugar, but I also cater to their entertainment needs. And, boy, are we entertaining. Just come in during the "Flashback 80s" lunch.

So, if you are brave enough to leave CAE for a few minutes and actually venture out across the street, come and visit me at the Quick Byte. You may see a couple cute girls dancing behind the counter while popping popcorn, but just remember that we are learning something important that you can't learn in your statics or fluid mechanics lectures. We are learning how to deal with all kinds of people and also having fun.

And if I get a smile from a shy engineer who finally isn't scared away by the cashier who is actually speaking to him or her, then that really makes my day. Even if I don't, I'll still keep dancing.

Kari Cox

The College of Engineering
University of Wisconsin-Madison

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Sparkle, Fizz, Boom! The Chemistry of Fireworks

By Nicholas Mueller

Every science has its hobbyists. Like groupies at a rock band, hobbyists celebrate their sciences, grouped around tables in garages, or over devices in a field far from home. If one looks closely, any number of hobby clubs can be found, focusing on any topic. Many hobby groups celebrate the wonders of pyrotechnics. Dedicated enthusiasts around the world make great, professional-quality, fireworks with a mix of home-brew tools and chemicals, as well as professional grade equipment ordered from firework supply houses.

The suburban fireworks master can create all manner of displays, from rockets and fountains to stars and sparklers. A good chemistry text, a set of instructions and a little cash to buy chemicals from supply houses is all that is needed, along with a little patience, care and safety.

Learning about fireworks is essential before one attempts to assemble any pyrotechnic device, for it is one of the most dangerous hobbies. By their nature, materials involved in pyrotechnic displays are dangerous. Everything that makes them pretty, loud and colorful can hurt you. For this reason, it is illegal to manufacture fireworks in most countries without a license. It is best to check your local laws before you start anything.

The science and procedure of creating fireworks developed mostly out of Europe. European royalty would sponsor immense displays for Christmas, royal birthdays, coronations and other events. Most often, engineers who worked on the military applications of pyrotechnics would be drafted to put together the shows. Displays included parts called temples and machines. Temples were mostly temporary buildings and frameworks built to shoot fireworks and to serve as a set. St. Peter's in Rome still bears marks from a fireworks display of the 18th century on its cupola.

Machines often included moving parts. One machine in particular featured a cutout of St. George jousting a wooden dragon which spit a shower of sparks from a firework in its mouth. Other fireworks displays included live participants who covered themselves in leaves and thick clothing to protect them from sparks and flames. These so-called "green-men" acted as advance publicity leading processionals of people to fireworks displays. They sometimes also acted out pyrotechnical pageants and plays.

Learning about fireworks is essential before one attempts to assemble any pyrotechnic device, for it is one of the most dangerous hobbies.

The majority of firework effects you see today are based on modern discoveries in chemistry and the underlying physics. A good example is the development of the myriad of colors used in the modern firework display. Before the 1800s, only yellow and orange flames could be worked into fireworks. These colors were produced with steels and charcoal in the various stars, shells and fountains. A common mixture of the day would include both these elements with some sort of binder and a sprinkling of other materials. Chlorates, discovered in the late 1700s and commonly used in industrial applications thereafter, added red and green to the fireworks' cabinet.

Chlorates are useful in most types of colored fire composition. Their large oxygen content is useful for starting the chemical reaction, and the ions they yield produce the color that is desired. For instance: mixing barium chlorate and orange shellac, a binder/fuel resin that is basically a complex carbohydrate with some trace elements, can produce a green flame. Potassium chlorate, orange shellac and strontium compounds can produce red flames.

Source: Karen Croysdale

Brilliant fireworks light up the night during the exciting grand finale.

Stable, safe formulae for white, blue and purple flames were developed in the 20th century. Before this time, the majority of recipes was unsafe and needed to be precisely mixed for them to work properly. The modern firework generates white flames with the addition of antimony and aluminum dust to potassium nitrates and some sort of fuel, such as charcoal or shellac. Blue coloration is generally achieved with the use of copper, sulfur and potassium compounds.

Commercial fireworks use only a small number of compounds to emit the colors of the spectrum. Table I contains the standard sources of colors in most commercial fireworks.

Table I: Coloration of Fireworks According to Emitting Material

Color	Emitters Used
Yellow	Sodium D-Line atomic emission
Orange	CaCl
Red	SrCl or SrOH
Green	BaCl
Blue	CuCl

Table I is far from being comprehensive, but it is a good approximation of what modern fireworks use. It may also be noted that the production of some colors is still hard for the fireworks industry. Count the number of turquoise and emerald-green fireworks you see at your next fireworks show, and you will probably find that there aren't many. This is because there are no commercially useful "pure" emitters in the green range of light.

When selecting ingredients for a firework "star" (the small blobs of mixture), one must be careful choosing a composition that is safe and stable for storage. It must work as expected every time and must burn consistently once lit. Consulting the table above, one can find the color desired and the compounds that, when raised to temperature, generate the color.

To generate those colors, a firework needs a pyrotechnic mixture that will generate the above molecules, evaporate them into the fire and then put them at a consistent high temperature as quickly as possible. To achieve good coloration, a substantial amount of the emitting molecules is also necessary. In short, the emitters are not alone; a fuel- oxidizer mixture is also necessary for a good firework.

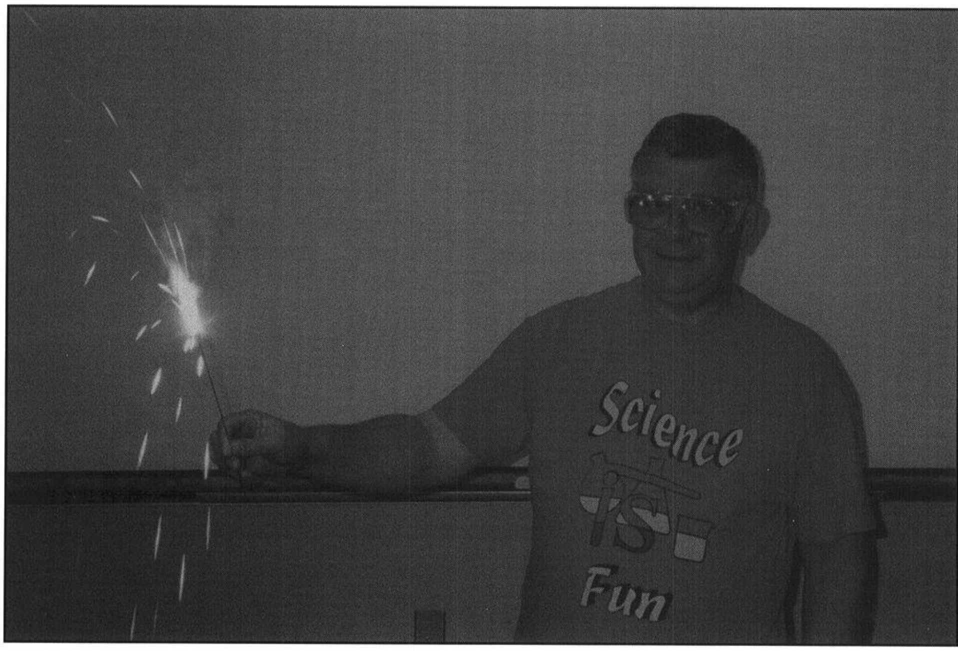
For a deep coloration, only the selected color's molecules must be present, and nothing else. To generate the emitting molecules at an adequate temperature, a fuel-oxidizer mixture is used. Most fireworks you can buy, as well as most homegrown fireworks, use organic fuels such as pitch and a variety of resins. These compositions cannot generate temperatures as high as those available from metallic fuels such as aluminum and magnesium. These metallic fuels are commonly used in "industrial-strength" fireworks, such as those used at shows and other large events sponsored by municipalities and corporations. However, molecular emitters such as CuCl are quickly burned up in these intense flames. As a result, one never sees blue stars that are as bright as red, yellow, orange and green stars. Another problem with metallic fuels is their generation metal oxides, which can easily washout colors.

Pure coloration in a firework requires pure ingredients as well. Elements which washout color must be kept out of the firework, either by carefully selecting components, or by using a little chemistry. For instance, red fireworks dependent upon strontium chloride or hydroxide to generate their color use an excess of fuel to soak up oxygen and prevent the formation of strontium oxide, which washes out color.

As an example, let's examine the composition of a typical yellow firework.
By parts volume:
Potassium perchlorate: 6
Sodium Hydrogen Carbonate: 2
Dextrin: 2
Water: 4

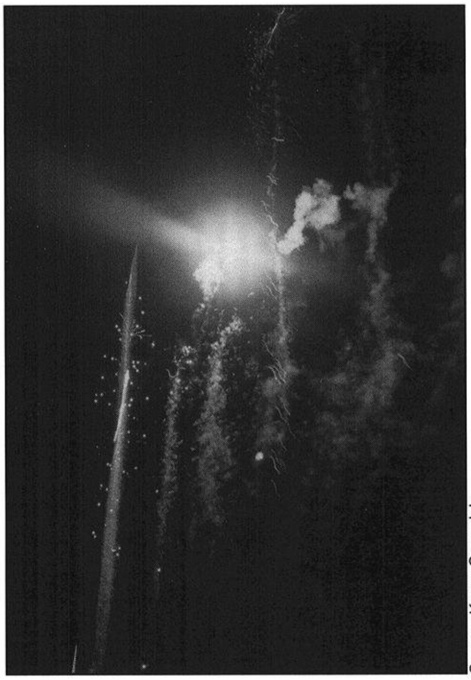
A good chemistry text, a set of instructions and a little cash to buy chemicals from supply houses is all that is needed

This generic recipe produces a safe, stable yellow "star," which is generally about the size of a cherry or strawberry. The water serves as a mixing agent only and is evaporated before using the firework. The dextrin serves as a binding agent and partially as a fuel for the fuel-oxidizer mixture. The potassium perchlorate serves as the oxidizer portion of the fuel-oxidizer mixture, and the hydrogen carbonate serves as the remainder of its fuel. This leaves sodium to burn inside the flame and produce a very bright yellow flame. An excess of perchlorate and fuel is used in the mixture to keep the star especially hot, and in other mixtures, such as that



Source: Karen Croysdale

Professor Shakhashiri shows off a sparkler.



Source: Karen Croysdale

Explosive fireworks shine through the night during the UW-Madison's Homecoming celebration.

Wisconsin Firework Laws

Consumer Fireworks

* Permitted - Cylinder fountains, cone fountains, sparklers with no magnesium, chlorate or perchlorate; snakes with no mercury; small smoke devices

* Prohibited - Firecrackers, wheels, torpedoes, skyrockets, roman candles, aerial salutes, bombs

Display Fireworks

* Need local permit
* Need insurance depending on location, not required by state law

A license is required by state law for manufacturing of fireworks

Information found at http://www.americanpyro.com

of a red star, prevents the formation of various oxides, which will solidify in the flame and wash-out colors.

The hobby and professional fields of fireworks are very well developed and several organizations are present in the United States of America and in Europe which hold conferences and put on shows. Though it is a dangerous hobby, it is also a rewarding one, which produces some of the most spectacular displays of science in history. And there is no fun greater than assembling your own beautiful firework and shooting it off to the awe of your family friends. Of course, always check to be sure your activities are legal before attempting to assemble a firework or shooting off commercial or homemade fireworks.

Author Bio: Nicholas P. Mueller is a sophomore in Materials Science and Engineering at UW-Madison. He has a passing interest in pyrotechnics and the associated subjects of physics and chemistry. This is his second article for the Wisconsin Engineer.

Computers and Radio Engineering

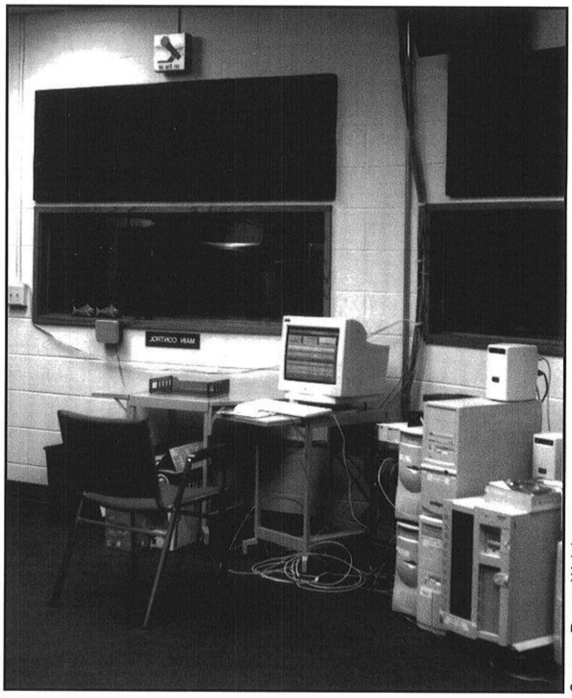
By Emily Smith

On your way to the grocery store, have you ever just driven in silence? What would you do without your car radio and your favorite radio station? While you're jamming in your car to the radio, did you ever think about who is behind scenes—the person responsible for all the technical details? Well, it's the radio engineer who gets your favorite music through the airwaves and into your car.

The tasks of a radio engineer have changed. The use of computer-based systems in a radio engineers' duties have reshaped their job description from one that was highly technical and required rhetorical maintenance to one that is creative and requires good personal relations.

The ways that a radio engineer now uses people, technology and computers to complete their everyday tasks is not the same as it was yesterday. An engineer no longer finds oneself fixing transistors and cleaning tape heads three times a week as they did before. Although these responsibilities are not yet obsolete, radio engineers now use computers more and more to run their stations smoothly and to use their technology optimally.

Mark Croom, chief engineer and operational director for WNWC AM/FM radio, says that his responsibilities as radio engineer have changed considerably with the introduction of new computer-based systems and equipment. His duties, which include installing and maintaining studio training equipment, making decisions as to what equipment to purchase and keeping equipment up to FCC standards, have placed new emphasis on his computer literacy.



Source: Renee Weinberger

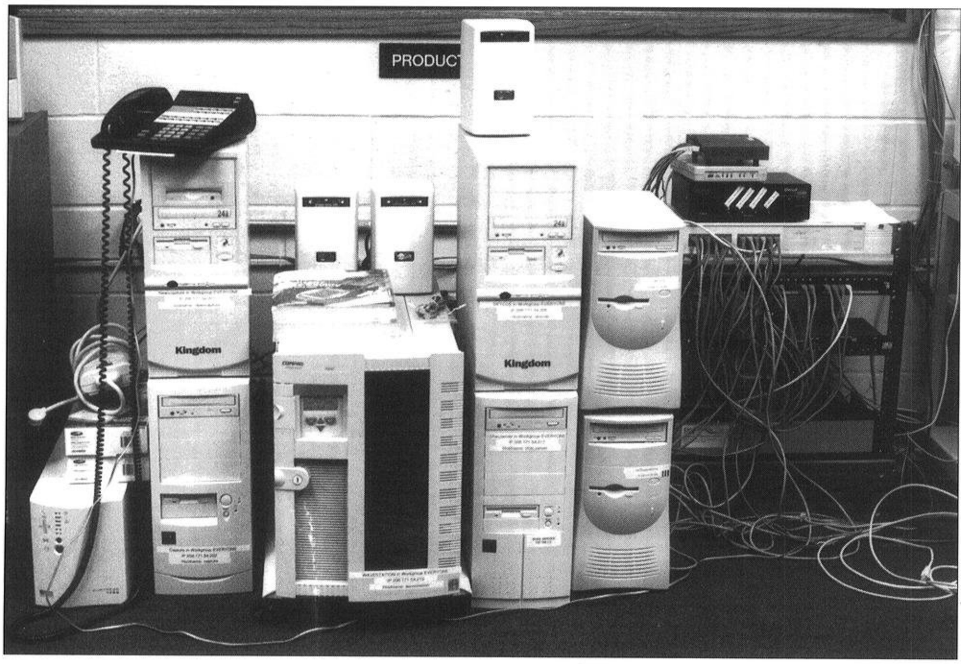
Radio Engineers get to use major computing power to put together radio programming.

Engineers no longer find themselves fixing transistors and cleaning tape heads three times a week as they did before

Croom now uses computers as his main tool to program daily music play lists and to efficiently use his audio systems. Because the use of computer systems with everyday operations has increased so much in the past few years, Croom now finds that to fulfill the demands of his position his need for computer knowledge is no longer a novelty but now a necessity.

With the increased application of computers involved in the radio engineers' duties, the need to find radio engineers with broad computer knowledge has increased as well. Radio engineers can receive their training anywhere from a four-year liberal arts college to a respectable correspondence course, but the need for "know how" with computer-based audio systems is becoming an essential criterion for prospective employees.

So how does a radio engineer accumulate this necessary knowledge? Most technical schools, such as the Madison Media Institute, are beginning to teach students the necessary understanding of computer-related equipment and systems. The most direct way of accumulating this knowledgibility, however, continues to be on-the-job training.



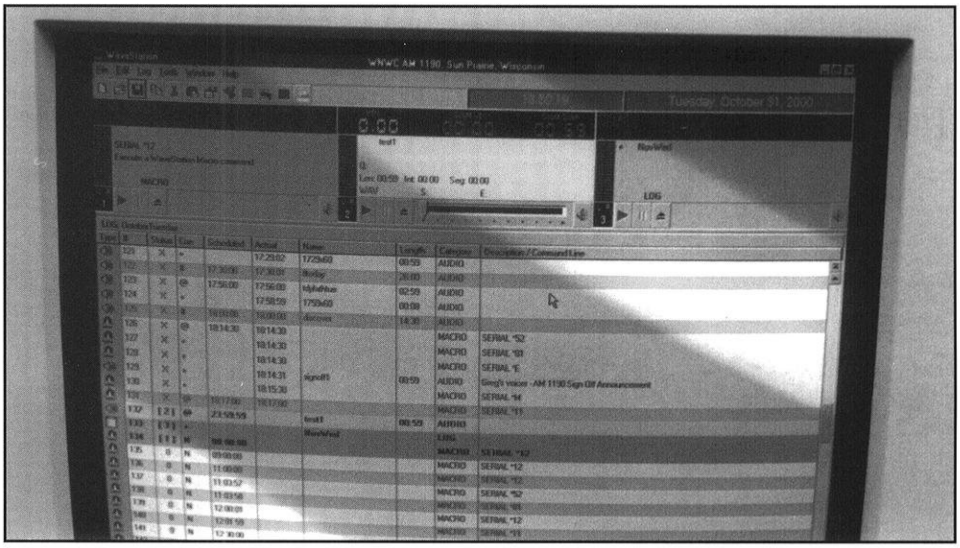
Source: Renee Weinberger

Computers like these are essential to WNWC AM/FM to carryout their daily broadcasts.

Many opportunities are available for those individuals who want to become a part of the radio community and who want to broaden their familiarity with the duties of a radio engineer. Here at the University of Wisconsin-Madison, an excellent way for interested students to gain hands-on experience is for them to get involved with WSUM, Madison Student Radio. WSUM provides opportunities for students to gain exposure to system operations and to express their interest in the broadcasting field.

The station is an excellent source of involvement for anyone who wants to commit a portion of their time to further study about what broadcasting and radio have to offer. It is also a great way for students to affect their community by doing something that they enjoy. Since WSUM offers a variety of opportunities, a student can also explore other radio-related careers if they are not sure if their pursuits lie in radio engineering. WSUM meets on Monday every other week at 6:00 pm. To contact WSUM, you can go to their website at ***http://www.wsum.wisc.edu***, or contact them by e-mail at ***wsum@wsum.wisc.edu.***

As one might predict, with the changing requirements of a radio engineer, the job opportunities are bound to change as well. This is because computers are now able to simplify many of the tasks that were once the responsibility of the radio engineer, and also because radio groups are now beginning to operate many more than one station. Fo example, the Madison Radio Group operate WIBA 1310 AM and 101.5 FM, WMLI 96.3 ESPN 1070 AM, MAD 92.1, and Z104.1. A anyone can tell, with one radio engineer supervising so many stations, there will be fewer employment opportunities.



Above is a picture of one of the computers used by WNWC.

Source: Renee Weinberger

A single engineer running so many stations at once is still difficult however, and an opportunity that extends from this new way of managing stations is the possibility of becoming an engineering assistant. Many chief engineers now have engineering assistants who help them with their everyday duties, such as programming and systems setup. The additional help is especially necessary when operations get particularly stressful for the radio engineer.

Radio engineering can become especially demanding during music promotions and additional station activities, which will place a greater demand on both the engineer and his assistant to work well together in a demanding atmosphere. Also, since radio-engineering systems are not always reliable, engineers can find themselves being needed during odd hours of the day to help with computer problems and operational difficulties.

Computer problems are a much more common malfunction at a station than they once were. Computers are not only used by the radio engineer themselves, but also by the on-air staff and by the management, so radio engineers now find themselves training staff members to properly use computer equipment and to solve minor computer problems.

Since a radio engineer now works more often then they did before with other individuals for computer training and problem solving, they now use people skills more often. In the past engineers did not need good personal skills because their job didn't bring them in contact with other individuals very often. Nowadays with the increased computer use, an engineer must have good personal skills to use their time wisely.

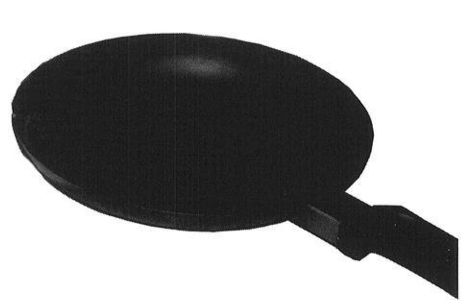
Computers have greatly changed the job description of radio engineering. With new technology and ways of doing business the job opportunities and demands have become much more diversified. Anyone interested in the field should take note of these changes and accommodate for them by attaining hands-on experience and by getting the necessary schooling and skills to satisfy a radio engineer's working demands.

Author Bio: This is Emily Smith's first time writing for the *Wisconsin Engineer.* Read her other article on page 16.

Websites to Look Into

- *http://www.sbe.org,* the official website of the Society of Broadcast Engineers, will keep you up to date on news, technology, and has a friendly list of job openings
- *http://www.northwinds.net/bchris* gives a descriptive and interesting timeline of the history of radio.
- *http://www.rronline.com* gives resources for radio engineers and technical staff. This site also includes news, notes and job listings.
- *http://www.madisonmedia.com* the official website of the Madison Media Institute, gives information on programs, enrollment and employment.

Sticking With a Non-Stick Material



By Erica Brewer

The world's most slippery substance sticks to everything today. Teflon is found in nail polish, plastics, cookware, machinery and wiring. Technology changes and Teflon sticks to the new applications.

In the beginning, the use of Teflon did not "stick" with many people. Roy Plunkett discovered Teflon in 1938. It was not until 1948 that DuPont used Teflon commercially. Plunkett, a chemist for DuPont, researched and developed new refrigerants that DuPont could sell to other manufacturers.

By accident, Plunkett created Teflon by storing tetrafluoroethylene in cylinder tubes and then storing them on dry ice. When Plunkett went to use the cylinders of gas one morning, he realized that no gas was released through a valve. He weighed the tube and found that nothing had leaked out. He decided to cut the tube open, and he discovered a waxy substance inside.

After months of testing this new substance, scientists at DuPont discovered that it possessed many interesting properties. The substance melted at a temperature approaching red heat, boiled away and burned without residue. Plunkett also tested the substance to see if it was insoluble in hot and cold water, petroleum ether, alcohol, concentrated sulfuric acid and nitric acid. When exposed to a soldering iron, the substance did not char or melt, but the most notable trait was that it did not stick to anything.

Plunkett shortened the name of the substance by calling it Teflon instead of tetrafluoroethylene. After applying for a patent, he waited for DuPont to figure out how the company would begin to use and market Teflon.

At first, Teflon was used predominately in industry. Baking machines were coated with it so loaves of bread would not stick. Also, other types of food processing equipment were coated with Teflon so less grease would be used in creating food.

Teflon was also used on different parts of industrial machinery such as gaskets and pumps, and even electrical wires were coated with Teflon. In World War II Teflon was used to coat proximity bombs because of its electrical and radar resistance.

Source: Bill Ketterhagen

Teflon coated pans such as this one allow food to be cooked without sticking to the pan, making both cooking and clean-up much easier.

DuPont strongly resisted using Teflon commercially due to fears of consumer misuse. Several tests had been conducted about the dangers of Teflon, and DuPont feared that

Teflon is also used to insulate thousands of miles of data communications cables because of its outstanding electrical properties, heat and chemical resistance.

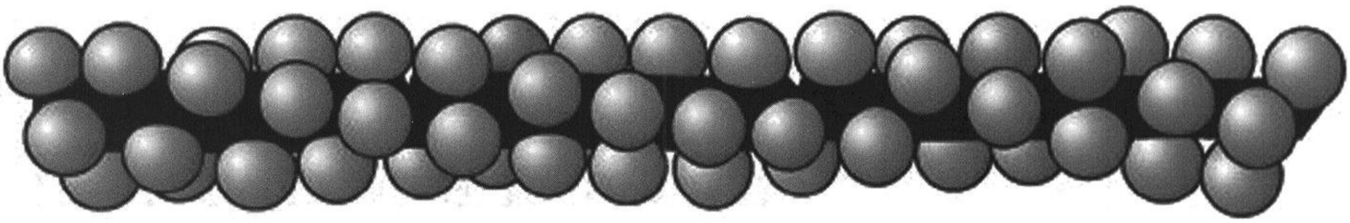
lawsuits would occur if consumers used Teflon-coated products improperly.

At 620° F, Teflon begins to melt and emit fumes. These fumes cause Polymer Fume Fever. The symptoms are similar to that of influenza, but it does not last as long. PFF is not as dangerous as it sounds, since symptoms only last for a few hours. Studies have shown that butter burned in an iron pan is equally as dangerous.

DuPont did not want to take any chances, so they waited until the 1960s to finally start making commercial Teflon-coated pans. Part of the push for Teflon-coated pans came from a Frenchman named Marc Gregorie.

Gregorie learned about Teflon in the 1950s and began using it on his fishing lines so they would not tangle as much. His wife thought about using Teflon on her cooking pans, so they sought the help of their engineering friend. The three of them developed a process of etching the pans and letting the Teflon fill the tiny pores of the pan, creating a coating.

The pans were such a success that the Gregories started their own company called Tefal, where they manufactured the pans. An American named Thomas Hardie heard



Source: http://www.dupont.com/teflon

Model of a molecule of TEFLON® brand PTFE fluorocarbon fiber showing arrangement of carbon and fluorine atoms.

about the Teflon pans and contacted Gregorie. Soon Hardie was selling Tefal pans to department stores in the U.S.

The trend of non-stick cookware began to take off, but lower quality pans were being made, and the reputation of non-stick cookware was becoming tarnished. DuPont was hesitant to enter the market with their Teflon pans.

Instead, DuPont heavily researched Teflon's uses in non-stick cookware and designed more superior products. The reputation of Teflon was saved, and today Teflon is used to coat baking pans, utensils and cooking pans.

Teflon has also continued to be used within industry and technology. Metallic and nonmetallic materials are coated with Teflon. Teflon is also used to insulate thousands of miles of data communications cables because of its outstanding electrical properties, heat and chemical resistance. Plastics are mixed with Teflon to be more resistant to stress cracking, chemical reactions and corrosions. Another use for Teflon is to use it as a coating to repel water or stains. Teflon is even used to make space suits.

The world would not be the same without Teflon. The future holds many more great uses for the stick-free substance. Teflon truly is worth sticking to.

Author Bio: Erica Brewer is a junior majoring in Family and Consumer Journalism and Communication Arts. She is not an engineer; she only lives with one.

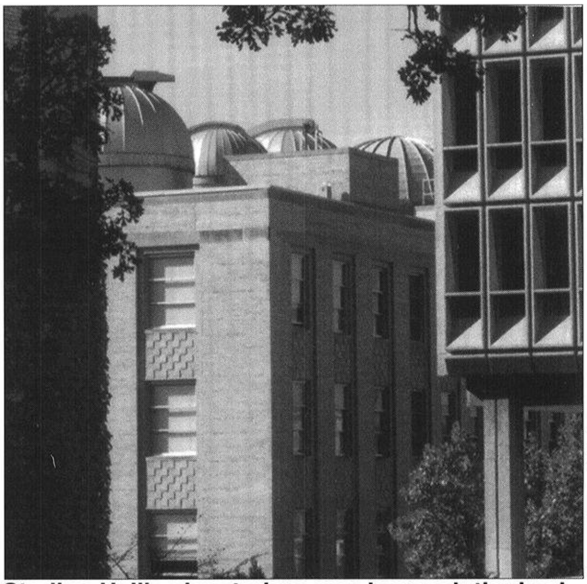
GriPhyN: Extreme Supercomputing for Physicists

By Lynn Weinberger

The biggest computing power these days lies not in one amazingly powerful supercomputer. Instead, it lies in individual computers networked together to share the task of data storage and computation. While the concept of sharing computation and storage amongst computers has been used in projects such as SETI@home and in applications such as Napster, physicists now want to harness that power to solve huge physics problems.

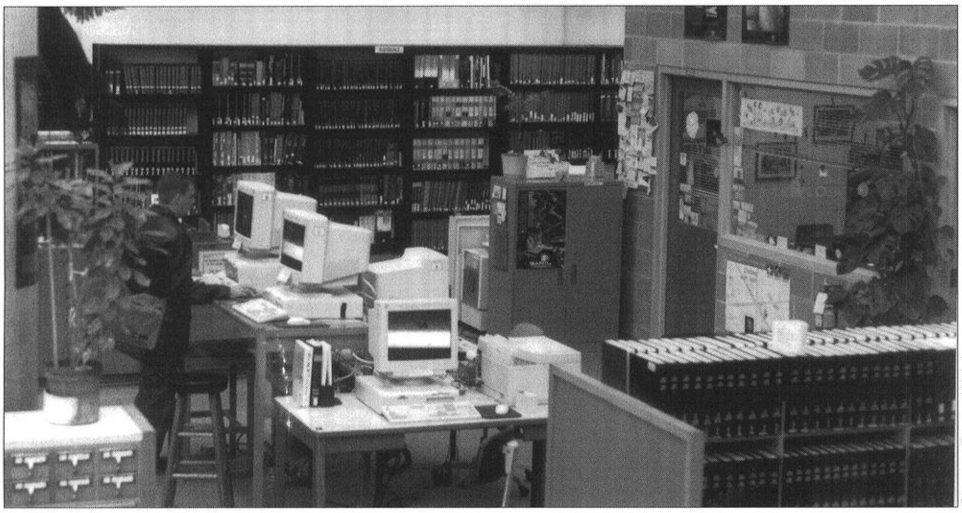
Researchers at the University of Florida and the University of Chicago are working on a project called Grid Physics Network (GriPhyN) that will tap the power of computers across the United States and Europe to work out complex physics problems and to store the data required for those computations. The GriPhyN project will first be used on three National Science Foundation (NSF) funded projects. The first project, the Large Hadron Collider (LHC), is attempting to determine the nature of mass through studying matter at the smallest scales. The second is the Laser Interferometer Gravitational Observatory (LIGO), which is attempting to measure the gravitational waves that Einstein predicted back in 1916, but no one has yet been able to directly observe or measure. The third project, Sloan Digital Sky Survey (SDSS), is surveying the sky to catalog stars, nebula and other large structures in space.

Since 1999, the SDSS has produced over three terabytes of data, which is roughly 3,000 times larger than a hard drive, assuming you have a one-gigabyte hard drive. The SDSS is expected to produce several petabytes (one million gigabytes) of data in total, which is about one thousand times more than a terabyte. If scientists wanted to study neutrinos, subatomic particles with no mass and no charge, they would have to sort through petabytes of data, which is about one million times larger than the average one-gigabyte hard drive.


Source: Renee Weinberger

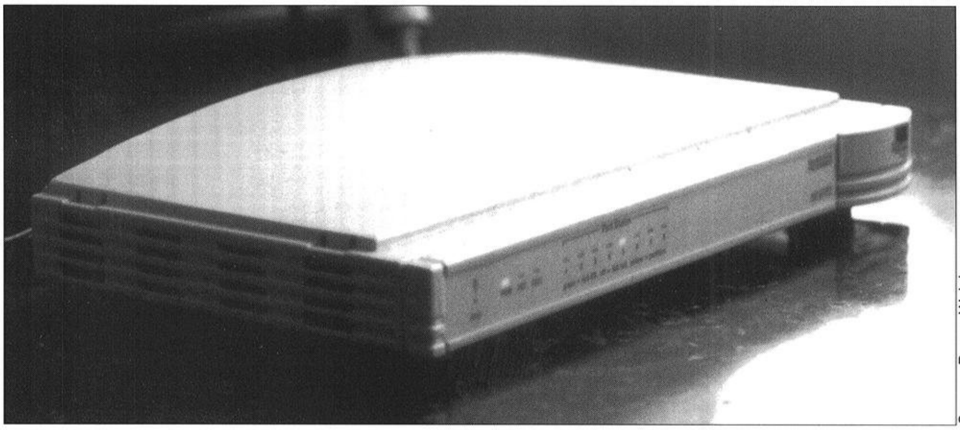
Sterling Hall's planetarium may be revolutionized by information from outer space that the new grid for Physics Networks could change.

The world's fastest computer, IBM's RS/6000 SP supercomputer, known as ASCI White, only has a computational ability of 12.3 teraflops per second. While teraflops per second may seem extraordinarily fast compared to ordinary computers, when the Macintosh G4 is claiming gigaflop processor speeds, it is about 1,000 times slower than the computational speed of GriPhyN. The ASCI White can store 160 terabytes of data, and although that's six times as much space needed to store the entire Library of Congress, it is not enough to handle the data produced by the SDSS.[1] However, GriPhyN can compute and store data sets ranging into the petaflop scale.[2] Paul Avery, lead scientist of GriPhyN and physics professor at the University of Florida, says "To GriPhyN users, thousands of computers and millions of gigabytes of data will look like one single computing engine of unprecedented power," one that is even more powerful than the ASCI White, the world's fastest supercomputer.[3]


Source: Renee Weinberger

Griphyn may streamline existing networks like this one in the physics library.

GriPhyN operates on a network called the Petascale Virtual Data Grid (PVDG) that works with the involved computers to "allocate storage, computer and network resources..." according to Avery.[2] The PVDG functions similarly to the World Wide Web



Source: Renee Weinberger

Griphyn, the new "Hub" for physicists, changes the way computers communicate.

(WWW) in that the PVDG must continue functioning when parts of it crash or break. It also must be able to grow to handle more data, more scientists and more computers. It must also keep copies of the data current. Like the WWW, PVDG does not store all the data in one central location, but across many computers that can be accessed worldwide. It also enables communication between scientists no matter what their location. The PVDG can do more than the WWW in that it can act as an extremely powerful computer

PVDG can do more than the WWW in that it can act as an extremely powerful computer

that allows scientists to perform calculations.

Unlike the WWW, GriPhyN's PVDG has a definitive structure based off a system of five tiers. The tiers show where you are in a network, and they work like a system of concentric circles, each dependent on the one closest to it. Tier 0 is the central facility located at European Organization for Nuclear Research (CERN) in Geneva. This is also the location of the nuclear particle collider used in the LHC project mentioned earlier. Tier 1 is linked to Tier 0 and is the national center for GriPhyN. For instance, the US would have one Tier 1 center. Linked to Tier 1 is the regional center or Tier 2. There would be several of these in a country.

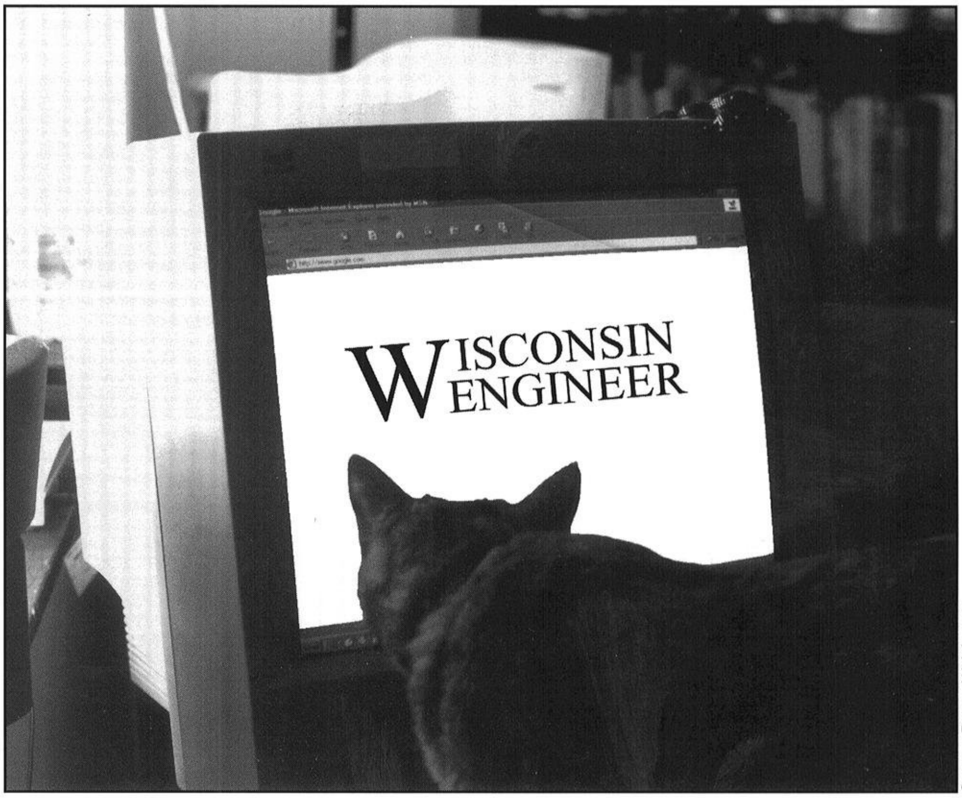
Linked to Tier 2 is Tier 3 or the participating universities such as California Institute of Technology, Harvard University, Indiana University, Northwestern University, University of California at Berkeley, University of Illinois at Chicago, University of Wisconsin-Madison and the University of Wisconsin-Milwaukee. The above listed Tiers 0 to 3 are all connected through a high speed Internet-2 style backbone that can transfer data at a rate of 155 megabytes per second, which is about 3,000 times faster than a 56 k modem. The individual scientists' workstations are connected to Tier 3 through connections ranging from 56 k modems to high-speed Internet connections.[2]

Beyond harnessing worldwide computing power, one of the reasons GriPhyN can run at petascale speeds is that it determines which data it needs to store and which data it doesn't. The only data it stores is that which cannot be derived from a formula because it takes less space to store a formula or equation than it does to store the whole number. Avery says, "As long as you have a recipe for creating the data, it doesn't have to actually exist. It might be cheaper, if you have a lot of resources, to recalculate a lot of raw data on the fly, rather than store it, because it may be just too big. In other cases, because it may be expensive to calculate, it may be much cheaper for you to store it in more than one place."[3]

GriPhyN's intelligent storage, incredible speed and petascale network would make it ideal for researching other topics such as weather patterns, crystallography data and human genome research. In addition to scientific applications, GriPhyN could find use in the business world for tracking consumer-buying patterns. So far, Avery and the GriPhyN researchers have received letters of support from companies such as IBM, Sun, SGI and Cisco.[4] Perhaps the GriPhyN project will not only solve the physics problems that plagued us in the 20th century, but it may also revolutionize the way we look at computing.

[1] http://www.llnl.gov/asci/news/white_news.html
[2] http://www.phys.ufl.edu/avery/mre
[3] Hercz, Robert, "Mega-network: Strength in Numbers," New York Times (28 September, 2000).
[4] http://www.phys.ufl.edu/~avery/mre/proposal_final.doc

Author Bio: Lynn Weinberger, an avid Napster user and occasional runner of SETI@home because she likes the little wave-like graphs, thinks that distributed computing is really awesome because it taps the power of thousands of computers- all of them doing their own little job.



Source: Renee Weinberger

Can GRIPHYN technology be employed by other computer users?

SETI@home: The In-home Way to Search for Extraterrestrial Intelligence

By Mike Vogel

When was the last time you heard E.T. phone home? When was the last time you listened for it? You may never have been able to listen for it before, but now you can. SETI@home gives you the ability to assist in the endless search for extraterrestrial intelligence at home. SETI, or the Search for Extraterrestrial Intelligence, was invented by David Gedy and created by David P. Anderson and Dan Werthimer. SETI@home makes it possible for the public to help in the search for extraterrestrial life.

The roots of SETI@home came from Project Phoenix. Project Phoenix, which is run by the SETI Institute of Mountain View, California, is a "targeted search" which analyzes small amounts of targets (stars and planets) with high sensitivity. The project was first started in a trailer truck with a few custom built computers and other machines. It has progressed to the 1,000 ft. radio telescope dish

About 17 months after the project started, 1.4 million people from over 200 countries had downloaded and returned one work unit

at Arecibo, Puerto Rico. This is the most sensitive radio telescope in the world. Unfortunately there are many other projects using the Arecibo dish as well, so project Phoenix is only allowed enough time to scan about 5% of the year.

From this project came a new and innovative idea, the SERENDIP Project (Search for Extraterrestrial Radio Emissions from Nearby Developed Intelligent Populations). SERENDIP was created at the University California at Berkley in 1978. Its main purpose is to scan the skies for radio transmissions that might be originating from other life. This fixes the problem of getting valuable time with the radio telescope by setting up an extra receiver onto the radio telescope. This is called a "piggyback" maneuver and does not get in the way of the telescope's work.

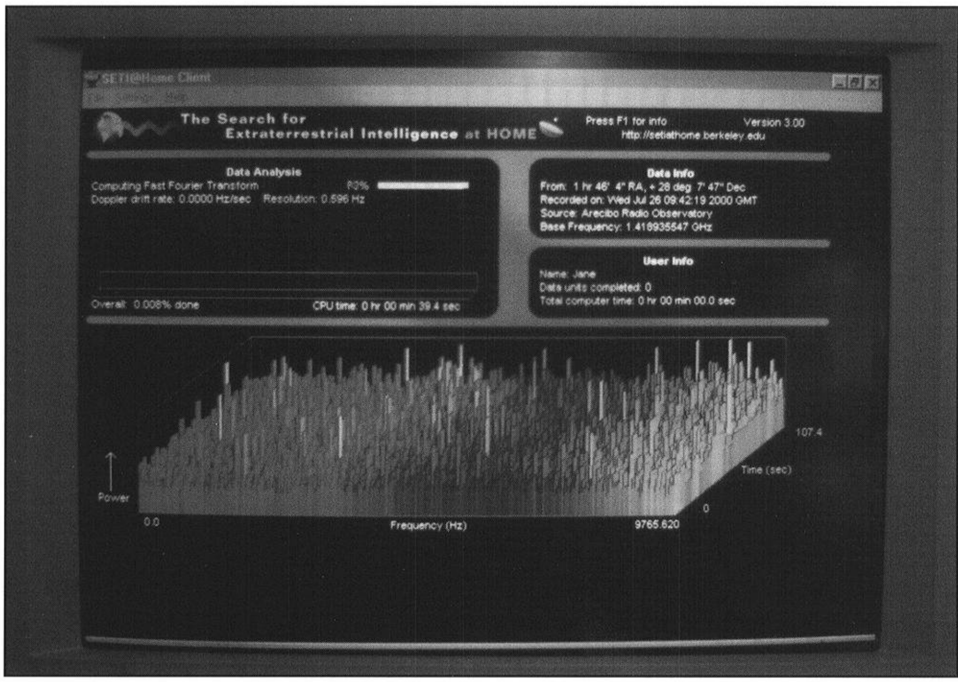
The current version, SERENDIP IV, is suspended above the Arecibo dish. There are many advantages and disadvantages to this procedure though. It can now scan about 30% of the sky and can run almost constantly, not 5% of the year. The disadvantage is that the receiver cannot point wherever it desires; it goes wherever the telescope goes. Since it runs so much of the time and can scan so much of the sky, it brings in a lot of information that needs to be analyzed and sorted. Even supercomputers cannot handle this load of information. This is where SETI@home comes in.

SETI@home allows the public to help in this search. The basic idea behind this is that the public can take this information that SERENDIP has collected, analyze it and send it back, therefore giving the project computer resources. SETI@home became extremely popular right after it was released to the public. By October 5, 2000, about 17 months after the project started, 1.4 million people from over 200 countries had downloaded

The project (SETI) was first started in a trailer truck with a few custom built computers and other machines. It has progressed to the 1,000 ft. radio telescope dish at Arecibo, Puerto Rico

and returned one work unit. This creates a supercomputer effect that no single supercomputer could ever achieve.

The process behind all this is very simple. All one has to do is go to the SETI@home website and download a 798-kilobyte program which can be set as your default



Source: Renee Weinberger

With SETI@Home, computer users can help seek out new life and new civilizations.

screensaver. Then you download a 350-kilobyte file known as a "work unit." This contains information recorded by the SERENDIP receiver. The program comes into effect and starts running when you are not using your computer.

SETI@home acts exactly like a screensaver. When you want to go back on your computer and do work, it shuts off until you leave again. It takes anywhere from 10 to 80 hours for one work unit. Then whenever you go online next, the computer sends the analysis back and gets another work unit. This continues until you get rid of the program. Through this simple tool, you can help in the search for extraterrestrial intelligence.

SETI@home has not found any signs for extraterrestrial intelligence. Even though there is no solid evidence found for extraterrestrial intelligence, there have been signals that may have originated from extraterrestrial life. For more information on this subject, go to the SETI@home website, *http://setiathome.ssl.berkeley.edu.*

Author Bio: Mike Vogel is a sophomore majoring in Mechanical Engineering and is working toward the T.C. Certificate.

Source: Renee Weinberger

Belleville, Wisconsin residents saw a UFO 14 years ago and honor this event with a parade each year. SETI@home is a great way for them to track down those aliens.

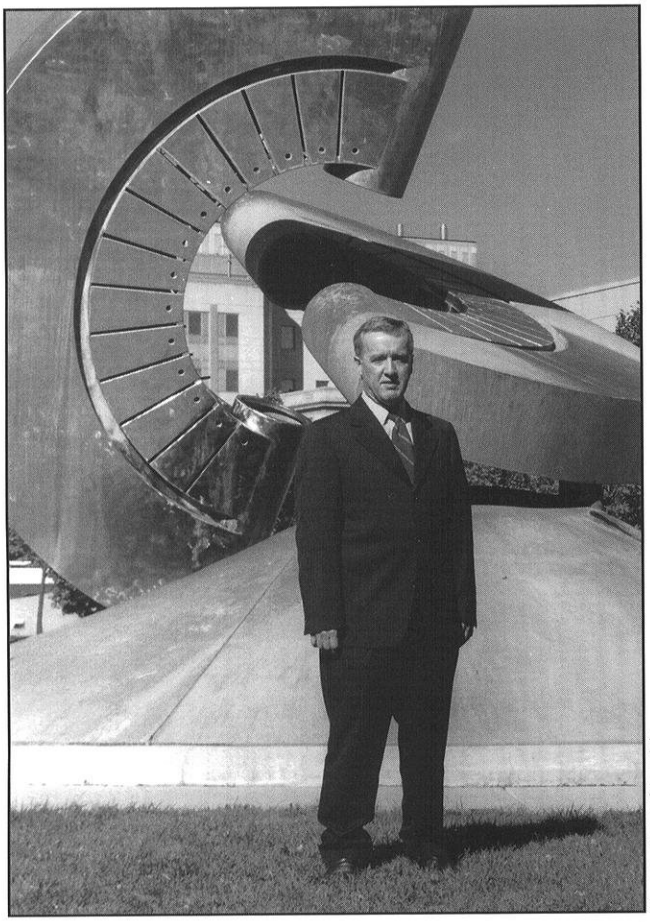
An Afternoon With Dr. O'Leary

By Tamara Larson

Most engineering students consider the Department of Engineering Professional Development (EPD) as the entity that organizes and manages the technical communication courses and requirements for engineering students. Although this is true, EPD also plays a major role in educating professionals already in the work field. The Chairman of the EPD Department, Dr. Philip O'Leary, P.E., shared some interesting information about his position as head of the department.

As a dedicated Wisconsinite born and raised in Janesville, O'Leary has an extensive history with the University of Wisconsin-Madison. O'Leary received his undergraduate and Masters degree in Agricultural Engineering and his Ph.D. in Land Resources from UW-Madison. O'Leary has been the Chairman of the EPD Department since 1995.

During the interview, O'Leary described the many different aspects of EPD and his involvement with the department. After getting through some of the more technical aspects of EPD, he talked about his own past experiences and how his travels to other parts of the world have given him additional knowledge and understanding—not only in engineering, but also in all walks of life.



Dr. Philip O'Leary P.E. is the chairman of Department of Engineering Professional Development.

WHAT IS EPD?

The EPD Department can be divided into two separate categories. The first feature is the Technical Communications Department, which includes undergraduate and graduate courses. Some of the more familiar classes include EPD 155: Basic Communication and EPD 275: Technical Presentations. There is also the Technical Communication Certificate available through EPD that allows engineering students to strengthen their communications skills.

The other side of EPD, which is run from the UW-Extensions Building, is intended for continuing education for engineers, architects, consultants and other technical professionals. Over 400 courses are offered each year in every aspect of engineering from construction management to chemical processing. Often courses are held in different areas of the country in order to accommodate engineering professionals who would rather not brave the cold Wisconsin winters. According to the EPD Annual Report of Outreach Activities, approximately 2,000 students enrolled in 1998.

These continuing education courses can be divided into two separate areas. The first half of these courses are designed for educating professionals on "cutting-edge" technologies while the other half of the courses are intended to give professionals a better understanding of fundamental engineering practices. For instance, O'Leary is the program director for a course entitled, *Designing and Implementing Alternative Earthen Covers for Waste Containment Facilities*. This two-day course falls under the "cutting-edge" technologies category because it is a brand new development in land resources.

O'Leary's accomplishments are as diverse as the students he teaches

Another faculty member on campus, Dr. Craig Benson, conducted a majority of the research for this innovative engineering practice and is one of the instructors for the course. O'Leary said, "the most likely candidates for [this course] are civil and environmental engineers, geologists and soil scientists." This seminar is held in Santa Fe, New Mexico, and runs in cooperation with the State of New Mexico Environment Department. (For more information on this course and other courses available through EPD, visit *http://www.epd.engr.wisc.edu*).

BEYOND EPD

Besides being the chairman of the EPD Department, O'Leary also administers a one-credit course during the spring semester for juniors, seniors and graduate students called *Implementing Pollution Prevention Strategies*.

He has been teaching this course for five years and believes that it gives students the opportunity to acquaint themselves with issues that they may not be familiar with until they enter into their professional careers. The course includes a number of field trips so that students can tour facilities and observe these strategies first hand. Some of the facilities included Babcock Ice Cream, UW-Madison Heating Plant, Madison Metropolitan Sewage Plant and Springs Manufacturing in Middleton.

O'Leary recognizes some differences between college students and engineers already in their career. The most obvious difference between the two groups is the variation in experience. He said this is to be expected because, besides internships and co-ops, there is a limited amount of opportunities for college students to gain experience in the work force. He continued on, however, to say that "many experienced engineers might not have the technical background of engineering fundamentals because of the wide variety of backgrounds in which they come from."

[O'Leary] has also traveled internationally with the purpose of educating and training other individuals

The division of Engineering Professional Development that runs out of the UW-Extensions building is intended for the continuing education of engineers, architects, consultants, and other technical professionals.

Even though O'Leary has taught a large variety of students and professionals here at UW-Madison, he has also traveled internationally with the purpose of educating and training other individuals. Some of the countries that he has visited include Hungary, Poland, Egypt, Saudi Arabia and Israel. While O'Leary was in Poland, one of his main tasks was to train local units of government that had gained control of the communities waste disposal departments from the federal government. O'Leary was responsible for, as he put it, "training the trainers." He aided in the organizing, instructing and directing landfill design and waste collection operations.

Most of O'Leary's travels out of the country were largely due to his involvement with the Solid and Hazardous Waste Education Center (SHWEC). He was the co-founder and co-director of SHWEC from 1991-1996, and according to him, the two main objectives of SHWEC are "to assist companies in pollution prevention systems and assist local communities in implementing recycling practices."

O'Leary's accomplishments are as diverse as the students he teaches. Over the last 34 years, he has played a role in educating thousands of individuals in many different aspects of engineering. I asked O'Leary what he enjoys most about where he is today. He believes that where he stands today gives him "the opportunity to pursue new interests and to become involved in technical issues." O'Leary's involvement with UW-Madison keeps him at the "cutting-edge" of technology, but at the same time allows him to educate others through his own experiences.

Author Bio: Tamara Larson is a junior majoring in Civil Engineering and Construction Management. She is an avid mountain biker and competes in the Wisconsin Off-Road Series. Look for her upcoming article on technological advancements in bicycle frame design.

ECS: The 'C' is for Convenient

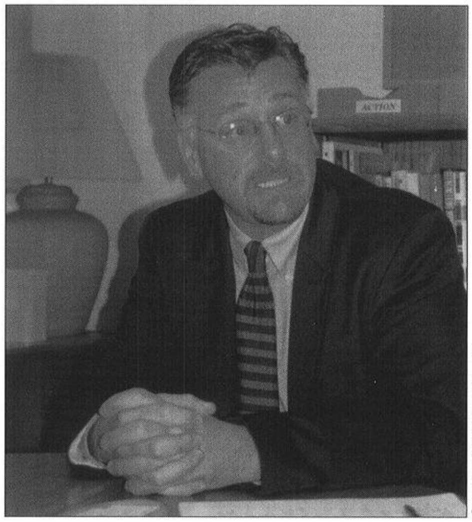
By Emily Smith

Engineering Career Services (ECS) at the University of Wisconsin-Madison has reduced its yearly expenses by $20,975. Since ECS has made its services available on the Internet for both students and employers, $18,368 has been saved on printing student resumes and $2,603 on the postage that would have been spent to send those resumes to employers. Besides reducing costs, the new online ECS system has made it more convenient for both employers and prospective employees to take advantage of the services ECS has to offer. It has also made these services available at the fingertips of anyone who is interested in the opportunity.

ECS began updating its system four semesters ago during the fall of 1999. Before that time, the primary method of signing students up for interviews with employers offering internships, co-ops or permanent positions, was for ECS to have a sign-up sheet available in Engineering Hall for students to register themselves on a first-come-first-serve basis for interviewing slots. ECS would then send the employer resumes of those students who woke up early enough to claim a slot.

'Besides being more convenient for both students and employers, and reducing [ECS] costs considerably, the new system is also much more ergonomically sound'

This method has obvious disadvantages. Students with keys to Engineering Hall could enter the building and get in line for high-demand jobs before the hall opened doors in the morning. "In addition," contributes Kathy Prem, assistant director of ECS, "students who were out of town or completing co-ops would not be able to sign themselves up for slots while they were away from campus."


Source: Bill Ketterhagen

John Young from Siebel Systems describes the benefits of the online ECS system.

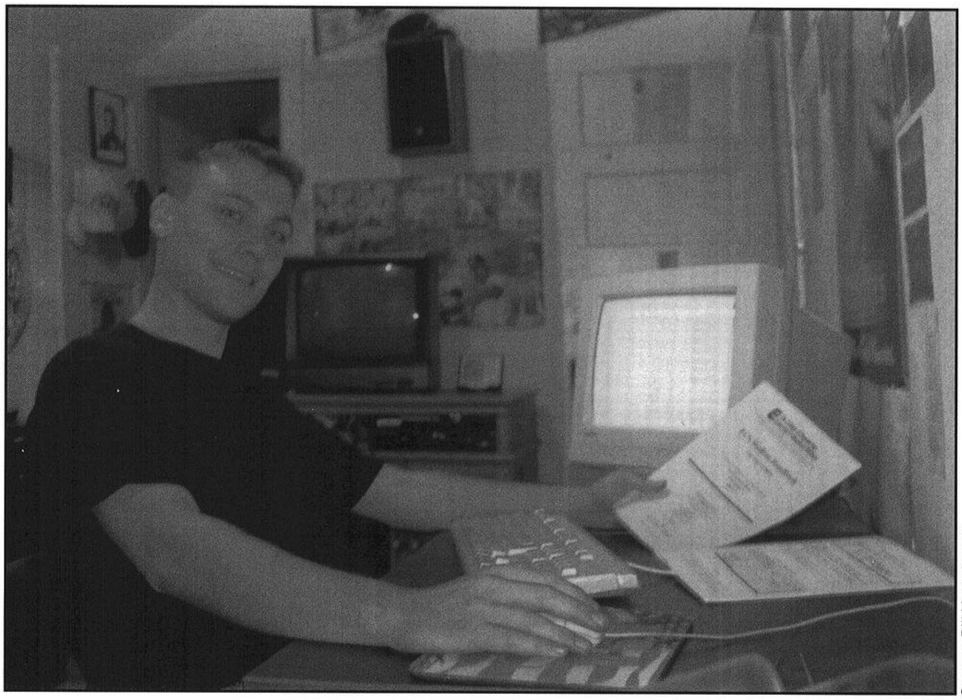
The old system was very primitive for employers as well. Companies had to hunt through a stack of resumes to find the qualifications of their prospective employees.

Companies can now access student resumes without having to hunt through papers, and they can pre-select student interviewees with very little hassle.

Tony Widjaja, a software engineer for National Instruments, states, "Searching through students' resumes was a very tedious and time consuming process, and multiple copies of student resumes would have to be made so that they could be viewed by everyone at the office."


Source: Bill Ketterhagen

Jeff Maxson, Panyawat Chattanrassamee, and Ben Socie (from left to right) relaxing in the lobby of Engineering Hall prior to interviewing.



Source: Bill Ketterhagen

The new online interview sign-up system allows students such as Ed Steele to sign-up for interviews in the comfort of their homes.

The updated ECS system now places all of its services for both students and employers right on the Internet. Students now post their resumes on the ECS website for companies to browse through. Employers are then able to pre-select students for possible interview times, and with a student's response, an interview will be lined up. Interview slots that go unclaimed are then posted on the ECS website for students to view. If competing students haven't already claimed all of the possible time slots, students are then able to sign themselves up for an unclaimed interview.

Employers are more than happy with the new way of setting up student interviews. Companies can now access student resumes without having to hunt through papers, and they can pre-select student interviewees with very little hassle. John M. Young, a senior corporate recruiter for Siebel eBusiness, utilized pre-selection to line up all of his student interviews at UW-Madison this year, and he comments that he "couldn't be more pleased with the student interest [in his company]."

The staff at ECS takes pride in the new system. "Besides being more convenient for both students and employers, and reducing [ECS] costs considerably, the new system is also much more ergonomically sound," comments Sandra Arnn, director for the College of Engineering Career Services. "So far," the director continues, "the majority of both students and companies have had an overall positive response."

Author Bio: This is Emily Smith's first time writing for the *Wisconsin Engineer*. Read her other article on page 6.

Students in Action: Engineering Organizations Update

Formula Racing

The UW Formula Racing team is on its way to building the most successful car ever to enter the Formula SAE competition that takes place in Michigan each May. The first semester of the year was dedicated to designing the 2001 car, and as the second semester rolls around, the manufacturing process in now in full swing. Over break, members of the team that spent any time in Madison dedicated much of their time and energy to the manufacturing of the car with hopes of having it done by March and ready for testing at Lot 60. The earlier the car is finished, the more time the team has to test the car. This maximized testing time ensures fewer problems with the car at competition, and hopefully even a first place finish!

This year, different from any other year, the team is already beginning work on the design for the 2002 car. With any luck, upon returning from competition in May, the team will be able to begin the manufacturing process as early as June for the 2002 car. The 2001 car is sure to be a success at competition this year, and with the extra time given by designing the 2002 car early, the timeline will be extended enough to give the team a little extra free time as well as enough time to test and present another award winning car in 2002.

If you would like to be involved in the manufacturing of the 2001 car for competition in May or the design for the 2002 car, contact either Rob Schellin (schellin@students.wisc.edu) or Greg Aykens (aykens@cae.wisc.edu) for more information or stop by the Formula office in the Mechanical Engineering building.

Polygon

Polygon as students on campus know it is the engineering student council. We try to help advance pre-engineers and undergraduates with various campus events and activities. We also try to promote engineering organizations with funding and collaboration on events these organizations host. Our meetings are open to all engineering students and held every other Wednesday starting on January 24^{th}, so please feel free to attend.

Some of the events Polygon hosted this past semester were the Pre-Engineering Bash, Advising Fair, a seminar on working with international companies and producing an engineering newsletter. Still, Polygon has a lot in store for this coming Spring semester. Polygon is planning on holding a Battle of the Bands, an Advising Fair, as well as a Dean's Spring Banquet honoring engineering student's accomplishments in academics and extra curriculars. Hope to see everyone at these events and good luck this semester!

ASME

ASME, It's What's For Dinner! Just as the new semester gets underway with tons of classes, homework and exams, ASME embarks on another rock star semester to give you a vacation from all that boring stuff. We have over 200 members every year and now we have 20 dedicated officers. It is a great way to get to know other ME's that share many of the same classes (and homework assignments) providing a way to network and get help in your classes. ASME plans activities for students to succeed in classes, prepare for the professional world, and meet new friends while demonstrating all the fun stuff that made you decide to become an engineer.

This semester ASME can be your ticket to the Chicago Auto Show, the Chicago Design Show, Relay For Life (a cancer fundraiser) and various other outreach events, numerous cookouts and bar socials, a winning E-week team, dinner twice a month, industry contacts, golf outings and much much more. The best part is that registration is free for all freshmen and 50 % off for all new members. If you want to get your feet wet with one of the biggest and most involved student organizations on the engineering campus then come check us out. We have meetings every other Tuesday at 5:30 in room 159 Mechanical Engineering.

This is going to be one of the most exciting semesters ever since we are hosting the largest regional conference of the year in March. It is our first chance to host the conference since the early 70's (what a party that must have been).

COME CHECK US OUT! YOU WILL NOT REGRET IT!

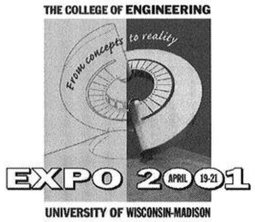
Website: http://www.cae.wisc.edu/~asme

Email: asme@cae.wisc.edu

Future Truck

The University of Wisconsin's FutureTruck Team is busy improving last year's hybrid-electric Chevrolet Suburban, nicknamed the "Moollennium". The goal of the four-year competition is to create a fuel-efficient, low emission vehicle. Last year was the first year of the truck competition, and it was held in Mesa, Arizona. The UW FutureTruck team walked away with 4th Place and more individual awards than any other school. This year, the team is making improvements to the truck that could not be done last year in the six months that they had the vehicle. Some of these improvements include a second-generation aluminum frame and reducing another 200 lbs out of a vehicle that is already the lightest in the competition. Other innovations for this year include using titanium. FutureTruck 2001 will be held at General Motor's Proving Grounds in Milford, Michigan ending with a road rally to the Capital steps in Washington D.C.

Engineering EXPO



Engineering EXPO is back! Engineering EXPO is a biennial, student-organized technology exhibition at UW-Madison's College of Engineering, featuring more than 90 industrial and student exhibits. With a crowd of nearly 16,000 students, faculty, and guests at previous EXPOs, UW-Madison's College of Engineering was able to acquaint the public with recent technological advances and Engineering exhibits through EXPO. Engineering EXPO 2001 will be a successful learning environment and interest fest for all those who attend. If you would like to have a display at the EXPO, please fill out the online registration form on our website.

Highlights of Engineering EXPO 2001:

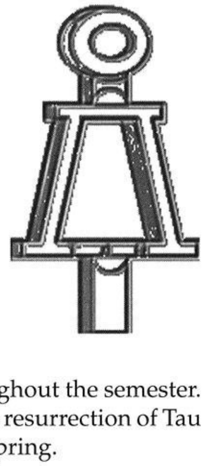
* Industrial Exhibits
* K-12 Student Days
* Robotics Competition
* Student Exhibits

WHEN: Thursday, April 19 - Saturday, April 21, 2001
LOCATION: UW-Madison Engineering Campus (north of Camp Randall)
TICKET PRICES: Adults - $4 at door, $3.50 in advance; Senior Citizens/Students - $3 at door, $2.50 in advance; Children 4 and under - FREE
MORE INFORMATION: Contact us by phone: (608) 262-5137, fax: (608) 262-8091 or www.cae.wisc.edu/~expo

Triangle Fraternity

Triangle Fraternity is serious about scholarship, sets and demonstrates high standards, and celebrates achievement. Our membership is composed of students majoring in engineering, architecture, and the sciences. This is done to bring together outstanding men with similar course work and career goals. Triangle understands the balance between academic, social, and athletic success and strives to attain a level of excellence in each of these three areas. We maintain a friendly, comfortable atmosphere where lifelong friendships can be made and well-rounded individuals are created. For more information, visit our web site at http://www.cae.wisc.edu/~triangle, or contact Tom Kaboski, at 231-2304.

Tau Beta Pi



Tau Beta Pi, an engineering honor society representing the entire college, looks forward to initiating another group of eligible students and keeping current members active in the organization and Madison community this spring. Initiation involves a variety of activities including hours of community service, an ALPS course in team building and sand casting of the society's symbol in bronze. Members will have more opportunity to enjoy short- and long-term volunteer projects and can look forward to industrial and social meetings throughout the semester. Plans are made for EXPO, a Pi-Mile Run and the resurrection of Tau Beta Pi's Bent Challenge! It should be a great spring.

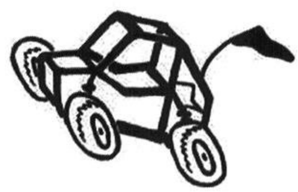
American Society of Agricultural Engineers

Members of the American Society of Agricultural Engineers serve in industry, academia, and public service. They each have broad training in various engineering disciplines, and they all share a key commonality: agricultural engineers are uniquely qualified to determine and develop more efficient and environmentally sensitive methods of cultivating food and fiber for an ever-increasing world population. Founded in Madison, Wisconsin in1907 and headquartered in St Joseph, Michigan, ASAE comprises 9,000 members representing more than 90 countries.

Agricultural engineering encompasses many different disciplines such biological engineering, food and process engineering, information and electrical technologies, power and machinery, soil and water, and structures and environment.

Student activities include Scale Tractor Pulling, Environmental Design Competition, field trips, national conventions, and etc. Students interested in the American Society of Agricultural Engineers are welcome to attend one of our Preprofessional club spring semester meetings. The meeting dates are: February 7th, March 7th, April 4th, and May 2nd. More information can be obtained by contacting Jill A. Grodecki at jagrodecki@students.wisc.edu.

SAE Mini-Baja



A 10 hp Briggs and Stratton sends our single passenger car through the mud and rocks. The 15-inches of travel in the suspension and 24-inch thick tread Titan wheels can handle the roughest terrain and still reach 35 mph in a straight. UW Baja has developed a legacy of tough cars in competition and has brought home 1st and 2nd place in the last two competitions. Members learn to design, build and race cars while gaining valuable engineering experience. To learn more about UW Baja visit our website at www.cae.wisc.edu/~baja or e-mail us at baja@cae.wisc.edu. It's fun in the mud that you can put on your resume.

AIChE

The American Institute of Chemical Engineers has a busy and exciting semester ahead. From the informational viewpoint, AIChE will have meetings with Cargill and 3M along with other possible industries. Abbott Laboratories will be the destination of a trip in the near future. Bridging the gap between work and play, Madison will be hosting Regional Conference on March 1-4. AIChE also takes a ski trip to Cascade Mountain and plays intramural basketball, volleyball, ultimate frisbee, and softball. It should be a great semeseter. Get involved by stopping by the meetings every other Wednesday, visit the website at www.cae.wisc.edu/~aiche, or e-mail via aiche@cae.wisc.edu.

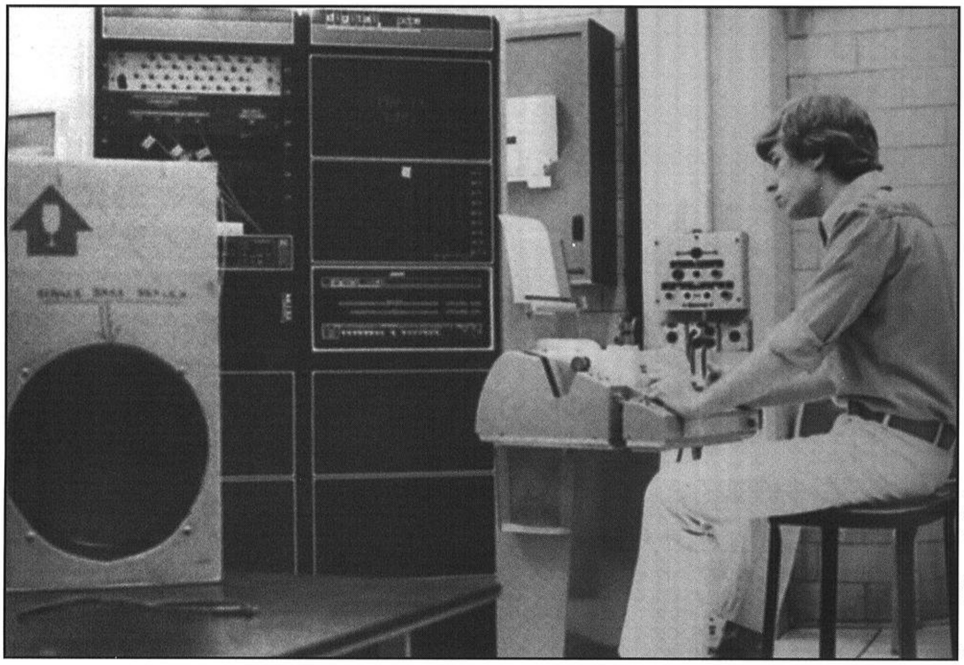
Computer Music

In this age of MP3s, Napster and CD-ROM, listening to music via the computer is not revolutionary. In fact, each day the millions of people jamming to their favorite music while typing away at work or surfing the Net do not give a second thought to the technology that allows them to do so. In this article, reprinted from the April 1977 issue of the Wisconsin Engineer, we can see just how amazing the idea of computer music really was at its roots.

By Alan Olson

Traditionally, computers have been thought of as high-speed tools to aid people in solving complex problems. While this is most certainly true, there exists another whole world of applications to which computers are ideally suited. This is the world of "Real Time" applications. Real Time means that the computer must now function within the time limitations set by some process or processes external to the computer itself. While a computer may be able to solve complex mathematical problems with great speed, this speed is not infinite. In fact, when one must deal with some external process, the speed with which the computer operates becomes quite critical, and may in some cases be simply too slow to perform adequately. There is a host of applications, however, which the computer can perform satisfactorily and synthesizing music happens to be one of them.

Our music synthesis scheme is by no means unique. Much has already been done at other major universities using equipment for [sic] more sophisticated than we have available. However, our equipment performs quite well in this particular application, given or performance criterion. We are using the PDP - 11/20 and PDP - 11/40 minicomputers along with conventional audio amplifiers and speaker systems to make the sounds audible. Our scheme is able to synthesize 4 simultaneous invoices available to each part. It should be noted that the computer must be told what to play as it has no ability of its own to compose musical pieces. All of the required information is stored in the computer's memory and is then recalled as needed. Our system has enough memory to store many hours worth of music of many different varieties.



Source: Wisconsin Engineer

This computer plays Bach, Mozart, and even Scott Joplin.

One may ask, "How is a computer able to synthesize music such as this?" As we all know, sound consists of time varying waves of air set into motion by some sort of transducer. This can be your own vocal cords or, in our case, a conventional speaker system. The electrical signals which the speaker transforms into sound can be produced by a variety of methods. A computer generates electrical signals using a device called a "Digital to Analog" converter. This device takes a number stored inside the computer and generates a voltage corresponding to that number. Thus, by varying these numbers through a stored sequence, a time varying electrical signal results which may then be transformed into sound. By using four such devices, one can produce four sound sources, as we have done.

In this age of MP3s, Napster and CD-ROM, the creation of music via the computer is not revolutionary

Our synthesis scheme, though somewhat impressive, is really quite crude. Much more sophisticated schemes exist such as the ARP and MOOG synthesizers, which are commercially available. Our equipment is simply to show to perform as well as these fine instruments. However, we have learned a great deal about real time computer applications and are seeking better ways all the time.

Hybrid Computer Lab

A New Tool For Science

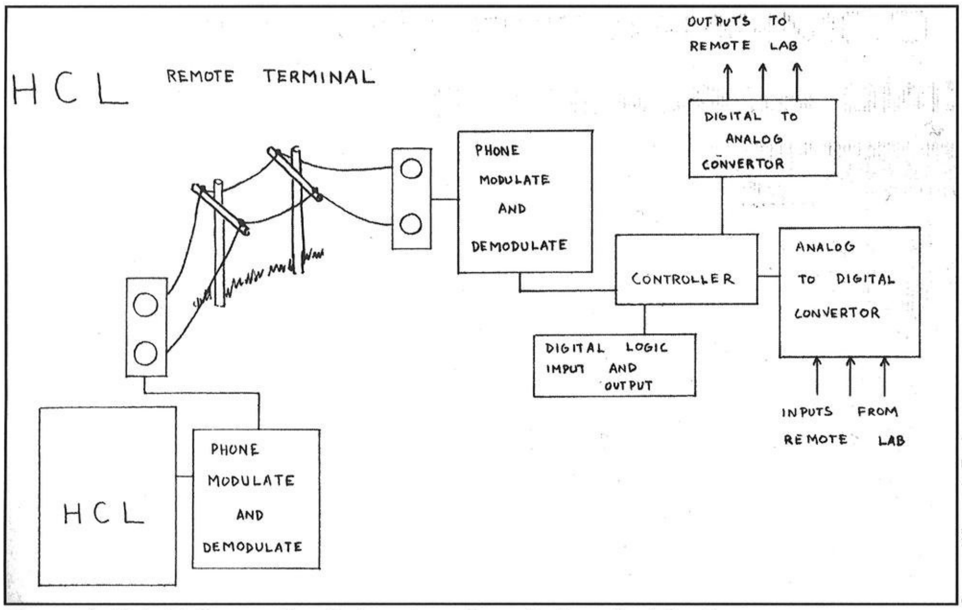
Biomedical Engineering has been gaining importance and popularity in the last few years. Biomedical Engineering became a department at UW-Madison only in June 1999, but important research has been going on since the 1960s. Here is an article reprinted from the November 1972 issue of the Wisconsin Engineer about the latest technology used to model the human body.

By Daniel Greco and Ken Kuehl

The Hybrid Computing Laboratory (HCL) on the University of Wisconsin Madison Campus combines the speed of a digital computer with the capabilities of the analog computer to provide new avenues of research in various areas of Science and Engineering.

The HCL, introduced in 1965, is located in room 1101 of the Engineering Research Building where it is used primarily by instructors and graduate students.

Scheduled for completion in December, the Remote Terminal System will enable users throughout the state to have access to the HCL facilities via telephone wires (See Fig. 1). Plans are also being made to link the HCL to the Univac 1108 in the Computer Science Building thereby upgrading the capacity of the system.



Source: Wisconsin Engineer

Figure 1: Hybrid Computing Laboratory Remote Terminal System

The advantages of the HCL can be seen in its uses and capabilities. The machine lends itself to simulation or modeling of complex systems. It can be used for solving simultaneous differential equations and date reduction. Recently, the HCL has been used to model biomedical functions and environmental systems.

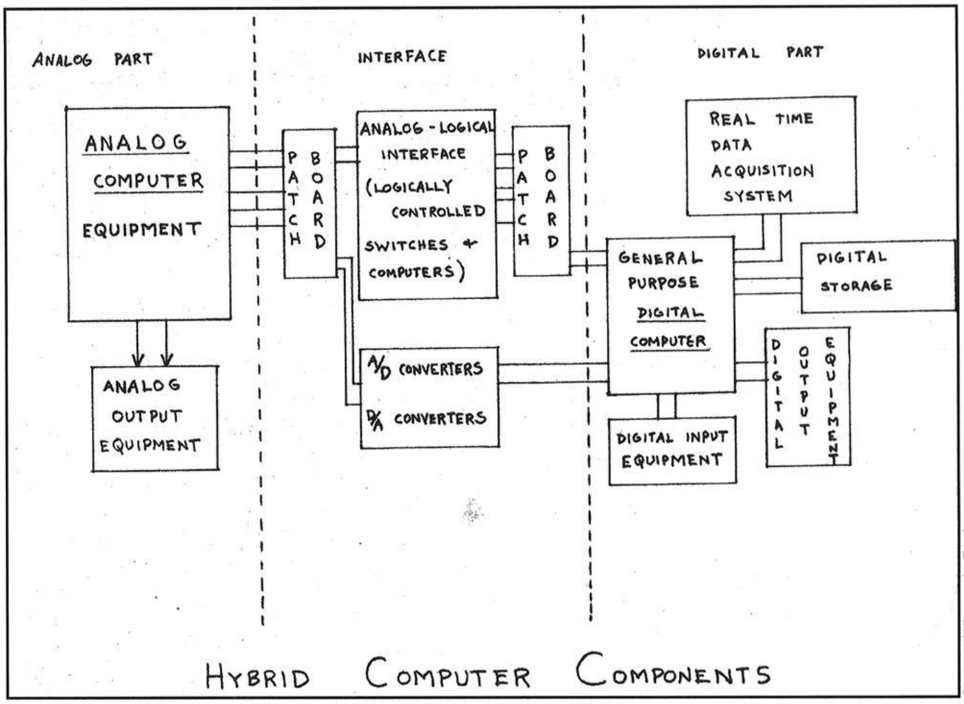
The versatility of a Hybrid computer is due to its composite structure utilizing two interconnected computers; the digital and the analog. The digital computer is basically a counting device capable of performing all of the basic math functions of addition, multiplication, and division, etc. It works very rapidly, but step-by-step in a sequence of discrete bits. Information such as a number is represented by the absence or presence of electrical impulse. This makes the amplitude of the pulse unimportant. The machine can store, or remember many bits of information being able to manipulate stored bits in virtually any desired way. However, it cannot show relationships between stored bits at the instant they are being generated.

The analog computer segment measures pulses. The amplitude of the pulse determines the numerical value of the information. Also, all data is fed into the machine and used simultaneously. This is necessary so that changes in parts of the data can be compared and related. Physical changes, such as the rotation of a gear or shaft, are coordinated mathematically as variables in differential equations. Since the analog computer is well suited for solving these equations, it can immediately show the effects of physical changes, as they are occurring. This is called real-time operation. Finally, the results are fed into the digital computer through an interfacing. The interfacing converts the analog solutions into binary (pulsed) form so that the digital computer can either proceed with further computations or store the answers. As an integrated team, the two computers make up for the shortcomings inherent in each. (See Fig. 2).

One example of Hybrid Computing in systems modeling is a project recently completed by Professor Vincent Rideout. With the help of NASA, the Wisconsin Alumni Research Foundation, and the U.W. Engineering Experiment Station, Professor Rideout modeled the cardiovascular-respiratory (cv-r) system of the human body, using approximately 120 different differential equations. The equations mathematically simulate the human heart, circulatory system, lungs, and the control systems present in the cv-r system. Valuable research is facilitated by the models, enabling researchers to reconstruct the bodily reactions when testing hypotheses regarding control mechanisms in the cv-r system. Further expansion of this system is to include a model of the body's muscular system thus bringing this project a step closer to becoming a tool which will provide medicine with more informations about the functions of the human body.

The initial need for a hybrid computer first arose in the 1960's in the then fast-growing aerospace industry. Investments by the government and other industries concerned with the space effort, gave the financial boost necessary to bring the hybrid computer into the field of science. Since then it has been recognized as an important tool with application in all fields of science.

Since 1965, the HCL has been updated by the installation of more modern input and output equipment increasing its versatility and capacity. The present equipment includes an analog and digital computer connected by various interface equipment and input/output devices. This input/output equipment consists of an 8 pen strip recorder from which about 80% of the output is obtained, a CRT, a voltmeter, a magnetic tape drive, a card reader, and a magnetic disc drive.



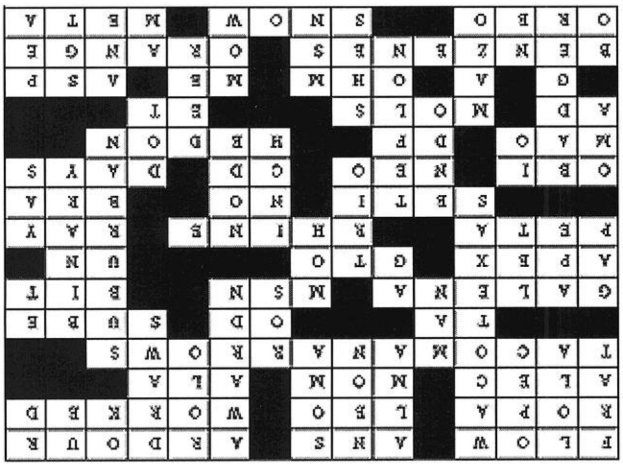
Source: Wisconsin Engineer

Figure 2: Hybrid Computer Components

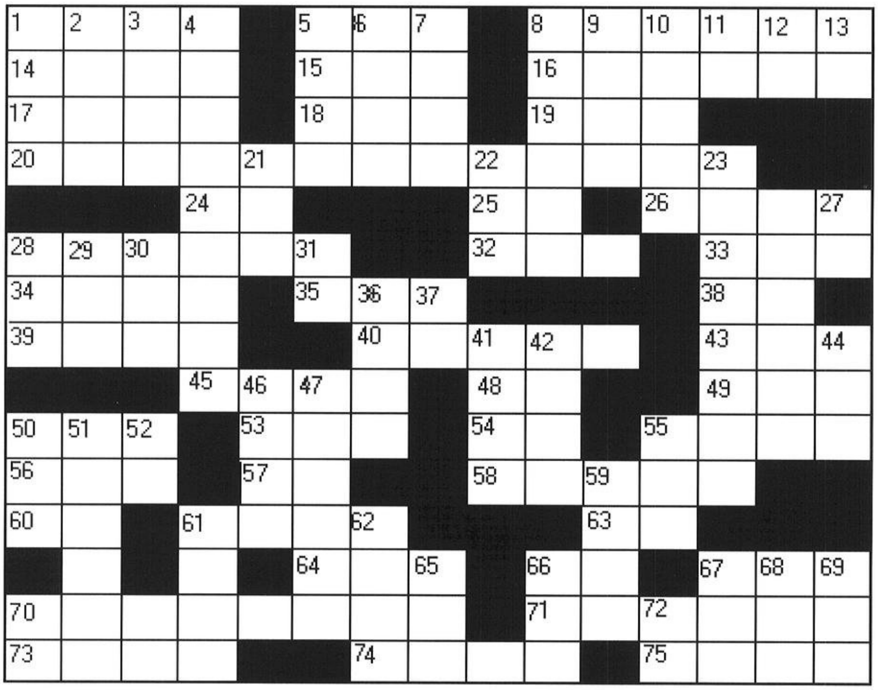
The Hybrid Computing Laboratory on this campus was made possible through the efforts of Professor Rideout, who was granted funds for the initial cost of the laboratory, and $500,000 from the National Science Foundation. The HCL is maintained by the University as a service organization under the U.W. Engineering and Experimental Station. The current staff consists of Professor Bollinger, the director, and Professor A. A. Frank, his assistant.

The Hybrid Computer facilities are open to anyone with an applicable problem. Currently 37 projects are being handled by the HCL, again illustrating its versatility and its ability to work in different areas simultaneously.

Solutions to Crossword on Page 24



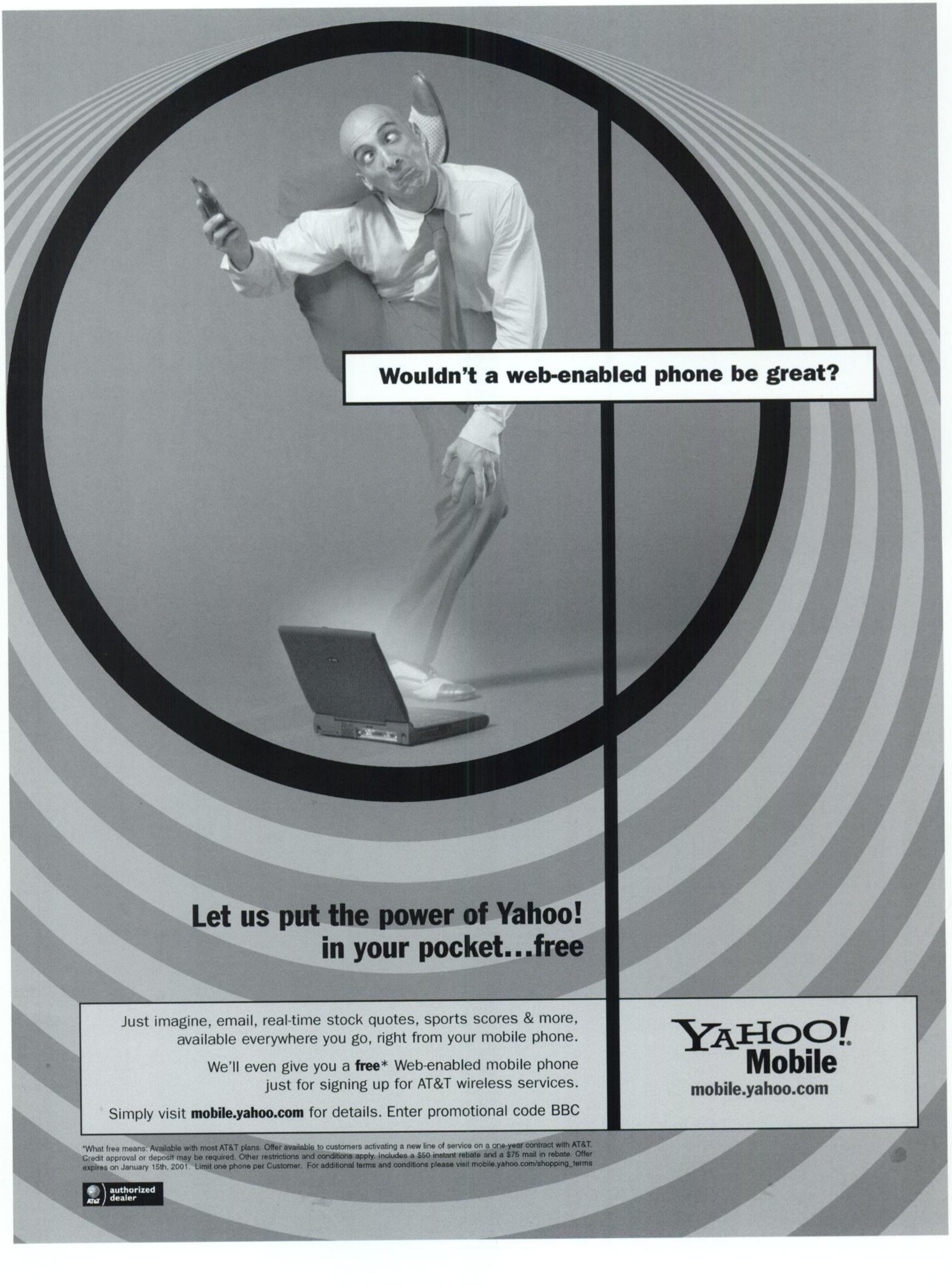
Just One More



Across:
1. flux
5. plural connective
8. passion (Br.)
14. clothing (Sp.)
15. August baby
16. toiled
17. A Baldwin
18. human childbearer
19. in the fashion of
20. Galloping Girdie
24. prof's aide
25. why one is in detox
26. Engineering/Business org.
28. Wisconsin state mineral
32. an ISP
33. Binary digit
34. peak
35. a classic car type
38. not
39. Animal rights gp.
40. River in Germany and Switzerland
43. gamma, beta, or IR
45. Alien search party gp.
48. negative response
49. busty restraining device
50. Star Wars character ___Wan
53. new
54. new-fangled record
55. anti-nights
56. Chinese chairman
57. Mexico ___ (Mexico city)
58. pleasure lover
60. current era
61. 6.02 $*10^{23}$ units
63. ALF was one
64. 19th century German physicist
66. Engineering dept. awarded the most money in scholarships last spring
67. Egyptian viper
70. aromatics
71. citrus
73. cookie
74. poor television reception symptom
75. benzene prefix

Down:
1. college male residence
2. "Run ___ Run"
3. oil org.
4. Reno's disaster site
5. "___mater"
6. noble gas
7. Wisconsin Engineer writing editor
8. accolades
9. caramel candy
10. sketches
11. agree
12. urban exploration abbv.
13. study and advancement
21. male homo sapien
22. memory
23. FutureTruck
27. see 64 across
28. popular clothier
29. impersonate
30. rent out
31. an engineer who might work for Deere
36. three some
37. exclamation of surprise
41. unused measurement
42. stationary point in a wave
44. slangy assents
46. internal prefix
47. CF_2 polymer
50. grandma (German)
51. Madison mascot
52. Jupiter's fifth moon
53. part of a web address
59. road vermin
61. Nude beach in Wisconsin
62. "___ all that"
63. see 32 across
65. yard chore
66. chemical suffix
67. army rank
69. green legume
72. radio choice

Solution on page 23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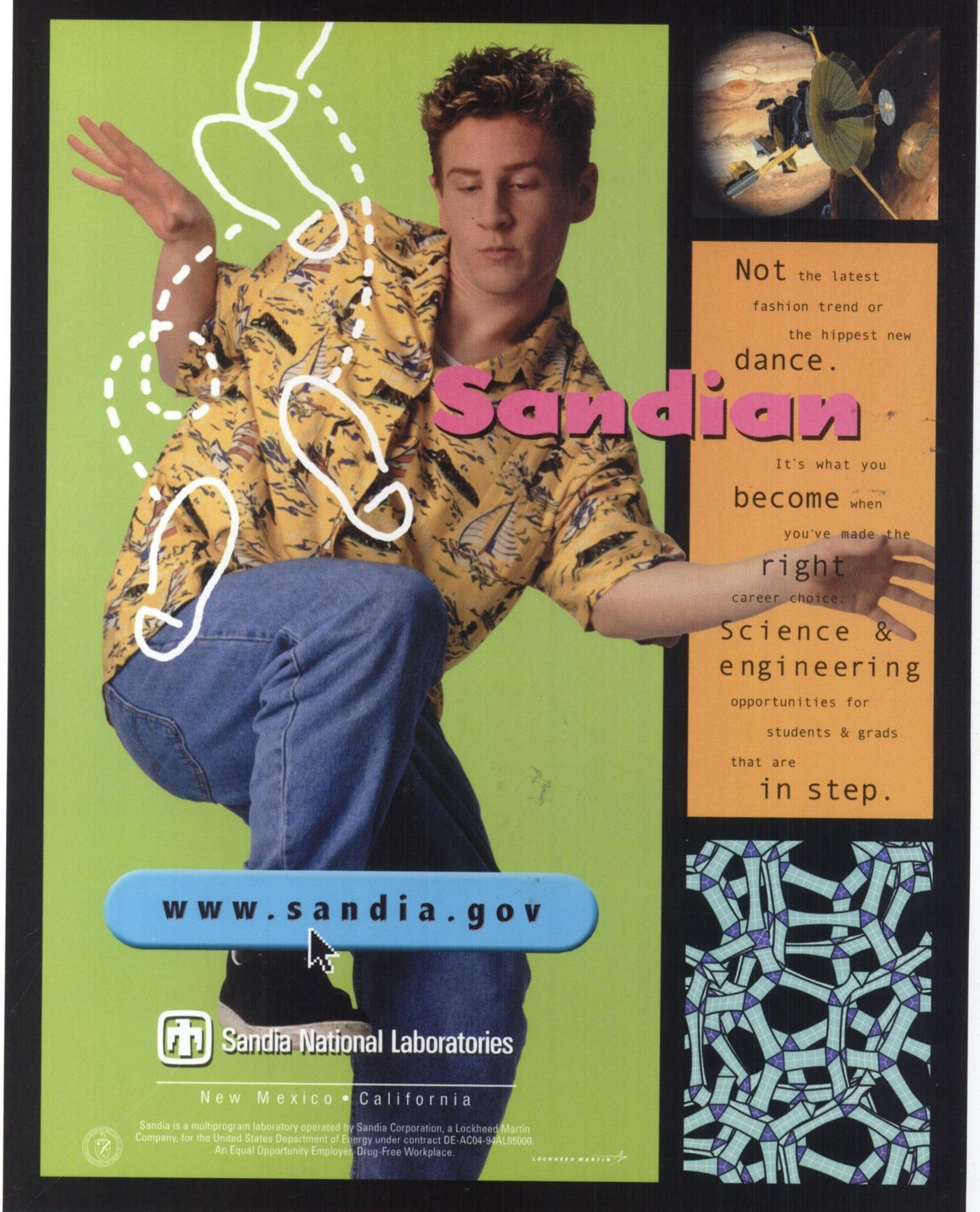
AT&T authorized dealer



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