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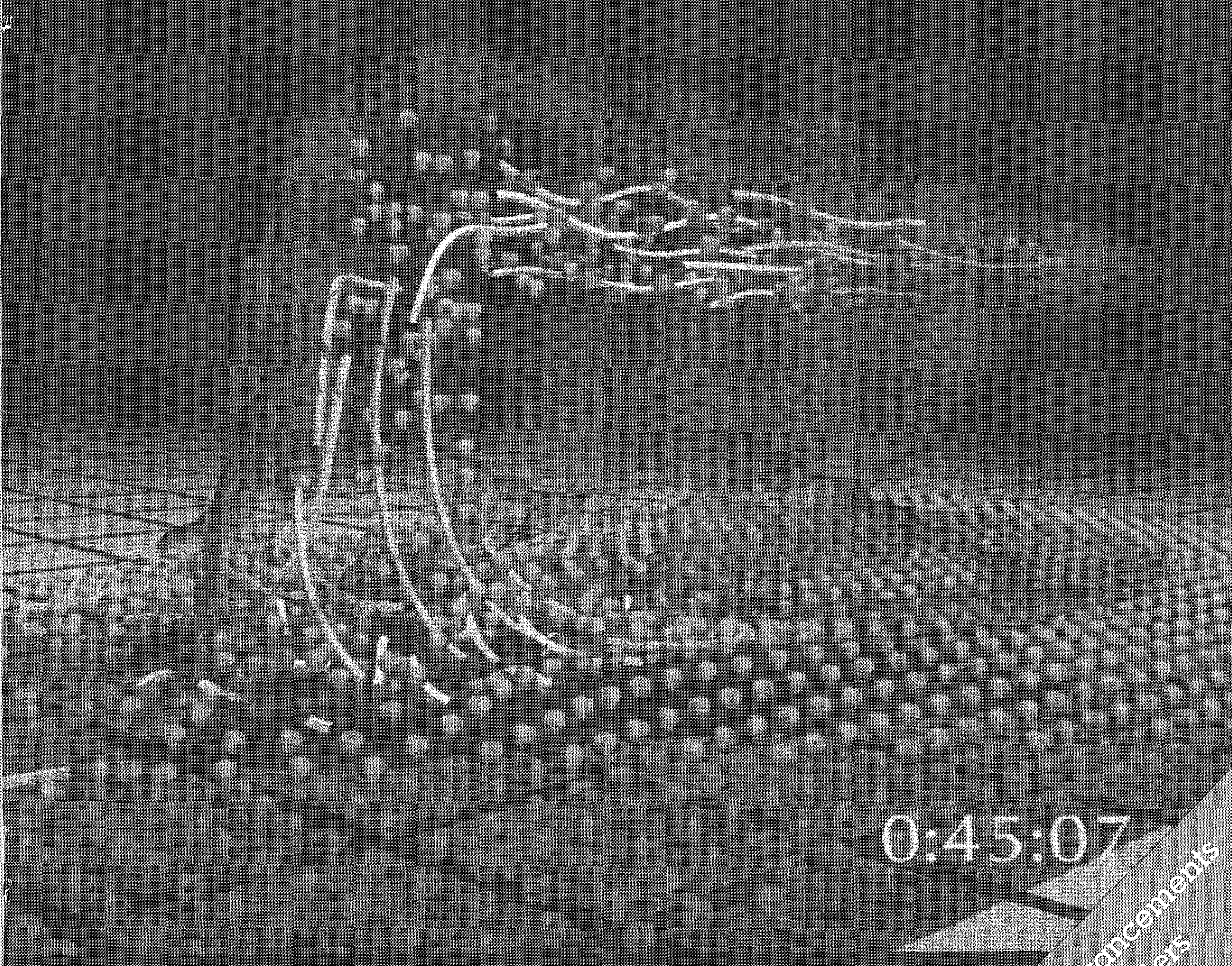
TECHNOLOG

September/October 1991



Automotive Advancements
Supercomputers
MIDI

IMMIGRATION LAW SEMINARS

October 16, 17, 28, 29

WHAT FOREIGN STUDENTS NEED TO KNOW!!

On September 29, 1990, President George Bush signed into law a New Immigration Act which makes significant changes in United States Immigration Law. Many of those changes will become effective on October 1, 1991. Some of those changes affect the process by which foreign students may obtain long-term employment after graduation, and are very helpful. However, under the new law it may become more difficult to obtain H-1B Temporary Work Status. The seminar will help you understand the new law. At the Seminar, you will be able to ask questions about specific issues of concern to you. You may submit questions in advance to Attorney Richard Breitman by sending them, with your Registration, to the address stated below. Attorney Breitman has more than 7 years experience in Immigration Law.

You must start planning for your future immigration status well before you graduate!!

WHO WILL CONDUCT THE SEMINARS???

The Seminars are sponsored by the **Law Office of Richard Breitman**. Attorney Breitman has been the Chairman of the Minnesota/Dakotas Chapter of the American Immigration Lawyers Association ("AILA") for the past two years and was recently re-elected to serve a third year. He is a member of the National Board of Governors of AILA. Attorney Breitman has organized seminars at the University in the past, and he has spoken about Immigration Law to many groups, locally, statewide, and nationally.

Seminar Location:	**Radisson Hotel Metrodome University of Minnesota In the "Medical Room" Address: 615 Washington Ave.**	**Across from the University of Minnesota Hospital Bldgs. on Washington Ave.**
Dates of Seminars:	**October 16, 17, 28 & 29**	**7:00 p.m. to 10:00 p.m.**
Registration Fee:	**$15 per seminar if paid at least 5 days before seminar.**	**$25 per seminar if paid less than 5 days before seminar.**

Your Name: ______________________________ Your Phone: ____________________

Your Address: ____

Seminar Date: [Circle the Seminar Date you will attend] **October 16, 17, 28, or 29**

I would like to Receive the New Publication: "The Immigration Newsletter" ___Yes ___No

To Register, Photocopy this Form, Fill in the Information and send it, with your check made out to:

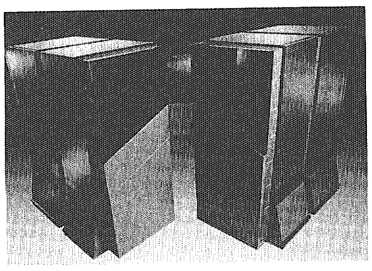
Law Offices of Richard L. Breitman
701 4th Avenue South, Suite 1440
Minneapolis, MN 55415

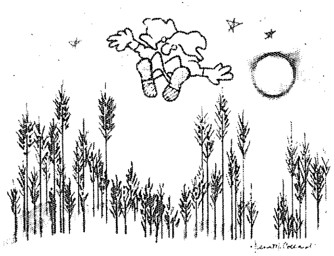
If you have any questions, please call Attorney Breitman at **822-4724**.

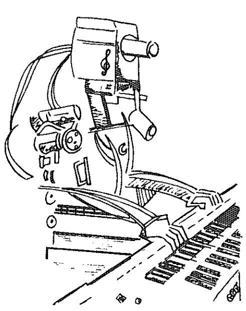
INFORMATION PROVIDED BY YOU WILL BE KEPT STRICTLY CONFIDENTIAL

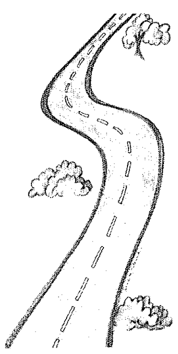
TECHNOLOG

Volume 72, Number 1 September/October 1991









About the Cover...
The weightless balls pictured moving with the wind depict air motion within and surrounding a modeled severe storm. This image courtesy of Robert Wilhelmson, National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign.

Departments

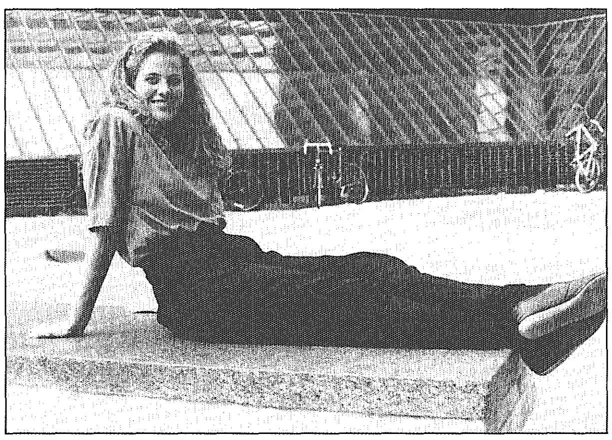
Editorial

Confessions of an Electroholic

"...Hi...my name is Laura S...and I'm an electroholic. I've been hooked on electrical devices for well over twenty years now. I can no longer deny my addiction. It had all started out so innocently...

I once lived a wonderful life with a nice job, a good husband, and 2.5 beautiful children. We laughed and loved in our house with the white picket fence. Life was great; that is until my husband brought home that first remote control. He said it would make life simpler, little did we know.

Everything moved quickly after that. Before we knew it, we owned every electrical gadget you could imagine—a VCR, a microwave, CD player, digital watches for the kids and the dog. Then a chip blew in our silicon world, and life has been nothing but a blinking 12:00 ever since.



First, I noticed the kids having problems in school. They were failing basic math, and I couldn't understand what was wrong—that is until they told me that the teacher wouldn't allow calculators. Talk about unfair!

Then it was my job. I was consistently tardy and couldn't explain why. Of course it all made sense when I discovered my digital alarm clock had a faulty battery. For some crazy reason, though, my boss didn't think that this was a valid excuse. Go figure! She terminated me, but not before I put a magnet in her computer files.

As if this was not bad enough, my CD player broke later that day. Near as I can figure, it happened just after I tried to shove one of those black, old-fashioned CDs into it.

Since I couldn't listen to music, I invited a friend over for popcorn and a movie. Unfortunately, with my microwave down, I couldn't possibly make popcorn. Much to my disbelief, my friend told me there was another way. I'm still not sure how she counted the individual kernels without an adding machine. It was no use, though, even with the popcorn, I just couldn't get my mind off the day's events.

In a final attempt to relax, I took the family to the Boundary Waters. However, much to our horror, we just could not find the electrical outlets. We couldn't wash, we couldn't cook, and the kids couldn't play Nintendo! It was Hell. Since we had no use for the microwave dinners we'd packed, we decided to find the nearest McDonald's. Sadly enough, we weren't going anywhere. For some strange reason, we were given a canoe without a motor.

Eventually, I ended up a shriveled mass in front of the television. But catastrophe followed me even here, for I was doomed to watch endless hours of the Home Shopping Network. I searched high, I searched low, I even searched in between—but I simply could **not** find my remote control. Finally, I just gave up and decided to call the shop. Just my luck, the battery on my cordless phone gave out, and I still haven't mastered those rotary dial do-hickies.

Driven to the end of my wits, I staggered into my trusty, old Mitsubishi and plowed through the garage door (guess what else was lost!). In a daze, I drove for what seemed like miles to the emergency room. Thinking back on it now, it was probably only about 2 blocks, but I can't be sure—my calculator is still broken.

Photo by David Sagar

The doctors gave me some pills, told me to keep warm, and, '...for God's Sakes, **stay away from electrical conveniences!'** This did nothing but aggravate my condition, as I obviously could not use my electric blanket and had no idea how to use those conventional ones.

Back in the emergency room, this time near death, I was finally admitted to the Electrical Dependency Ward. I am now able, through the 'miracle' of technology, to breathe and eat.

How could I have come to this? Looking back, though, it had all seemed so right at the time. I can only hope none of these machines break..."

"...Good morning! It's seven o'clock here at KQSX! Rise and shine, you lazy bum..."

My radio alarm shook me from my nightmare. As I Waterpiked my teeth, I thought, what a foolish dream!

Laura E. Sokol

TECHNOLOG

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Perspectives

2000: A New Generation Begins

by Christos Zachariades

Every aspect of life is improving each year. Likewise automobile styling, engineering, performance, accommodation, and safety are improving. Cars of today cost much more than those of twenty years ago. Neither the tax nor the labor costs justify the higher price, though. Greater sophistication and more detailed equipment used in today's cars cause this price upswing.

Automobiles are faster and more economical now, engine efficiency has risen a bit, safety has progressed, and emission laws have forced car manufacturers to become environmentally conscious. On the other hand, few cars are significantly more comfortable or space-efficient than their predecessors. High costs developing new models adds to this slow progression. Manufacturers are more thoughtful before trying something new because of the expensive risk they take.

Will things change in the next decade? The answer is, probably, yes. There is an aspect of the car industry's purpose that was not mentioned—reliability. This is due to production engineering and grade automation that will bring a great revolution in the near future. Car manufacturers base their future plans mainly on automotive electronics.

For a car manufacturer, there is one task to fulfill: "Always be the best among your competitors." Competition has two meanings—competition in the race and competition in the market. Both have the same net result. Manufacturers are researching for ongoing improvements and advances that are also economical and affordable to the customer.

The future technology aims for more powerful and efficient engines, better aerodynamics, safety, reliability, comfort, fuel economy, and drivers' information. From the mid 1960s when the first electronics were installed up to the present diodes, discrete transistors, and microprocessors, technology in automobiles advances. Some of the first applications were the radio and the electronic clock. At a later stage, these independent components were linked together. In the last few years, electronics have produced anti-lock brakes, display panels, and cellular telephones to name a few.

Present designers rework existing models by replacing various parts or adding new enhancements to the vehicle, a process known as the "add-on policy." In the future, designers will rely on electronics for performance improvements.

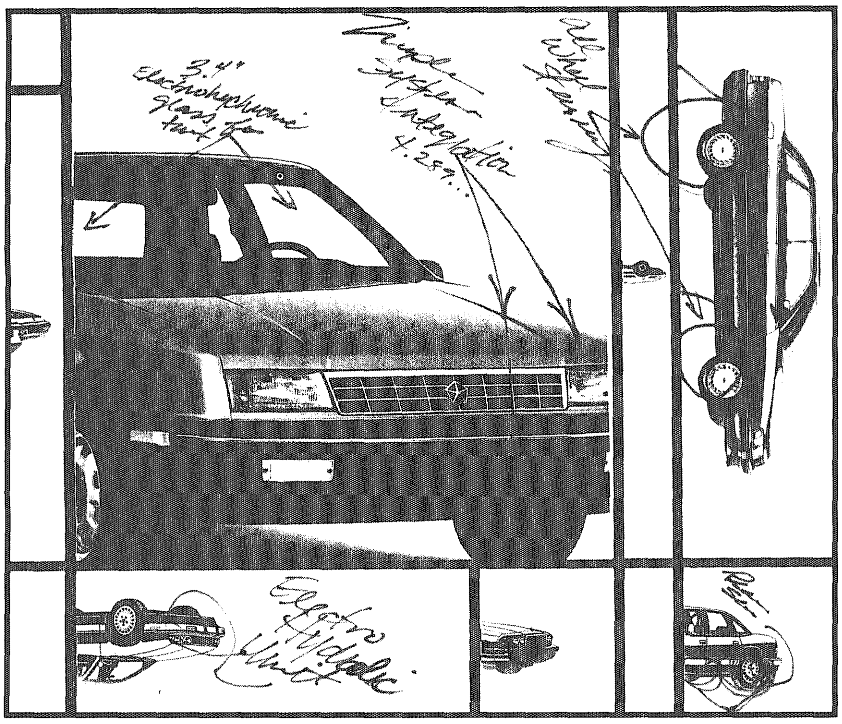
To achieve more power, the transmission and the engine will be electrically linked into one unit. The transmission will be highly adaptive so that the controller will shift, adjusting torque and drive ratio to any change of speed. The driver will easily have control under all conditions.

In development, a triple system integration will combine steering, brakes, and suspension. An electronic system will be added to the suspension system, controlling spring rate and independently damping each wheel. An electro-hydraulic unit will modulate devices to control shock absorber damping.

All-wheel steered vehicles will be available in almost all models. The rear wheels will be controlled electronically based on the speed, displacement, and other input. This will improve the car's maneuverability, simplifying parallel parking and lane changing.

A traction control system will integrate braking with the power train to achieve both maximum acceleration and minimum stopping distance, thus reducing the risk of collision. The system combines sensing devices like radars, lasers, and infrared detectors, fixed around the vehicle to monitor the presence of collision risks. The information gathered by the sensors is analyzed by a computer that forces the vehicle to reduce acceleration, apply brakes, or even tighten seat belts.

By the year 2000, the information available to the driver display and control will change amazingly.



Vehicle speed will be available by a holographic display. Other information will be accessed by a multifunction display panel based on liquid crystal, vacuum fluorescent, or light emitting diode technology. Even maintenance related data, alarm conditions, and audible or visual instructions will be available. A voice recognition system will be installed for use in entertainment, driver information, display mode selection, and telephone dialing.

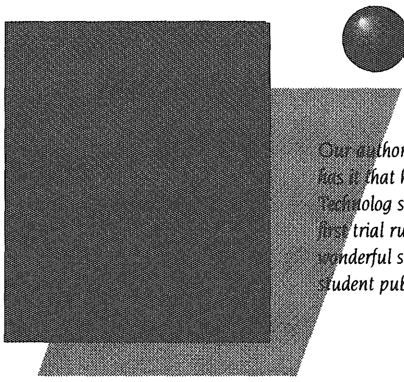
The climate control system will be affected by automotive electronics. Temperature, humidity, and air sensors available around the passenger compartment will adjust the climate condition quickly and automatically. The interior will consist of different zones, each operating independently. Electrochronic glass will be used to moderate sun loading so that, in case of hot weather, the glass will become darker.

Passenger seats will be able to change their configuration through voice command. The automobile entertainment system will mainly be an audio system, although some video application should be available. A fully automatic equalizing system will optimize the quality of sound delivered to each passenger based on sensors distributed to each passenger zone.

Navigation systems will be available in future cars. Maps will be stored on CD-ROM, easily accessed by the driver through a digital screen. The CD-ROM will also provide yellow pages information. Satellites will be employed in order to track a vehicle's geographic location and provide the driver with traffic information.

To achieve such innovation, other electronic developments are necessary, mainly, a new power distribution system. This system will increase power from 1 kW to 3–6 kW, and will include dual voltage of 12 and 48 volts. Also, a network is necessary to adopt information to the vehicle's central computer. The several computers on use will need to develop the appropriate software. Advances are also necessary on semiconductor devices, actuators, sensactors, digital and signal processing or voice recognition, and new silicon chips which have a large memory.

Automobile technology is still in the early stages. According to engineers, however, the future is not far off. These advances will not be the last in the evolution of automotive electronics. Perhaps the next stage will be an automobile that can "communicate" with the external environment—another step towards the self-controlled car.



TECHNOLOG

Writer Profile

Our author, Christos Zachariades, has flown the country. Rumor has it that he now resides in Cyprus...but don't tell the CIA. The Technolog sent out its new-fangled satellite photography unit for its first trial run and the results were spectacular. It captured this wonderful shot of Christos on a rare foggy day. (This is, after all, a student publication.)

Illustration by Dena M. Collard

CDs: A Trendy Piece of Decorator Plastic?

by James Sater

Compact discs seemed like a dream come true in 1983. Excited music fans thought the laser disc would be the plateau of music evolution, and rumors spread that brand new CDs would last a millennium without any signs of deterioration. Skeptics, on the other hand, worried that the compact discs of the present might die out as quickly as the 8-track tapes of the 1970s.

In the eight years since CDs first entered the marketplace, optimistic consumers and cynical critics alike have realized the disc's true impact and limitations. With this new awakening, compact discs are now viewed as a surprise hit *and* a great disappointment.

While a CD looks something like a small, shiny record, it's far more technologically advanced than a record. The digital form allows compact discs to avoid the losses of quality inherent in standard records and cassettes.

The production of a compact disc entails the sound to be broken up by a computer into approximately 44,100 segments, or samples, which are printed on the disc. These segments are read individually by a laser inside the compact disc player. A light-sensitive device then creates electrical signals based on the reflected light. The amplifier then sends these electrical signals to the speakers and converts them to a high definition, very clean musical reproduction.

Despite early complaints that CDs were too expensive, roughly twice that of records or cassette tapes, CDs have survived. Not only have they survived, but they have thrived. So much so that today they comprise about 30 percent of music sales in the United States. Cassettes make up 65 percent of the market, and records, now virtually obsolete, constitute the other five percent.

Most music critics say that compact discs have helped bring contemporary music out of the slump it was in 10 years ago. Because CDs can play back sound more clearly than records and cassettes, recording artists have been forced to make higher quality music. Likewise, the flexible, 74-minute format of compact discs allows musicians to release longer albums that sound more linear than cassettes that have a distinct "Side A" and "Side B." Owners of specially designed compact disc players can listen to hours of music without raising a finger.

Today, CDs can be found not only in music stores, but in automotive stereo stores and even in 12 packs of Coca-Cola. In this creative spurt of merchandising mania, Sony gave away 5.6 million 3-inch compact discs to purchasers of multi-packs of Coke, Diet Coke and Sprite. The musicians featured on the special cola CDs included Paul Young, Rosanne Cash, and Lisa Lisa & Cult Jam. This promotional gimmick between soda pop and pop music is another sign of the growing prevalence of music CDs.

In addition, CDs have spawned devices that store information for computers. The CD-ROM (Compact Disc Ready-Only Memory), for instance, can hold about 250,000 pages of text. And in 1988, manufacturers released CD-Vs (Compact Disc Videos), which add video to high fidelity audio.

Despite this popularity and numerous applications, compact discs are still far from perfect. Even regular cassettes still have a few advantages over compact discs, after all, consumers can't buy blank CDs to record over or erase.

Two new music devices are due on music store shelves toward the end of next year. One of these devices is Sony's 2.5-inch mini-disc, or MD. Although MDs will look somewhat similar to the standard 5-inch CDs and hold the same amount of music, MDs won't produce as high quality of sound as their larger counterparts. But, unlike portable CDs, mini-discs will be as easy to carry around in portable players as cassettes are. Like cassettes, the mini-discs won't skip when they're jolted the way standard CDs may when used in portable CD players.

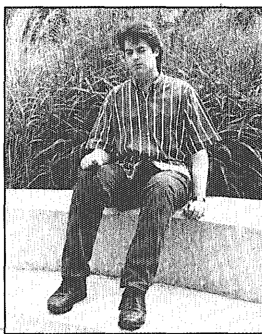
Another device due out toward the end of next year is the digital compact cassette. The size of regular cassettes and equally as portable, DCs will still have the advantage of high quality sound. DC players will also be able to play ordinary cassette tapes. However, a very limited range of music is expected to be initially released.

Until then, compact disc owners will have to keep their CDs in good shape. Despite reports in the early 1980s, compact discs cannot store music flawlessly for centuries to come. Even the most diligent attempts to preserve CDs won't halt deterioration, the music stored on CDs will eventually show some signs of wear after a decade or two.

 Photo by David Sagar, Illustration by Dena M. Collard

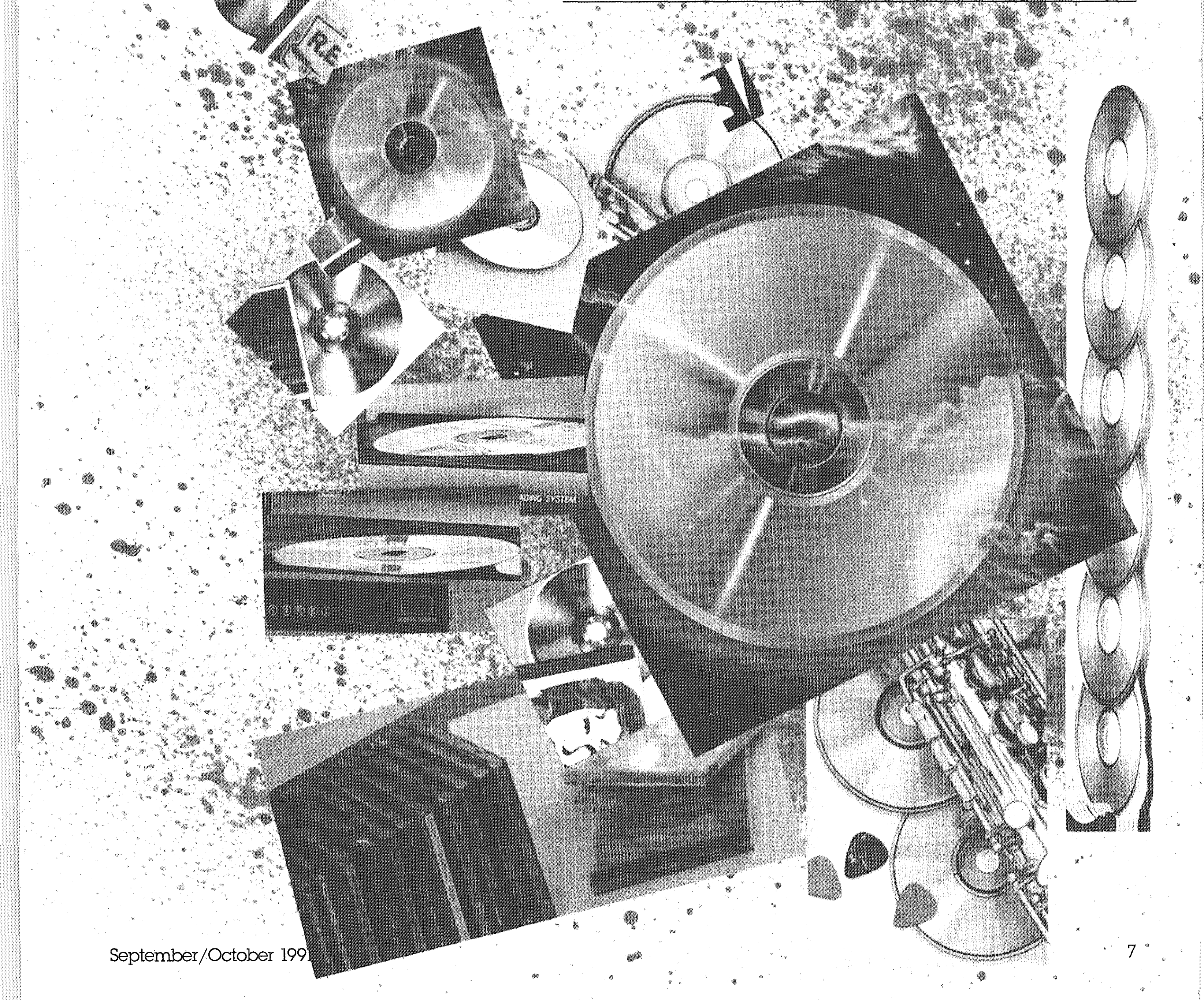
CDs, because of their high definition sound, also tend to magnify the shortcomings of early recordings. Recently, some of the music that was recorded earlier this century on 78-rpm records has been transferred to compact discs and re-released on the market. But, because the music was taken from old deteriorating records, the revived tunes of such greats as Louis Armstrong, Miles Davis, and Elvis Presley did not carry the same sound quality as music originally recorded directly onto CD. The restoration process of old records involves substituting and/or recreating music because the original records tend to show too much wear to be transferred completely onto compact discs.

So, while the early claims of near legendary status for the compact discs have proven to be exaggerated, skeptics cannot deny the influence and popularity that the CD presently enjoys. Likewise, owners must also accept the fact that their devices are not the pinnacle of music reproduction technology. What **is** clear in both cases, though, is that the CD industry has thrived for nearly a decade, and will continue to do so for years to come.



TECHNOLOG
Writer Profile

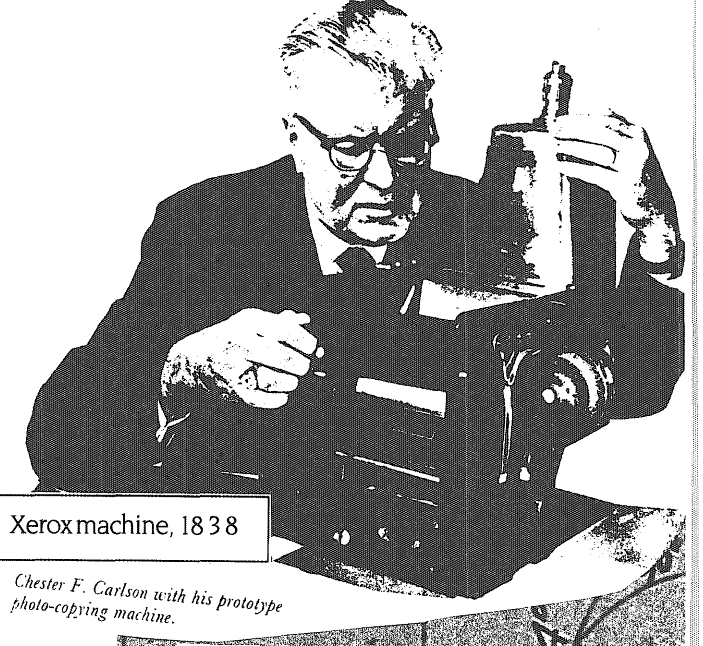
Based on an outstanding term with the Minnesota Daily, *James, a journalism major has been rescued with a promotion to the* Minnesota Technolog *staff.*



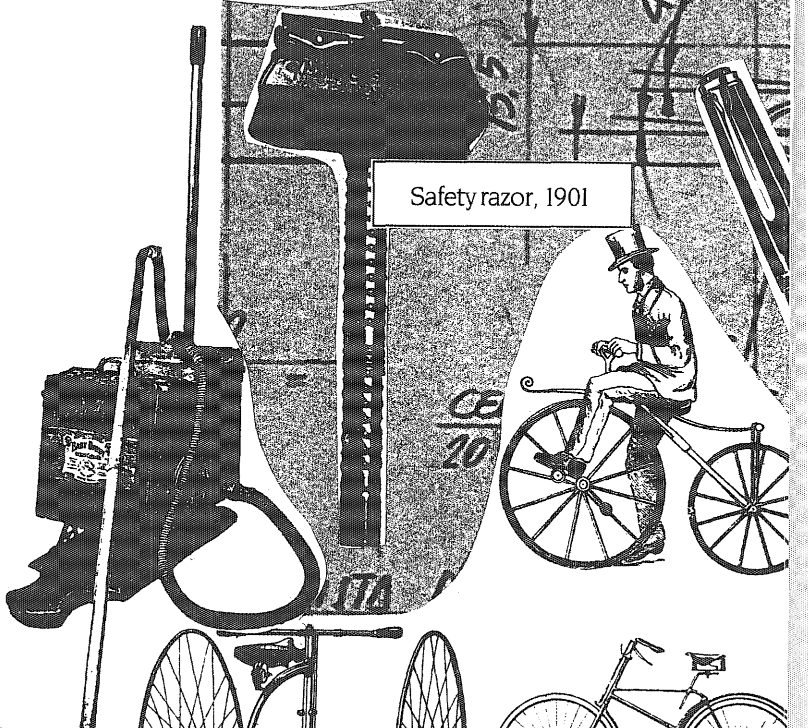
Did You Realize. . .

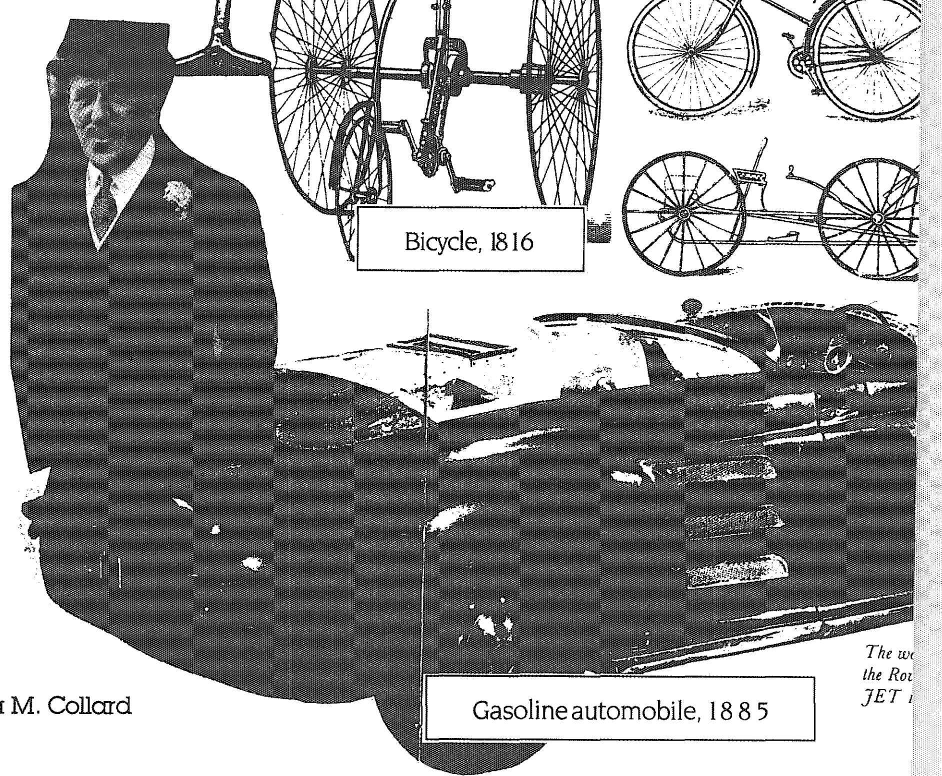
The next time you start complaining about how hard it is to be a college student these days, imagine how difficult things were for students in the past. For instance, students in 104 A.D. probably didn't do homework assignments on paper, but rather, may have chiseled their Calculus III assignments on granite. The following is a list of everyday devices and the years they were invented:

Paper	105 A.D.
Compass	1269
Clock	1360
Printing Press	1450
Compound Microscope	1590
Thermometer	1593
Electric Battery	1800
Photography	1826
Match	1827
Gas Refrigerator	1834
Elevator	1852
Bunsen Burner	1855
Washing Machine	1858
Vacuum Cleaner	1869
Phonograph	1877
Cash Register	1879
Incandescent Light	1879
Stethoscope	1890
Zipper	1893
Air Conditioner	1902
Frozen Food	1920s
Fluorescent Light	1935
Microwave Oven	1950s
Laser	1960
Personal Computer	1975


Xerox machine, 1838

Chester F. Carlson with his prototype photo-copying machine.

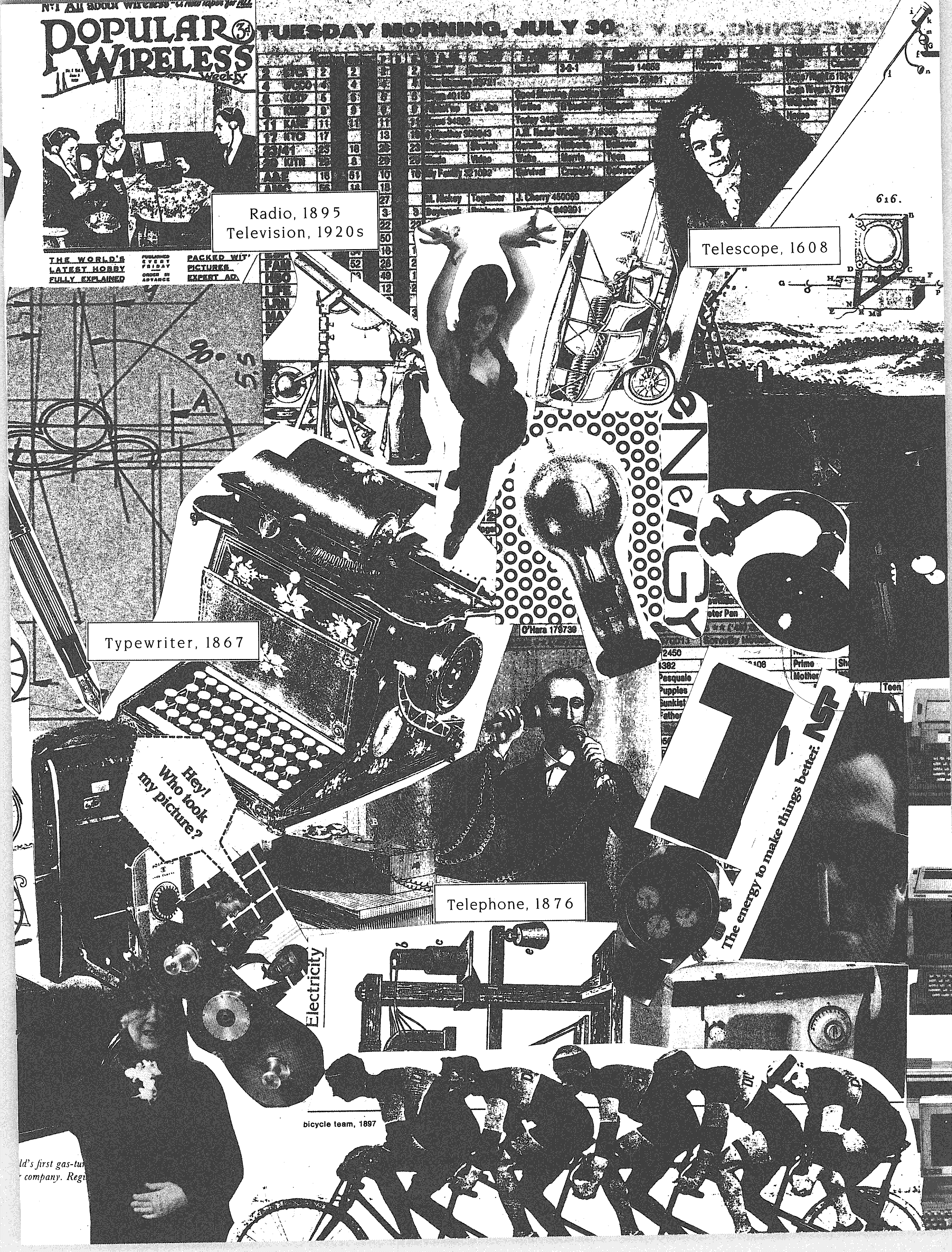

Safety razor, 1901


Bicycle, 1816

Gasoline automobile, 1885

The w... the Ro... JET ...

Research by James Satter, Collage by Dena M. Collard



No 1 All about Wireless
POPULAR WIRELESS
Weekly
THE WORLD'S LATEST HOBBY FULLY EXPLAINED
PACKED WITH PICTURES
TUESDAY MORNING, JULY 30
Radio, 1895
Television, 1920s
Telescope, 1608
616.
Typewriter, 1867
eNerGY
Hey! Who took my picture?
Telephone, 1876
The energy to make things better.
Electricity
bicycle team, 1897

Supercomputers in Science and Industry

By Darrin P. Johnson

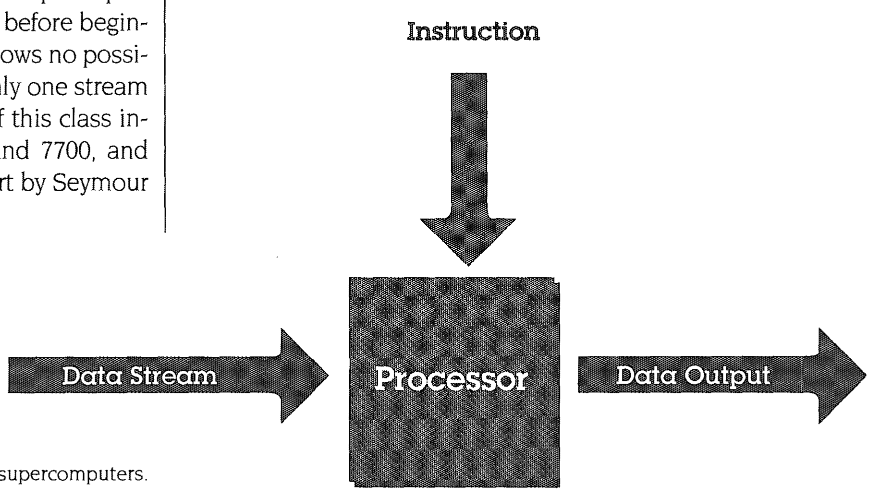
Supercomputers have traditionally been defined as the biggest and fastest computers ever developed. The primary features distinguishing supercomputers from other computers are the ability to perform many operations extremely quickly and the availability of large amounts of physical memory. Supercomputers having physical memories which exceed 4 billion bytes, equivalent to 4048 megabytes or roughly 4048 3½" floppy disks can complete simple mathematical operations in less than 10 nanoseconds.

These fantastic speeds are generated in two ways: vector and parallel processing. Vector processing uses a single set of instructions to feed large sequences of numbers through a "pipeline" or assembly line of operations. Parallel supercomputers accomplish these simultaneous operations by having several independent processors working in unison.

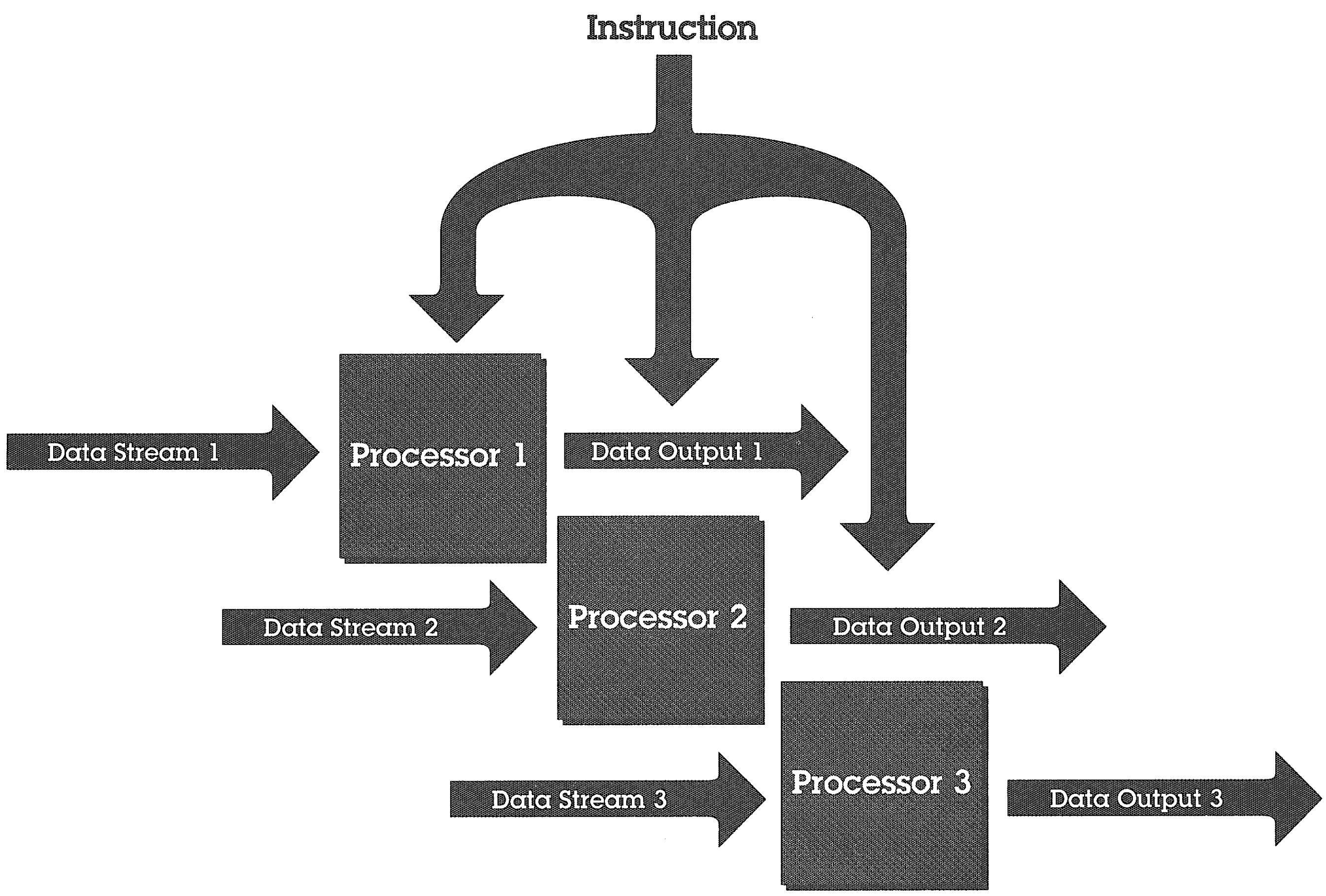
All supercomputers are characterized by their ability to perform much faster in vector or parallel mode than in scalar mode (single operations on scalar numbers at any one time) which is used primarily in personal computers and workstations. A vector supercomputer can do upwards of 275 million floating point operations (calculations) in a second (MFLOPS), while some massively parallel computers can achieve speeds up to 5 GFLOPS (5120 MFLOPS).

The advent of supercomputers was marked by the use of vector processing in a SISD (Single Instruction stream, Single Data stream) computer design in the 1970s. The SISD computer performs each operation in a program to completion before beginning the next instruction. This serial processing allows no possibility of overlap within the machine, and allows only one stream of data through the CPU. Early supercomputers of this class included Control Data Corporation's (CDC) 6600 and 7700, and Cray Research, Inc.'s (CRI) Cray-1, all created in part by Seymour Cray. Today, the power of those early supercomputers can now be found in personal workstations. The SISD architecture is similar to that of most personal computers and workstations today.

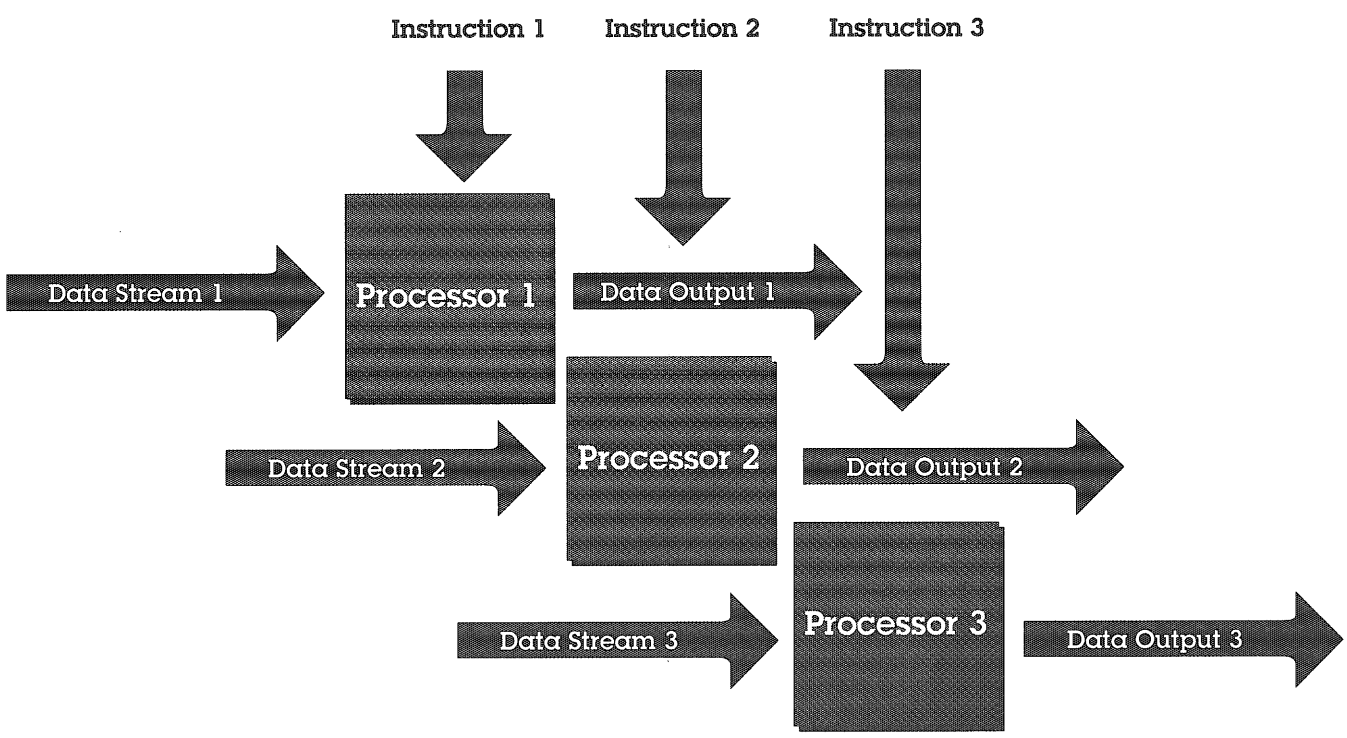
The SIMD (Single Instruction stream, Multiple Data stream) has a single instruction processor and multiple arithmetic and logical processors, allowing simultaneous computation to be performed on different streams of data. SIMD machines perform special-purpose parallel processing by applying certain types of computations to large data sets. Current models in this category include CDC's Cyber 205, Convex C-1, and CRI's single-processor computers.



SISD architechture, used by early supercomputers.



The evolution of super computers: SIMD architecture (above), MIMD architecture (below).



Illustrations by Darrin P. Johnson

A variation on the SIMD architecture allows multiple identical Arithmetic Logical Units (ALUs) to assign the same instructions, but to operate on different partitions of the program data. Machines using this technology include ILLIAC IV and Thinking Machines' Connection Machine.

Another popular computer design is the MIMD (Multiple Instruction stream, Multiple Data stream), which has multiple instruction processors and multiple arithmetic and logical processors. This allows multiple computations to be performed on different streams of data. MIMD machines are essentially general-purpose, multiuser, parallel processors. Although shared memory MIMD machines are easy to build, they suffer from limited expansibility. Distributed-memory MIMD machines are more difficult to produce, but bypass the bottlenecks of shared memory MIMD machines. MIMD machines include CRI's Cray-2, X-MP and Y-MP, and nCube 2.

Massively parallel supercomputers, a special group included in the SIMD and MIMD architectures, have become popular since the late 1980s. Although in most cases the clock speed (time to do a simple calculation) is much greater than traditional supercomputers, they rely on very large numbers of processors to do multiple calculations. Unlike the nCube 2, a SIMD machine which has up to 1024 processors, the Thinking Machine, a MIMD machine, has up to 64,000 processors that achieve speeds of 1–5 GFLOPS (1024 MFLOPS).

The future of massive parallelism or a hybrid of parallelism and vectorization may allow 100 GFLOP hardware performances by the mid 1990s and TeraFLOP (1024 GFLOPS) performances by the end of the decade. However, until software development progresses enough to meet hardware capabilities, the actual performance will lag behind the theoretical peak capacity. Researchers are presently challenged to find new approaches for developing software to support the increasing capability of parallelism, and to take advantage of the possibility of increased speeds.

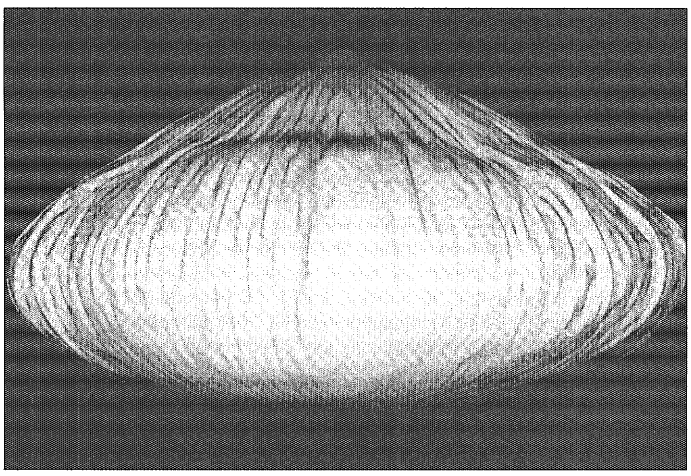
Supercomputers and Applications in Science and Industry

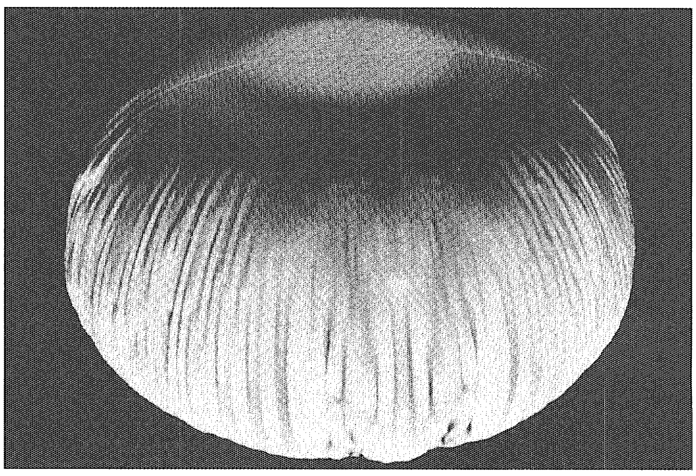
Supercomputers allow scientists to essentially create a laboratory in their computer instead of putting a computer in a laboratory. This aids researchers in fields as diverse as aeronautical engineering, biology, meteorology, and other fields, to probe phenomenon beyond the reach of physical experimentation. Supercomputers not only process experimental data, but also can become an excellent place in which to create additional data through simulations. Chemists can study the properties of a theoretical molecule before it is synthesized. Auto companies can simulate crash tests of automobiles instead of spending millions of dollars to develop prototypes for real crash tests. This savings can then be passed onto the consumer. Aerospace engineers can optimize an aircraft or a spacecraft structure before producing models or a final product.

Supercomputers also enable researchers to model complex systems with increasing realism, and have made it possible to study complex phenomena that could not be studied otherwise, because of safety and/or economical limitations. Models for reality simulations can incorporate multiple scientific disciplines with greater accuracy and with complicated relationships among the variables and systems. A supercomputer acts as a research tool that provides new insights and new approaches to problem solving in all of the sciences. Some of the more exciting areas of science where supercomputers play an important role include, but are certainly not limited to, biological and chemical science, meteorological and atmospheric studies, and automotive engineering.

Biological and Chemical Sciences

By using supercomputers to explore the chemistry of life, researchers are opening new doors to better understanding the interactions of biological molecules on a microscopic and macroscopic level. Supercomputers are also essential in the study of chemistry on a global scale. As the complex-





Illustrations Courtesy of Cray Research, Inc.

ity of modeling chemical and biochemical systems yields to the computational power of supercomputers, researchers will be able to enjoy the cost- and time-saving benefits of large-scale computation. Everyone stands to benefit as this research leads to improved chemical designs, health care treatments, and a better understanding of how biological molecules interact.

Researchers use advanced molecular computational methods coupled with the power and flexible environment of general-purpose supercomputers to provide a new approach for the development of therapeutic drugs for cancer and AIDS. Supercomputers allow the computation of chemical, conformational, electronic, and energetic properties to determine a drug's clinical effectiveness. Scientists are using supercomputers to develop drugs that can effectively suppress the ability of cancerous cells or the AIDS virus to reproduce, while still allowing minimal toxicity to the patient.

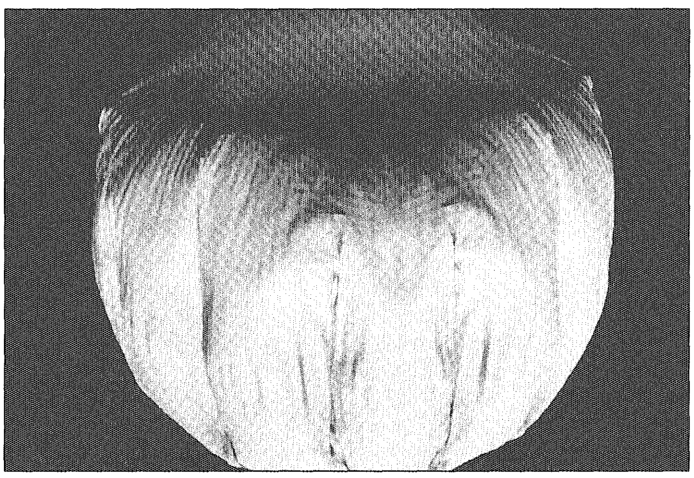
Traditionally, large users of supercomputer resources have traditionally come from chemistry, in which mathematical models play a central role in research and development. Problems in these areas lend themselves naturally to computational methods, and as a result, the power of computational models can help provide increasingly powerful computational resources which include supercomputers. The use of quantum chemical simulations has led to the better understanding of synthetic chemicals such as Krytox, a high-performance polymer lubricant developed by Du Pont, which does not burn easily and doesn't corrode metal. Chemical simulation has also aided in the development of HFC-134a, a synthetic non-harmful coolant, an alternative to ozone hazardous CFCs (chlorofluorocarbons). Synthetic agents such as Krytox and HFC-134a can be "created" and analyzed for important properties before large scale synthesis and analysis of the chemical. Synthetic chemicals can be manufactured at a lower cost and brought quickly to market.

Meteorology and Atmospheric Studies

Natural phenomenon of weather effects the earth in often fascinating and fearful ways. Everyone's life is affected both indirectly and directly everyday by weather. Many have dreamt of controlling the weather, from increasing rainfall to stop drought or eliminating smog from the skies of Los Angeles. Obviously, the technology to control weather is far from reality, but supercomputers allow meteorologists and other atmospheric scientists to predict with greater accuracy. The ability to make more accurate predictions allows planners in agriculture, industry, and government to use resources more efficiently.

Many researchers are currently looking at the effects of human activity on the Earth's atmosphere, especially the depletion of ozone gases. Almon G. Turner from the University of Detroit is using Cray Research supercomputers at the National Center for Supercomputing Applications (NCSA) to see how CFCs interact with ozone. Turner and his associates use quantum-mechanical methods to study the problem and to refine ozone depletion models. This example illustrates the multi-disciplinary study incorporating chemistry and atmospheric studies.

A better understanding of severe storms is also of great interest for its ability to prevent economic and human loss by predicting storm magnitude and characteristics. Also, with the aid of supercomputers, NCSA researchers are able to create four-dimensional (three spatial dimensions and time) models to study the evolution of weather from small cumulus clouds to giant storms. In a simulation of a storm that occurred in Oklahoma on April 3, 1964, researchers used the wind, temperature, and humidity values taken from close proximities of the storm to initialize the model. Using a grid domain (100×54×16 km), the storm model (running on a Cray-2) took roughly the same amount of time to calculate as did the original storm to reach maturity. This simulation provided researchers with a better understanding of storm dynamics and physics.



Three stages of air bag deployment and inflation. This is the first large-scale air bag simulation that accurately models the second-order effects of wrinkling, creasing, and tearing.

One of the major environmental issues that has concerned public policy makers from the 1980s to the present is acid rain. Environmentalists, industrial representatives, and government officials all offer differing opinions on the type, level, and timing of controls that should be imposed on the chemical emissions that are a major cause of acid rain. Today, some of the chemicals responsible for acid rain remain unchanged in the atmosphere and some are neutralized, but others are oxidized into more acidic forms through a complex series of chemical, meteorological, physical, and biological interactions.

Researchers at the National Center for Atmospheric Research initially developed the Regional Acid Deposition Model (RADM) on a Cray X-MP/48 in 1983. The model is presently used by the U.S. Environmental Protection Agency in policy analysis, and will be used more extensively as the model is refined. Some of the factors in the RADM model include the amount of emissions, meteorology, gas-phase chemistry, transport and mixing of chemical species, dry deposition, and cloud processes. The model describes the effect of each component on a particular chemical species and its concentration in a geophysical domain in a properly balanced computational sequence. This mathematically represents the simultaneous interactions of chemical species at any given location and time. RADM's ability to predict interactions of the chemicals responsible for acid rain plays an important economic and environmental role in federal policy. The importance of RADM is increased by the fact that the same gases responsible for acid rain are also suspected to play a major role in ozone depletion.

Automotive Engineering

Supercomputers have also been applied extensively in analyzing structural integrity and the dynamics of fluid flow (air or water) about large structures such as cars, ships, and aircraft. The speed of the supercomputer permits rapid analysis of many alternatives before a prototype is designed. More thorough evaluations of different body configurations have resulted in improved automotive, ship, and aircraft design, as well as increased safety for users of these forms of transportation.

Today, many automotive companies use supercomputers to make crashworthiness analysis (crash testing) a practical design tool. Traditionally, crashworthiness (the ability to remain "intact" in the event of an impact) of newly designed vehicles was verified by conducting a series of physical tests. However, such tests are time-consuming and require prototypes that are expensive to manufacture. Additionally, such tests could only be performed late in the design cycle. The time-consuming, costly crashworthiness predictions would therefore be best obtained by numerical simulations.

With the advent of supercomputers, and more refined and extensive numerical model simulations, all of the major automotive companies can incorporate crashworthiness analysis into the early design of cars. Simulations with detailed models having 10,000 to 30,000 finite elements (points describing the car) can be analyzed for crashworthiness. These analyzations include the behavior of the fuel tank or any other components of the car and can examine the integrity during impact. These tests allow engineers to simulate real-life situations, and allow them to obtain answers to important questions long before the hardware exists.

Supercomputer engineering in the automotive industry also extends into the development of air bags as a safety feature. Researchers from Lawrence Livermore Software Technology Corp. and Cray Research, Inc. created a 13,000-element generic model of the deployment of an air bag. The first large scale simulation incorporated the effects of wrinkling, creasing, and tearing due to over inflation, and now researchers are adding the additional variable of the force of a dummy hitting the air bag. Simply by adding this variable, the model size will increase to 50,000 dynamic elements and increase the computation time by more than three-fold.

Conclusion

Supercomputers open up new realms for investigations and enable greater problem domains to be considered. Problems in science can range widely in scale from nanoseconds to years and from macro-structures to micro-structures with the supercomputer's ability to solve problems at all levels. By combining multiple scientific disciplines and scales into a single problem space, supercomputers allow detailed investigations of what had previously been impossible. By achieving a greater understanding through numerical experimentation, researchers go far beyond what had been theoretically described only by equations.

Acknowledgement

The author would like to thank Steve Perry and Colleen DeGrio of Cray Research, Inc. for providing photographs of applications that run on their general-purpose supercomputers. The author would especially like to thank Colleen DeGrio for providing the background information on some of the key applications in supercomputer industry.

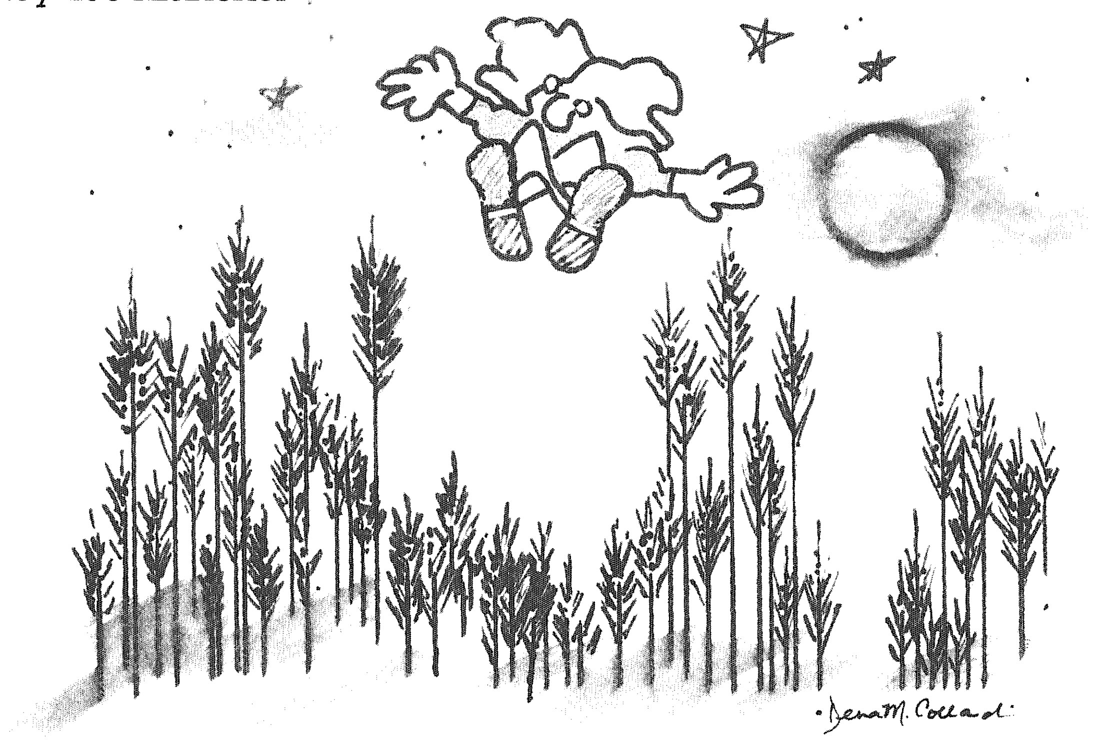
TECHNOLOG
Writer Profile

Darrin is finishing a double-major in Biochemistry and Genetics and hopes to start on another major in Computer Science. He loves the freedom of academia, but is being subjected to the evils of policy makers (yeah, you Carlson) and will probably have to stop watching soap-operas and get a real job to survive.

Photo by David Sagar

The Omni

by Lee Klancher



Careening a few feet above a golden sea of wheat, your feet jerk under your seat as the thrashing stalks whip by. Then, without warning, you pull up from the field, your senses reeling, your stomach clenching as you twist and roll into the sky. Blue brilliance gives way to deep magenta followed by velvet black illuminated with the brilliant points of the heavens...

Have you been astrally projected into the cockpit of a test version of a YF-22 hyper-sonic jet? Did someone sprinkle angel-dust on your Fruit Loops this morning? Did Professor Putnik's lecture bore you into a dream-filled stupor? No. Actually, you are at the Science Museum of Minnesota in St. Paul, watching a movie.

Mind you, this isn't just any movie. This movie is projected on the inside of a dome and complimented with surround sound that pulls you inside the action. This particular scene is from a movie produced by the Science Museum of Minnesota entitled, *Seasons*. And yes, your stomach does clench and your senses do reel.

One of the first OMNIMAX® theatres to open, the Omnitheatre, has titillated audiences since 1978. Now, more than 80 OMNIMAX® and IMAX® (IMAX® have large, rounded screens rather than a full dome) theatres are located around the world. Movies are filmed with a special lens and film, projected onto a domed screen, and enhanced with surround-sound six-channel audio.The effect resembles 3-D movies—taking on a bit of reality.

How It Works

A fish-eye lens, a rolling-loop projector, extra-wide film, a high-powered projector lamp, and a dome-shaped screen create the basics of an OMNIMAX® theatre. The projection system is similar to those used for major motion pictures. However, when you peer into the glass-enclosed, purple-lighted projection booth at the Omni, there are not a lot of familiar sights.

The projector, a behemoth block of metal mounted on tracks that disappear into the booth's ceiling, dominates the center of the booth. Two 6-foot horizontal platters ponderously spin huge reels of film. A control panel sits on a pedestal sharing the center of the room, bathed in the room's purple light and glowing with lighted switches and various digital readouts. Audio equipment fills the right wall: amplifiers, mixing boards, a reel-to-reel tape player turning 16-inch reels, lighted meters, and LCD readouts. Inexplicably, a CD player rests serenely in the center of the massive equipment. (We'll talk about that later.)

Illustration by Dena M. Collard

Absorbing all of this in the minute or two it takes to walk past the glass-enclosed projection booth and into the theatre. Arriving in the cool enclave of the theatre, your immediate impression is that you have walked inside a huge Ping-Pong ball. The enormous dome (76 feet in diameter) is bathed in soft lighting and the perforated aluminum screen looks close enough to touch as you walk up the steep theatre floor to your cushy reclining seat.

When the lights dim and the show begins, technology goes to work and makes the video come to life. Perched in your seat, the screen arches above, behind and to the left and right of you, with the bottom of the screen several feet below the level of the lower seats. You are effectively surrounded by the screen. When the camera soars out over the Grand Canyon or skims above a wheat field, you can look down at the ground and up at the sky.

Bright Light, Big Video

To project such a wide-angle image, the projector must be at the center of the dome. From there, its fish-eye lens projects a 180° image. The projector is not permanently mounted in the center of the theatre, rather, it is raised for showing and lowered for rewinding and reloading.

At the heart of this projector is a powerful Xenon gas-filled lamp which gives off 12,000 kW of light, drawing its power from a modified arc welder. The lamp is both air and water-cooled because it produces enough power to crack an unshielded lens in less than a minute. The light from the powerful unit is reflected to the camera lens by three mirrors, two of which are water-cooled to keep the reflective material from melting. Robert L. Evans, Director of the Omnitheatre, says that the lamps cost about $6,000 a piece and that three or four are replaced each year.

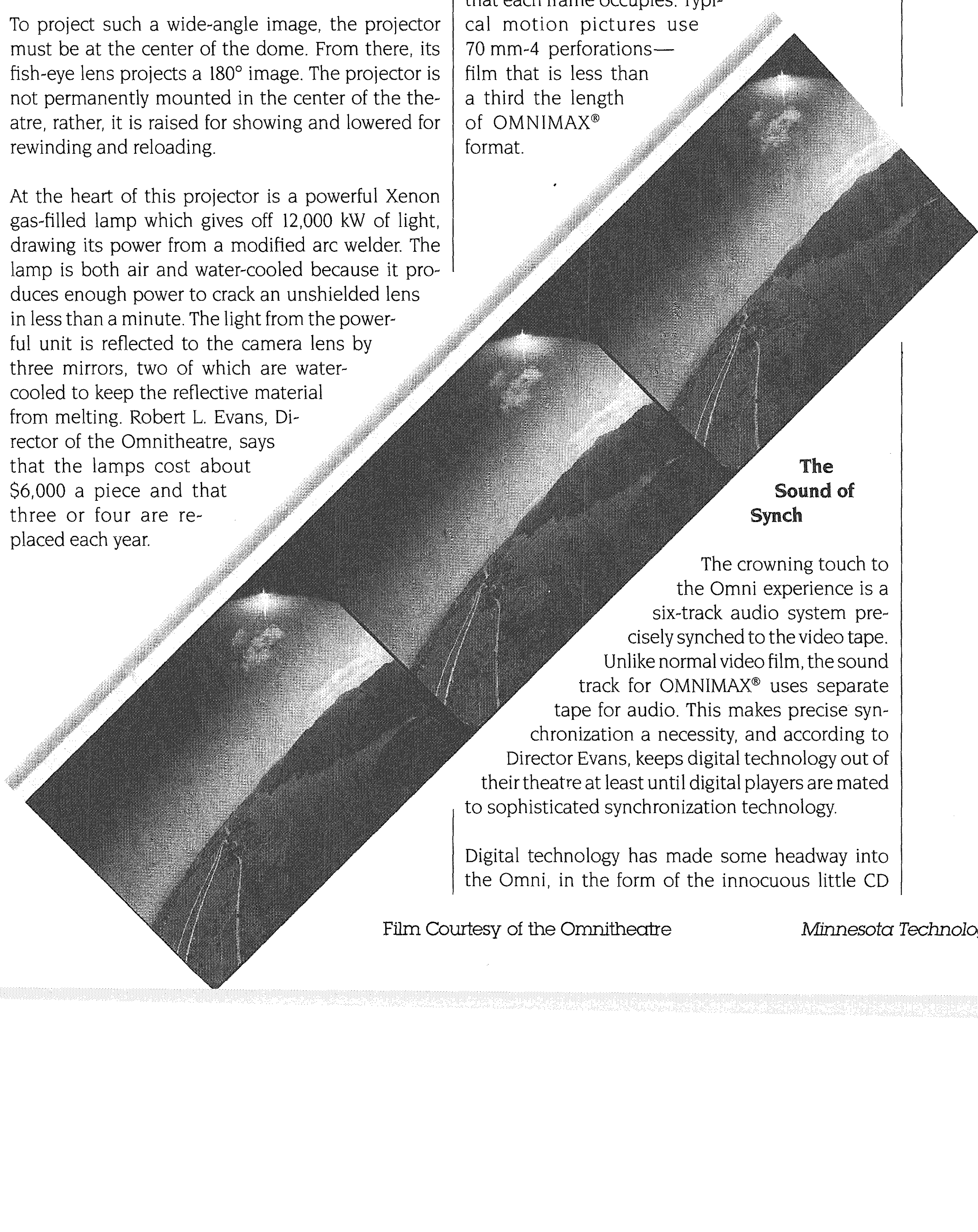
A powerful lamp is needed because the image is widely-dispersed by the fish-eye lens. The end result yields a clear, crisp picture that spans the 100-foot curve of screen. Aside from the lens and powerful lamp, the projector is a commonly-used type called a rolling-loop projector. This type differs from those used by school teachers in a few basic ways. First off, the film runs past the lamp horizontally rather than vertically. Also, a common "school" projector uses a shutter with continuously moving film running past it. In a rolling-loop projector, no shutter exists, actually stopping the film for a few milliseconds.

The film is 70 mm wide. This is not remarkable, as many high-quality motion pictures are shot on this film. What is remarkable, though, is how large a chunk of film is used by the OMNIMAX®/IMAX® format, referred to as "70 mm-15 perforations." 70 mm refers to the width of the film and 15 perforations describes the length of a strip that each frame occupies. Typical motion pictures use 70 mm-4 perforations—film that is less than a third the length of OMNIMAX® format.

The Sound of Synch

The crowning touch to the Omni experience is a six-track audio system precisely synched to the video tape. Unlike normal video film, the sound track for OMNIMAX® uses separate tape for audio. This makes precise synchronization a necessity, and according to Director Evans, keeps digital technology out of their theatre at least until digital players are mated to sophisticated synchronization technology.

Digital technology has made some headway into the Omni, in the form of the innocuous little CD



Film Courtesy of the Omnitheatre

player nestled among the tangle of wires, amps, and mixing boards of the 5,000 watt system.

"That," explains Omnitheatre Director Robert L. Evans, "is for entrance and exit music. We ordinarily use a DAT (Digital Audio Tape) player, but it isn't working right now." CD and DAT players, apparently, aren't up to the task of playing exit/entrance music for 8–10 shows a day, 7 days a week. Evans says that the DAT players only last a year or two, while the decade-old audio equipment originally installed in the theatre has had no problem.

Your brain is fooled into thinking you are really there.

You experience vertigo and the sensation of speed.

The output end of the system consists of 12 clusters of speakers, supplemented with 4 clusters of bass speakers, totalling 52 speakers putting out over 5,000 watts of six-track audio sound. The perforated aluminum screen effectively hides the speakers and allows sound to freely penetrate into the theatre.

The six-track sound contributes to the effect of placing the viewer inside the action by imitated, real-world surround sound. Bombarded from all sides by sounds and images, your brain is fooled into thinking you are really there and you experience vertigo and the sensation of speed from the confines of velvet-covered seat.

Shake Your Movie Makers

When the museum opened, the technology was so new that no movies were available to show. So the Science Museum made their first OMNIMAX® movie, *Seasons*, in time for the 1978 opening—and that same film is still showing in Omnitheatres around the country. In fact, the Science Museum went on to produce five more movies (*Ring of Fire*, *Genesis*, *Darwin in the Galapagos*, *The Great Barrier Reefs*, and *The Magic Egg*) and is in the process of making two more (*The Tropical Rainforest* and *The Great White Shark*).

Because these movies are made with special cameras that, as you might expect, cost millions to make. The original production was a grassroots affair, made with help from local organizations such as Channel 5, (who provided a helicopter), and a local fire department. The films go to theatres around the world and the Omnitheatre rents movies internationally, as well.

So, the next time you get the urge to take in a movie and have had it with the usual Hollywood fare, bored with two-dimensional special effects, it may be time to check out what the Science Museum's Omnitheatre is all about. Just don't look down...

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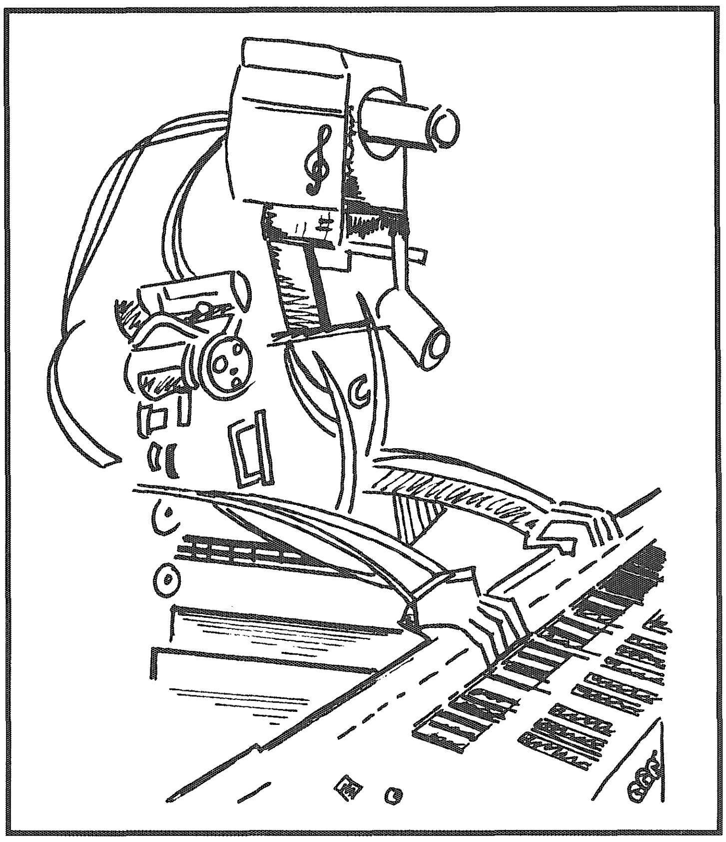
TECHNOLOG
Writer Profile

Lee Klancher, last year's Technolog god, was spotted recently pondering such wonders as the Taksonometric Function, and other wonders of his year in print. Lee deemed himself too holy to be photographed by mere mortals. An aspiring magazine engineer, Lee finds himself near completion of a degree in Journalism from his favorite "meat-grinder" University.

Music, Machines, and MIDI

by Jeff Conrad



So you're listening to the radio, and you hear some really bad disco music, computer-generated country music, or polka new age music. Going through the Twin Cities stations, you find that all the airwaves are filled with electronic beeps and drums. Even the announcers voices have been tampered with electronically. "This modern radio is trash!" you say as you turn off your stereo and power up the TV. Some computer generated television station logo flies all over the place while making weird, unnatural sounds that upset you. You turn the TV volume off and pop a compact disc into your player. Suddenly, there's a menu on your television to choose what instruments you want to hear on the first track. You turn off all the electronic appliances, grab a candle and an old paperback, and head up to the attic. Have you entered another dimension? No, you're probably just overwhelmed by the electronic computerized gadgetry flooding the world of communication. With a computer, speakers, and a synthesizer, you can make your own compositions. These days, you don't have to be a computer programmer or a musician to work with electronic music.

Synthesizers

Synthesizers are electronic devices that modify an electronic signal into a new output signal. Unlike other musical instruments such as a piano or guitar, there are no moving parts inside a synthesizer and no physically direct sound produced. What the synthesizer does produce is an output signal which can only be heard from certain kinds of speakers.

The terms synthesizer and keyboard are frequently confused, but the difference is simple. A synthesizer may come with a keyboard, or just a stereo-component–sized box with input jacks for a keyboard.

A keyboard is the user interface of the synthesizer. When a key is pressed, the keyboard sends electrical signals describing the note pressed, and the velocity at which the key was struck. These electronic signals are sent to the synthesizer, which does not distinguish the signal's origin (keyboard or computer), it only recognizes the input information and begins processing the note.

Early experiments with electronic music were interesting, but the sounds generated weren't powerful enough to compose musical compositions around them. Back in the late sixties and early seventies when synthesizers first entered the popular music scene, they were monophonic, therefore only producing one sound from each synthesizer at a time. Early synthesizers looked a lot like an old-style telephone switchboard, with wires plugged in all over the place.

In the late seventies, polyphonic keyboards were introduced, usually allowing less than ten voices at a time. These keyboards allowed for more interesting sound capabilities from one machine, but they lacked the ability to store sounds, which meant that switching to another sound meant losing the previous one.

Today, there are basically three types of synthesizers: analog, digital, and hybrid combinations of the other two. But before the development of the microprocessor, all synthesizers were analog. In an analog representation of sound, the basic elements of the sound are pitch, or fundamental frequency; timbre, the relationship of other frequencies in the sound that give it its 'color'; and loudness or volume. An analog synthesizer has each of these sound elements

Illustration by Dena M. Collard

represented as an electrical component or set of components. The *oscillator* creates the basic waveform controlling the pitch, the *filter* removes user specified frequencies from the oscillator's waveform, and is responsible for timbre of the sound and the *amplifier* controls the volume.

Part of a sound necessary for most synthesizers is the envelope serving as the overall relationship of the volume with time. A common envelope representation is an ADSR curve, which stands for attack, decay, sustain, and release. The user can specify for the synthesizer, using input controls, the points on a curve that describe the volume of the sound as a function of time. When a note is played, the synthesizer combines the output from the filter, then amplifies it based on the envelope. When users create a new *voice*, or sound, they can build from old voices by changing parameters controlling the oscillators, filters, amplifiers, and envelopes. Although modern synthesizers allow users to specify more elaborate envelopes, the envelopes can be reduced to a more complex ADSR representation.

Digital synthesizers use microprocessors to *compute* sounds. Whereas the analog synthesizers have electronic components to produce an oscillation signal, a digital synthesizer stores a representation of the oscillation or computes it through some mathematical process. These digitized representations can be small samples of various common electronic waveforms or of actual real-world sounds. The digital synthesizer uses more algorithms on the waveform information to produce an output sound. Different methods, like frequency modulation, linear arithmetic, or additive synthesis are used.

Although most of the digitized waveforms on today's synthesizers are stored in wavetables in ROM, there are also dedicated samplers which allow you to record any sound you can get into their input jacks. These sampled sounds can then be modified and later played back. With both samplers and synthesizers, an important factor in the quality of the sound is the sampling rate. The faster the sampling rate, the better the resolution of the sound. But higher rates require more memory, which eventually means a higher price tag. The faster the sampling rate, the better the sample approximates the true sound.

In the 1980s, computer memory chips were put in synthesizers. Soon keyboards stored hundreds of different constructed sounds at a time. With the introduction of computer components into musical equipment came interfaces between these machines. These interfaces allowed musicians to experiment with "layered" sounds, the same notes played from different synthesizers at the same time. With computers came recording devices, called sequencers, recording digital information about musical performances. These computerized devices had each manufacturer developing their own unique communications protocol between their own products. MIDI resolved this problem.

Meet MIDI

MIDI, which stands for Musical Instrument Digital Interface, is a technical specification designed to allow electronic components, like synthesizers and computers, of different manufacturers to be used together. Functionally, MIDI is a 31.25-kbit/sec serial asynchronous line transmission between musical devices. Its main purpose is to pass simple notes and measure information from one electronic instrument to another.

MIDI can also send control information allowing one "master" controlling keyboard to control several synthesizers. This allows users to save space by controlling stereo component sized rack-mount synthesizers from their master controller.

The way to use MIDI in a series is illustrated here. There are usually two or three jacks on any electronic instrument. MIDI IN allows the device to be sent signals from another MIDI instrument. MIDI OUT allows a controlling instrument to command other instruments. MIDI THRU allows what was passed in on the MIDI IN to be directly echoed to other devices.

An example of what happens when instruments are connected together in a MIDI chain is as follows. When a key is pressed on a keyboard sending output to MIDI channel 4, a chunk of data is sent out reporting the note number (the key pressed) and the velocity, comparable to how hard a piano key is hit. When the key is released, a "note off" message is sent.

In the above example, a synthesizer connected down the MIDI chain from the first synthesizer, not listening to channel 4, would receive the MIDI message, but just ignore it. On the other hand, if a drum machine were connected to the first keyboard via MIDI and was set to receive notes on channel four, it would try to play that note. Most instruments allow the user to define notes for other functions. In the example of the drum machine, it may be set up to play a wood block sound for a "play middle C" message on that channel.

MIDI allows for a variety of different playing interfaces to be used. No longer is MIDI used only by keyboard players. There are MIDI interfaces for guitars, clarinets, drums, and xylophones. There is even a device from Stanford University called the BioMuse, which digitally processes the body's nerve impulses, allowing handicapped people to play music.

Computers' Contribution

Some personal computers today come with sound chips capable of impressive stereo sound, while others continue to be sold with one-channel sound output. Steve Job's NeXTstation and NeXTcube computers each come with CD-quality Motorola 56001 25 MHz digital signal processors. Current Macintoshes and Amigas, though better than machines of yesteryear in terms of built in sound output, still require expansion boards to get quality stereo sampling capability.

If you can't wait for the computing industry to put out your ideal music machine, and you already have a computer, you may be interested in purchasing a MIDI interface. Basic MIDI cards for the PC compatible market are about $100 a piece, and serial port adapters (no card) for the Macintosh family run around $50. Some computers, like the recent Ataris, come with built-in MIDI ports. Some more elaborate MIDI card interfaces include SMPTE (video signal output for VCRs), on-board synthesizers, or professional quality digital samplers.

It's the old computer card add-on syndrome: you can't really use your new device unless you've got some floppies with some working code on them. Sometimes software is bundled with the hardware, and both parts of the package may satisfy your needs and meet your budget. The challenge of music software programming is to provide a usable interface for whatever it is the user is doing, whether it be scoring, editing, or experimenting.

There are many dedicated software applications on the market that are modular and fulfill one or two functions. The new software on the market can use Interapplication Communication and the MIDI Manager on the Macintosh, or use the Multimedia Manager by Microsoft for PC-compatibles, so you can have numerous programs running simultaneously and doing things "live" in real time with your MIDI equipment.

Tools of the Trade

Sequencers are recording, playback, and editing tools for electronic music. The two kinds are software and hardware sequencers. Software sequencers allow musicians to record and play back MIDI information from a computer, whereas hardware sequencers have electronics dedicated to this capability. Some synthesizers, called "workstations," come with built-in sequencers.

The difference between a sequencer and a mixer is that a mixer records the actual sounds of instruments and voices onto tapes or some other medium, while a MIDI sequencer records only the physical representation of the playing. It will record which key was pressed and when. A mixer may record digitally, but the digital information represents characteristics of a "played, audible" sound. The information in a MIDI sequencer can be made to play back on instruments other than the ones it was recorded on, so a musician can easily change the part of a viola over to a violin with a couple keystrokes or mouse clicks.

Music can be entered into a sequencer either in real time (meaning you just play like you want it to sound) or you can enter the music bit by bit in step time. Usually the sequencer will have some minimum time step expressed in parts of quarter notes,

Windows Multimedia Extensions MME

Multitasking has made its way into the personal computer market, and the newer music software is using it. Multitasking has been on personal computers for years now, but there has not been personal computer operating systems that allow data to be directly exchanged between programs running on the same computer like Unix's pipe function. Now with Macintosh's System 7.0, Midi Manager 2.0, and Microsoft's Multimedia Extensions (MME), personal computer musicians can use intelligent musical software that works together in real-time.

Like Apple's Midi Manager, the MME system is devised for device independence, providing you have the minimum operating PC-compatible system which requires a 10 MHz 286 with 2 MB RAM and a 30 MB drive, in addition to a CD-ROM drive.

MME receives MIDI messages from what ever programs are present, like sequencers and patch editors, and passes these to the physical hardware interfaces. The reverse is also true—input into the MIDI interface is corrected by the MME software for the user's hardware environment.

One new program, MME Mappers, handles patch mapping for different hardware environments.

After it is configured for the user's equipment, the program intercepts program change messages from programs running under Windows and changes the program number to select the appropriate sounds on the connected synthesizer.

like 1/96. You can then move around the sequence using controls like "fast forward" or "rewind" to get to the step where you want to add or delete something. When editing, software sequencers work better for seeing a larger amount of information at one time. A 13" CRT may be dangerous to look at, but it allows more information to be presented than a 6 cm × 1 cm LCD screen, found on most hardware sequencers.

Sequencers also allow quantization, a way of "cleaning up" notes. When you meant to play right on the beat in 4-4 time, but you waited a little too long, you can go back and edit the sequence manually, or quantize the whole sequence to make it match the beat more closely. Since overquantization produces too mechanical a sound, newer sequencers allow rhythmic inflections to allow notes to slide before and after the beat to give a more natural, "live," feel.

The main ways to display sequences of note information are the traditional note and clef format, the event format, and the piano roll style. The event format is unique to MIDI sequences, and simply shows the MIDI commands, such as "note on" and "note off" messages. The other two formats are computer graphics versions of the real tools. Some software incorporates the three types of displays, but most excel at only one.

Scorers are specialized note-oriented sequencing programs designed for making printed scores. As with word processors, after the final edit, the output can be laser printed. Programs designed specifically for scoring usually lack the experimenting features of other sequencing software, but also cost less.

The problems of electronic music data representation by software sequencers are understandable with effects like pitch bending and aftertouch, both available on today's synthesizers. Researchers like Professor John V. Carlis at the University of Minnesota are experimenting with alternative methods for visually representing musical data. Carlis has devised a system where the musical frequencies are located around a spiral extending into three dimensions. About the spiral, at various intervals, are the frequency locations of the notes of the basic 12 tone scale. At each revolution of 90 degrees around the spiral, semitones are produced. Notes are shown by polygons around the spiral. The note polygons' dimensions and location quantify the pitch, duration, and amplitude. Note sequences can be entered into this graphics system to visualize in a non-traditional way of how the harmonies interact. The current version shows a still frame of music at one time, but Carlis hopes to eventually have an animated version.

Since synthesizers are useful for producing new sounds, and usually have a limited amount of memory, software tools called librarians can organize your sound library. You can save sounds to computer disks, or mix and match them into groups.

Sound editors are software tools that give you a graphical representation of the tone and envelope of a sound on the computer screen. You can then control the editing of the waveform instead of from the synthesizer using the computer keyboard as a mouse.

Education

As technology becomes less expensive, more schools can afford synthesizers and keyboards for students. Small electronic keyboards, though producing far from professional quality sound, give children access to music at a young age. In musical training, educational software allows students to interact with the computerized music. With MIDI educational software, the computer can catch mistakes in notes played, like typing tutor software for computers. For learning musical fundamentals, MIDI can be used to tutor students with computerized instructions of video and sound. Computer software can't replace instructors, but can serve as learning tools at school or in the home.

For thirty years, researchers have studied the algorithms of music, trying to get computers to do more than make "beeps." As computers become faster and smaller, new sets of improvisational software tools have been developed. These allow the computer to assist in playing music, either with simple bass lines or by mimicking the user. Software in this area ranges from the very simple educational products to the more advanced research-oriented products.

An interesting improvisational tool was released at the September 1990 Cyber Arts International conference. Here, Messrs. Meyer and Rona demonstrated new Macintosh software that could take incomplete musical arrangements and make a complete output score consistent in style with the input. The software appeared to do as they had shown, by entering some music, and pressing a few buttons, the machine seemed to produce an output based on the input. Even the most skeptical onlookers were amazed as the computer played away, during their presentation. At the end of their talk, they opened the stage curtain to reveal a MIDI-connected keyboard player. The software was actually a HyperCard interface, not a real music collaborator, and most of the audience had been fooled.

An example of software designed for the average computer user with little or no musical background is Pete Langston's Incidental Music Generator IMG/1 program. Usually during a long series of a video presentation with no narration or other interesting sounds, background music is used to fill the emptiness. The problem is that with little musical experience, most people in that situation would end up frustrated trying to make the music fit the criteria of just the right style and length, while sounding only mediocre at best. Usually the end product is either a stretch of silence or the "pirating" of someone else's existing music.

IMG/I will create arbitrary background music devoid of real semantic content but still acceptable music. "The user simply selects a musical style, sets the tempo, and types a length in seconds to determine the exact duration of a piece."

If you want to experiment with "pre-recorded" music, through a MIDI setup, you can now order disk sequences of music ranging from Top 40s Paula Abdul to works by Vivaldi. The sounds of the instruments are there, but the voices aren't.

Concerns

Just like other technology and artistic issues today, there are people who consider themselves purists or non-purists. Musical purists object to electronic musicians reducing music to data. Computers can allow manipulation of a whole symphony, but can't differentiate Bach from Bananarama.

Pete Mathison, who plays in the band Farm Accident, says that the effects of electronic music and sequencers on the recording industry has forced musicians to be more than just studio players. Musicians these days need to have the ability to play live or use computers also.

While some artists involved with traditional instruments see their careers and values lessened by computers, there are also composers and musicians who use computers regularly as tools. Pete Mathison said that computers need to be used "...as a valuable tool. Trying to look at the electronics as a replacement for musicians is the wrong approach." Mike Salovich, a guitar player, added that although computers are very good at producing new sounds, they fall short when they try to duplicate real instruments.

General MIDI

Warner News Media, division of Warner Communications, introduced the idea of a standardized subset of the MIDI protocols at a meeting of the MIDI Manufacturers Association.

General MIDI lets a consumer run a MIDI cable from a sequence player to a sound module and have a predictable set of sound come out the other end.

The General MIDI Level 1 specifications basically allow you to translate the same capabilities and presets from your synthesizer to each another. It will solve the problems current MIDI users have of matching pitch bend ratios and how the voices numbers on the display relate to how they are really stored. Also, when you bring your sequenced song over to a friend's house, the standardized mapping will look up the equivalents of the different equipment.

CD+MIDI was the older variation on CDs that contained MIDI data along with the audio. The new version will be CD Interactive, a planned entertainment system coming out at the end of this year. The result will blur the lines between different forms of art and entertainment, allowing the listener more participation.

The example of the fake software at the conference mentioned earlier showed that although computers can assist with some tasks, it may still be a long time before manufacturers will design a computer that can create and compose music. But someday, as Professor Carlis suggested, there may be computer algorithms sophisticated enough to "beat out a reggae in the style of Mahler." Maybe the next Cray will come out with some of this software built in.

An unfortunate possibility for the future was introduced in a recent *Electronic Musician* article involving computers and music. Musicians of the future could end up as office workers, sitting in front of CRTs at a desk all day. To avoid this, the music industry needs to address computers as great tools for generating and experimenting with ideas, they'll never replace musicians altogether.

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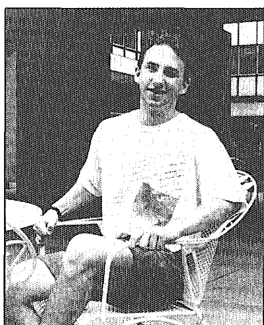
To obtain a copy of the MIDI 1.0 Specification, or of General MIDILevel 1 Specification ($5) contact: International MIDI Association 5316 W. 57th St., Los Angeles, CA 90056.

Using MIDI with Video

Multimedia is the current catch phrase usually describing computerized, integrated use of video and sound. Whatever you wish to call it, the demand for this sort of work is growing. Especially in the technical world of communications, where there is a demand for instructional videos, video manuals, and industrial videos, the slide projectors are falling to the wayside while computer interfaced projection devices, videos, and laserdiscs are passing them by.

The personal computer has entered into this, helping amateur video producers to work on scoring, timing, and editing, along with special animation capabilities like character generation, animation, and rendering.

In the video editing process, Amiga's personal computers can be used with a device called a Video Toaster to produce many kinds of special effects. The computer can also remember frame locations. With a special VCR, once you have set up all of the sequences with all of the rights background sounds, it will run through and record your final tape by prompting you to insert the proper CD in the CD player, the Videotape in the VCR, etc. Basically, it takes care of all the little editing quirks that cause some of the most frustration with VCRs.



TECHNOLOG
Writer Profile

Rumor has it that Jeff, former head chef at KFC, hopes to further his education by presiding over the Board of Publications. His lifetime goal is resolving the debate over that darned plastic utensil: Is it a spork or a foon? We understand that he will be enlisting the help of the board in this endeavor.

Photo by David Sagar

Automotive Advancements

by Pat Hafner

Imagine a day when you can't decide who to see for a car repair—the neighborhood mechanic or a local computer expert. Or stopping in to replenish the vehicle's fuel supply at your nearby hydrogen station. We're not to that point yet, of course; but one thing's for certain, gone are the days of simple automobiles that require little more than an oil change every three years. New technology submerging with super-charged V-8s, reclining seats, and new-fangled cigarette lighters. Future trends may redefine what automobiles are all about. Appeals to efficiency, advanced automation, environmental awareness, and just pure novelty are factors influencing new developments.

Illustration by Dena M. Collard

Years ago the possibility of a computer included among the car's working parts may have seemed appropriate only for a science fiction novel, but not today. Current on-board computers, such as the one contained in General Motors' 1991 Saturn Sports Sedan, are a brand new feature in the automobile industry. One of its main benefits is rapid and accurate problem diagnosis, saving both time and excessive service costs.

The computer within the car can be hooked up to a shop computer, and with special software sent from the factory, operating problems can be diagnosed quickly. Not only is the time of the actual repair reduced, but now the waiting period for the crew to receive the software is reduced by sending it via satellite. In

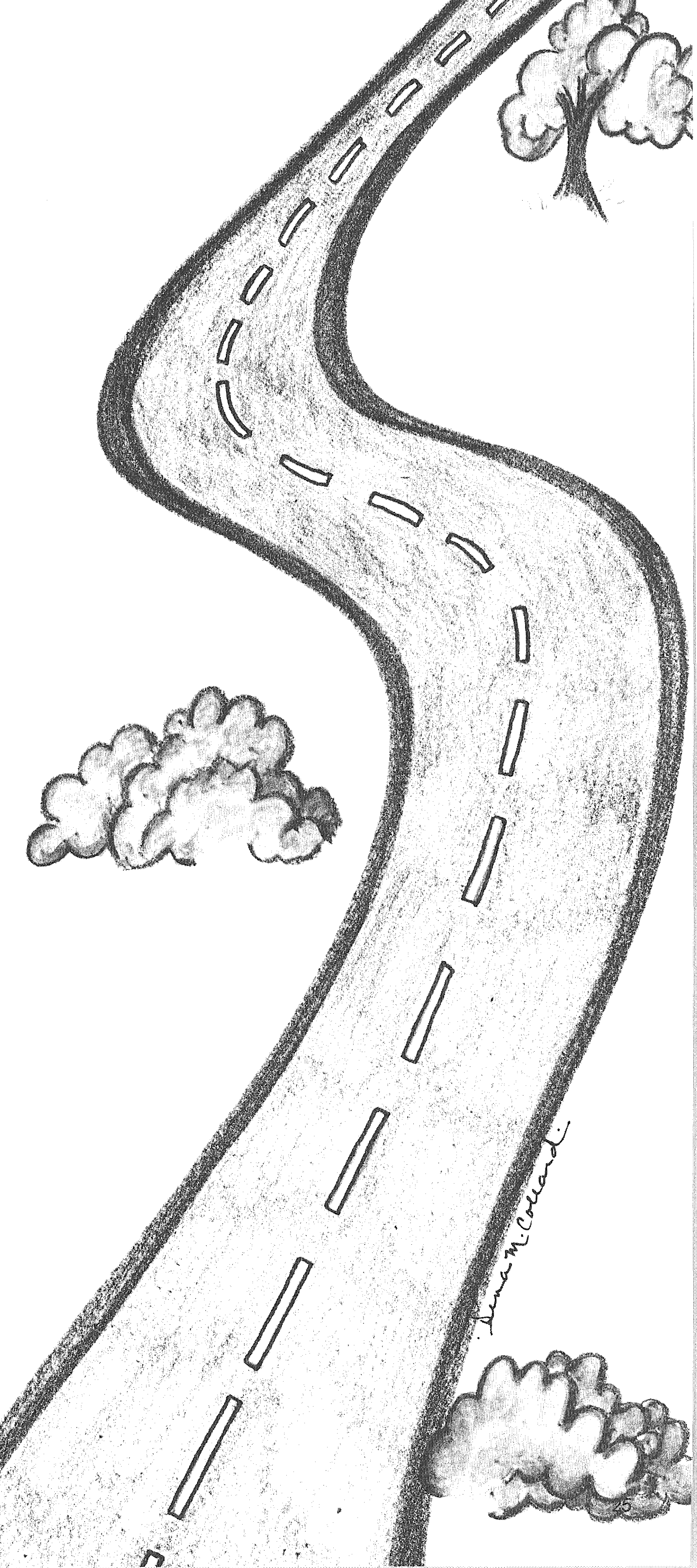
Remember the Hindenburg.
If a serious accident occurred, you could end up with a small crater in the ground.
—Sid Klingeman

addition to the diagnostic capabilities of the Saturn's computer, the car actually *doing* the repair itself is also a possibility because of its ablity to manipulate various functions of the its system electronically.

Many new ideas center around making driving easier. Some manufacturers have used a computer to take this a step further—*no* driver. Shin Caterpillar Mitsubishi and Nittetsu Mining Co. have managed to put two driver-less 77-ton capacity dump trucks into operation, both of which are currently moving huge loads in a Japanese rock quarry.

The trucks are fitted with computerized controllers, a gyrocompass and speed sensors, that guide the navigation and track progression from the original starting point. A laptop computer within the truck cab is used to program a route, using X-Y coordinates in specific patterns.

A similar development introduced by the Eaton Corporation also utilizes a computerized system. The conventional manual transmission in a semi-truck is replaced by a semiautomatic manual transmission. All clutch and shifting operations are controlled by a microprocessor once the vehicle is in motion. The driver has only to request the shifts by the use of a small, hand-sized lever that initially moves the truck. This computer-monitored shifting reduces the risk of improper gear shift while on a steeply downhill road, where a missed shift could result in the runaway of an enormous vehicle. The semiautomatic transmission is considered to be just as durable and to have as much torque as the standard manual transmission.



The Green Machine

In today's world, the quest for anything that reduces or eliminates harm to the environment is sought. The automotive industry, in compliance with this quest, is increasing efforts to utilize alternative energy sources in place of gasoline. Two prominent sources in speculation are electricity and hydrogen.

Although the idea of an electric car is not new, significant improvements may make it a more feasible idea. One model thought to be the fastest of its kind on the market is the German-made Pohlmann E1. It runs primarily on lead-acid batteries, which can perform in both cold and hot weather from storage in protective water-duct trays.

The unit can reach a top speed of 70 mph. Made to avoid wind resistance, its fiberglass body is wedge-shaped and has no air intake pockets in the front. This lowered wind resistance helps the car attain such a speed, as well as sparing the car's energy supply.

One of the most interesting and useful features of the Pohlmann E1 is its 2-motor setup. They are capable of switching between series and parallel operation modes as the situation demands. Upon initial takeoff, the motors will be in series wiring mode, as the car draws a lot of power at this point. Series operation also takes place when there is a sudden burst of acceleration after a period of constant speed. For steady cruising, the parallel operation is used, which naturally draws less power from the battery supply. The advantage the E1 gains from this particular motor setup include the ability both conserving energy and being able to accelerate rapidly when necessary.

The Pohlmann E1 is capable of a 65-mile range at a constant speed of 35 mph. Although this would not be ideal for a long road trip, it is a step in the right environmental direction. It is most likely a primitive version of what we'll see in the years to come; and a car with lower toxins and less noise pollution will certainly be welcomed into our crowded streets.

Hydrogen as fuel? Some companies are seriously considering it, namely Mercedes-Benz, BMW, and Mazda. The primary idea behind this is implementing a fuel that has superior performance and lower emissions than gasoline. Zero emmissions sound great, but there are a few other considerations when using hydrogen. There are actually some questions in terms of its effects on the environment, as it produces nitrogen oxide when used. In addition, tremendous amounts of electricity are required to produce the hydrogen.

According to Sid Klingeman of Precison Automotive in Minneapolis, hydrogen's highly explosive nature must also be conidered. "Remember the Hindenburg," he said. "If a serious accident occured, you could end up with a small crater in the ground. The hydrogen supply would have to be extremely well-protected." Klingeman said this could be possible with the use of a fuel cell providing plenty of insulation and padding, such as those currently used by NASCAR racers to insulate safely the highly volatile fuels they use. And you were worried about someone rear-ending your Pinto?

Despite all of the disadvantages of hydrogen as fuel, it has one outstanding benefit—*no* carbon monoxide emissions. Just the thought of that is enough to make any city dweller breathe easier, and certainly justifies the continued research.

No Training Wheels Needed

Children's toys are becming more technologically advanced all the time, but one new item may be only for those kids ready for the big time. It's a miniature version of a '34 Ford Roadster, appropriately called the "Tot Rod," manufactured by Tom Morin of Arizona. The mini race car powered by a 5 h.p. Briggs & Stratton engine has a fiberglass body, centrifugal clutch, and "posi-stop" disc brakes. These dual brake pads assure junior can come to a skidding halt at a second's notice. And just when you think your child is about to outgrow the vehicle, take note: the throttle and brakes are fully adjustable to accomodate rapidly growing speed demons. The never-ending thrills of owning this machine can be purchased for about $1,900.

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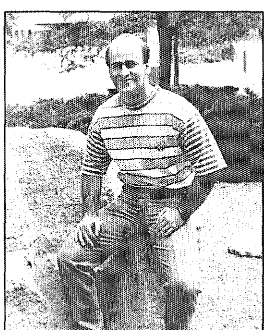


TECHNOLOG
Writer Profile

Pat, last seen cruisin' in his Tot Rod, is moonlighting these days as a comedy figure. You may have seen Pat starring in his latest guest spot on Saturday Night Life.

Photograph by David Sagar

"Tate Laboratory" Turns 25

Former U Professor, John T. Tate, Created the "Air-Borne Doodlebug" and Won a Presidential Medal For Merit

by James Sater

Twenty-five years ago, the University of Minnesota's physics building got noticed. On June 21, 1966, approximately 500 members of the American Physical Society came to the University to attend their annual meeting, and to watch the building officially become the John T. Tate Laboratory of Physics.

The majority of students who now attend class in the building are too young to remember who Tate was or why anyone wanted to name a building after him in 1966. Likewise, most students aren't aware that the physics building had only a functional name until it became the Tate Laboratory. However, the general public at the time came to know Tate as the inventor of the "air-borne doodlebug" and other devices that were used against German submarines during World War II. Although contemporary students know little about John Torrence Tate, he was one of the most highly honored professors ever to work at the University.

Despite his accomplishments, Tate's life had humble beginnings on a farm in Adams County, Iowa on July 28, 1889. About 1,000 people lived in the nearest town. After graduating from the University of Nebraska, Tate joined the University of Minnesota faculty in 1916 as a physics professor. His initial annual salary was $1,500—which was considered very low at the time. In 1917 Tate married Lois Beatrice Fossler, who unfortunately died 12 years later. The couple did have one child, John, Jr.

During World War I, Tate temporarily left the University to serve as a lieutenant in the U.S. military. Although Tate had no pilot's license, he sometimes flew military aircraft to test new equipment he had designed. Tate returned to the University after the war and became a full professor in 1920. Much of Tate's work involved the study of electrons, and he helped the

Although Tate had no pilot's license, he flew military aircraft to test new equipment he had designed.

physics department focus more on nuclear physics during the 1930s. A year later, Tate co-founded the American Institute of Physics.

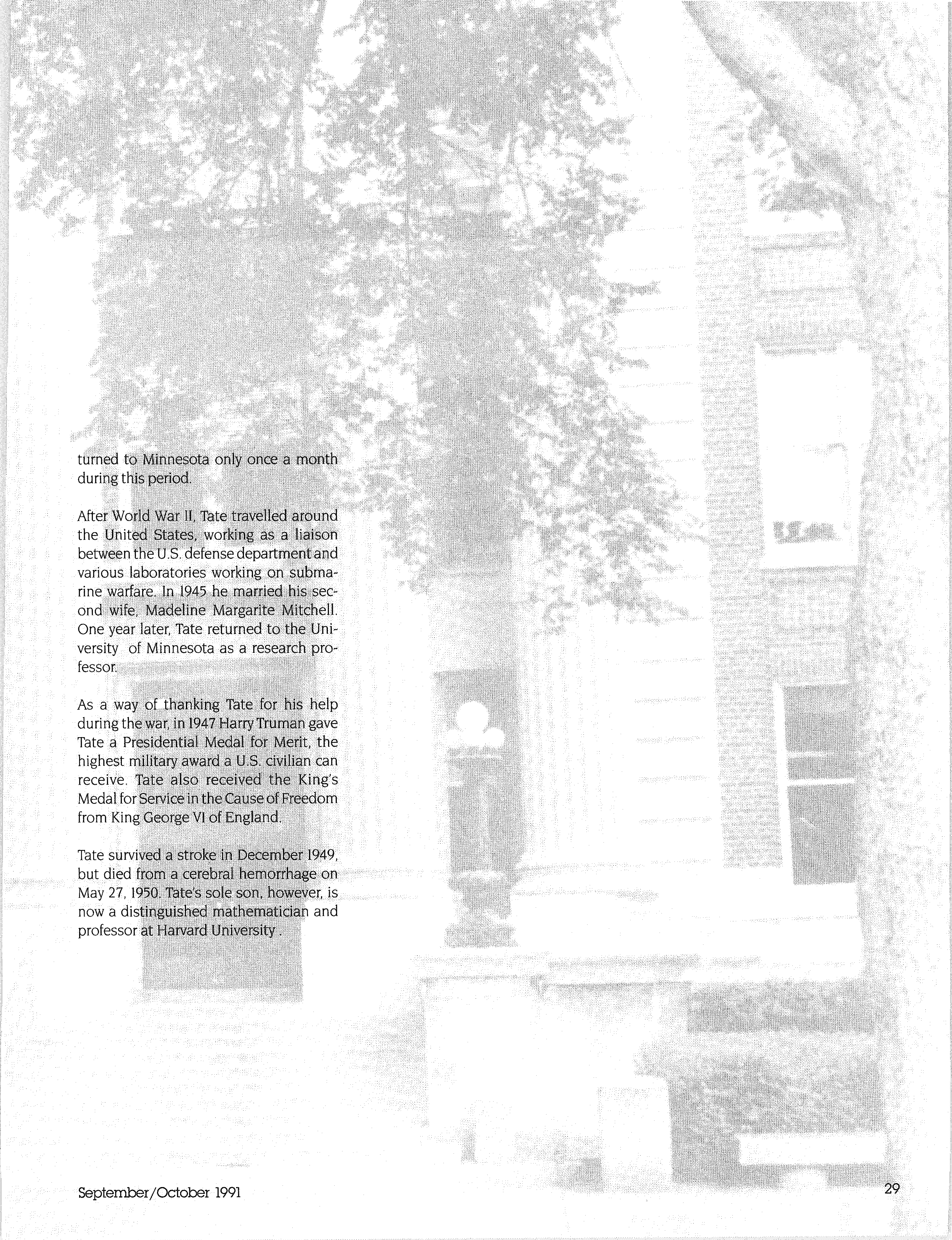
Tate earned the respect of both his colleagues and his students. One of the graduate students who Tate advised during the 1930s was Alfred Nier. Nier, now an emeritus regents professor at the University, says Tate appeared approachable and aloof at the same time. "His door was always open, so you could wander in any time you wanted, but you did so at your own risk," Nier says.

Although Tate went out of his way to be available for students, he seemed very business-like to people who didn't know him, Nier says. And this made Tate a little intimidating.

Tate's students and co-workers knew him to be a shy man who happened to be the University faculty's champion billiard player at the time. In his spare time, Tate also liked to play golf and read detective novels.

In 1937, Tate was promoted to Dean of the College of Science, Literature, and the Arts (CSLA). The physics department, which was then part of CSLA, didn't join the Institute of Technology until CSLA became the College of Liberal Arts in 1963. Although Tate officially served as dean until 1944, he spent the last three years of his position almost entirely absent from Minnesota.

During the early 1940s, Tate moved to Washington D.C. to serve as chief of Division 6 of the National Defense Regional committee. Tate led a group of U.S. civilian scientists who developed "anti-submarine" devices that were used against German and Japanese vessels during World War II. One of the devices Tate helped design was the "air-borne doodlebug," a device that could locate submarines from the air. Tate re-



turned to Minnesota only once a month during this period.

After World War II, Tate travelled around the United States, working as a liaison between the U.S. defense department and various laboratories working on submarine warfare. In 1945 he married his second wife, Madeline Margarite Mitchell. One year later, Tate returned to the University of Minnesota as a research professor.

As a way of thanking Tate for his help during the war, in 1947 Harry Truman gave Tate a Presidential Medal for Merit, the highest military award a U.S. civilian can receive. Tate also received the King's Medal for Service in the Cause of Freedom from King George VI of England.

Tate survived a stroke in December 1949, but died from a cerebral hemorrhage on May 27, 1950. Tate's sole son, however, is now a distinguished mathematician and professor at Harvard University .

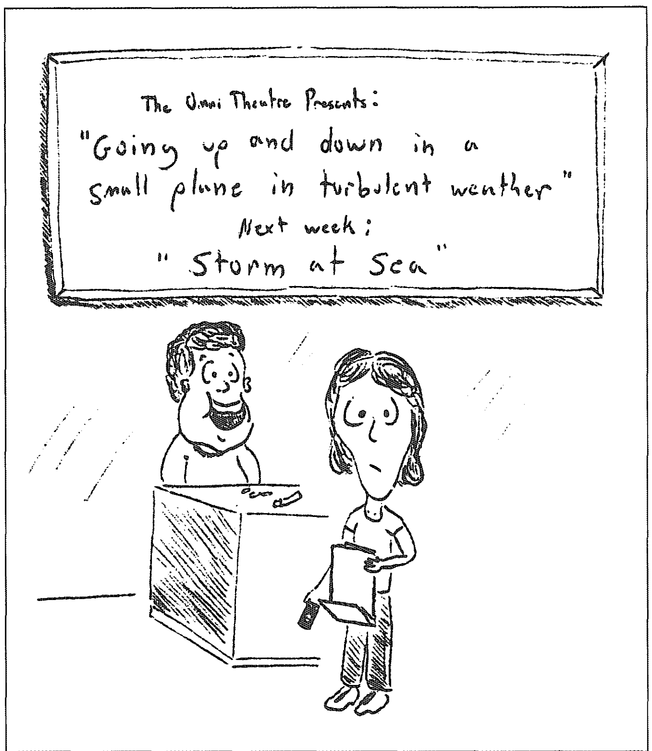
Diversions

Social Classes in the '90s

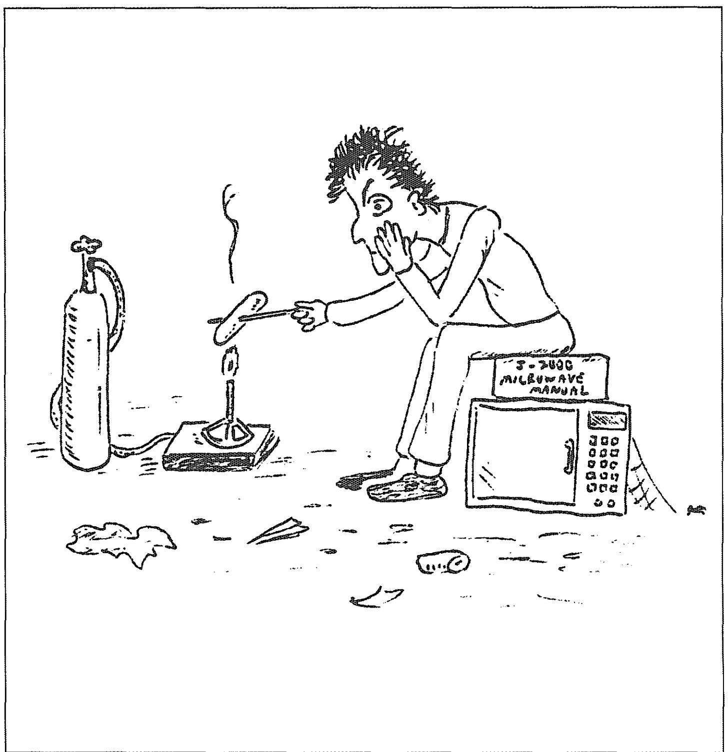
by Jeff Conrad

Socioeconomic Status	**Super-rich**	**Yuppie Suburbanites**
Transportation	Personal Learjet.	Lexus
Home Audio	In-house live orchestra.	Dolby surround stereo system with CD, DAT, tape, preamps, and eight surrounding speakers.
Car Audio	Same as the Yuppie's home audio.	CD Stereo, AM/FM.
Home Video	4 m × 4 m wall screen LCD display, cable and satellite hookups for 2 million channels, writable video laser discs for home movies (occasionally assistance from Industrial Light and Magic).	27" HDTV monitor, 276 channels, super-VHS VCR.
Computer	Cray Y-MP.	Mac IIx or 486 compatible, CD-ROM drive, scanner, laserprinter.
Upcoming Vacations	Around the world luxury liner cruise next year.	Plane trip to Europe next summer.
Purchasing Quote	"Now you're sure this machine can handle word processing? It's for my daughter/son, you know."	"How much for the talking car function?"

Just Getting By	Technolog Staffer
'76 Impala.	Air Reeboks.
Sony Walkman.	2 AM Radio Shack colortronic radios tuned to same station.
FM Stereo with 5 presets, analog.	(None.) Sings Billy Joel songs and uses steering wheel for percussion. Can be heard over car engine only at stoplights.
5" black and white combination radio, television. 13 VHF and 40 UHF channels.	Looks out apartment window for entertainment.
Texas Instruments TI-99/4(a).	Vacuum tube Vacomatic (hand) calculator, 1.2 cubic meters, with easy rolling wheels and car battery adaptor.
Road trip to Madison next month.	MTC Bus downtown next week.
"Now you said that TI will stay with their personal computers well into the nineties, right?"	"Now the last set of paper clips I bought from you guys didn't bend back to their original shape after using them a couple times. You're sure I won't run into the same problem this time, right?"



"Enjoy the show! Next!"



And Bob, a bachelor, never did learn how to cook.

minnesota

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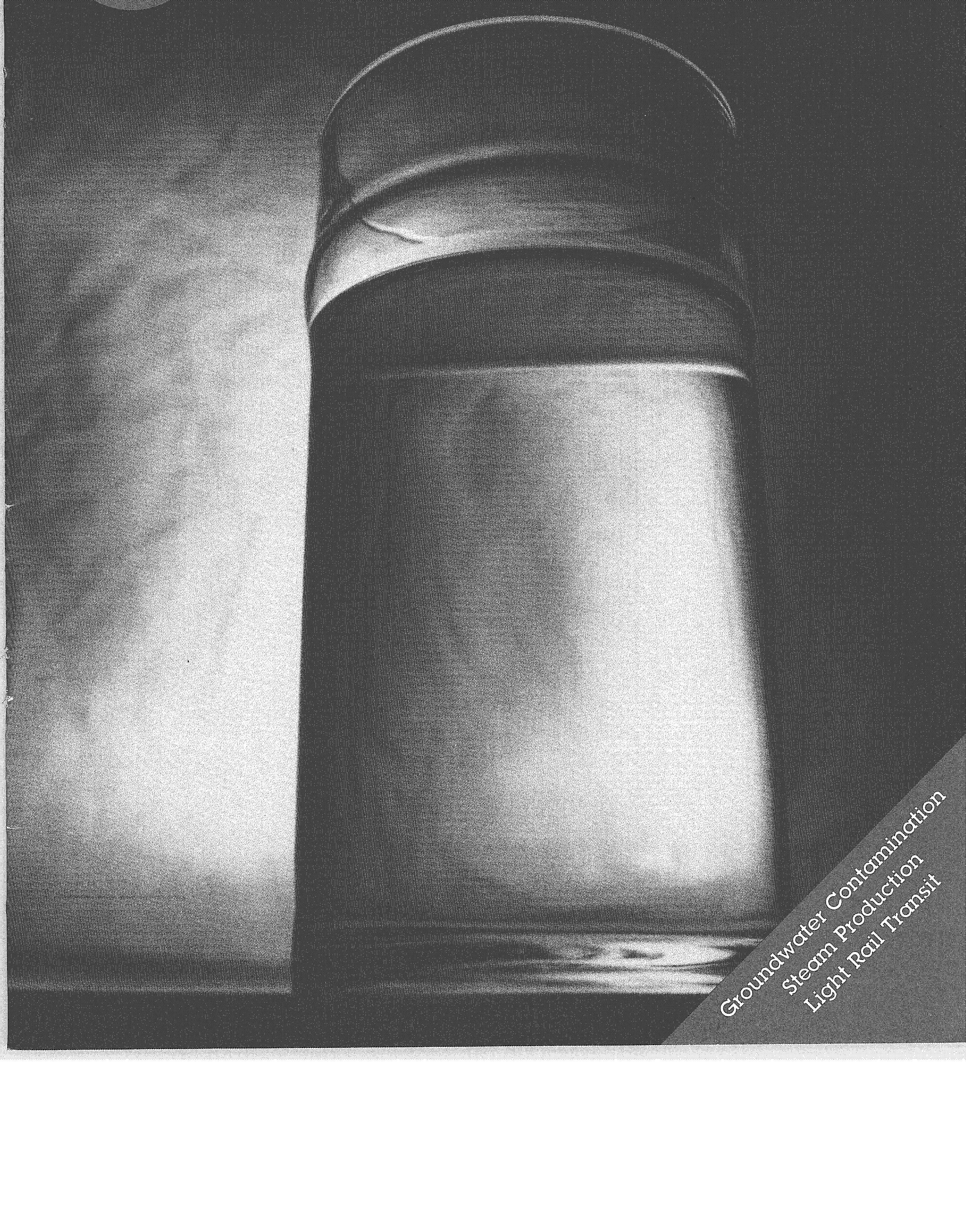

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Steam Production
Light Rail Transit

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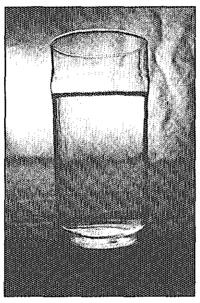
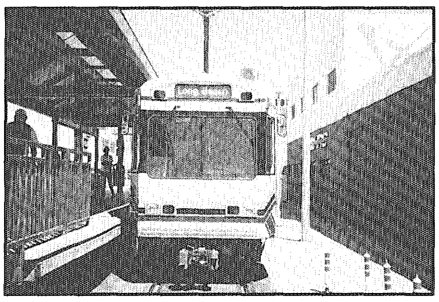
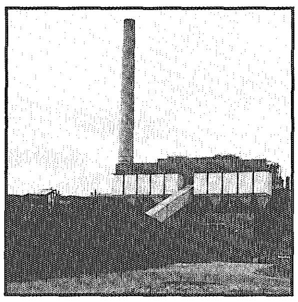
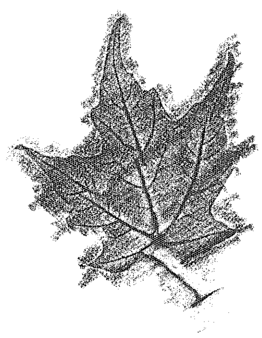








Departments

About the Cover...
Believe it or not, this photo of a glass of possibly contaminated Minneapolis water was taken by our staff photograher, David Sager.

Editorial

Wake Up and Smell the Dandelions

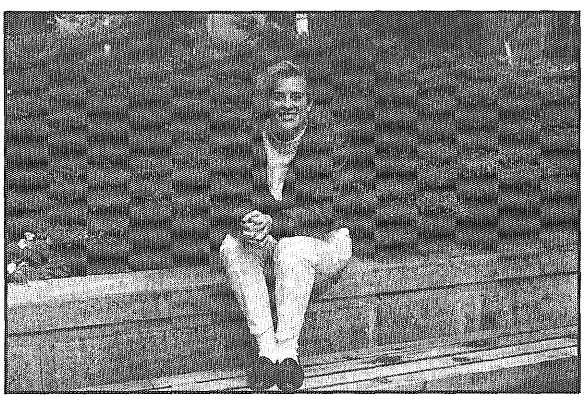
"Contaminate your bed, and you will one night suffocate in your own waste," warned Chief Seattle, former Chief of an Indian tribe, in response to the "white man's" treatment of our mother earth. Well over a century later, the essence of his statement hits so close to home it scares me.

Everyday, in all sorts of ways, we contaminate the environment—*our* environment. When looking at our own actions, from the lawn chemicals we apply to the by-products created from factories, I am becoming increasingly aware of the choices we make and the consequences of these decisions.

Most factories belch contaminants into the sky. Later, these contaminants return to the ground in the form of acid rain which aids in deteriorating buildings and monuments.

Many of those same factories are built along rivers or lakes, using the water to flush out their system or for cooling purposes. Unfortunately, when the water returns to the river or lake, it is unfit for some plant and animal life residing in the area because of either contaminants or temperature.

Conscious decisions involving energy sources have also had devastating results. Because of our country's dependence on petroleum to fuel our cars and heat our homes, we fill and ship large supertankers from oil-rich parts of the world.



Unfortunately, mistakes are inevitable. High volumes of petroleum leak into precious ecosystems, initially damaging only a few notches in its food chain. Like a domino effect, though, the predators of the animal life ingesting the oil may not have any live prey, or will eat the prey that has ingested oil, and so on. Eventually, that ecosystem may be wiped out altogether or, as another possibility, the final predators in that food chain could be those responsible for the damage in the first place.

I don't mean to single out industry, although it is an easily visible contributor of pollution. We, as individuals, need to confront the consequences of our own actions, too.

Why is it that we consider a plush green lawn to be a status symbol, anyway? We risk damaging the quality of our environment by putting chemicals on the lawn—and for what benefit? Are our priorities mixed up? Those chemicals seep down into our soil and ground water supplies, causing unnecessary illness and death. Why sacrifice the water we need to drink to have a plush, green lawn?

Fortunately, counter examples do exist. Some people have challenged the norms by making a conscious effort to end unnecessary pollution.

While watching the news recently, I saw a short piece about an unusual golf course. The Lidd Golf Course, located near the Pelican Rapids, is an *organic* golf course.

Structurally, the course is similar to most other courses with tee boxes at each of eighteen holes. However, differences between this course and a typical golf course can be easily observed. From the wild flowers growing rampant on the

Photo by David Sager

fairway to the gopher holes on the greens, this golf course poses extra challenges for all who try to conquer it.

The Lidds aren't professed environmentalists. They are simply "regular" people who, unlike most other golf course owners, use no lawn chemicals on their course. At the present time, this course is considered a novelty. In the near future, however, as we discover more of the harmful effects of lawn chemicals, I think we'll see an abundance of not only organic golf courses but many other natural and organic-related businesses.

Imagine what it would be like if everyone entirely revamped their way of thinking. We could all modify our view of what we consider beautiful, what we consider to be acceptable, and even what we consider worthwhile to compromise. Maybe then we could even consider dandelions (which generally look like most other flowers) as aesthetically desirable instead of just plain weeds.

Instead of trying to come up with ways to repair the environmental damage we create daily, we'd see more progress with very little effort by simply changing our way of thinking. But, as it stands now, we seem to weigh endangering ourselves and our families as a preferable compromise.

Before you make a decision that could remotely or severely affect the environment, please remember these words from Chief Seattle. "Man did not weave the web of life, he is merely a strand in it. Whatever he does to the web, he does to himself."

Laura E. Sokol

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Perspectives

Science and Show Business

Taking a Closer Look at Paul Douglas

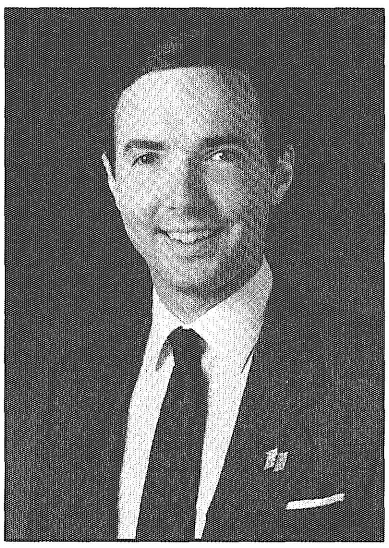
by James Satter

A lot of things have changed for Paul Douglas over the past six years. In 1985, when *Minnesota Technolog* first interviewed the chief meteorologist at Channel 11, he was still relatively new to Minnesota and the station was just beginning to use its Doppler Radar System.

Now, Doppler radar is a household word in the Twin Cities, and Douglas is arguably the most well-known science communicator in the area. Despite his science education and journalism training, Douglas sees himself largely as a TV entertainer. Though confident and outgoing during his weather forecasts, Douglas secretly craves fewer hours and more privacy.

In addition to working full-time at KARE-TV, appearing Monday through Friday on the station's five, six, and ten o'clock news shows, Douglas does radio forecasts for KDWB-FM and writes a daily weather column for the *Star Tribune* newspaper. Last year the Voyageur Press published Douglas' book, *Prairie Skies*, a lengthy guide to Minnesota weather. And in 1989, Douglas founded Total Weather, Inc., a company that supplies customized forecasts to local businesses.

A sign of Douglas' growing success is his acceptance of about one or two invitations each week to speak to schools, nursing homes, and other organizations that are interested in the weather. Public speaking is not part of his official responsibilities at KARE. Douglas says he isn't comfortable speaking in front of crowds, but feels it is important to keep in touch with living, breathing people. "I think you can end up with a very warped perception of reality if you're in TV," says Douglas. For this reason he tries not to conceptualize life as only a series of sound bites and news segments.



Although Douglas is well-known in the Twin Cities for his talkative and relaxed on-air style, he describes himself as quiet and self-conscious without the cameras and 10 minutes of makeup on his face. Being a local celebrity is a mixed blessing for a self-confessed introvert like Douglas. He says he gets frustrated when strangers come up to him on the street and say something like, "You spoke to my seventh-grade class four years ago. I was in the back," then expect him to recognize them. But there's a flip-side to high visibility. "If nobody came up and said, 'Hey Paul, how's the weather,' I'd be worried because no one would be watching," he explains.

Nonetheless, Douglas still finds strangers nerve-wracking on occasion. "Some people look at me as a zoo animal, as an exhibit, as something that's not quite human," he says. Looking more closely shows that, while still human, Douglas isn't everything he seems to be on television. For one thing, Paul Douglas isn't his real name.

Born Douglas Paul Kruhoeffer in Lancaster, Pennsylvania, he didn't adopt the name Paul Douglas until he was a high school senior in 1976. That's when he began his first meteorology job, broadcasting weather forecasts for a local radio station. After being told that the station deejays wouldn't be able to pronounce Kruhoeffer, he chose the pseudonym "Paul Douglas," and has used it ever since. Legally, he's still Douglas Paul Kruhoeffer, and he says he likes the anonymity that accompanies a dual identity.

Having a stage name doesn't seem unusual to him. After all, Douglas sees his role at KARE as a combination of meteorology and entertainment. He describes himself as a storyteller of sorts. And part of being a storyteller is getting the audience to pay attention. Although Douglas doesn't wear strange outfits like Willard Scott of the "Today" show, Douglas still tries to dress up the weather forecasts while wearing a suit. "The challenge for me is just repackaging [the weather]," he says. "My biggest fear is being boring...you don't want to get into a rut."

Photo courtesy of KARE 11

One way Douglas breathes fresh air into his forecasts is by stepping outside of the KARE studio to broadcast the reports from the "back yard." Douglas helped come up with this gimmick shortly after joining the station in the mid 1980s. At that time many Twin Citians were watching "Leave it to Beaver" reruns at 10 p.m. instead of the news, and the station thought outdoor weather forecasts might attract viewers.

Standing outside means getting snowed on in the winter and unintentionally swallowing a few insects in the summer. Does this bother Douglas? Not really. He says that, like most TV meteorologists, he's part scientist, part soothsayer, and part court jester. When the skies are clear and sunny, he's more of a jester; when the weather's severe, he's mostly a scientist. And unlike 70 percent of TV weather people in the United States, Douglas *is* a trained scientist.

Some people look at me as a zoo animal, as an exhibit, as something that's not quite human.

–Paul Douglas.

Douglas graduated from Pennsylvania State University in 1980 with a bachelor's degree in meteorology. He received a Seal of Approval from the American Meteorological Society in June 1982. In May of that year, he won a first place Associated Press award in public affairs for "Nuclear Gamble," a 10-part series that examined nuclear safety after the Three Mile Island accident. Douglas also has appeared as a weather consultant on ABC's "Nightline."

Before moving to Minnesota, he worked as a meteorologist and science reporter at Satellite News Channels in Stamford, Connecticut. There, he broadcasted 21 two-minute weather summaries for cities across the nation. Wanting to return to local news and give more complete forecasts, he accepted an offer to become KARE 11's chief meteorologist in 1983.

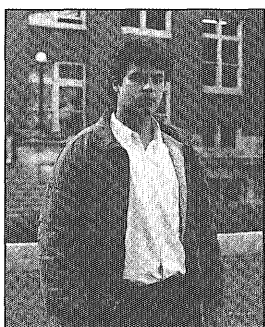
Doulgas expresses a strong affection for Minnesota. He enjoys living in a place where the seasons change and he says that Minnesotans know more about the weather than people in most parts of the country. "There's a fascination with weather in this state," he says. "Everybody has to some degree a stake in the weather."

Another Minnesota perk for the meteorologist is that the state has life-threatening weather about 50 days out of the year, according to Douglas. Sadistic as it may sound, Douglas says that having dangerous weather conditions makes him feel important and needed. But he says his favorite type of weather is a non-threatening summer thunderstorm—they're safe yet exciting.

On a typical work day, Douglas arrives at the Channel 11 station around 2 p.m. He spends the next few hours sifting through data to prepare for his broadcasts later that evening. Meanwhile, another meteorologist uses a "70,000 dollar Etch-A-Sketch" to create the maps that appear on screen during the show. Douglas thinks each map takes between five and 15 minutes to finish. With the station's Doppler Radar System and other forecasting equipment, Douglas says the KARE 11 weather reports are accurate about 90 percent of the time.

Unlike many TV news figures, Douglas doesn't read his lines off a teleprompter. Rather, he tries to familiarize himself enough with the data so he can speak naturally about the weather while he's on the air. There's some ad-libbing involved and he says he likes the freedom and flexibility the station gives him.

Douglas doesn't like getting off work at midnight. "The hours stink," he complains. Douglas tries to reserve his weekends for his wife Laurie and their three-year-old son, William. However, Douglas still wishes his evenings were free for his family. "I think there's a certain amount of guilt with the job," he says. Guilt aside, on Monday afternoon Douglas Paul Kruhoeffer returns to the KARE 11 studio and once again becomes Paul Douglas.



TECHNOLOG
Writer Profile

James likes summer thunderstorms about as much as he likes Paul Douglas. That aside, we're proud to note that, after continuously working for us from the first issue, James still hasn't regressed to working for the Minnesota Daily.

Photo by David Sager

Inevitable Oil Spills

Not So Glamorous Results of Fossil Fuel Dependency

by Laura Sokol

"It seemed unbelievable that human beings with technology so advanced enough to build a supertanker were helpless to clean up the mess when that technology failed,"—Don Nardo, Oil Spills.

Progress in oil spill cleanup technology has been sparse in the U.S. Most of the tools used today are ones developed during the 1970s: floating booms, skimmers, sorbents, chemical dispersants, and ignition techniques. Unfortunately, none of these techniques do much to alleviate the devastating effects oil spills have on the environment.

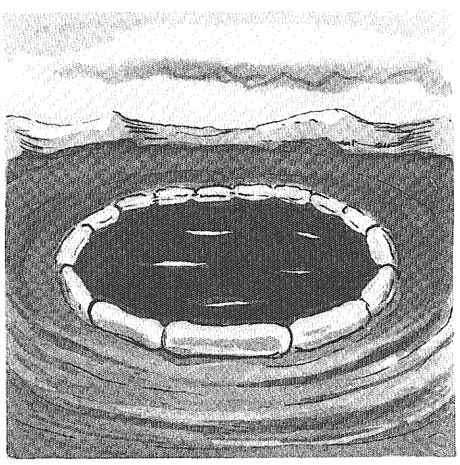
Even the decision as to how to clean up an oil spill is quite involved. Many factors such as wind and water currents, location, and plant and animal life residing in the area can affect which cleanup techniques are chosen. The sooner the cleanup methods are applied, the higher the success rates. However, overly ambitious cleanups can prove to be counterproductive when ineffective, poorly chosen means are used.

"We cannot 'clean' or 'treat' or even 'stabilize' oiled lands. At best we can sop up the dripping excess and become aware of our choices. . .," says Page Spencer, author of *White Silk and Black Tar.* Unfortunately, her statement is true.

The only 100 percent effective method of preventing an oil spill from occurring in the first place would be to stop shipping oil. But, because the U.S. and many other countries are dependent on this fossil fuel, this is not a feasible alternative. That's where the need for effective cleanup techniques comes into play.

Containing the Spill

The first step in oil spill cleanup is containing the petroleum. This technique is most effective during the first few hours after a spill. The cleanup crew sets large rubber or plastic floating fences, called booms, around the outer edges of the slick. This prevents the oil from spreading further.



Booms come in many shapes and sizes. Some pop out and inflate much like a jack-in-the-box, while others come in sections that the crew must join together. There are even booms made of bubbles. Along with using them as fences, booms can also "herd" oil slicks together or move the oil away from currents.

Illustrations by Melinda Maury

Skimming the Surface

After the slick is contained, the cleanup crew can use small boats equipped with skimmers to remove the surface oil. Most skimmers have storage tanks where the polluted water is held until the oil rises to the top. The best conditions for use of skimmers are calm water and a small oil slick. Several different types of skimmers are available.

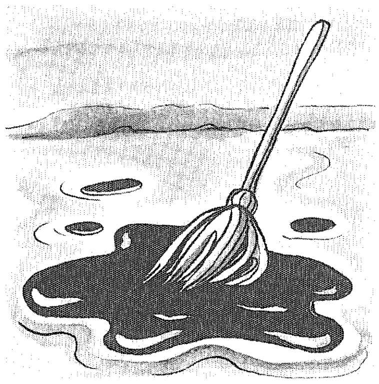
One type of skimmer is the vacuum skimmer. It works much like a household vacuum, sucking up oil through hollow tubes.

Another type of skimmer has large, partially submerged floating disks that spin through the water collecting oil on the disk surface. The disks are later scraped of the buildup, which is then disposed of in storage tanks.

A third type of skimmer is the rope skimmer, which is made of a porous material. The rope is passed through an oil slick, allowing the oil to collect inside. Both the rope skimmer and the floating disk-type skimmer are useful in moderately choppy water.

Mopping It Up

Absorbents, commonly termed "sorbents," are the "quicker picker uppers" of oil spill cleanup technology. Much like sponges or paper towels, they lay on top of the spill and mop up the oil. After soaking up the oil, they are then removed from the surface, wrung of the excess oil, and reused.

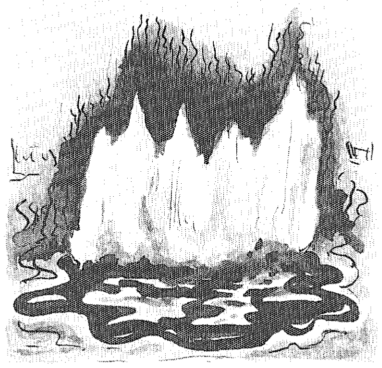


Sorbents are made of mineral substances such as talc, or vegetable products such as straw or corncob grindings. Additional inventions include synthetic materials such as foam chips made of polyurethane and polystyrene.

The disadvantage with using sorbents is the time and energy it takes for placement and removal of the paper towel-like material.

Another problem arises in disposal of the oily sorbents. As of now, they can only be buried or burned, much like the industrial and household garbage we currently create.

Burning the Spilled Oil



This technique has a limited spectrum of use because it can only be used safely in open water or on snow. At times, it can be nearly impossible to ignite the oil, occasionally requiring the use of bombs. Keeping the fires burning proves to be an even more difficult task.

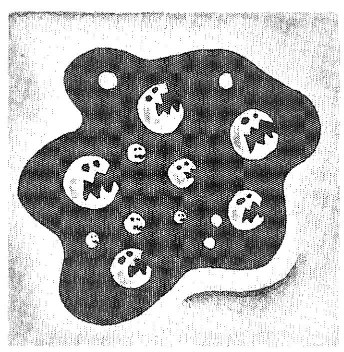
Dispersants Take Oil Out of the Way, But...

Chemical dispersants are mild detergents which break up and displace oil. This technique works best when the water is turbulent, enabling the dispersants to mix thoroughly with the oil.

The controversy surrounding the use of dispersants arises from the fact that the oil is impossible to recover. While dispersants may save beaches and the animals living in that area, the oil hasn't disappeared. Waves merely carry the tiny oil droplets that have been broken down by the dispersants to another ecosystem residing in deeper water.

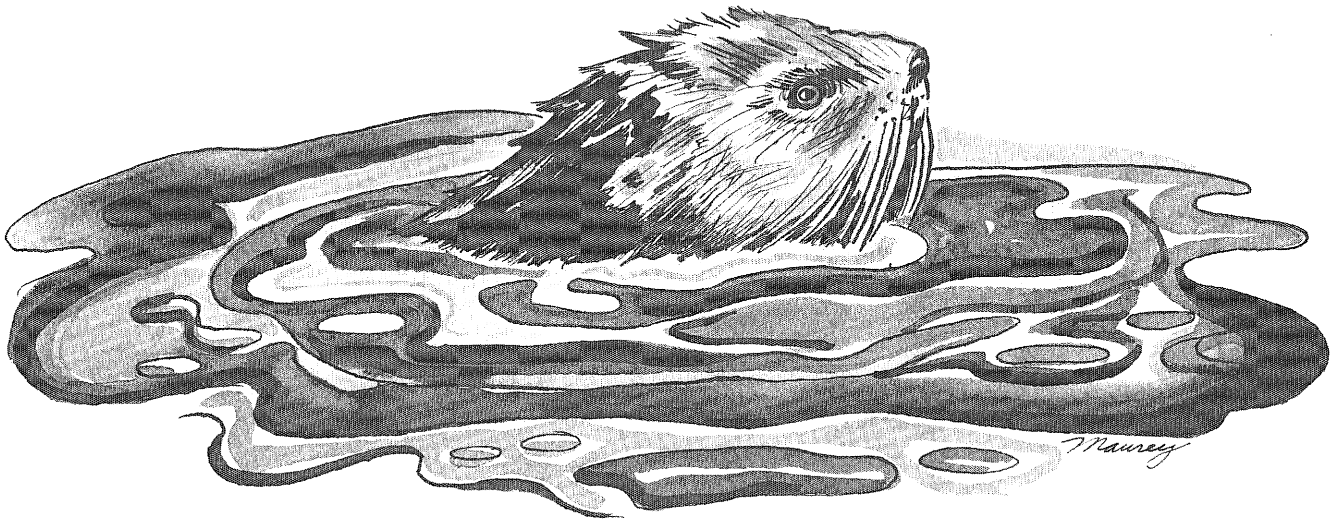
Fertilizer

A new technology, still in the experimental phase, uses certain bacteria found in fertilizer. This discovery produced the first patent issued to a genetically engineered lifeform.



The bacteria, Inipol EAP 22, are known to consume petroleum. When placed in the midst of an oil slick, they aid in the natural biodegradation process of the oil.

Unfortunately, before the fertilizer can be added to the cleanup process, every beach that will be treated must first be hosed down to disperse the oil. Additionally, the bacteria technique doesn't work effectively in cold weather because the bacteria's activity slows.



This biological method was first used after the infamous Exxon Valdez oil spill near Alaska. Exxon researchers sprayed 70 miles of beaches with the fertilizer hoping "...to stimulate the growth of naturally occurring bacteria known to have an appetite for hydrocarbons." While the results were encouraging, the bacteria will continue to be tested for long-term effects.

Even if some damage is created by the bacteria, experts view the risk as "small relative to the potential benefit." Another positive aspect is that the fertilizer successfully triggered interest in more research and experimentation of biological cleanup techniques.

Elastol

Another experimental substance being tested is called elastol. Unlike a dispersant, which breaks down the oil, elastol turns the petroleum into an elastic syrup that floats on the water surface. It is estimated that, if used in conjunction with skimmers, elastol can increase the amount of oil recovered tenfold over that of skimmers alone.

Current oil cleanup methods leave much to be desired. Increased spending on research and development for improving and finding new cleanup methods is necessary. Additionally, money spent on finding ways to prevent these disasters from happening is equally important, if not more so.

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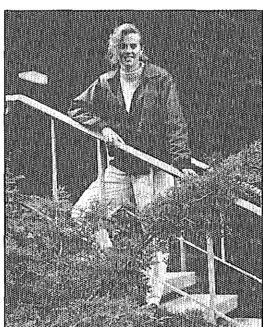

TECHNOLOG
Writer Profile

Laura, Technolog CEO *and self-thought goddess, found inspiration for this article while cleaning up a coffee pot that had tipped over.* While *working round the clock on the previous issue, Laura, in a caffeine delirium, reached for that coffee pot a little too desperately.*

The Zebra Mussel Saga

What Will It Take to Control This Prolific, Voracious Organism?

by Scott Ryun

The news on zebra mussels took a turn for the worse this summer. In September, U.S. Fish and Wildlife Service biologists, searching for native clams to be used in a federal program to control the proliferation of the zebra mussel, found a zebra mussel attached to a native river clam. The zebra mussel, which was found in the Mississippi River near La Crosse, Wisconsin, was compared with specimens preserved at the agency's research laboratory in La Crosse to confirm its identity.

The zebra mussel, native to the Caspian Sea, has infested the Great Lakes since 1986. It is believed they were dumped with ballast water from ships operating between the Lakes and Europe.

The zebra mussel has damaged the natural environment in the Great Lakes. The mussel is one of only two foreign mussels capable of attaching themselves to virtually any solid surface, including aquatic animals. The mussel does not seem to have any natural predators in this country and, unfortunately, reproduces rapidly. Because of this, the mussel is able to overtake native clams.

Zebra mussels feed by filtering enormous amounts of tiny aquatic life from the water. In fact, large numbers of zebra mussels can consume virtually all of the nutrients and algae in the water at the expense of native clams and other aquatic life.

The black-and-white striped mussel is now found in all of the Great Lakes. They have encrusted the water intakes of power and water treatment plants, causing millions of dollars worth of damage.

The zebra mussel found near La Crosse, Wisconsin, is not the first to be found outside of the Great Lakes. In June, conservation officials found zebra mussels in the Illinois River, about 500 miles south of the La Crosse site. It is believed that the mussels migrated from Lake Michigan to the Chicago River, to the Illinois River, and then on to the Mississippi River. Such travel is possible because the mussel can attach itself to barges and to the feet of water birds. By attaching themselves to boats, many fear the mussels will be transported to inland lakes where they will devour the food sources of the lake's native inhabitants.

Currently, Ohio State University and the U.S. Fish and Wildlife Service are working to find a chemical to control the zebra mussel population. At the same time, other researchers are trying to develop a synthetic coating to repel the mussels. Until the mussel population can be controlled, all lakes and waterways are in constant danger of dissolution.

Source

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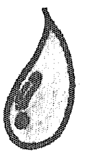
Illustration by Melinda Maury

Features

Is Your Drinking Water Safe?

by Joanne Lewis

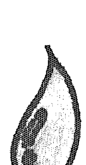


Health enthusiasts suggest drinking 8–10 glasses of water per day. However, if your water comes from the tap, you may be drinking 8–10 glasses of contaminants each day.

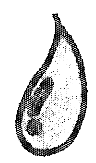
Because 75% of Minnesotans depend on groundwater as a source of drinking water, groundwater contamination is a growing concern. The increased concern for the environment has prompted Minnesotans to take a closer look at where their drinking water comes from. According to *Protecting Our Groundwater: A Grower's Guide*, groundwater forms when water moves below the earth's surface and fills empty spaces in and around rocks and porous materials. This groundwater becomes the source of water supply to wells and springs. A recent survey found that 85% of Minnesotans think our groundwater is not protected enough.

Causes

Groundwater contamination is often attributed to pesticide and fertilizer use by rural residents. However, this is not a complete picture. A number of other sources of groundwater contamination are overlooked. Sources of contaminants range from livestock and poultry manure to fertilizer used at greenhouses and nurseries, residential fertilizer (such as *Weed-B-Gon*, and others), household septic systems, and sewage sludge. The list continues.



Nitrate contamination of groundwater from fertilizers poses a health threat to humans. According to a recent publication of the Minnesota Extension Service, nitrate levels of over 10 ppm (which is equivalent to 10 pounds of nitrate in a million pounds of water) cause a life-threatening condition in infants as well as possible development of cancer in adults.

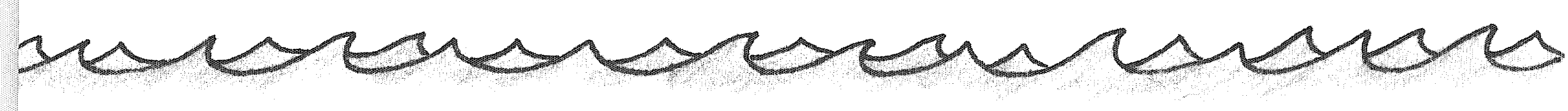


Nitrate is a form of nitrogen which results when ammonia, present in both human and animal waste, is converted by microorganisms into nitrate. Nitrate itself is not harmful. Danger occurs when there is an excess of nitrates in the soil from sources such as greenhouse fertilizer, household septic systems, and agricultural fertilizer. If plants and other organisms cannot fully utilize the amount of nitrates in the soil, the excess is carried into our groundwater through a process called leaching. Leaching is the process by which rain, snow, and water from irrigation carry excess nitrates through the soil and into our water.

A recent survey found that 85% of Minnesotans think our groundwater is not protected enough.

Problems

The concern for the development of a safe groundwater standard has risen due to ecological problems and health risks caused by elevated nitrate levels. According to a recent article in the Groundwater Bulletin, acquired methemoglobinemia, referred to as the "blue-baby syndrome," is a health risk to infants under six months of age. "Nitrate-contaminated



well water may be an increasingly important cause of infant illness in rural areas." It is often not recognized and thus not reported as methemoglobinemia. Illness or death is attributed to conditions such as congenital heart disease or sudden infant death syndrome. One study from 1945 to 1972 showed only about 2000 cases worldwide. The lack of reported cases leaves many infants misdiagnosed.

Methemoglobinemia is caused when nitrate contaminated water is ingested and the nitrate is converted by bacteria in the stomach to nitrite. Nitrite combines with oxygen-carrying hemoglobin and forms methemoglobin, which cannot carry oxygen. With an increase of methemoglobin, less oxygen becomes available to the body tissues and the person essentially suffocates. Those suffering from the disease have a blue tint to their skin and a brown coloring to their blood. The condition is potentially fatal.

Infants are more susceptible to this condition for several reasons. First, the low acidity of an infant's stomach allows increased growth of the bacteria which converts nitrate to nitrite. Secondly, infant hemoglobin is more rapidly converted to methemoglobin than adult hemoglobin. Finally, infants have a low concentration of the enzyme necessary to convert methemoglobin back to hemoglobin.

This condition can occur in older children and adults. However, because the level of bacteria present in infants lessens as one ages, the level of nitrate contamination would have to be much higher for older groups to be affected.

Those suffering from the disease have a blue tint to their skin and a brown coloring to their blood.

Pesticide use also contributes to groundwater contamination by leaching toxic chemicals into our soil and water. According to a survey done by the Environmental Protection Agency, Atrazine, a weed control product used on corn, ranked second in frequency of contaminants in rural home drinking water. Another commonly used pesticide, Alachlor (used in products such as the herbicide, *Lasso*), was found at a level above what is acceptable to protect human health. These and other pesticides are carried by naturally occurring erosion.

Concern for the health of the human race and its groundwater is becoming the focus of many projects and studies done by the EPA, USDA, Minnesota Extension Service, and our state and local government agencies. The Minnesota Groundwater Protection Act was established for this reason and states "...that groundwater be maintained in its natural condition, free from any degradation caused by human activities." With these attitudes, we can move towards maintaining clean drinking water.

Prevention

The selection of a safe pesticide is essential in preventing contamination. Currently, the method used is to evaluate both the soil and pesticide characteristics in order to choose a pesticide compatible with the soil to which it is applied. The soil characteristics considered are texture, conductivity, and organic matter content. In choosing a pesticide, chemical characteristics such as solubility, absorption, and half-life are considered.

A new technology for removal of toxic chemicals uses a familiar source of energy, sunlight.

Another method of preventing nitrate contamination is timing the application of nitrogen (such as in fertilizer) effectively. The applications can be split to reduce the amount of nitrogen put into the soil at the time of each application. This system is based on the soil and hydrology of the area.

Treatment

If groundwater is already contaminated, nitrates can be removed from the water. Unfortunately, the nitrate removal process is often inadequate in removing other contaminants that may be present when high levels of nitrates are found. However, with regular maintenance, some distillation units can provide effective treatment for home use. Most often, correcting the source of the contamination is the recommended solution.

A new technology for removal of toxic chemicals uses a familiar source of energy, sunlight. Solar detoxification has shown promising results. At the Solar Energy Research Institute in Colorado, an experiment was conducted to determine its effectiveness. In this experiment, the toxic compound called trichloroethylene (TCE–a toxic chemical used as an industrial cleaner in the 1960s) was successfully removed from groundwater. Polluted water with an added catalyst is pumped through glass tubes called reactors which have sunlight reflected upon them by curved glass troughs. According to the Institute, "high-energy photons in sunlight interact with the catalyst and break down the toxic chemicals into non-toxic products." The use of sunlight, a free source of energy, holds the possibility of providing us with clean drinking water.

With a new awareness to the contamination of our groundwater, we can now concentrate on ways to prevent this catastrophe and make our drinking water safe.

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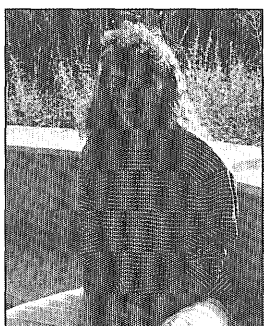


TECHNOLOG
Writer Profile

Joanne, a Scientific and Technical Communication major, became concerned when her skin matched her blue Timberwolves sweatshirt. Searching for possible causes, she found contaminated groundwater to be a prime suspect, and felt obligated to pass this information on to Technolog *readers.*

Photo by David Sager

1992 Technolog Science Fiction Contest

An outside panel of judges will select the top three entries. These will be printed in the April issue of the *Technolog*. Winning authors will receive prize money accordingly:

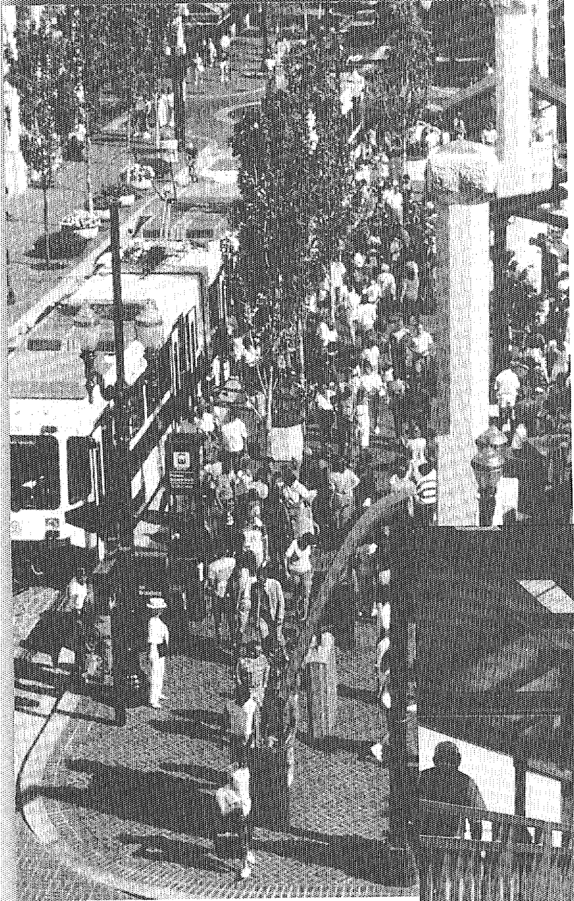
First: $ 100
Second: $ 75
Third: $ 50

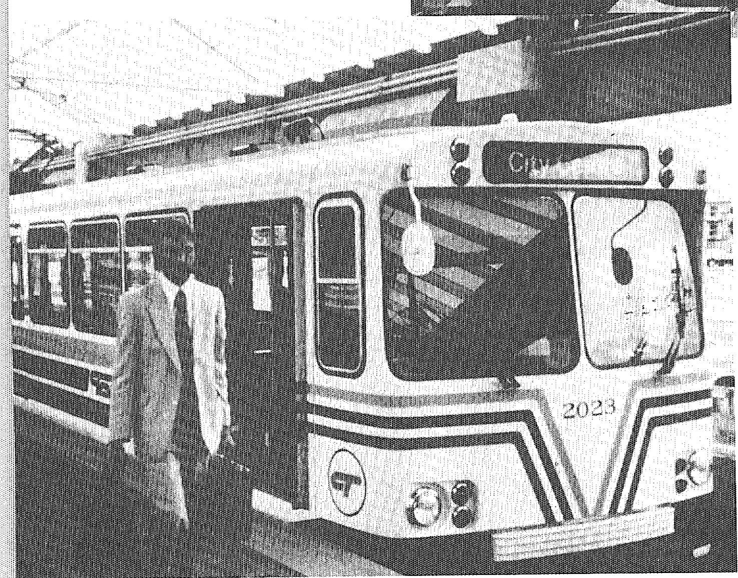
Contest Rules:

The contest is open to all registered U of MN students, except *Technolog* and ITBP members. Entries must be typed and double-spaced, and no longer than 3000 words. Attach a cover page entitled science fiction contest entry, and don't forget to include your name, address, and phone number. Do not include your name on the manuscript! Entries may be turned into room 5 of Lind Hall.

DEADLINE: January 24, 1992

Light Rail Transit





An Attempt to Tame the Last Frontier: Our Traffic Jams

by Scott Ryun

Envision a sunny morning in the year 2000. Realizing that you have hit the snooze button on your alarm clock one too many times, you hastily get out of bed to get ready so you will not miss the bus. But, the bus does not take you to work, it takes you to the local Light Rail Transit (LRT) depot where you catch the LRT vehicle to take you downtown to work.

Is this only a dream? Will over ten years of debate and planning for LRT be realized in its development? Maybe.

What is LRT?

Welcome to what may become a new era of transportation in the Twin Cities Metro area. Light Rail Transit consists of a rail line, a rail vehicle, and a power source.

The National Transportation Research Board defines LRT as "...a metropolitan electric railway system characterized by its ability to operate as single cars or short trains along exclusive right-of-way at ground level, on aerial structures, in subways, or, occasionally, in streets and to board and discharge passengers at track or car-floor level." LRT vehicles are designed so that they operate from an overhead electrical power source. Since it operates on electric power, it is quiet and produces few pollutants. LRT vehicles can operate in ice, snow, or heavy rain and travel at a maximum speed of 55 mph. A cab at the front of each train operates the vehicle, so the vehicles can be linked together in short trains or operated independently.

Why is LRT Important?

LRT is currently used in over a dozen cities across the nation and is adequately suited to the ever-changing priorities of a growing metropolitan area. It differs from the popular subway systems of New York City, San Francisco, and Chicago in that these subways are based on heavy rail systems. Heavy rail usually consists of a three rail track in which the third rail provides electrical power to the train (the long strings of cars joined together) and requires a specially designated path of operation known as a right-of-way. Heavy rail systems run on designated right-of-ways which have construction costs three times that of LRT.

LRT rails may be positioned in a variety of ways such that they operate in exclusive right-of-ways, in reserved lanes, highway medians, in underground tunnel systems, abandoned railroad right-of-ways, and within rarely used railroad right-of-ways. LRT may even share roadway surfaces alongside streets and sidewalks with other vehicles, since the flow of cross traffic is not unduly hampered by LRT and the power cables are placed overhead where they are safely above cars and pedestrians. Because of the flexibility of the LRT system, it can provide access to many areas that would be inaccessible by heavy rail systems.

This flexibility is very important in the Twin Cities because the space for dedicated systems is not available. Adequate room for highway and freeway expansions is hard to obtain as their funding dwindles and a local roadway travel increase is expected.

The Metropolitan Council anticipates a growth rate of two to four percent annually in local roadway travel. To relieve this pending traffic congestion, LRT could become an important part of a regional transit system. A three-car LRT train would be able to conveniently transport 500 people, which equates to almost seven buses at full capacity.

The current automobile loading factor for the Twin Cities is placed at 1.1 persons per automobile. This means that over 450 automobiles could potentially be removed from area roads simply by having them ride one of the aforementioned three-car light rail vehicles. A more conservative figure recognized by the Regional Transit Board is 350 to 400 automobiles. With this type of reduction it is anticipated that an LRT system could eliminate approximately 3,600 automobiles from area highways per hour in each direction, or nine miles of I-94 during a peak rush hour.

This is not to say that the car is dead; "park and ride" lots will be created for the LRT system where a person may park their car and ride the LRT system. However, LRT would reduce the pressure for the creation of more parking in the downtown area where the cost of creating a parking lot is quite high.

LRT would also benefit the environment. With the removal of some 3000 plus cars per hour in each direction, a reduction in pollution occurs. LRT vehicles are powered by electricity produced at large power plants which are governed under stringent federal air quality regulations, unlike the heavily polluting individual motor vehicles. In fact, each person using public transit for one year keeps nine pounds of hydrocarbons, sixty-two pounds of carbon monoxide, and nearly nine pounds of nitrogen oxide out of the region's air.

This is not the only benefit. It is also estimated that by taking public transit each person saves an average of 150 to 200 gallons of gasoline annually.

Not only is LRT beneficial for the environment, but it allows for greater accessibility to individuals with limited mobility. People with disabilities, senior citizens, and those with small children achieve greater accessibility by having the boarding level at the same level as the LRT vehicle, one of the requirements for an LRT system in the Twin Cities Metro area.

LRT has already proven to be a highly safe and reliable form of transportation in all weather conditions. LRT has performed well in all of the weather conditions expected in the Twin Cities Metro area and has proven itself in cities such as Boston, Calgary, and Edmonton. LRT is not hindered by rain, icy conditions, or a sudden snowfall. As with all forms of public transit, LRT is much safer than personal automobiles.

Where would the LRT travel?

After over ten years of debate and planning for the LRT system in the Twin Cities, a plan of where and when to build LRT routes has been established. The most recent proposals are based on information gained in 1989.

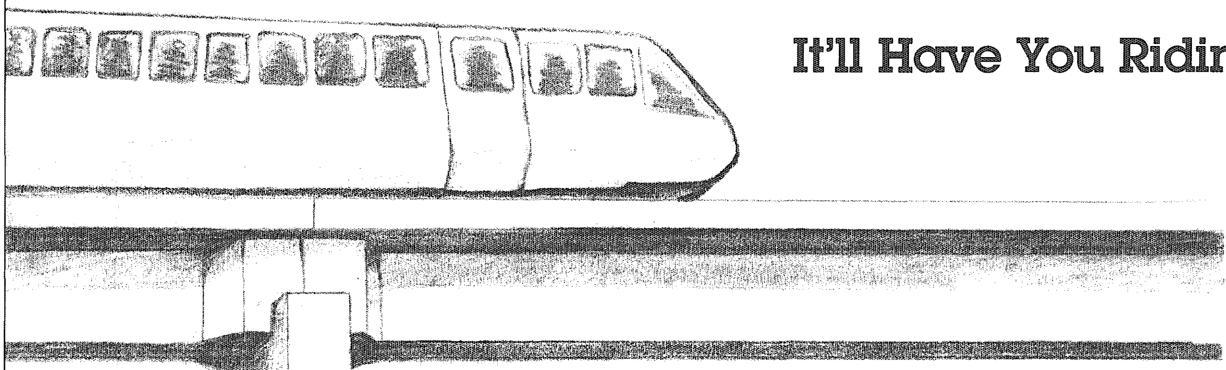
Phase A

The first area expected to benefit from LRT would be the *Central Corridor.* This is the area between downtown Minneapolis and downtown St. Paul, and includes the University of Minnesota campus. For this corridor, the three possible routes specified

(continued on page 17)

The Mass Transit "Miracle"

It'll Have You Riding On Air



Unlike many mass transit systems which are powered directly by electricity or diesel power plants, Jakarta, Indonesia's capital city, has a mass transit system that runs on air. Yes, air.

Aeromovel, which has operated since 1989, is based on rather simple physics principles. The system consists of an elevated concrete guideway supporting the rails on which the cars roll. A 39 inch by 39 inch hollow concrete air duct, shaped like a box, lies under the rails. Each car has square metal propulsion "sails" which hang from the front and rear of the car. Ground-based external blowers force pressurized air into the air duct, providing the force that propels the cars.

Blower pressure is kept at a mere two pounds per square inch. This equates to a total thrust of over three thousand pounds on the car's "sail." If the front blower of the car is set to suction, the force on the car is doubled, enabling the car to reach a top speed of 50 mph. Acceleration, speed, and braking are controlled by regulating the output of the blowers and by opening and closing air valves along the air duct.

As a car moves over a given section of its line, it is isolated from the rest of the line by large flap valves which block off a length of air duct. Blowers, serving individual sections, are able to move up to 50,000 cubic feet of air each minute. The whole system is computerized from a central location, allowing for complete control over each blower.

The blowers are really the work-horse of the system. By pressurizing the air behind a car's rear sail, forward thrust is achieved. If quicker acceleration is desired the blower ahead of the front sail can be set for negative pressure.

By pressurizing the air ahead of a moving car an opposing force is created to slow the cars. Final braking is accomplished by disc brakes on the individual cars. The whole time the car is in motion, flap valves are opening and closing in front and behind the cars while different blowers are coming into operation. This allows a smaller area to be pressurized and provides the ability to have multiple cars on individual lines.

Since the car does not carry a heavy electric motor or other driving gear, a high payload to dead-weight ratio is obtained. This allows an added passenger capacity with a given energy input. The passenger payload of a fully loaded car in the Aeromovel system is 70% of the car's weight whereas the New York city subway system has a passenger payload of only 33%.

Since the cars do not carry heavy propulsion systems, they can be constructed of lighter and less expensive materials. The reduction in weight also lessens the maintenance requirements of the rails and associated hardware. This contributes to a lowering of capital costs and cost per passenger of up to half that of conventional people movers.

Safety is not compromised either. The cars always have columns of pressurized air between them. In addition, the sails on the cars are slotted into the track, thus eliminating the possibility of a derailment. Also, since the system runs on air, there is no shock hazard from an exposed electrical power source.

With systems such as the Aeromovel, the extension of economical people movers is possible. The inexpensive maintenance of this innovative transportation system may lead to an expansion of this system worldwide. It may also provide a safer alternative to our electric train system. Who knows what the future holds for us here? We could soon be riding on air.

"Atmosphere Railway"

Oddly enough, the designers of the Aeromovel had no knowledge of the "Atmosphere Railway."Although this seems to be a rather new development in the mass transportation of people, it actually dates back to the 19th century. In 1847, the "Atmosphere Railway" was built covering 52 miles of the Dover Coast in England.

The system was engineered much like the Aeromovel, but it had an Achilles heel. The flaps and sails of the "Atmosphere Railway" were built of leather which proved to be unable to stand up the assaults of fog, sea spray, salt, and the gnawing of rats. Because of this shortcoming, the railway lasted only eight short months before operations were ceased.

Illustration by Joyce Rajendren

are along Interstate 94 and the Soo Line Railroad, along University Avenue, and along the Pierce-Butler arterial streets.

Phase A includes the necessary yards and shops for operations and maintenance. In downtown Minneapolis, a 1.1 mile underground tunnel would be created. In St. Paul, Cedar and Fourth streets have been designated as the preferred surface alignments. The estimated cost of this first phase is approximately $400 million dollars (in 1990 dollars).

Phase B

Phase B consists of five additional routes added to the Central Corridor. The *Minneapolis Northeast Corridor* would connect downtown Minneapolis with the Northtown shopping center in Anoka County, traveling through Columbia Heights, Fridley, Spring Lake Park, and Blaine.

Minneapolis Northwest Corridor would connect downtown Minneapolis with 63rd Avenue North in the northern suburb of Osseo, traveling through Golden Valley and Robbinsdale.

Minneapolis South Corridor would connect downtown Minneapolis with 96th Street in Bloomington, traveling through Richfield.

Hiawatha Corridor is intended to eventually extend to the Twin Cities' International Airport, but for Phase B it would link downtown Minneapolis with the Government Services and Administration Building at Fort Snelling.

The fifth corridor planned for Phase B, the *St. Paul South Corridor*, would connect downtown St. Paul with northern Inver Grove Heights, parallel to Robert Street and the Lafayette Freeway. The estimated cost of these routes is $750 million (in 1990 dollars).

Phase C

Phase C seeks the creation of three additional routes and extensions of two routes created in Phase B. The *Minneapolis Southwest Corridor* would be created out of downtown Minneapolis and extend to U.S. Highway 169 in Hopkins, traveling through downtown St. Louis Park and downtown Hopkins.

St. Paul Northeast Corridor would connect downtown St. Paul with I-694 in Vadnais Heights, traveling through Maplewood and terminating at the Maplewood Mall.

St. Paul Northwest Corridor would branch off of the Central Corridor near Snelling Avenue and extend to County Road C, near Rosedale Center, in Roseville.

As mentioned before, *Hiawatha Corridor* would be extended from the Government Services and Administration Building to the airport and may be further extended to the Mall of America.

The *Minneapolis South Corridor* may also be extended into Burnsville, with a termination point of either Trunk Highway 13 or the Burnsville Center.

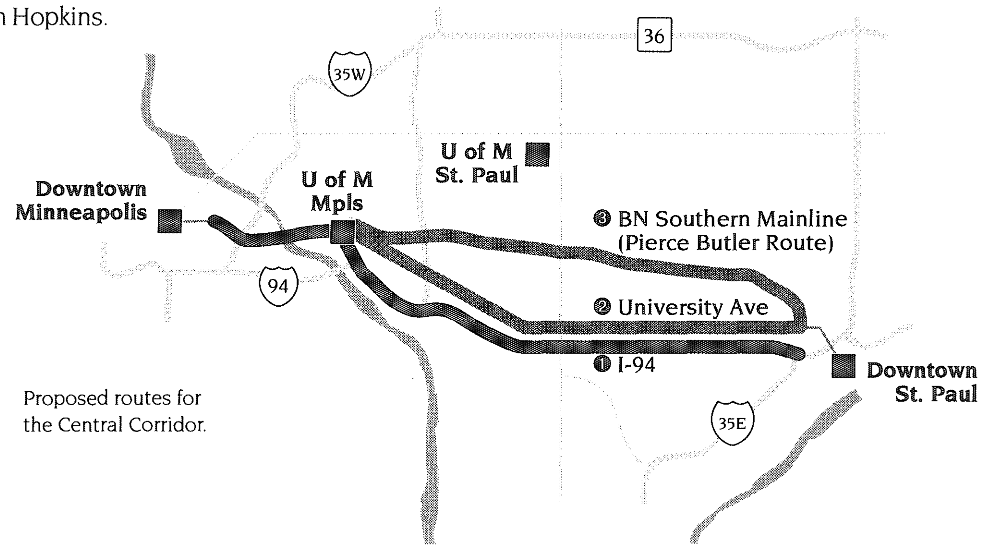
Phase D

This phase is considered the maximum 20 year plan and calls for further extension of the corridors built in prior phases. Comprehensive planning of this phase depends on what the near future will bring for LRT. Planning for something as far in the future as this phase must take into account the possible changes in ridership and other such factors. Therefore, this phase is most likely to see changes before it ever goes into final planning and the engineering stages.

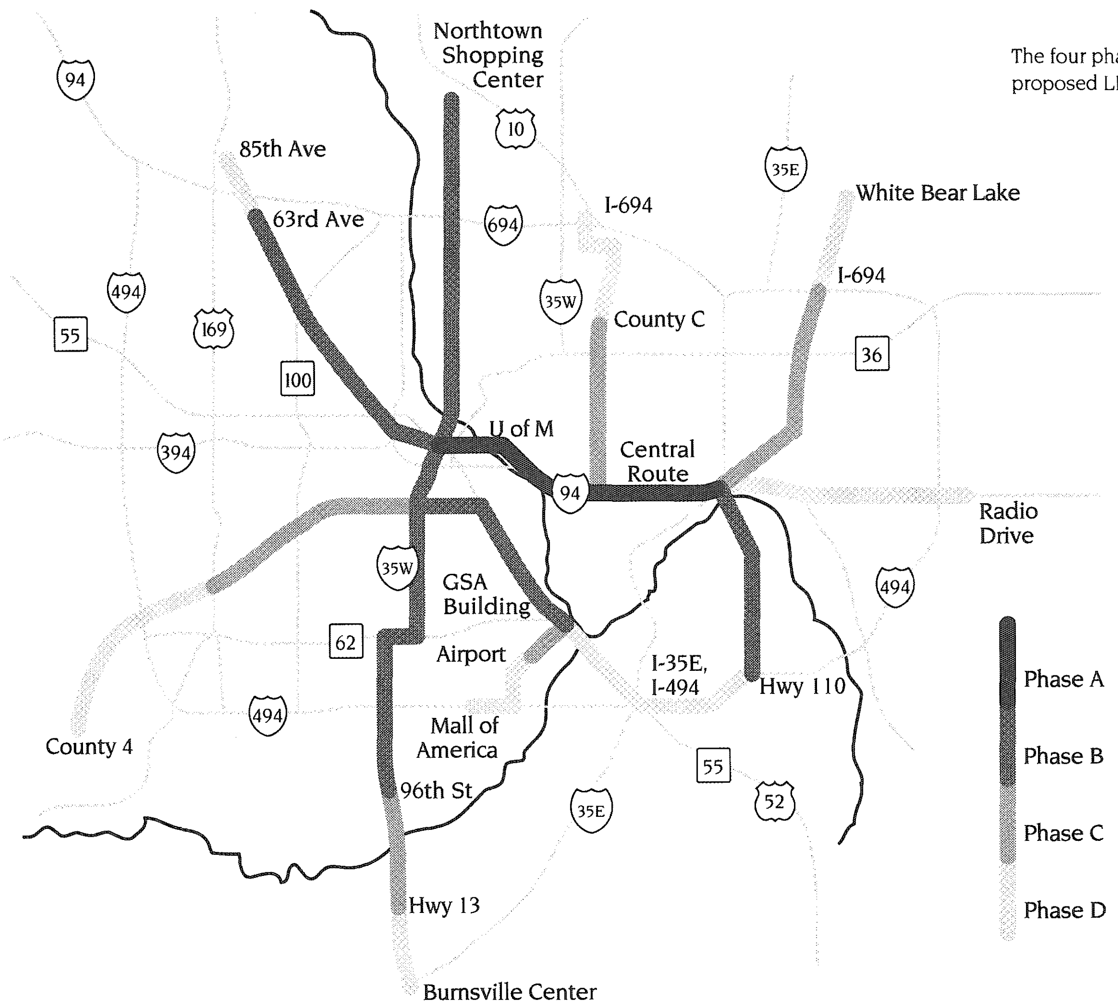
Will the Twin Cities ever have LRT?

The answer to this question is still maybe. Over the past ten years the Hennepin County Board has contributed $57.4 million towards Light Rail Transit. For LRT to be fully on line in the year 1997, funding would have had to have been approved in 1991. However, this was not the case.

A one percent increase in the sales tax for the seven county metro area was requested and denied due to budget shortfalls among other things. Similarly, the Hennepin County Board decided not to levy property taxes to pay for LRT. Along with this, a Citizens League analysis used the LRT planner's own data to show that the huge investment of money necessary to implement LRT would only serve three to four percent of the daily trips in the metro area.



Proposed routes for the Central Corridor.



The four phases of the proposed LRT system.

Although this is true, during peak travel hours, especially rush hour, up to half of all trips are on public transit. Nonetheless, the Regional Transit Board has been instructed to reevaluate the proposed corridors, to update development and financial proposals, and to look at possible alternatives to LRT.

Realizing that the Twin Cities Metro area has continued to grow, a comprehensive regional transit plan is needed, and it needs to be implemented. The question is whether such a system, whether it be LRT or some other form of public transportation, will be in place before the traffic jams on I-94, I-35W, and many of the other area roads severely inhibit the ability of people to go to work.

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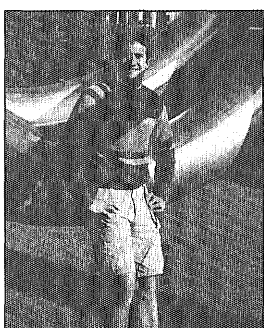


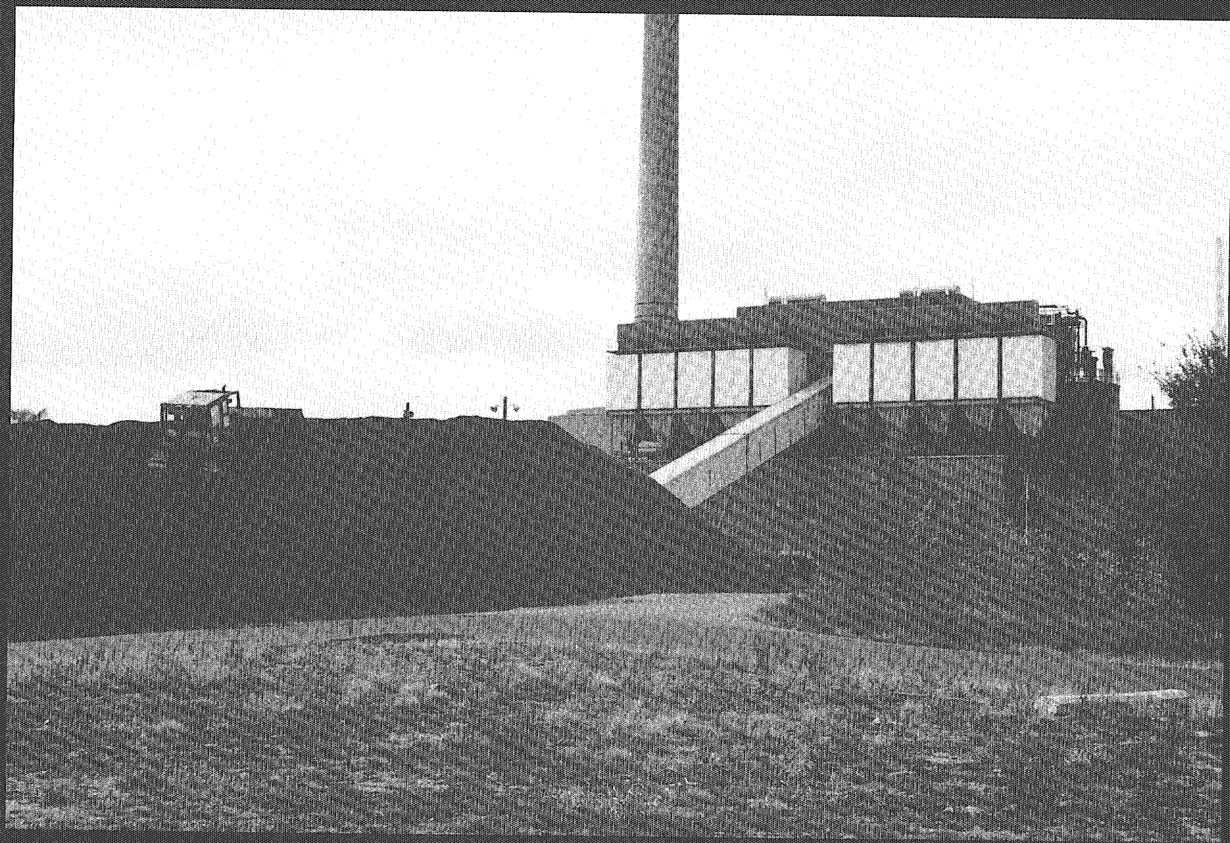
TECHNOLOG
Writer Profile

Scott has grown impatient waiting for the Twin Cities to get LRT. Rumor has it he's building a teleportation device in his basement. Scott plans to have the device working in time for a vacation in Jakarta over winter break. His expenses will of course be paid by the Technolog.

Steam Production

It's Not Just a Bunch of Hot Air

by Rodney Hehenberger



The undeniable, unmistakable fact is that winter is upon us. With it, of course, come the Arctic temperatures of Minnesota's most dreaded season, as well as yet *another* attendance deterrent for University students. After all, who wants to put their feet on a cold bathroom floor, hop on one of the 6-wheel refrigerators of the Medicine Lake Lines, and trudge across the frozen tundra of Northrop Mall for the simple reward of arriving in time for that 9:05 chemistry class?

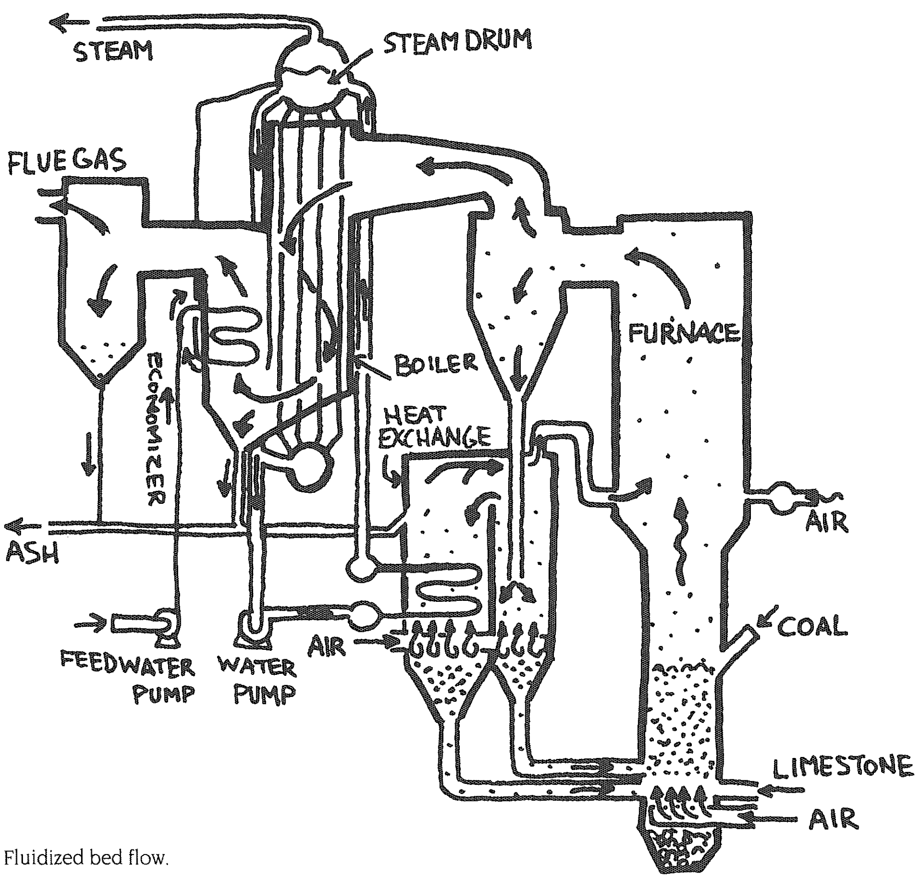
Photo by David Sagar

Fortunately, thanks to the products of three steam plants located in Minneapolis and St. Paul, students and staff can take solace in the fact that they will be able to defrost themselves over a radiator or heating vent. Through a vast maze of furnaces, boilers, and pipes, these plants put out enough steam to heat the equivalent of 35,000 houses. Using 200,000 tons of coal and thousands of tons of gas and oil to convert over three billion pounds of water into steam, the overall process of the University's steam heating plants implement a great number of smaller steps. From the preparation of fuel to be consumed to the outputs of steam and numerous emissions, the transformation of these raw materials into heat is fascinating—and at times controversial.

Recently, the University's negotiations for a privatized steam system have accented the controversy. The negotiations involve the implementation of a private source for the University's steam needs. This is an enormous undertaking, since the University is looking at a billion dollar, 25-year contract to allow complete steam manufacturing from a private source. The need to update current facilities exists, but problems centered around which fuel source to install and what its impacts are on the environment also need to be addressed.

For decades, the use of inefficient, obsolete equipment to produce steam was the financially profitable option to development and installation of more advanced, expensive machinery. This was due to cheap fuel costs prior to the 1970s, roughly the same time the boilers now operating in our own steam plants were built. Since the energy crisis, though, skyrocketing fuel costs and improved understanding of their environmental impacts have justified higher capital investment on improved systems.

Likewise, the University has afforded some refinements in its plants. Even so, their boilers presently run at efficiency rates of only 60 to 85 percent, a range from poor to good. Unfortunately, there are no "simple" revisions that can significantly change these 15 to 60 year old boilers—particularly when one realizes that the industry standard for obsolete equipment is 45 years. Concern for environmental problems coupled with the present inefficiency of the steam heating plants has led to the increasing importance of the University's recent negotiations for a privatized steam system.



Fluidized bed flow.

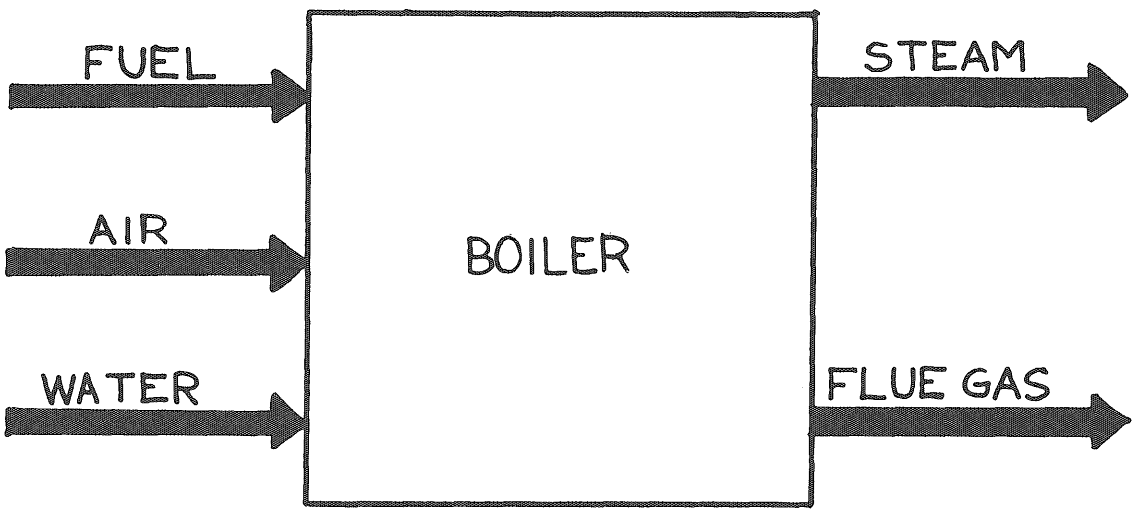
Fuel Choices

One of the primary dilemmas facing any plant designer is the type of fuel to use. The three longtime staples of the industry—oil, natural gas, and coal—are increasingly seen as less perfect fuel sources. Of these traditional fuels, oil is a rarely used source because of high prices both financially and environmentally. Natural gas, though environmentally more safe, is still thought to be a limited resource. And coal, long the workhorse of the steam industry, emits twice as much carbon dioxide as gas, not to mention that it is also non-renewable. So, new fuel sources are sought, as are an abundance of refinements to the presently used fuels.

The 16 existing boilers of the University's steam heating plants each consume one or more of these traditional fuels, as they were constructed at a time when it was impractical to use the more radical ideas of solid waste (biomass) or wood waste firing. While both of these technologies are young, some plants operating in the state implement these fueling systems. In Red Wing, for instance, Northern States Power (NSP) has agreed to convert four boilers at the Red Wing Steam Plant and the Wilmarth Steam Plant from coal burning to solid waste burning. Also, operating in Grand Rapids, Minnesota, is Blandon Paper's wood burning plant. The plant's furnaces consume wood unusable for production.

These fueling methods are not yet widely used as power sources. However, their operation at the two plants here in Minnesota would seem to lend them credibility as possibilities, since NSP is among those bidding for the steam system.

As types of fuels vary, so do the ways that the University steam plants burn them. In the easiest method, four of the boilers take the gas or oil and blow it into a firing chamber. This chamber burns them in the same form they are received. Another relatively understandable way to burn a



Basic inputs and outputs.

fuel, used with the coal furnaces, is to throw it into the furnace in large chunks and burn it in this form. Four of the coal burning facilities use this type of fueling, referred to as "stoker firing." It is a relatively limited type of consumption, as stokers are generally only able to burn about 250,000 pounds of fuel per hour.

A refinement of this, also used by some of the University's furnaces, is to use coal that is pulverized, making it easier to oxidize completely and proceed to burn the dust in suspension within the burners. In addition to the boilers using only one of these fueling options, several of the boilers are also capable of burning coal, gas, *or* oil, depending on the seasonal affordability of fuel.

Once through the burning stage of the furnace, the steam industry uses a few methods of transferring the energy from the combusted gas to the feedwater. At a basic level, these include the firetube boiler, the fluidized bed boiler, and the water tube boiler (the type used exclusively by the University steam heat plants). Each of these is characterized and well described by its name.

Firetube Boiler

In a firetube boiler, for instance, the heat is blasted through pipes that are surrounded by pressurized water. The amount of heat that is dispersed into the liquid is primarily determined by the number of passes that the gas makes through the boiler before it is expelled. While not the largest or most powerful of boiler types, firetubes are still very popular because of their simple construction and ability to be easily transported.

Though not used in the main heating plants, vast numbers of firetube boilers operate in individual buildings throughout the campus. Referred to as "packaged boilers," they are used because they can be pre-fabricated in the factory and simply slid onto tracks within the building. They are not used in the University steam plants for several reasons. Typically used with liquid fuels, the firetube boiler is limited in size because of both the need for pressurized containment of the water and the restraints on diameter and thickness of the chamber. Also, "the practical limit" for the steam pressure of firetubes is about 250 psig, and some of the University boilers produce steam in excess of 400 psig. Most importantly, though, they are not used because of their shorter life span in comparison to the other types of boilers. For these reasons, other types of boilers are widely used and beneficial in their own ways.

Fluidized Bed Boiler

Less conveniently constructed and transferred, but still commonly used, is the "fluidized bed" category. This version of heat transfer sends air through several "beds" of chemicals that allow heating, liming (a pollution control measure), and recirculation of unused heat in one unit. It allows a more uniform dispersion of heat and, in many cases, more complete burning of the fuel. Among its environmental benefits are its lower NO_x formation and, because of the longer time in the furnace, the greater effectiveness of the limestone's reaction with the sulfur dioxide. State of the art examples of this type have recirculated heat and reused low temperature condensate (the remnant of heat drained steam) that get an exceptionally high percentage of the fuel's energy to convert to the temperature and pressure of the steam.

Inside a watertube, the heat is most effectively transferred when the greatest possible surface area of the tubes is exposed to the hot air circulating around them. "Baffles," tubes with fins protruding from them, are used to increase the surface area in contact with the furnace.

Watertube Boiler

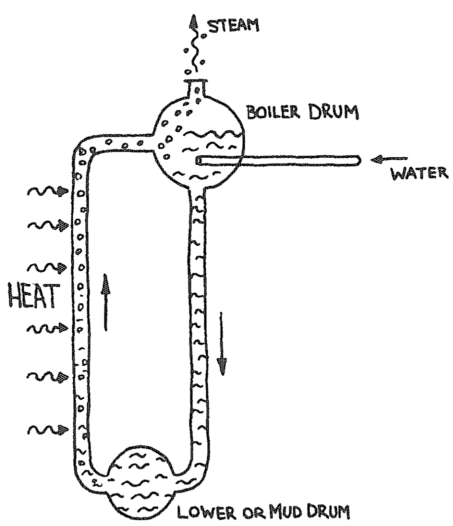
At the University steam heating plants, however, the sole type of boiler used is the "watertube." It is presently the most commonly used boiler in American industry, as well. As the name implies, this style pipes pressurized water through air heated to between 2200 and 2500 degrees Fahrenheit—operating in exactly the inverse fashion of the firetube.

As with the firetube, a greater percentage of heat transfer is accomplished by sending the water through the boiler more than once. This is often done by using two "drums" which allow sufficiently heated steam to be captured. At the same time, the water and steam that have not yet reached the correct temperature and pressure for use drop to the lower tank. By means of pipes that send the steam up, "risers," and the water down, "down-comers," the condensate is exposed to the most heat possible.

Yet another method of capturing the greatest amount of energy is to send the flue gas through the boiler in such a way that it passes through every conceivable pipe within the boiler.

Throughout the process of producing steam, pressure control is a vital feature of any type of boiler. When water "flashes" into steam, steam pressure drops creating greater resistance to water flow and increased deposits of chemicals formerly suspended in the water. Despite this danger, the watertube remains a tremendously flexible style that is widely exploited by the steam industry because of the limitless shapes that condensate-carrying tubes can form and its ability to produce huge amounts of steam.

Circulation of watertube boiler.



Steam Generation

Once through the boiler stage of production, there are several outputs of steam generation. They can be separated into those related to the water process, such as condensate, various residues of the water, and steam, and those related to the fueling, such as flue gas, unburned fuel, sulfur dioxide, NO_x, carbon dioxide, etc. Some of these outputs, such as the steam, are obviously useful to the operator. Most are not. It is here that the plant designers must decide what has potential benefit and what is discardable, a decision based on what is deemed accessible energy versus the potential risks and financial hassles.

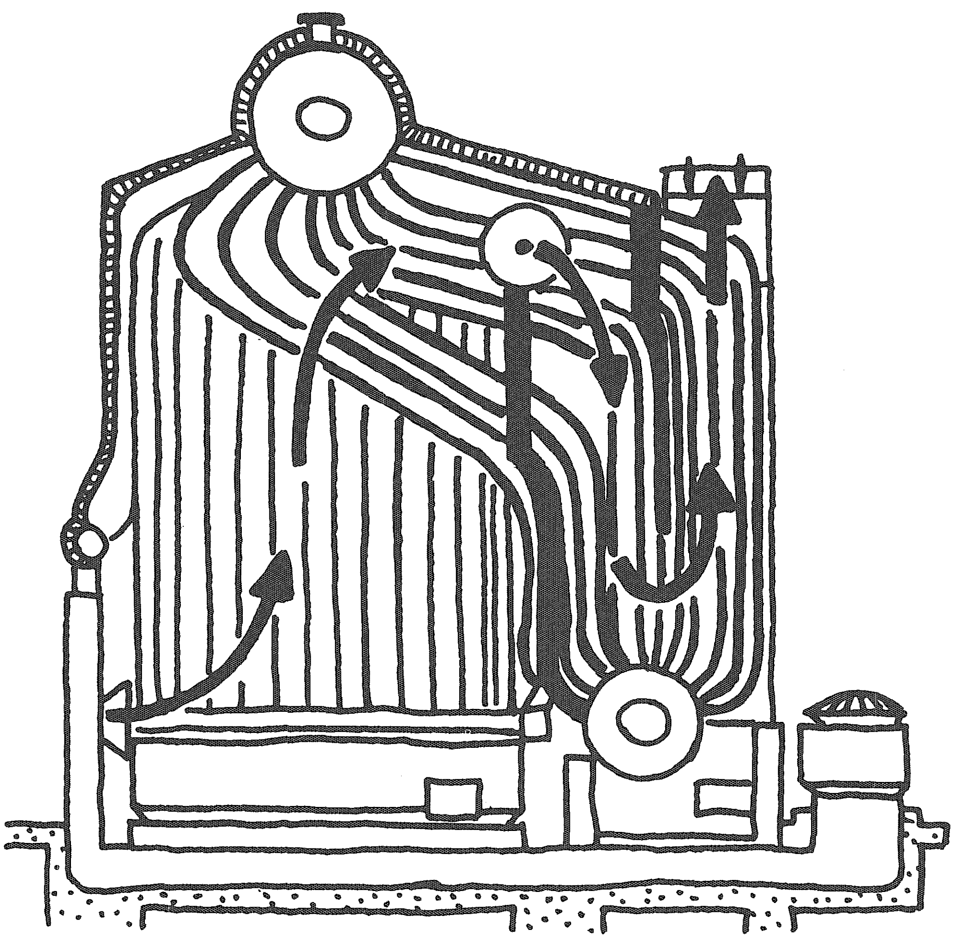
Though less apparent than steam, some emissions are also advantageous to try to tap. The best example of this is probably the recirculation of the semi-burned gases used to be sent out the stack with no further effect other than on the environment. Greater efficiency can be achieved by sending the semi-heated flue gas back through low pressure water. By using this system, referred to as an "economizer," the flue gases add a great deal of heat to the incoming water. Once in the main boiler, then, the high temperature gases need only add a little more energy to get the steam to the desired pressure.

Several parts of this process need careful supervision, such as loss of flue gas pressure, loss of steam pressure through the initial cycle, and "flashing." All of these defeat any advantages that might have been gained by recirculating the heat. Proper use of economizers, though, allows plant operators to save a tremendous quantity of heat that would otherwise simply be coughed out the stack.

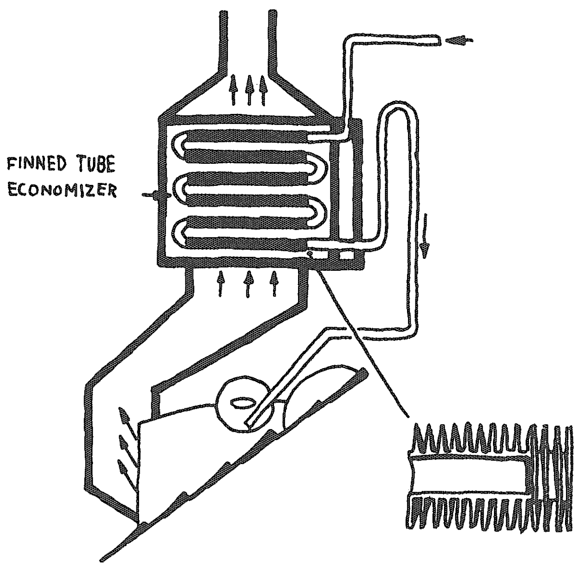
Emissions

In a very myopic sense, this ends the trip from water to steam. The steam has been sold to the vendor for a vast assortment of uses, the fuel has been burned, and each of us is kept cool in the summer and warm in the winter through the power of these steam plants. But, in a much wider, more conscientious sense, there is still the most vital portion of steam production to be dealt with—the unnecessary emissions.

While other emissions that are thrown out of the stack, such as sulfur dioxide, NO_x, and carbon dioxide, are merely waste to the operator, they are severely detri-



Convection currents in boiler.



Baffled economizer flow.

mental to the environment into which they are released. Although everyone appears to agree that something needs to be done about the potential environmental effects, there is a great disparity in the *degree* of change needed. How important is acid rain? How much needs to be done about global warming? Are these even problems that need to be dealt with?

For instance, flue gases regularly emitted from steam plants contain sulfur dioxide emissions. These then become a foreign partner to such atmospheric activities as rain clouds, and change a spring shower to deadly precipitation. This is commonly referred to as "acid rain," and is causing global havoc because of nations that do not have stringent laws, companies that don't comply with regulations, and, as presently occurring in Iran, large scale burning of fossil fuels in war. By polluting the rainfalls of delicate ecosystems, acid rain poisons the food and water of a vast array of life forms.

While emissions such as sulfur dioxide result in the life-threatening problems of acid rain, these are "peanuts compared to the problem of global warming," according to Rob Hogg, member of the Steam Plant Advisory Board. Burning fossil fuels such as coal and natural gas causes emissions of gases such as nitrous oxide and carbon dioxide, which in turn float into the atmosphere and clog the regular ventilation process of the earth.

While these may appear to be problems that could only be dealt with on some far-away, mystic level of government, this is *not* the case. Today, our University ranks 20th in the state in its sulfur dioxide emissions, and ninth in the Twin Cities area. It releases several greenhouse gases, among them, methane, nitrous oxide, and tons of carbon dioxide. Hundreds of thousands of tons of coal are burned annually, not to mention additional amounts of both gas and oil. The University does comply with regulations regarding sulfur dioxide and operates at an efficiency between 60 and 85 percent, which is generally within its permitted allowance. Carbon, however, is an unregulated gas, and the University has very few guidelines to follow in this regard.

Right now, the University is negotiating a new steam contract for a 25-year, billion dollar system that will affect our area for years to come. It is a necessary and overdue plant that will supply our community with heat and power. It will keep us warm through our agonizing winters and cool in our sweltering summers. But, it will come at a price that we must be aware of—and it will not solve its own problems. Steam production is a long, complicated, and costly process that affects all of us. We all benefit from its products. But in the long run, if we don't deal with its shortfalls, we will all suffer its detriments.

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TECHNOLOG
Writer Profile

Even though Rodney has seen the "plush" Technolog *office, he has decided, after extensive begging and pleading, to write an article. Rodney will have a double major, of all things, English and math.*

Photo by David Sager

Is It Grass or Trash?

Yet Another Recycling Issue

by Patrick Hafner

The United States currently faces a storage space problem—landfills are nearing capacity at an alarming rate. Annually, U.S. citizens discard 160 million tons of trash and waste. A significant portion of this trash is yard waste—namely leaves, branches, and especially, grass clippings. Clippings alone comprise 75% of all yard waste, which in turn constitutes 18% of all landfill material. This comes out to about 30 million tons, an amount significantly greater than that of all discarded glass and plastic combined. This tremendous volume makes yard waste a significant part of the landfill problem.

Consequently, many cities and townships have passed legislation banning the discarding of yard waste in the conventional manner. Over fifteen states have already put this into effect, and many more have it in the works for the near future. The vast number of homeowners who formerly deposited grass clippings and other lawn material into plastic bags and put them in the trash are forced to find an alternative.

The development of two devices for homeowner use may provide the necessary alternative. The mulching mower and the chipper/shredder are the two items becoming instrumental in solving this problem. Basically made to slice, chop, and pulverize material into small increments, the mulching mower and chipper/shredder make recycling much easier.

...turn a large handful of dry leaves into powder instantly.

Although certainly not new items in the lawn care industry, these two machines are no longer restricted for use by professionals. Whereas many people had never so much as heard of a mulching mower a couple years back, home ownership of these mowers is now quite common. Consequently, most hardware stores and retail stores now carry them. Chipper/shredders, now sold by many local dealers, have seen a similar increase in popularity through use in city neighborhoods. Mulching mowers generally run in price from $250 up to $500. A chipper/shredder can be acquired for around $500, with super heavy-duty models starting out at $1500 or more.

Mulching Power

So how is the biggest constituent of yard waste, grass clippings, taken care of? As Thomas Halbach of the University's Department of Soil Science states, "the least impact on the environment is to leave the clippings where you grow them." Halbach, an Assistant State Specialist of Water Quality and Waste Management, says research indicates that grass clippings are recycled back into the soil best when they are one-inch in length or shorter. Smaller clippings allow the release of potassium, phosphorus, and nitrogen much more readily, which is valuable for re-fertilizing the lawn. Mulching mowers are specially designed for cutting grass clippings into extremely fine segments ideal for recycling back into the soil.

One way the mulching mower handles grass so effectively is by incorporating a "multi-pitch" blade. This special blade has a twisting configuration, made to slice grass several times and increase vacuum action under the mowing deck. This differs from a regular lawn mowing blade which has a more straight-edge design made to cut grass just once before shooting it from under the mower.

In addition to the multi-pitch blade, a high-baffled mowing deck enhances mulching action. This special deck has a large, balloon-like appearance compared to standard mower decks. The high baffle causes vacuumed grass clippings to swirl around underneath, allowing multiple cuts of each clipping. After circulated and cut, the clippings are forced back into the lawn to begin the recycling process.

The end result of this cutting/vacuuming action is finely cut grass evenly distributed over the lawn. When mulched properly, the clippings are not noticeable and create a smooth appearance. Some people simply do not like the look of the "wind rows" a regular lawn mowers makes, which also delays the natural recycling process.

Dead organic matter can sometimes settle into the lawn and inhibit healthy growth. This matter, referred to as thatch, can be caused by leaving very long grass clippings on the lawn, as is typical when using a standard side-discharge mower. Build-up of thatch is apparently not a concern when using a mulching mower. "Thatch is not a problem with mulched grass", comments Jan Lemieux, a product information consultant at Troy-Bilt Inc., the original manufacturer of mulching mowers. "The clippings are cut so fine, that, in combination with sun and rain, thatch is eliminated."

The Chipper/Shredder

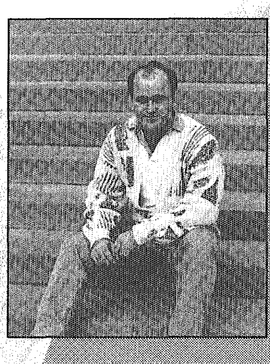
The chipper/shredder is a machine designed to handle larger material such as branches, vines, leaves, pine cones, acorns, etc. Heavy-duty models can reduce a 3-inch thick branch to a finely sliced pile of chips in seconds, and will turn a large handful of dry leaves into powder instantly.

The chipper/shredder contains two separate compartments. The first, located on top of the unit, has a large opening used for twigs, leaves, and other small yard waste. The refuse is processed by a set of cutting flails, which Jan Lemieux says is "...like an axle with several free-swinging knives on it." There are between four and 16 cutting flails on the axle, depending on the unit. Below the flails is a screen through which debris can fall. It will remain exposed to the flails until sliced finely enough to pass through the screen. Thus, the finer the screen, the smaller the increments of pulverized material.

The other opening, a chute on the side of the unit, is for branches. As they are pushed through, the branches meet a single carbon steel blade. The blade, whose tip travels 100 to 140 mph, chips the branches down rapidly, sending the chips down to the flails. The flails then break the chips down even finer, to the exact degree determined by the size of the screen used. This chipping/shredding process can reduce the volume of a branch pile to one-tenth its original size.

If homeowners are constructing their own composting bin, they can put the ground-up product of the chipper/shredder to effective use. Grass clippings will decompose much faster when blended with wood chips, as additional airspace will be provided. So, the chipper/shredder not only reduces the volume of branches in a yard, but can also provide a key ingredient, wood chips, to the composting process.

The chipper/shredder and the mulching mower are two steps in the right direction for reducing landfill waste. They make it possible to take care of yard waste at home, save time and haul-away expenses, and provide another helping hand for our environment.



TECHNOLOG
Writer Profile

Pat, the only English major on staff, originally wrote a sonnet about the joys of lawn mowing. The poem was pulled from this issue.

Photo by David Sager

Freshman Advising Goes Up as Enrollment Goes Down

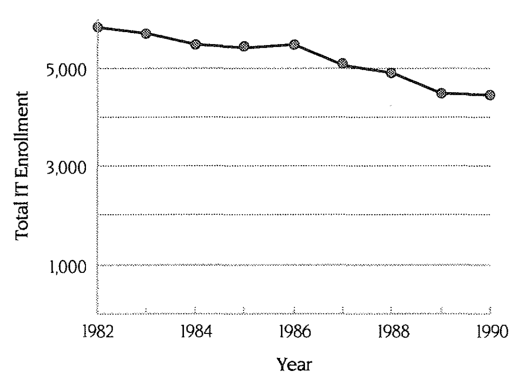
IT Offers New Support for New Students

by Scott Ryun

Freshmen who entered the Institute of Technology in September benefit from closer faculty advising and more student camaraderie than students of the past. The IT administration restructured freshman counseling in time for the approximately 600 new students who entered the college this fall. Based on the advising program that the IT honors program has used for six years, this college hopes this new program will increase IT students' sense of belonging as well as their grade point averages.

This year's freshmen are broken down into six groups, with approximately 100 students in each. Five groups are made up of general IT freshman, and one group is exclusively for honors students. Each group has a faculty advisor, a professional advisor, and a peer advisor. The groups are expected to stay together in the same class and recitation sections as much as possible for the rest of this academic year, according to Ben Sharpe, director of admissions for the Institute of Technology.

As students get to know more of their classmates, they'll hopefully develop more friends on campus, and the informal academic support groups can also help out with difficult physics problems.



Note: Graphic displays fall quarter enrollments and does not include UNITE or adult specials. Source: Student Support Services.

Although IT administrators want students to feel comfortable in college, they don't want students to stay in school too long. Advisors are now recommending students to take four courses. By taking 14–17 credits, new students will be able to graduate in four years. Most University of Minnesota students spend between five and six years as undergraduates.

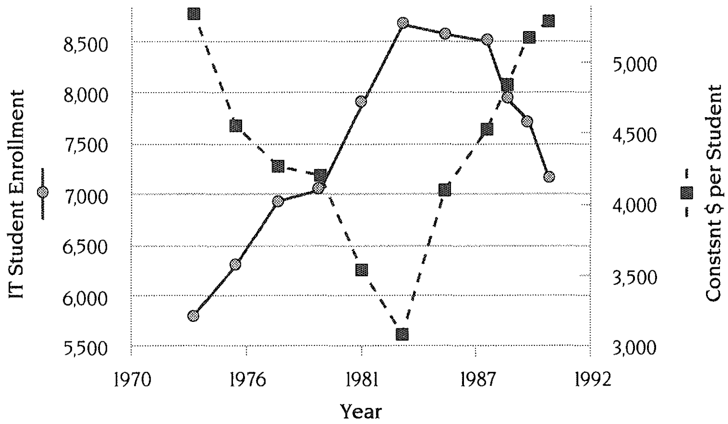
One reason the college is able to improve undergraduate advising is because IT enrollment has decreased by approximately 1,500 students since 1982. Students planning to graduate from the Institute of Technology this spring may remember freshman enrollment as high as 1,000 students—almost double what it was this year. Lowered enrollment in the college is due primarily to demographics of the available student body. Other factors that have decreased student enrollment in IT include:

- Many prospective students believe that the University of Minnesota has become less prestigious.
- Students often think they must attend smaller Universities for their first two years before becoming part of a large institution like the University of Minnesota.
- Some students feel that the degrees offered in the Institute of Technology are not as rewarding and/or glamorous as they once were.
- Students from outside the Twin Cities area save money by living with their parents and attending a college near home.
- The College of Architecture and Landscape Architecture split from the Institute of Technology in 1988, thereby reducing the number of IT students.
- Access to Excellence plan (formerly called Commitment to Focus).

Even so, Sharpe expects the number of students entering IT to increase next year.

This graphic shows both the IT Student enrollment and the number of dollars spent per student. Because of the large number of people that were in the Institute of Technology, the amount of funding per student dropped significantly in the mid-eighties. Funding is now making a comeback to the level that it was at in the early seventies.

Whether the IT to Excellence plan actually helps IT students cannot be determined at this time. However, increased monetary aid and personal attention given to the incoming students is definitely a good start.



Note: Graphic shows data in the 1973 value of the dollar.

What's Your IT IQ?

How Much Do You Know About the Institute of Technology?

by James Satter

Now that most of us are somewhere between midterms and finals, that little test-taker inside our brains might be getting restless. So, calm your nerves by taking this quick quiz about the Institute of Technology.

1. What is IT?

A. A giant spider in a popular Stephen King novel.
B. A nickname for unpopular teaching assistants.
C. An acronym for the Institute of Technology.
D. The 11th planet from the sun.

2. Until last spring, students have known Ettore Infante as the dean of IT. But what do Infante's close friends call him?

A. Spock
B. Bones
C. Jim
D. Chekov

3. How many foreign language courses are IT students required to take?

A. cuatro
B. deux
C. none
D. C

4. How much money did the IT Student Board of Publications leave in the Student Organization Group Investment Trust last August?

A. $ 703,000
B. $1
C. $19.99
D. –$60

5. Where is the IT Dean's Office located?

A. 105 Lind Hall
B. 105 Walter Library
C. 105 Johnston Hall
D. 105 St. Paul Student Center

6. What is the official magazine of the Institute of Technology?

A. *TV Guide*
B. *Minnesota Technolog*
C. *Rolling Stone*
D. *Time*

7. How high must an undergraduate's grade point average be to graduate with "high distinction" from IT?

A. 3.80
B. 3.14
C. 1.00
D. 4.30

8. What is the correct spelling of "metallurgical"?

A. M-E-T-A-L-E-R-G-E-R-I-C-A-L
B. 3-M
C. M-E-T-A-L-L-U-R-G-I-C-A-L
D. I-D-O-N-'-T-K-N-O-W

9. Which engineering degree is NOT offered in IT?

A. Bachelor of Human Engineering
B. Bachelor of Civil Engineering
C. Bachelor of Agricultural Engineering
D. Bachelor of Electrical Engineering

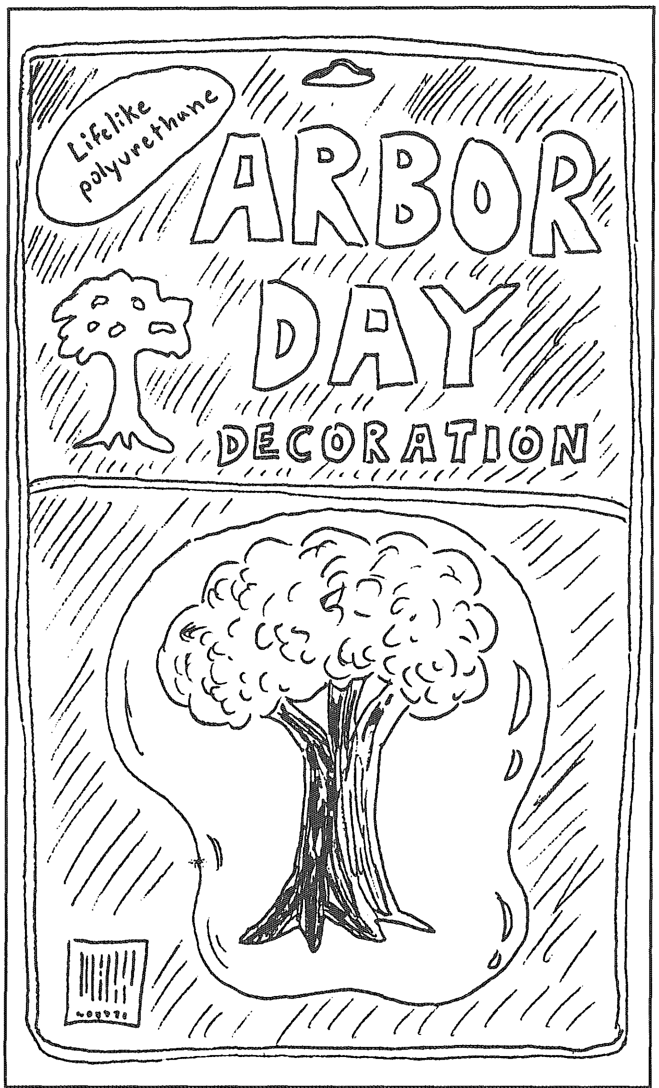
10. What is the number of the last page in the 1991-1993 IT "Bulletin"?

A. undecided
B. infinity
C. 112
D. 5/7

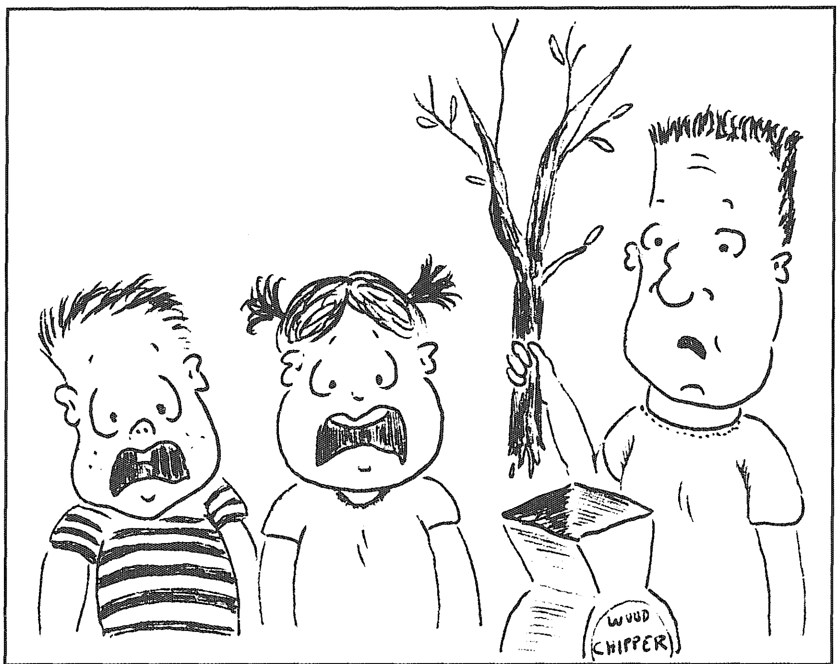
Answer Key

Because this quiz was not designed by experts, high scores are not necessarily a sign of intelligence, aptitude, or potential.

1: C 2: C 3: C 4: B 5: B 6: B 7: A 8: C 9: A 10: C

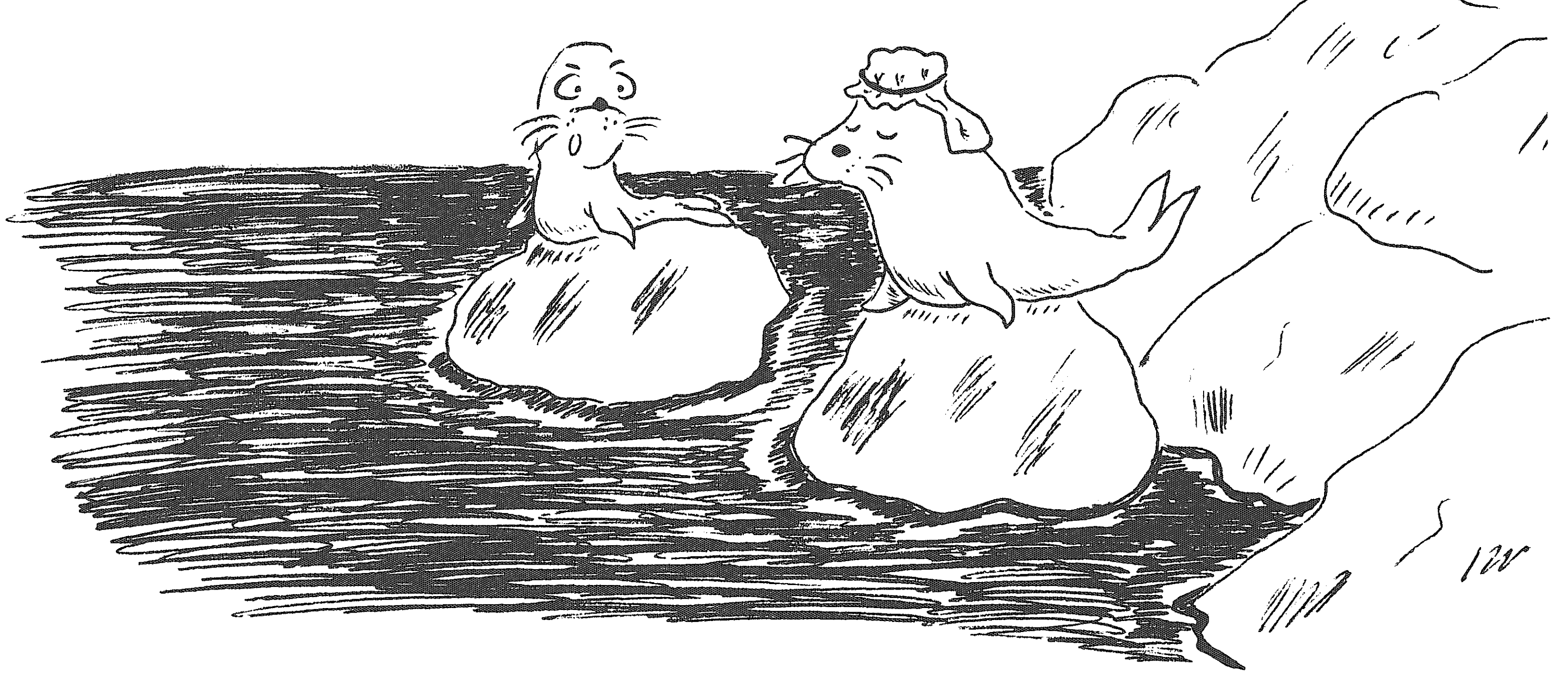


Products that miss the point.



"Oh... I guess that tree wasn't too small for a squirrel to be living in it."

"In your dreams Kyle."



Illustrations by Dennis VanDenBerg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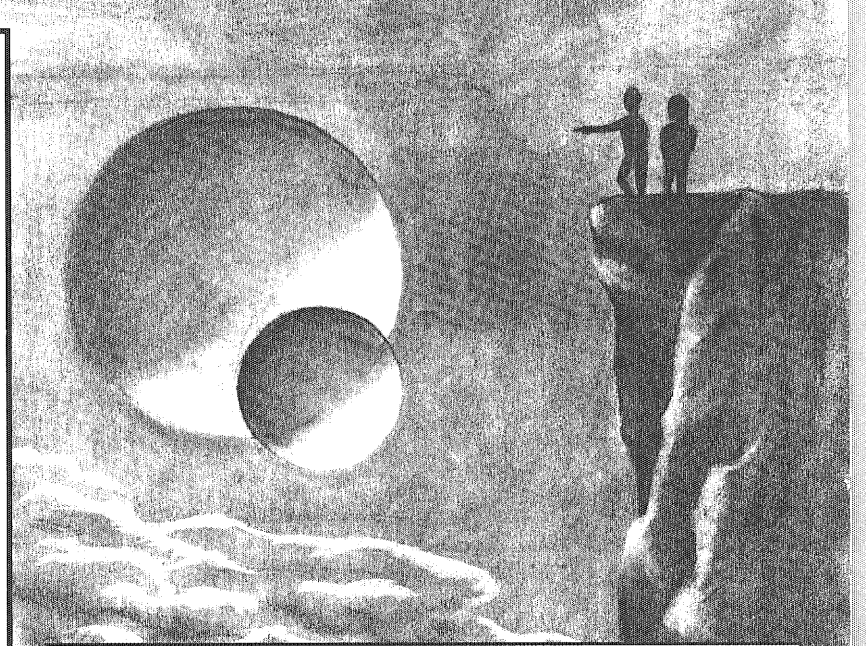
TECHNOLOG
January 1992
Wind Power in Minnesota
The Soundproof House
Alternative Lighting



1992 Technolog Science Fiction Contest

An outside panel of judges will select the top three entries. These will be printed in the April issue of the *Technolog*. Winning authors will receive prize money accordingly:

First: $ 100 **Second:** $ 75 **Third:** $ 50

Contest Rules:

The contest is open to all registered U of MN students, except *Technolog* and ITBP members. Entries must be typed and double-spaced, and no longer than 3000 words. Attach a cover page entitled science fiction contest entry, and don't forget to include your name, address, and phone number. Do not include your name on the manuscript! Entries may be turned in to Room 5 of Lind Hall.

DEADLINE: January 24, 1992

Need a résumé booster?

IT Board of Publications is looking for a few good people to fill the following positions:

Business Manager
Minnesota Technolog

Along with posessing organizational and accuracy skills, applicant should like to work with both numbers and money. Business Manager is responsible for all monetary transactions of the *Minnestoa Technolog*. Business Manager receives $125 per issue for eight issues. Position includes two spring issues this academic year and six issues the '92–'93 academic year. Applicant selected receives a free trip to Ohio State in April to attend the annual convention of Engineering College Magazines Associated (ECMA).

Editor-in-Chief
Minnesota Technolog

Receive valuable training in magazine layout and editing. No prior experience is required, but applicants should be well organized and posess above average communication skills. Editor-in-Chief receives $440 per issue, six issues per academic year. Applicant selected receives a free trip to Ohio State in April to attend the annual convention of Engineering College Magazines Associated (ECMA).

Qualifications

Applicants must be University students taking at least six credits per quarter. To apply, submit a résumé, cover letter, and unofficial transcripts from all colleges attended. Editor applicants must supply writing samples.

Editor
IT *Connection*

Gain valuable experience in publishing, layout, and editing as the Editor of IT's newsletter. The connection Editor receives $80 per issue, 15 issues per academic year.

Application Deadlines:

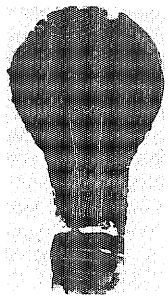
Business Manager	January 17, 1992
Editors	January 24, 1992

Send application materials to:

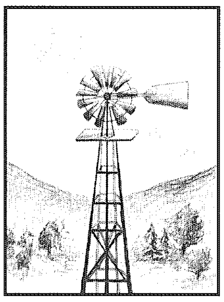
Jeff Conrad ▪ President, IT Board of Publications ▪ Room 5, Lind Hall ▪ University of MN ▪ 207 Church St. SE ▪ Minneapolis, MN 55455

TECHNOLOG

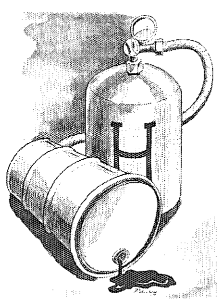
Volume 72, Number 3 January 1992



Our writer came up with the "bright" idea for this article, so let it shed a little light as you read on.



Blow through this article about the past, present, and future of wind power. You may be surprised to find out what's happening in Minnesota, practically in your own backyard.



In the future, we may not be fueling up at a gas station, but rather some other means. Our writer discusses the possibility of hydrogen to create power.

The Metropolitan Air Commission is joining both the Federal Aviation Administration and representatives of Minneapolis–St.Paul Airport's surrounding communities in researching home sound insulation to provide noise relief.

Departments

About the Cover...
This composition of light bulbs was cleverly compiled by our very own Art Director, Dena M. Collard.

Editorial

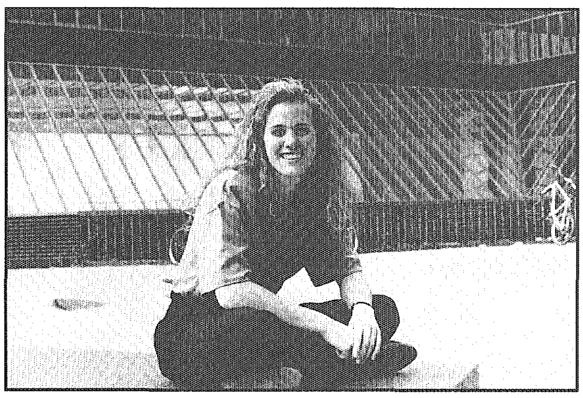
If It Ain't Broke, Don't Fix It. Or Should We?

Why are we falling so far behind? What is the United States doing wrong? What is Japan doing right?

What does it take to stay on top? I don't think our problem lies within a lack of knowledge or potential to strive for more knowledge. Along with knowledge, we need another resource—money. Sure, it isn't cheap to research and develop new ideas and it is a gamble, but research money is an investment for our future.

Unlike many countries, the U.S. government's policies don't always support its best interests. For example, why doesn't the federal government support research of renewable energy resources? I know, I know—at this time, some of the alternative energy processes may seem a bit farfetched, but what about the future? Conservation and renewable energy research and development can add to the U.S.'s national energy security and industrial competitiveness.

However, whether on a large scale such as the federal level and on a smaller one like businesses, I think our problem has more to do with the way we implement, or rather don't implement, new ideas. We need to *apply* more of the innovative ideas in search of improvements that are feasible. To quote an old adage, if at first we don't succeed, try, try again. As a future engineer, your job will depend upon that trial and error process, assuming that your ideas won't be thrown out before they are given a fair shake.



What caused Japan to pull ahead?

It all started after World War II. Japan had lost almost everything, and consequently needed to rebuild from scratch. While rebuilding, the country took hold of the latest technology. They had no choice but to accept the most recent innovations to attempt to stay competitive. Although starting over had probably seemed devastating at the time, that move has proven to be their saving grace.

Unfortunately we in the U.S. are stuck in a rut believing that *the way it's always been done* is the best way, but is it? Where are we now? Where are we heading?

In the 1940s, to be successful, a company needed to focus on quantity. There was a big market to fill and the U.S. was prepared to fill it, and consequently, was quite successful. Although it worked at the time, the market has changed. The emphasis has shifted from mass quantity to a more user-friendly, qualitative approach. To be successful, comapanies need to change with the market.

Also in the 1940s, William Deming, a management consultant in the U.S., started talking about pushing quality, not quantity, on the production line. He talked about small groups of co-workers checking on each other, making sure that no mistakes left the production floor. Unfortunately, we in the U.S. listened with closed ears. After all, why should we have listened?

Consequently, Deming left the U.S. for Japan, where they listened eagerly. They incorporated his management approach, and to this day, are

Photo by David Sager

successful. I'm not saying that his management technique is the only reason for their success, but rather that the leaders, that those who stay on top, need to adapt to the future trends of the market.

> *Unfortunately we in the U.S. are stuck in a rut believing that the way it's always been done is the best way, but is it? Where are we now? Where are we heading?*

For the U.S. to be a leader, we need to accept and welcome change. The first thing we need to change is our management style. Our managers aren't trained for managing innovation. We don't encourage new and unusual ideas because few will ever turn out to be a worthwhile investment of both time and money. And when we finally do plug money into a new idea, instead of thinking of it as a long-term investment, we expect quick, positive results.

What is it going to take for the U.S. to realize we need change? How many technologically advanced products are conceptualized and built in the U.S.? I think we need a joint venture of our federal government and industry. Let's face it, we've already lost many companies. If we don't learn to accept change and pool our resources, five or ten years from now we will have completely lost the edge.

Laura E. Sokol

January 1992

TECHNOLOG

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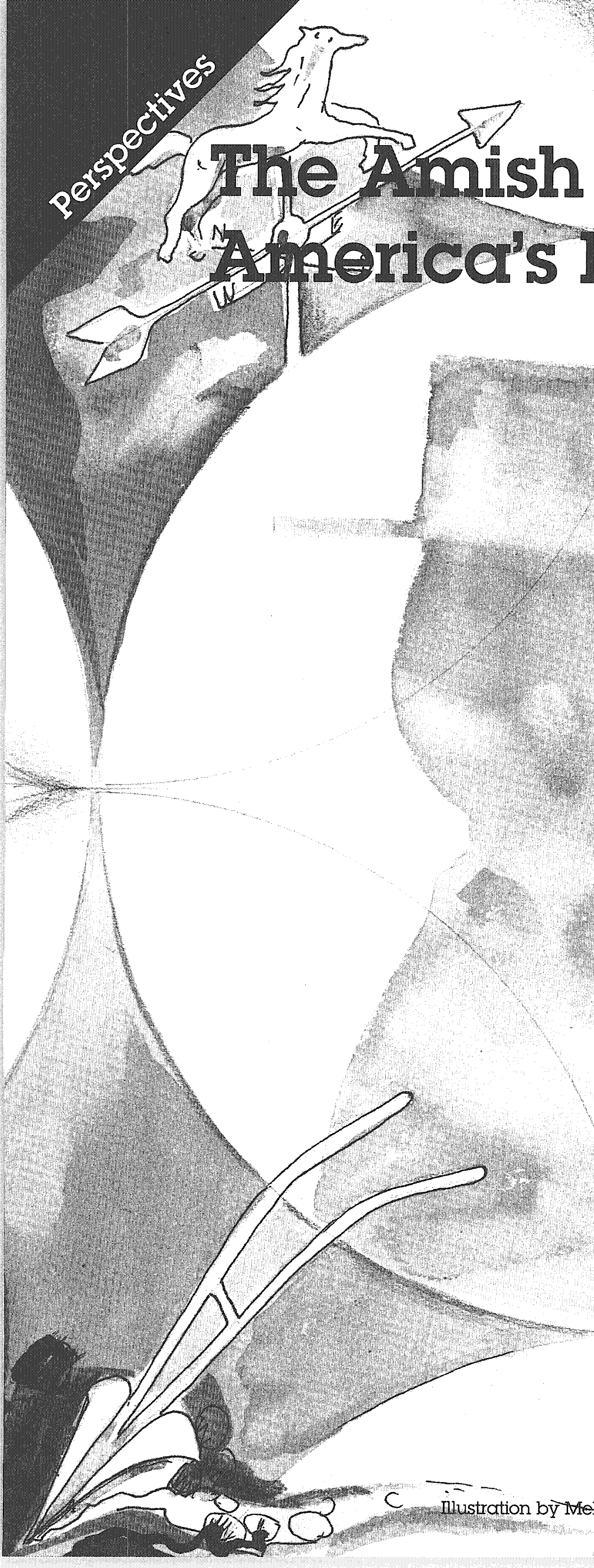
The Amish America's Energy Savers

by James Satter



While many Minnesotans wonder how to cut down on energy costs this winter, one segment of the population isn't worrying much about about high utility bills. That segment is the Amish. Although some Americans consider the Amish anti-social because they choose not to use many modern devices, the Amish people's ability to conserve energy could make even the most conscientious college student feel gluttonous in comparison.

Pennsylvania, Ohio, and Illinois each boast approximately 100 Amish settlements, and Minnesota has five settlements of its own. With more than 600 members, the Amish settlement in Harmony is the largest in our state. The settlement regularly offers tours to outsiders, showing them customs that are almost 300 years old and a way of life reminiscent of the mid–to–late 1880s.

By relying very little on technology and using small amounts of energy, the Amish people have preserved their sense of community, their self-sufficiency, and their distinction from the rest of the nation. Their conservative attitudes don't come from superstition, they come from the belief that too much technology poses a threat to their values. For example, the Amish choose not to be photographed because they consider portraits to be vain, not because cameras are inherently evil.

These pro-earth, anti-consumption attitudes may sound attractive to outsiders in theory, but practicing Amish customs is a different matter. Amish rules forbid computers, radios, televisions, tape recorders, electric lights, indoor heating, and most electrical appliances. Some less-obtrusive devices are allowed, however, such as calculators, flashlights, hearing aids, and 12-volt electric batteries and motors. And Amish men and boys use guns to hunt small animals on their farmlands. Telephones are allowed for community use only, and cars and tractors are used for practical purposes.

The Amish way of life is a lot more complicated than renouncing modern conveniences. Amish settlements are almost entirely agrarian, and the Amish adhere to strict religious rules and conservative dress codes. The Amish don't

Illustration by Melinda Maurey

have hobbies, per se; they relax by not working, not by doing something "fun." In addition, Amish schools only teach through the eighth grade because the Amish don't see much value in secondary or college educations.

The Amish religious sect began in Europe in 1693 and Amish followers first came to North America in the early 1700s. Since the turn of the century, the number of Amish living in North America has increased 20-fold. Roughly 5,000 Amish lived on the continent in 1900 compared to the 100,000 Amish in the United States and Canada today. About 25 percent of Amish children leave the settlements upon reaching adulthood, but the Amish population continues to grow because Amish couples often have eight or more children. The Amish don't use birth control because they consider it unnatural.

Although some Amish beliefs may seem archaic, they do have their advantages. An Amish community isn't paralyzed when a power shortage occurs because the Amish don't use much power anyway. So while many Americans struggle to find alternative energy sources, the Amish may wonder what the fuss is all about.

Sources

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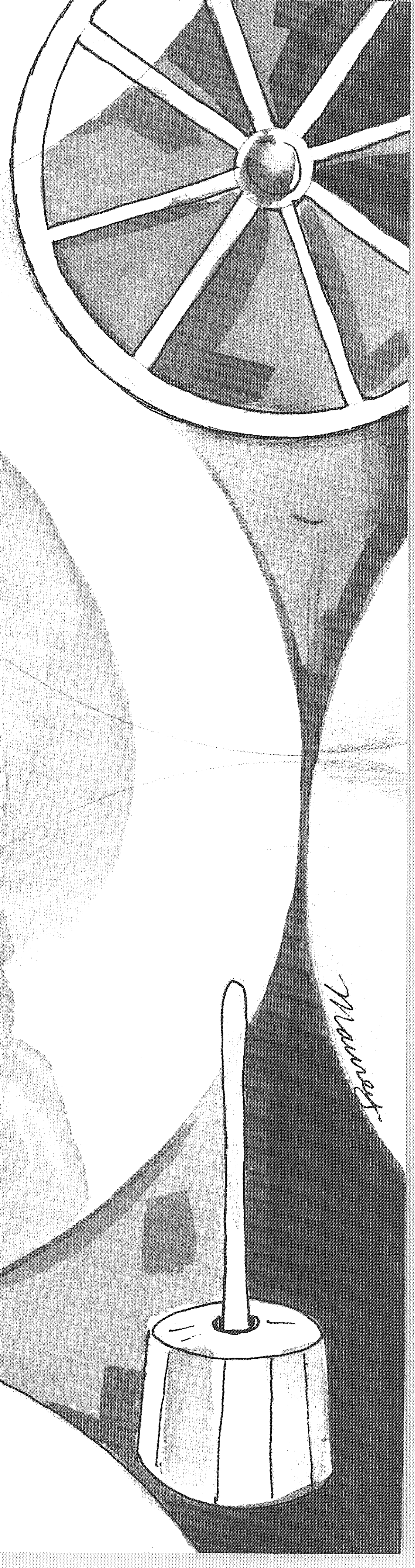

TECHNOLOG
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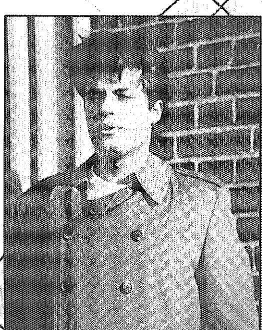
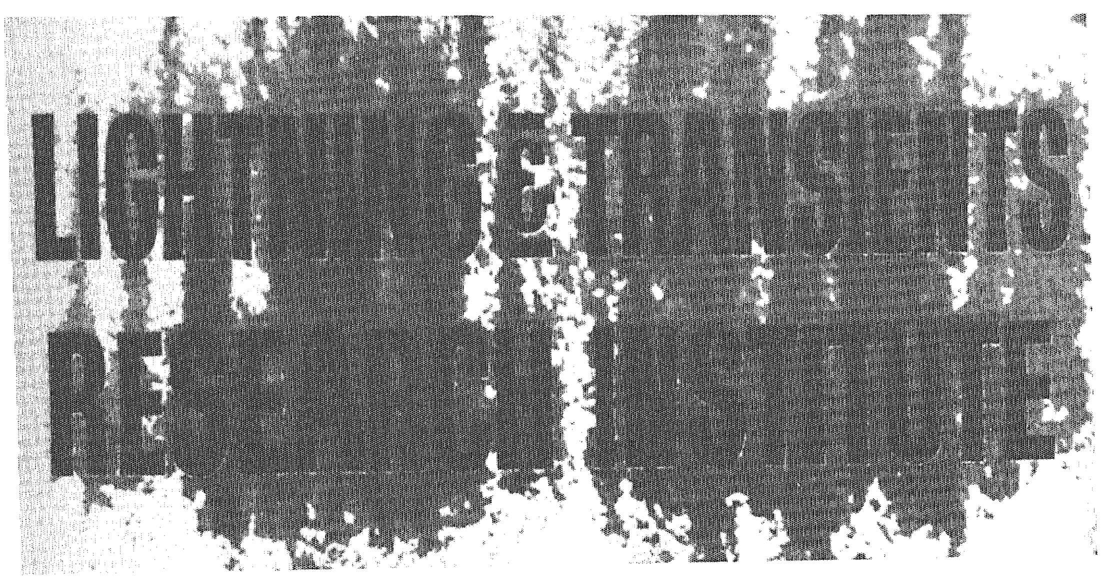


James, a Technolog *associate editor, has decided to give up all electrical appliances for the Amish way of life. Rumor has it he's having a hard time getting rid of his* Nintendo, *though.*

Photo by Peter Kauffner



by Pat Kellogg

The abandoned building sits beside highway 280, strange electric cables and wires connecting it to ruined power transformers nearby. Inside, a giant warehouse stores broken control panels and arcane machinery. Amid warnings of hazardous contamination, a battered sign hangs on the front of the ruin: "Lightning and Transients Research Institute."

When I first drove by the building on a spooky fall night, I thought it would be a perfect place for aliens to live. I imagined mad scientists conducting experiments about secrets *Humankind Was Not Meant To Know.* UFOs were trying to control mankind from this very spot! As it turned out, the building' s history is far more interesting than that.

The strange building was built in the early 1900s by St. Croix Valley Power, an independent utility company. They would bring in power from the St. Croix River, and using a series of step-down transformers, distribute electricity to the city of Minneapolis. Even today, some of the storage sheds that housed giant transformers can be seen.

In the late thirties, St. Croix Valley Power merged into NSP, and since the building was no longer needed, it was sold to the University of Minnesota. At the same time, Morris Newman was a professor of electrical engineering at the University, conducting experiments in lightning research. Unfortunately, he had a conflict of interest with Professor Harding, who wanted to concentrate on engineering design, specifically vacuum tubes. Their conflict resulted in a series of heated debates. Since the department didn't have enough money to fund them both, Newman left to start a private company—The Lightning and Transients Research Institute (LTRI). He rented the building and land from the U of M, and received money from various aeronautical companies, including Boeing and the military, in order to test aircraft components.

The military was very interested in lightning research at the time. During World War II, US airplanes would often get hit by lightning, which would sometimes freeze their stabilizers, resulting in lethal crashes. Newman developed an invention called the Marx Generator, which would simulate lightning by producing a powerful electric charge. Banks of capacitors stored 12 million volts, which would be discharged on disassembled aircraft sitting outside. Occasionally, Newman would run a wire across highway 280 to get more "travel time," and run the current over the traffic below! At 100,000 Amps of current, this means about 1.2 TRILLION (1.2 x 1012) watts of electrical power was running over the heads of Minneapolis motorists.

As powerful as the Marx Generator was, it couldn't compare to real lightning. A typical lightning strike contains 100 million volts, and carries its energy over a 1 kilometer length. The positive charge builds up at the base of the thundercloud and discharges to the neutral earth. At the same time, a return strike comes up from the ground to meet it. This process takes about 40 milliseconds. Then, another strike will occur over the same ionically charged path, then another. As many as 24 individual electrical discharges are in each bolt of lightning, giving a "flickering effect" to the human eye.

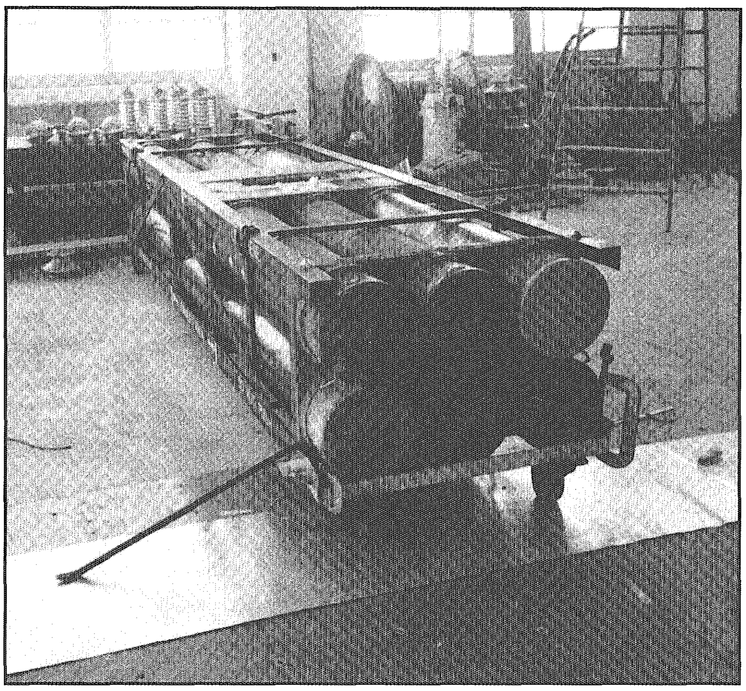
To more accurately simulate real lightning, Morris Newman expanded his research to Florida in the late 1960s. He purchased a retired navy ship from WWII, and refitted it to capture lightning. He shot a rocket which was connected to a metal wire to guide an electric charge into a promising cloud. Instruments on the deck of the ship would then measure the directed lightning' s voltage, current, and light output. In this fashion, Newman collected important information on lightning that is still used today.

Physics Professor Emeritus George Freier remembers Newman fondly as a colorful character. "Newman once rode a bicycle across Russia and Siberia, staying at the houses of

Photos by Roswell Camp

the Russian physicists he knew—and he knew them all!" Another time, Newman wanted a photograph of a certain test, so he took pictures while *inside* a jet fuselage while it was being bombarded with electricity.

Professor Freier helped Newman with some research at Cape Kennedy concerning the Apollo 12 rocket. In 1969, the Apollo 12 was hit by lightning twice during take-off, destroying some important equipment. Since the "launch window" for rocket missions is small, NASA had to occasionally launch during heavily overcast skies. Newman produced a test rocket to discharge clouds safely, which Professor Freier says, "worked 17 out of 23 times, but was never used." However, a set of electric field "mills" they developed was used by NASA to map out the electric field of an overcast sky.



Storage pipes used to hold PCBs can leak over time, leading to contamination.

When Morris Newman died in 1974, work was turned over to John Robb. Robb had also received his masters degree in EE at the U of M, and continued the work Newman had started. Unfortunately, a skiing accident at Buck Hill in 1986 impaired John Robb's memory, and with only eight employees at the Institute, research couldn't go on. Without Robb's guidance, the building was shut down, leaving most of the equipment inside. For nine months, nothing was done with the building. The University took back the land, and made plans for its use, since it is next door to the University Computing Center. However, in the meantime, vandals broke into the building, destroying much of the machinery and ruining the electronics.

What the vandals didn't know is that the site was storing polychlorinated biphenyls, commonly known as PCBs. PCBs are used in transformers, and had leaked out of the power equipment and into the ground. The vandalism made the problem worse, spreading contamination to levels as high as 1000 ppm (parts per million). As of today, the University of Minnesota is responsible to clean up the land before it can sell it. Andy Phelan at the Environmental Health and Safety Department of the U of M, estimates the cost of the clean-up to be "about 600 to 700 thousand dollars," when it gets done.

There are several steps to salvaging the property. First of all, contaminated soil has to be brought to a secure landfill or be burned, which removes most of the PCBs. Also, the building has surface contamination, so the walls and floor need to be scrubbed with special solutions or sandblasted. However, as Phelan points out, the full effect of PCBs on cancer is not well known, and some experts debate it. Of the 200 different types of PCBs, only 22 (the most chlorinated isomers) are thought to be carcinogenic.

For now, the University's strange building is in limbo, and its fate is not known. With the closing of the LRTI Institute, Minnesota lost the only group doing research about the effects of lightning and transients. Not only is the building shut down, but so is all research into understanding the mysterious and unknown effects of lightning.

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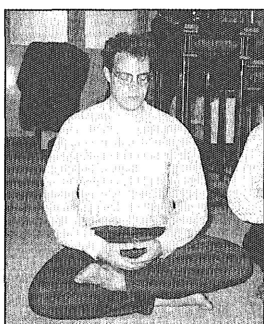
Special thanks to -

Andy Phelan and Fay Thompson at the University of Minnesota Environmental Health and Safety Department, and Professor Emeritus George Freier

TECHNOLOG
Writer Profile



Pat is shown here conceptualizing his article for the Technolog *(it takes that much concentration, you know). Now that he's come back out of the woodwork, we plan to utilize his talents more often in the upcoming issues.*

Features

The Search for a Better Light Bulb.

by Scott Ryun

During the mid- to late-seventies, the nation suffered an oil crisis which alerted us as to how vital our energy natural resources are. In an effort to better utilize our resources, many contributions have been made toward energy conservation, especially electrical energy.

The Twin Cities have more than 150 days annually in which the temperature falls below 32°, and an average (taken from 1950-1980) of 8,007 heating degree days per year.

Not only had the price of energy increased, but according to "The State Energy Factbook," in 1981, Minnesota produced only 13.5% of the energy consumed in the state. Because of the increased energy costs, the state of Minnesota, local governments, and utilities have been actively developing and promoting energy conservation projects.

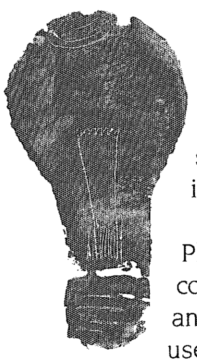
Northern States Power (NSP) is one of the public utilities actively endorsing energy conservation. In fact, NSP has published books on how to save both energy and the environment. Their first book, *50 Things You Can Do To Save The Earth*, deals with a wide range of environmental issues, while a companion volume, *25 Simple Energy Things You Can Do To Save The Earth*, specifically targets saving energy. NSP also operates a 'round the clock phone line called "Ask NSP" (1-800-432-7677, Twin Cities area 330-6000) in which real live people answer questions concerning energy and safety.

Current Conservation

About half of all electricity produces lighting. For this reason, lighting technology is desired to avoid the need for new, expensive electricity producing facilities, providing more light for less cost to consumers, and reducing the current electrical demands on municipalities.

Fluorescent lighting has become increasingly prevalent even in residential applications due to its considerable reduction in energy use per unit of light energy produced as compared to standard incandescent lighting. Technological advances in fluorescent lighting have shrunk the size of the bulb, increased its efficiency, reduced the amount of eye strain incurred, and reduced its price.

Both the one- and two-piece compact fluorescents are better than older and bulkier tube-type fluorescent lights. Although not as miserly on electricity as the two-piece compact fluorescent, the one-piece fluorescent does not flicker upon start-up. The initial cost of the compact fluorescent lights is greater than their incandescent counterparts, but the fluorescent bulbs will last longer and more than pay for themselves in energy savings. During a two-piece fluorescent's lifetime, the bulb will pay for itself almost three times in energy savings over that of the standard 60W incandescent bulbs.



Capsylite bulbs, which cost about the same as regular incandescents, provide some energy savings over standard incandescent bulbs.

Philips, a leading Dutch company, has introduced an induction lamp which uses about the same amount of energy as a fluorescent and claims to outlast any other type of light. Its lifetime is considered to be 60,000 hours—60 times the life of a standard incandescent and 6 times the life of a fluorescent bulb. A low-pressure mercury gas is excited by a high-frequency energy flow creating ultraviolet light that becomes visible when passed through a coating of triphosphor fluorescent (the same as that on the inside of a standard fluorescent) on the inside of the bulb.

The long lifetime of the lamp is achieved because there are no parts to wear out. In an incandescent, the filament burns off until at some point it snaps. With the induction lamp, only the phosphor coating may degrade.

To further conserve lighting costs, skylights minimize daytime energy usage. One alternative to the conventional skylight is the **SunLight Pipe** which is installed without cutting the joists or rafters in a person's home. The SunLight Pipe is comprised of a 13-inch wide aluminum pipe with a reflective lining that is capped by a clear acrylic roof dome on the outside and a white acrylic ceiling fixture inside. There is even an optional damper which shuts out unwanted light during the brightest parts of the day.

Manchester Airport, in England, has decided to go with the idea of full-spectrum natural lighting by installing four 20-foot-long crystal chandeliers lit from dawn to dusk by the sun. Parabolic heliostats on the roof beam the sun's rays onto fixed mirrors that divert the light into the chandeliers. The chandeliers are constructed of several "sparkle tubes" diffusing the sunlight sideways. For nighttime operation, integrated floodlights provide the light radiating from the chandeliers. Maintenance is minimal since there is no need to clean or replace numerous bulbs, and energy is saved in the summer since large amounts of light are directed inside without the heat usually generated by large lighting systems.

Anticipated Advancements

Through the use of **advanced lighting controls** that regulate the amount of light given off from light sources the level of indoor lighting would be adjusted so that the total would remain constant. Energy would be saved at times when natural lighting is available by avoiding the overproduction of artificial light. This new ability to tightly control lighting is expected to save 25% over current technology and is anticipated to be available commercially within 3-5 years.

Illustration by Dena M. Collard

Improving the **phosphor coatings** used in fluorescent lighting can increase the amount of visible light and reduce the heat radiated. This improvement could save 30% over current technology and is expected to be available commercially within 6-10 years.

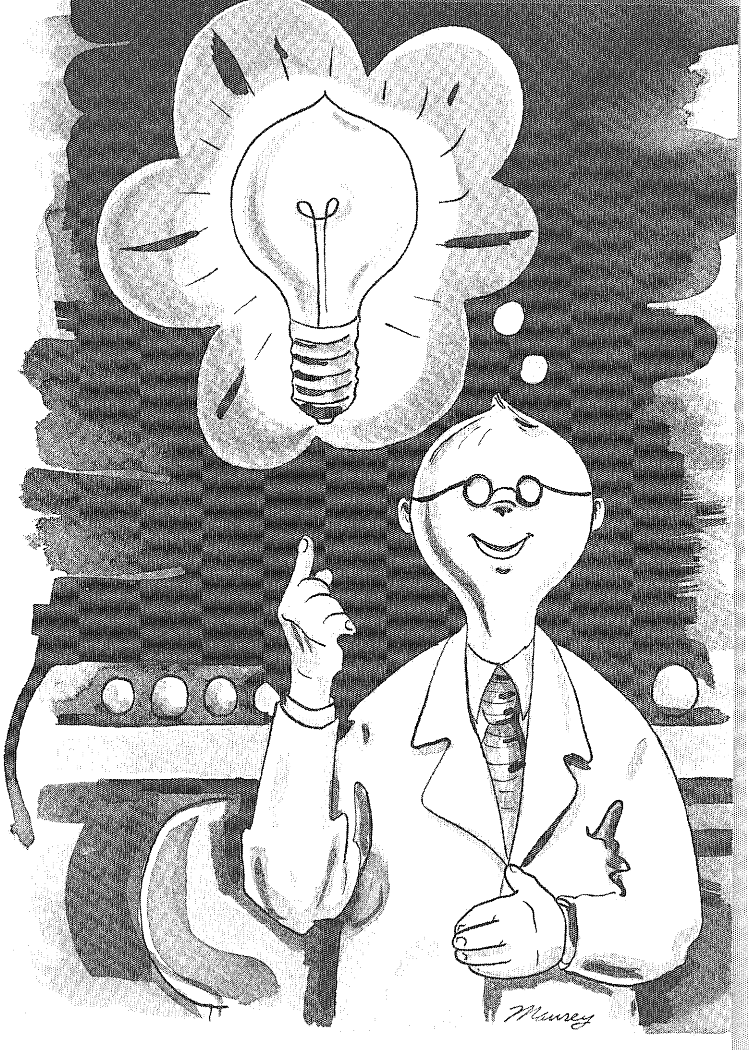
The goal of **dynamic lighting design** is to combine all known energy efficient lighting technologies and their technical performance characteristics in a systems analysis approach, leading to guidelines and principles for energy efficient and effective geometries with respect to building design. This means that rooms of a building should be designed with respect to their purpose and lighting requirements. Expected savings from the employment of such foresight is anticipated to be 20% over current technologies and should be commercially available in 3-5 years.

The **electrodeless High Intensity Discharge Light**, HID, is an attempt to develop a low wattage, electrodeless lamp. Electrodeless HID lamps (lamps without a filament) permit the use of new light producing compounds (similar to those of fluorescent bulbs) that were not possible before because they reacted with tungsten filaments, as used in the ordinary incandescent light bulb. It is anticipated that this would save 50% over current technology and should be commercially available within 6-10 years.

Surface Wave Fluorescent refers to an attempt to develop an extremely efficient fluorescent light by altering the electrochemical reaction that occurs within the fluorescent bulb. This type of light would gain efficiency by reducing the loss of radiation trapped within the bulb. Anticipated savings over current technology is 35%, and is expected to be commercially available unit will be available in 6-10 years.

Isotopically Enriched Fluorescent is the approach of a project that studies the improved energy efficiency in fluorescent lamp performance. It occurs by either allocation of the isotopic composition of natural mercury by enrichment with mercury (196) or by providing the lamp with dc axial magnetic fields. This project is aimed at increasing the efficiency of fluorescent lights by improving the radiation pattern within the bulb. It is expected that this could save 7% over current technology and should be available commercially within 3-5 years.

Core Commercial Daylighting is a simple method that small business owners can use to optimize lighting in their (usually rented) facilities. The method adjusts the lighting of facilities through the use of efficient and properly placed lighting, accounting for the existing fixtures and assuring compatibility and efficiency. Anticipated savings is 10% over current technology and should be available commercially within 1-2 years.



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TECHNOLOG
Writer Profile

Left in the dark,Scott, a senior in engineering, is frantically feeling his way through his drawers trying to find a light bulb, any light bulb. We wish him the best of luck

Illustration by Melinda Maurey, photo by David Sager

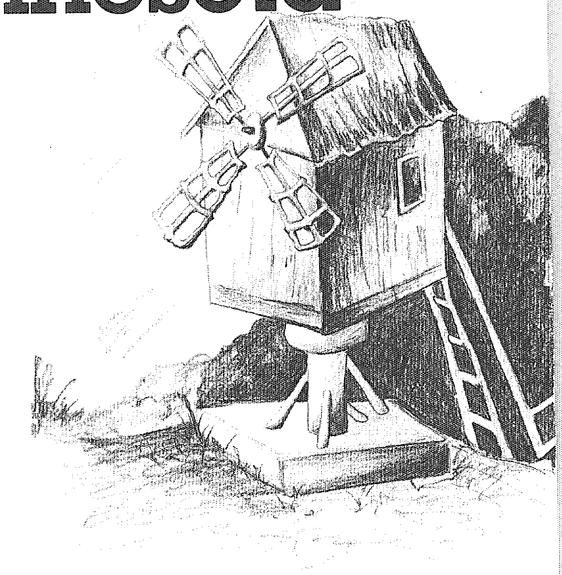
Inherit the Wind, Minnesota

by James Satter

To some Minnesotans, a potential energy source isn t just blowing in the wind it is the wind. Although many people consider wind power to be outdated, unpractical or something that only works on the West Coast, a few Midwestern companies are trying to prove the skeptics wrong.

For example, Northern States Power Company (NSP) built and began operating the Holland Wind Turbine Station in southern Minnesota during the late 1980s. At 79 feet tall, the station s three wind turbines make up the largest wind—powered generation project of this type in the state. And Phoenix Industries in Crookston, Minn., is one of the companies that manufactures wind turbine blades for commercial use. The National Renewable Energy Laboratory in Colorado now is developing plans to generate electricity by using power from Midwestern winds.

Modern wind turbines, like those at the NSP station in Holland, Minn.,are large towers consisting of two primary parts: an electrical engine and a rotor. A rotor has large blades similar to an airplane propeller. When the wind blows, the rotor spins, turning the shaft of the electrical generator. The electrical power can be used immediately or stored in battery banks for later use.



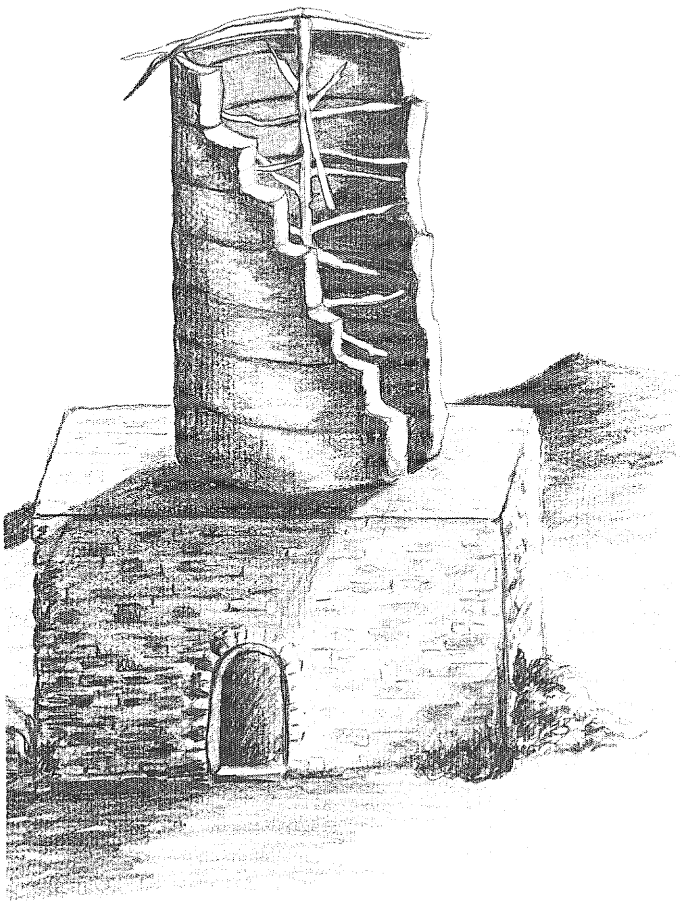
Northern European Postmill of 12th Century.

In the United States, wind power production has tripled since 1985. And unlike oil, wind power does not produce sulfur and nitrogen oxides, which contribute to smog and acid rain.

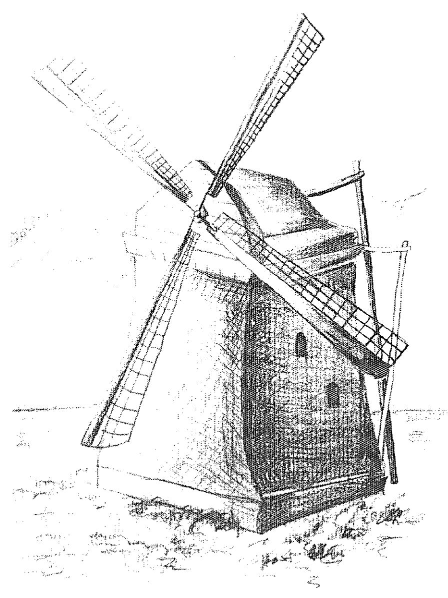
Most wind turbines function effectively when wind speeds range from 8 mph (a gentle breeze) to 40 mph (when gusts break twigs off trees and wind pressure makes walking outdoors difficult). This variability is important because wind speeds can change as much as 30 mph in a few seconds. The average wind speed in Minnesota is about 10 to 12 mph.

Electricity from wind power currently costs about 8 cents per kilowatt hour, compared to the average cost of 7 cents per kilowatt hour for most energy sources. However, the U.S. Department of Energy projects that the cost of wind power could fall as low as 5 cents per kilowatt hour if companies develop wind turbines that are more durable and have blades that can capture 25 percent more energy from the wind.

Although many researchers now treat wind power as a new idea, the Babylonians conceived of using windmills for irrigation as early as 2000 B.C. However, the first windmills probably weren t built until 600 A.D. in Iran, where people used the wooden mills to grind grain. Windmills spread throughout Europe by 1100 A.D., and Dutch settlers in North American used windmills are early as the 1600s.



Siestan windmill discovered in Iran, believed to have been built around 600 A.D.

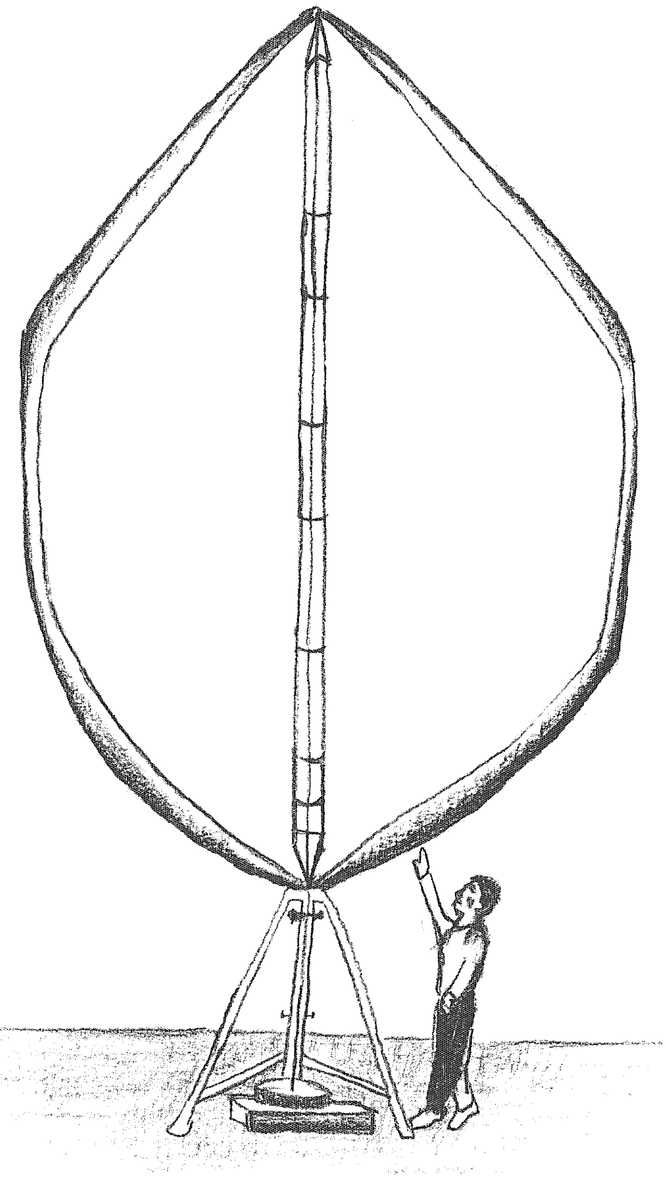


Dutch Tower mill of 16th Century.

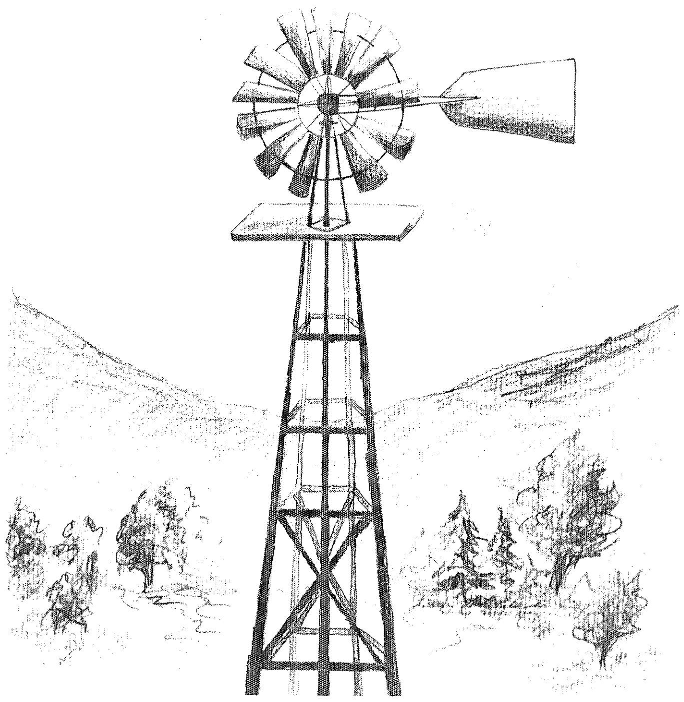
Illustrations by Theresa Durner

From 1880 to 1935, approximately 6.5 million windmills were sold in the United States. Farmers often used the mills to pump water to their houses or generate electricity. But when the federal government began building numerous central generating plants in the 1930s, bringing electricity to rural areas, windmill sales declined substantially.

Wind power now is gaining popularity, but don t expect it to completely replace oil in the near future. Although California is well known for using wind power, the state s 16,000 wind turbines generate enough electricity to meet only one percent of the state s energy needs. In other words, California would require nearly 1.6 million wind turbines—about one turbine per 16 Californians—to produce all of the state s electricity through wind power. That means that 16 million wind turbines could power the nation.



21st Century Huge Darrieus or eggbeater-type wind turbine.



19th Century American Multi-vane used to pump water onto farms.

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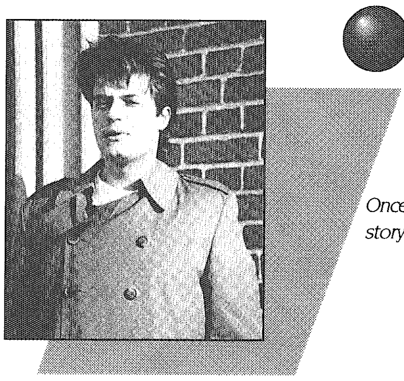


TECHNOLOG
Writer Profile

Once again, James has pulled through with another story. Refer to page 5 for insight on James.

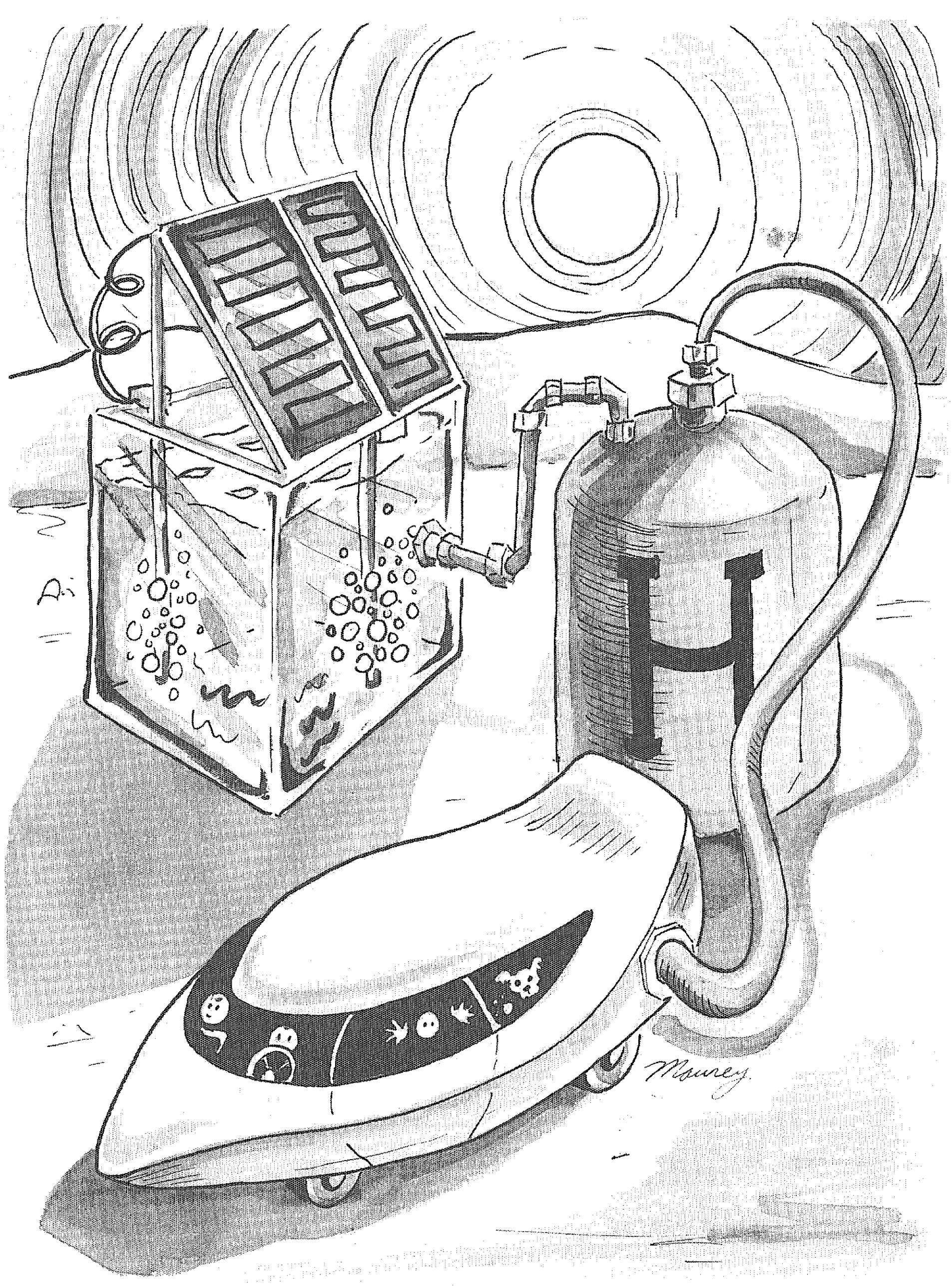
Photo by Peter Kauffner

Solar Hydrogen

Fuel of the Future?

by Pat Hafner

Our world needs a new energy source, and one exists that can help eliminate pollution problems. It is produced mostly with renewable resources, unlike the irreplaceable fossil fuels we burn daily. Its use would result in a dramatically lowered level of environmental toxins. And at the same time, it could yank the controls from the Mideast oil suppliers, who we presently depend on for most of our fuel.



What is this energy source? Hydrogen.

The use of hydrogen as fuel is a tremendous idea. Using this clean-burning substance eliminates the aftermath of pollutants such as sulfur dioxide, carbon monoxide, and radioactive waste. When hydrogen is burned in the open air, it leaves behind only water vapor and traces of nitrogen oxide. It is fairly simple to produce. Along with certain equipment, the only ingredients necessary to make hydrogen are water and electricity. Although its rapid oxidation rate makes it explosive, hydrogen is considered relatively safe if harnessed and used carefully. And a very attractive benefit of switching to hydrogen as a primary fuel would be reduced dependence on foreign oil. World-wide availability of a superior fuel would diminish the wealth and political clout of oil supply owners...a select and powerful few.

Although the common use of hydrogen as fuel has been talked about for years, recent technology may bring the possibility closer. Hydrogen is produced by a process called *electrolysis*. While immersed in a salt solution, usually potassium hydroxide, an electrical current passes between a positive and a negative electrode. The positive electrode attracts oxygen and the negative electrode accumulates the hydrogen. A favored way to obtain the electricity required for this process is through solar power.

Solar power is constantly available and its use creates no pollutants. However, using solar power looked undesirable for many years due to high cost and inefficiency. The recent development of very thin, less expensive solar cells may change this outlook.

Solar cells convert sunlight that falls on them into electricity. Conventional

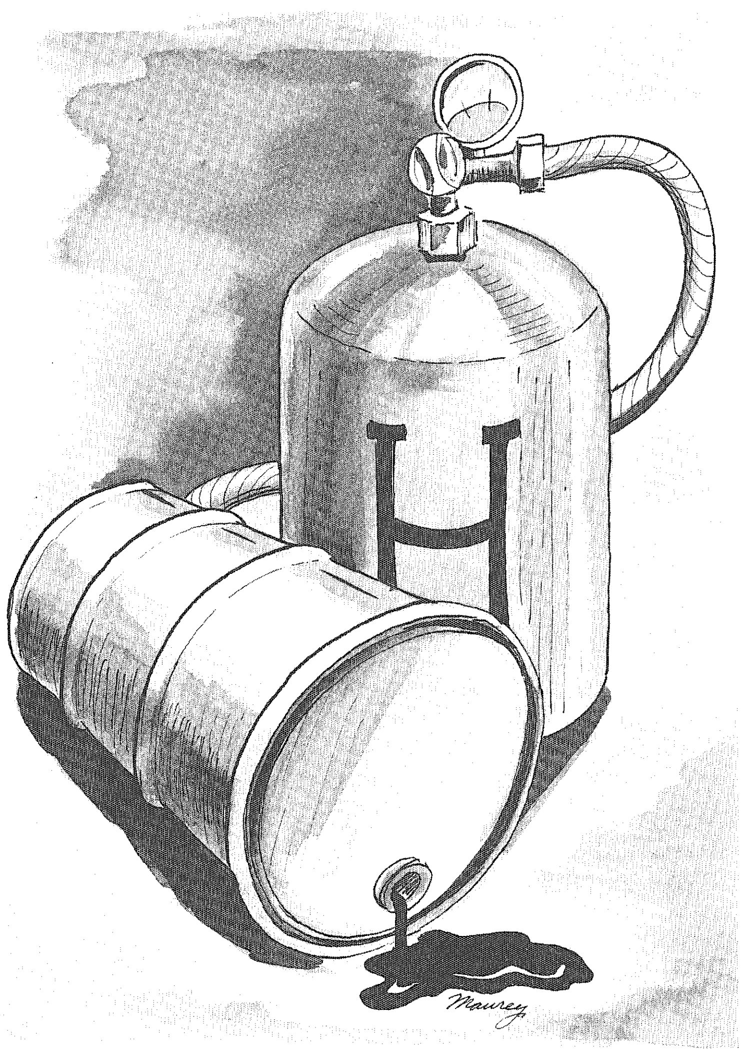
Illustrations by Melinda Maurey

solar cells, made from crystalline silicon, are generally 100 to 200 micrometers thick. Advanced versions of these cells can now be made as thin as one micrometer. This means substantially less material used to make the solar cells, thereby reducing expenses.

Amorphous silicon is used to make the thin cells, instead of the conventional crystalline silicon, Although less efficient at converting sunlight into electricity, amorphous silicon more easily makes the desired extra thin cells.

Hydrogen produced from the solar process could be widely used in the near future. Dr. Joan Ogden and Dr. Robert Williams, authors of the World Resources Institute report, "Solar Hydrogen", say solar hydrogen could begin to replace automotive fuels within the next 10 years. What's more, the prices could be competitive with current fuel costs. By the year 2000, the equivalent of a gallon of gasoline in solar produced hydrogen will cost from $1.68 to $2.35. As Ogden mentions, the environmental considerations of switching to hydrogen certainly justify paying a little more for the fuel.

According to the WRI report, producing enough hydrogen to fuel the transportation needs of the entire United States would require the use of only 1% of U.S. land area. And a solar hydrogen plant large enough to service vehicles in a city the size of Phoenix, Arizona, would cost about $10 million. In contrast, a similar plant to produce methanol, another possible alternative fuel, would cost 60 times that amount. Currently, West Germany is constructing its own 500-kilowatt hydrogen plant, which will use solar-generated electricity to make the hydrogen. It is also building a similar plant with Saudi Arabia near Riyadh.



On a smaller scale, researchers and enthusiasts have managed to utilize fairly normal equipment to look for solar hydrogen breakthroughs. Dr. Peter Lehman, a professor in the Environmental Resources Engineering Dept. at California's Humboldt State University, puts the product of his hydrogen production to interesting use. After acquiring hydrogen and oxygen through electrolysis, they are stored in 500-gallon tanks. The two elements can now be fed through a converter at any time to produce electricity. In this case, the electricity powers the aeration compressor to the Marine Lab's fish tanks! These fish are reportedly very healthy and are pleased with Dr. Lehman's research.

L.E. Spicer, a renewable energy enthusiast from Lineville, Iowa, states some unique aspects of his production and use of hydrogen. To generate electricity for the electrolysis process, he uses a wind-powered generator. The water he uses is simply rain water.

Once the hydrogen is acquired, he puts it to creative use. He can convert an ordinary propane cooking stove to run on hydrogen with just a few adjustments, including regulating the jet size and the pressure. Also, he has converted a gasoline engine to run on hydrogen. A propane/air mixer was adapted to a gas carburetor to make the change. Spicer says that hydrogen can also be used to safely run an acetylene welding torch.

Despite many benefits, hydrogen as fuel has some drawbacks. The most nagging is storage. To store hydrogen as a gas, the tank required would be very heavy and cumbersome. Even highly compressed hydrogen gas requires an extremely large container, one which would dwarf an ordinary gas tank on a car. One proposed alternative is lightweight metal "hydride" beds that absorb hydrogen gas. When heated, the beds release the hydrogen. The beds are heavy though, and store only 1 to 2% hydrogen by weight. This would get the average vehicle only 100 miles. Research is being done by Ovonic Battery Co. of Michigan regarding higher capacity hydrides.

Using hydrogen as a liquid can be done, but it must be kept at -423 degrees F or less. This presents a problem, and presently liquid hydrogen is only appropriate for central fueling stations where buses, trucks and van fleets refuel.

Despite storage problems and changeover expenses, the conversion to solar hydrogen seems overdue. The benefits would almost certainly outweigh the disadvantages. However, the government actually gives very little funding to research and development efforts. The Dept. of Energy spends only $5 million a year for this purpose. Considering the amounts funnelled into other government activities, this seems a small portion when such potential benefits are at stake.

According to James Gustave Speth, President of the World Resources Institute, "We are seeing a new energy crisis unfolding. Fossil fuel combustion is responsible for a complex web of problems." He concludes by saying, "Our concern is that in the rush to make short term policy decisions, policy makers do not preclude alternatives like solar hydrogen."

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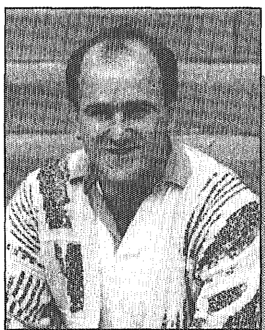

TECHNOLOG
Writer Profile

Pat has been busy rigging up a concoction in his basement laboratory. Unidentified sources say it has something to do with this article. Guess we'll have to wait and see.

Photo by David Sager

Can You Hear the Crickets?

by Joanne Lewis

As you sit back and relax after a long day at work, you hear not the sound of crickets chirping, but instead, the thunderous roar of a 747 airplane. This is the sound residents of five communities surrounding the Twin Cities airport hear daily.

Illustration by Dena M. Collard

In order to alleviate noise pollution caused by the nearby airport , the Metropolitan Airports Commission (MAC) has introduced the Part 150 Program. Residents of Richfield, Bloomington, South Minneapolis, Eagan, and Mendota Heights will be eligible for the noise relief program. As many as 15,000 homes are included in these communities. Steve Vecchi, manager of the Part 150 Program, is working with the Federal Aviation Administration (FAA), representatives of the five communities, and the MAC to implement this program.

Vecchi calls the program a multi-faceted one. It is actually three separate programs that are being offered to homeowners in the five surrounding areas. The sound insulation program involves a soundproofing of certain rooms in a home. With the purchase guarantee program, the property is acquired at a fair market value and is resold for residential use. The land acquisition program involves clearing and demolishing homes where there is a reasonable consensus among residents to vacate the area. The first two programs are designed to maintain the existing neighborhoods, while the land acquisition program is for those areas considered to be unfit for residential neighborhoods.

According to Vecchi, South Minneapolis has already chosen to maintain the existing neighborhoods, while a neighborhood in Richfield has chosen the land acquisition program for approximately 400 homes. He also expects some acquisition areas in Eagan as well.

Sound insulation has been demonstrated in a house in Richfield, Minnesota. The house, at 6314 Standish Ave. South, was open for tours in August 1991, to show noise-weary neighbors of the airport that noise reduction devices could make their homes quieter and more peaceful.

In three rooms of the house, thicker walls, windows and ceilings reduce levels of noise to a whisper. The soundproofing demonstrated three different levels of noise reduction. According to a August 1991 article in the Star Tribune, the 5 and 10-decibel reduction allow a slight vibration as jets pass above and in the 15-decibel room, the vibration is eliminated and a soft wind-like sound is heard.

A room with 5-decibel reduction included new acoustic windows, another added an extra layer of wallboard for a 10-decibel reduction, and one with the windows, walls and a additional ceiling layer was at a 15-decibel reduction.

The rooms that have been soundproofed don't look much different than the other rooms in the Standish house. The acoustic windows are just two panes of glass with a two-inch air space between. The rooms and ceiling height have been slightly reduced in size due to the extra layer.

The question now is—who will be the first to receive the noise relief measures? According to Vecchi, the program will most likely start with homes closest to the airport. Throughout the entire project, representatives from each community have been involved in decisions regarding their homes. This includes the decision on allocation of funds, and which community receives the program first. Vecchi expects a decision to be made on this in approximately three months. According to Vecchi, the communities know their situations best, so they are able to determine what is best for themselves.

Vecchi expects to spend approximately $4 million in the first year (1992). Actual implementation of the program will begin in April 1992. The amount of money will increase approximately $3-4 million each year, allowing the Council to begin the program while monitoring its progress. The program is expected to be 60 percent completed by the year 1996.

The cost to the Council, Vecchi says, is the only thing that may delay progress. The program has taken 6-7 years to get off the ground, and the cost to the council is expected to reach $60-100 million by the time it is completed. When it is completed will, again, be determined by the funds available.

The sound insulation kit alone costs $15-25,000 per home to implement. There is no cost to the homeowner because this is a part of a solution to make these neighborhoods more compatible with the area which they are located. According to Vecchi, the funds come 80 percent from the FAA, and 20 percent from the MAC.

According to Vecchi, the Part 150 Program is not a solution to the noise pollution problem, but rather part of a solution to noise pollution. The programs offered through Part 150 give residents options not often given in situations where the noise level of nearby airports is an annoyance to neighboring communities. Some airports have demolished all surrounding neighborhoods, says Vecchi. Some other solutions to the noise problem involve the action of the airport itself. However, at this time, the Part 150 Program is being implemented to better the existing neighborhoods and the lives of people in them.

Photo by David Sager

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TECHNOLOG
Writer Profile

Joanne, a newcomer to the Technolog *this year, has decided to start up a fan club for people who idolize the* Editor. *Membership fee has not been decided upon at this time, but rumor has it the waiting list should be long.*

 Photo by Peter Kauffner

On the Campus

Racing with the Sun

by Lee Klancher

A hard-working group of University of Minnesota students is hopeful that they can put together a winning combination of car design, cash, and strategy and come home to victory in Sunrayce 93.

A group of University students is currently designing a solar-powered race car for the '93 Sunrayce competition. While the car is just a concept at this point, the team has a lot of optimism and energy. If all goes as planned, they will be racing from Texas to Minneapolis against other college student-built solar cars from June 20 to 26, 1993.

Sunrayce USA pits solar-powered race cars designed and constructed by college students against one another in a grueling cross-country race fueled by the sun. The cars run for five to seven hours a day and spend the mornings and evenings sitting in the sun, charging their batteries. The car to traverse the course in the least amount of time is declared the winner.

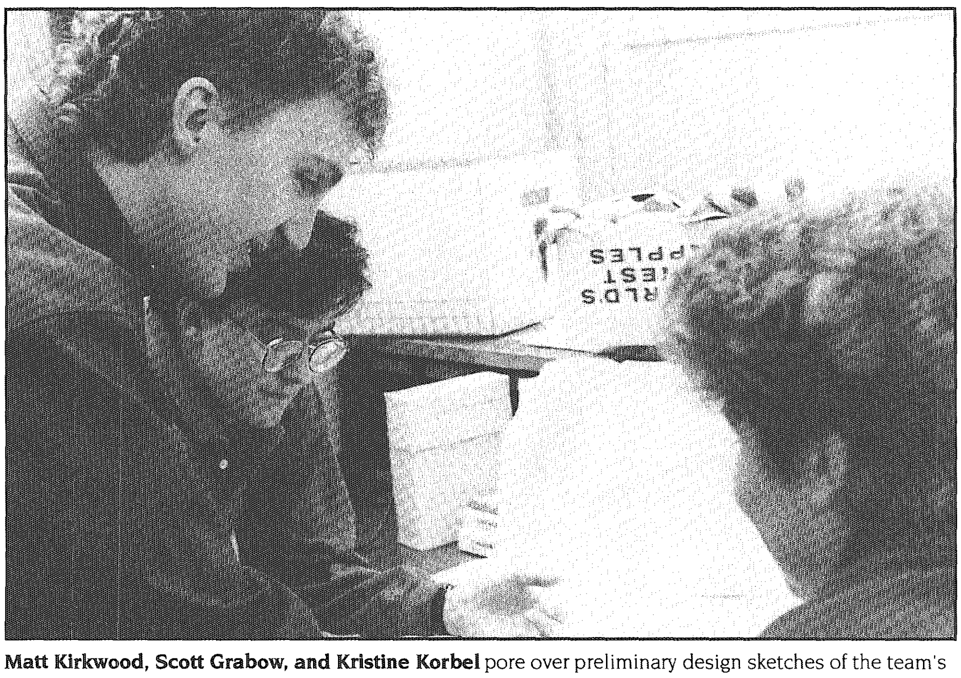
Soapbox Cars

While the cars are designed, maintained, and built by college students, they are hardly soapbox cars. The cars must meet certain basic standards (weight, size, rigidity), but the rule of thumb for design is "anything goes."

The winner of Sunrayce 90, the University of Michigan's *Sunrunner*, led the race for the entire eight days and ran the course at an average speed of 22 m.p.h.. With a price tag of over $800,000 the car sported state-of-the-art technology and design. The cost of the 14,000 satellite-quality photovoltaic cells alone was $200,000. In addition, the University of Michigan group enlisted the help of a meteorological team that took periodic measurements that determined the most efficient power use.

It's hard to beat the big bucks, but some of the low-dollar cars, such as Mankato State's *Northern Light*, fared decently in the competition. This car was tested with some, ahh, innovative ideas. The body was stress-tested by dropping a Honda Civic CRX on top of it. Also, the windshield was formed by heating it in a residence hall cafeteria's pizza oven. The *Northern Light* was economical as solar race cars go, but the $45,000 price tag was hardly pocket change.

This year's rules for the race limit the type of batteries and photovoltaic cells that can be used. This will cut down on some expenses, but to perform well, dollars as well as sense will be necessary. The University team is well aware of the need for cash. "That's our main goal right now—to get the fundraiser started," said Brad Schulz, the Mechanical Group Leader. In order to do that, the team will need to have their proposal accepted.



Matt Kirkwood, Scott Grabow, and Kristine Korbel pore over preliminary design sketches of the team's solar car.

A proposal was drawn up and sent to race officials on Dec 3, 1991. Only 36 proposals will be accepted, but team members are confident that theirs will go through. The proposal essentially shows the race directors that your team is capable of designing a car. "You just have to show that you're serious," Schulz said. This team is "serious" in spades.

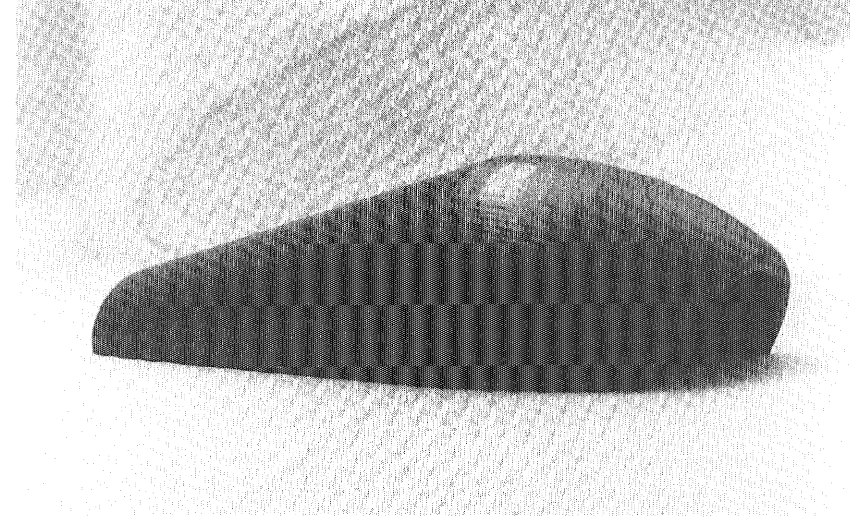
When I first spoke to Matt Kirkwood, a fourth-year Electrical Engineering major who is the Project Manager, his only worry was that the race would be cancelled. There was some doubt about the '93 race, and his team had been hard at work since last spring. When he told me the race was on, he positively beamed. "The most exciting news is that we now have a race," he said.

According to Scott Grabow, a member of the 1990 *Northern Light* design team, the Minnesota team's hard work has given them a

Photos by Lee Klancher

jump on the competition. Grabow is a first-year graduate student in mechanical engineering here at the University. He helped design and build Mankato State's *Northern Light* and is now a member of the Minnesota team. "We have a really good start," he said, "This team has done a lot of work, a lot of thinking, and has a lot of drive."

The team is confident that their application will be accepted and put them in the '93 race. Once accepted, teams receive a $4,000 grant and help raising money. The extent of that help remains to be seen, but, either way, the accepted teams will be notified in March.



The initial design for the body is complete enough for the team to have had a model built. The wax model was made by a computer which read the dimensions from a CAD/CAM program.

A Paper Tiger

At this point, the car exists only as a concept. Basic ideas are forming, but final details do not exist. "The actual final design has not been chosen," Schulz said, "and we're not final on any particular parts."

Schulz, a third-year Mechanical Engineering student, is the Mechanical Group Leader. His team combines three different areas; wheels and tires, suspension, and the frame. At this point, the teams are leaning toward a uni-body type composite frame, a shape that's best described as a tall, upside-down deviled egg with four bicycle wheels.

The body design is based on a simple engineering principle: more size equals more solar cells which equals more power. When asked to describe the design, Kirkwood said with a smile, "It's big." The car will be as wide, long, and high as the rules will allow. It will be 2 meters wide, 6 meters long, and 1.45 meters high. Roughly, that is 6 feet wide, 4.5 feet high, and 18 feet long, for you non-metric heathens.

The egg-shape of the top of the car will be aerodynamically efficient and will expose the solar cells to the maximum amount of sunlight. The height of the car will allow solar cells to be mounted down the sides of the car so that power can be gathered during twilight hours.

The solar cells themselves will be a unique design pioneered by a Swiss team. Unlike traditional cells, which run electrical contacts on the surface of the cell, the Swiss cell buries the electrical contacts in a laser groove, leaving the entire surface of the cell available to gather power. The innovation increases cell efficiency by about 20 percent. The Minnesota team plans to use a modification of this design and squeak a bit more power out of the cells.

Oops...

The team was stalled at the beginning due to some confusion with the Mechanical Engineering (ME) department. The eagerly-awaited official rules for Sunrayce 93 were sent off to the ME department. Unfortunately, the design team didn't have an address registered and the ME department sent the rules back. A second set of rules was received several weeks later.

The design will undoubtedly change over the next year, but, with the arrival of the official rules, design evolution is in full swing. With a lot of hard work, an intelligent design, a barrel-full of cash, and a little bit of luck, the Minnesota team can put together a winning combination for Sunrayce 93.

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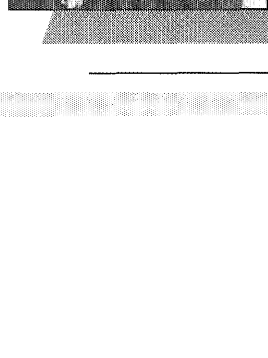
To Get Involved

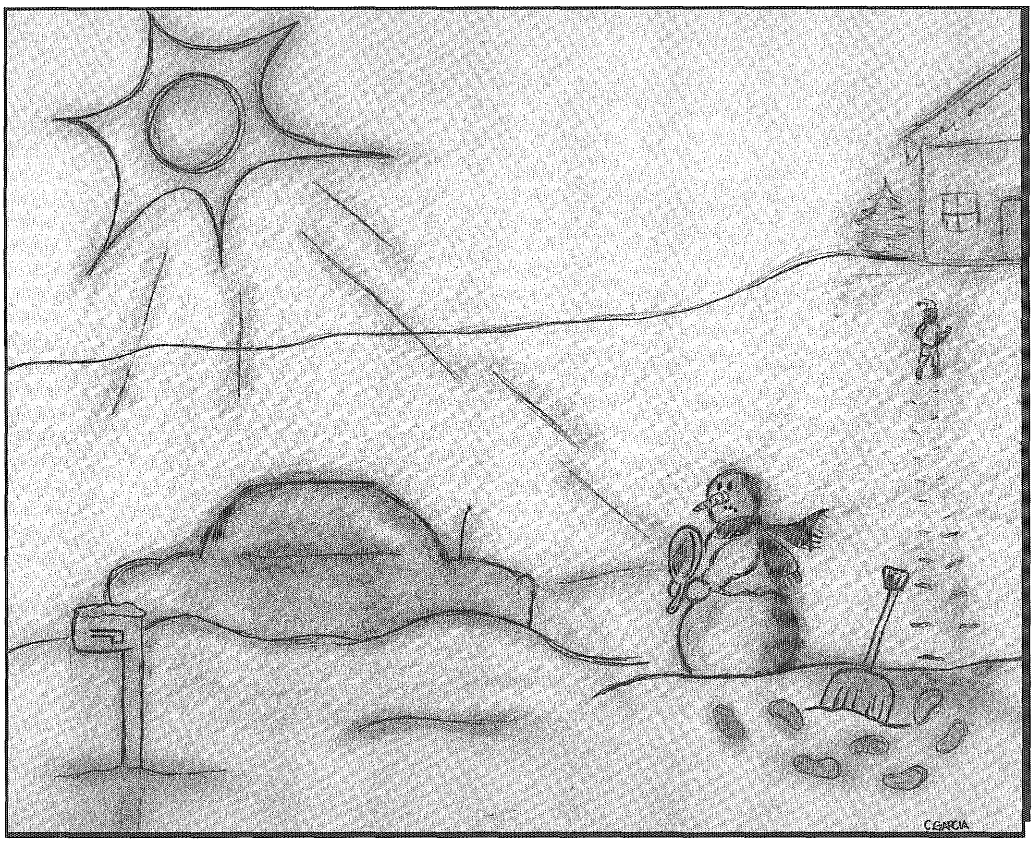
If you are interested in joining the Sunrayce team, contact Matt Kirkwood or Kristine Korbel at 623-4394 or attend a general meeting. General meetings are held every Tuesday—stop by room 121, old EE at 6:15 PM.



TECHNOLOG
Writer Profile

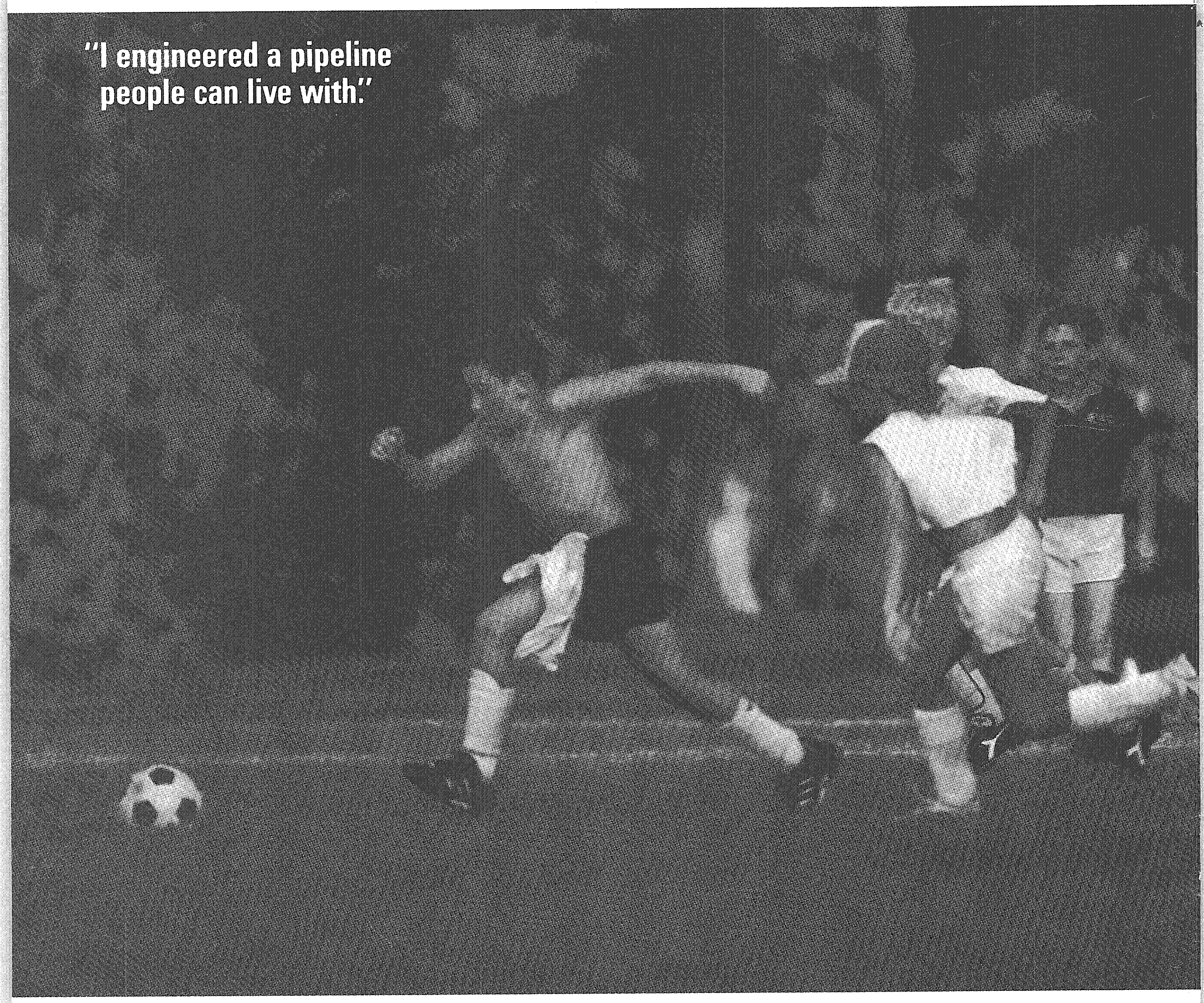
Lee Klancher will soon be graduating with a journalism degree and is looking forward to poverty. He is a big fan of the solar car project and is conducting his own experiments with a beer-cooled solar-powered sun umbrella. Unfortunately, the user suffers debilitating side affects after several hours of use, but Lee is conducting extensive research and hopes to iron out the bugs and market his product. Lee is shown testing various brands of coolants.

Oh, yeah? Well, if it wasn't a plane, what was it, Mr. 'I-have-a soundproof-house?'



Cartoons by Dennis VanDenBerg (top), Christina Garcia (bottom)

"Pa says yer sposed ta keep blowin' till 'The Simpsons' is over."


"I engineered a pipeline
people can live with."


minnesota
TECHNOLOG
February/March 1992
Negative Effects of Technology
Bioartificial Pancreas
Ergonomics

In memory of

Bernice F. Calander

June 1, 1914 - December 12, 1991

This issue is dedicated to the memory of a wonderful person who gave a bright, cherry smile to everyone she met. I remember a few words of wisdom she used to say to me, "Education is something that will stay with you always, so get all that you can."

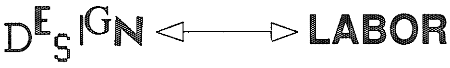
Although her health has failed her, her memory will live on in me indefinitely.

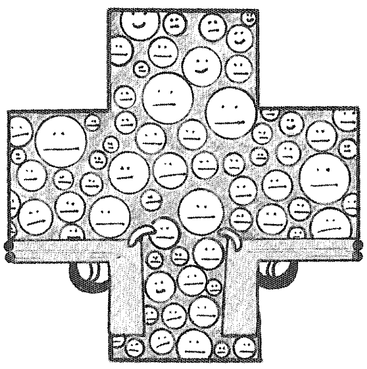
I will sorely miss you, grandma.

-Laura E. Sokol

TECHNOLOG

Volume 72, *Number* 4 — *February/March* 1992





About the Cover

This picture shows the cross-section of a bioartificial pancreas, a 200um diameter hollow fiber with islet cells loaded inside. Slide courtesy of Houdin Dehnad, Dr. Blackshear of the Mechanical Engineering Department, and Dr. Sutherland of the Surgery Department.

Departments

Editorial

How Far is Too Far?

Medical technology advancements can lead to improved health, but can also lead to some extremely controversial dilemmas.

Although advances in medical technology have given many people alternatives to deal with health problems, none come with a guarantee. Short-term advantages may end up with long-term, unforeseen complications.

On December 12, 1991, Bernice F. Calander died of a terminal form of cancer. In an attempt to alleviate some of the symptoms, she tried chemotherapy. The treatments prevented the cancer cells from spreading so quickly. Although the treatments may have bought her more time in better health, they also worked the reverse. They created a longer, slower, more painful deterioration, tearing those who cared about her to pieces.

I am one of those people—Bernice was my grandma.

Watching my grandma slowly reduced to a skeleton was the hardest thing I'd ever had to face. Because of that experience, I question the "need" or "want" for some medical technology.

I have a friend who got hit by a drunk driver in December. He is hooked up to machines with little chance of survival. His prospects look dim, but because a small percentage of his brain is still functioning, legally he must remain dependent upon machines.

Why is it that because we have the technology, we are required use it? Shouldn't there be a consideration of whether it is actually helping the person? Where do we draw the line, or do we?

Take another case, for example, in which a pregnant woman has tests done on her fetus. For practical reasons, such as deciding what clothes and furniture to buy or name to choose, it may make sense to find out the sex of the child. But, on the other hand, that action also takes out the thrill, the mystery of wondering whether it will be a girl or boy.

At the same time, she can also find out whether the child will be mentally retarded. Should she know that information before the child is born? Will it affect her decision of whether or not to keep the child? If modern medicine can't determine whether the retardation is mild or severe, who's to say if it will be a blessing or a burden to rear the child?

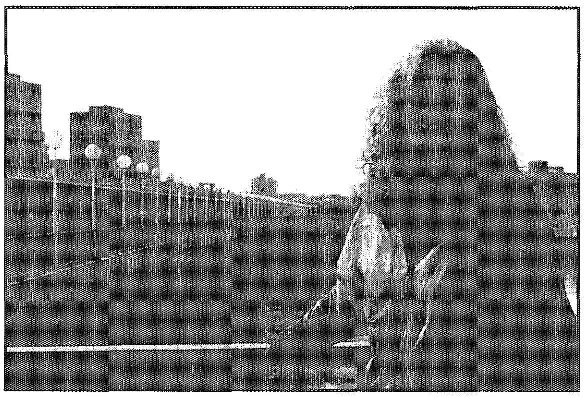
It is not just with fetuses that medical researchers can determine controversial information—it can hit pretty close to home also. With medical technology, psychological and hereditary tendencies may be able to be determined.

Some of this information may be helpful in preventing and detecting diseases earlier. It might help to prevent diseases such as alcoholism or Alzheimer's or certain forms of cancer through greater awareness of the warning signs. However, if this information gets into the wrong hands, you may be discriminated against by health insurance acceptance and rates, and by job personnel staff. What may happen in the future, if after testing plenty of criminals they pinpoint certain common genetic codes that coincidentally you also happen to have?

And what about genetic alterations? This may alleviate some diseases, but is it too much like playing God? What if it is taken too far? There's a reason we fought in WWII. Could Nazi-type eugenics recur, and would they be legal this time? Should we draw a line?

Illustration by Melinda Maurey

Just because we have the technology doesn't mean it ought to be used. It is simply technology for technology's sake, and nothing more.



I can't tell you what the "right" thing to do is, or whether what is legally right is truly best. All I know is that no experience has had a more drastic impact on my life than my grandma's illness. And because of that impact, many ethical questions have been raised in my mind. I believe questions like the ones I have mentioned will need to be addressed in the future, although I don't know how soon. My only hope is that consideration of the long-term effects is made before what seem to be short-term decisions end up with disastrous consequences.

Laura E. Sokol

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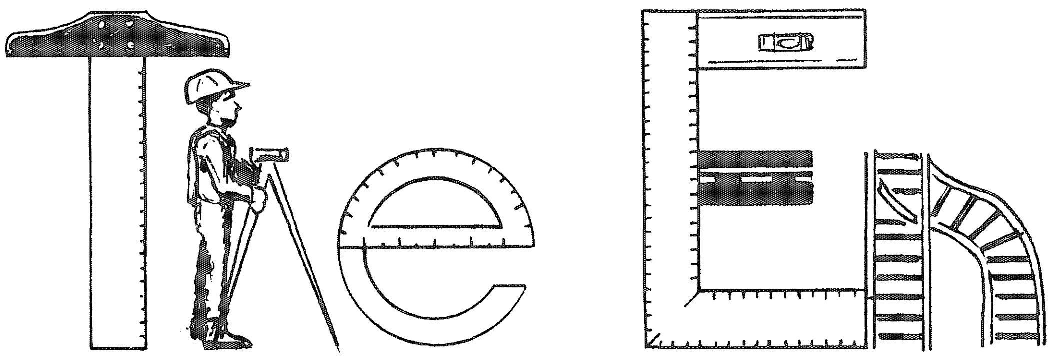
Photo by David Sager

Perspectives

What's in a

by Pat Hafner



After several grueling years in the Institute of Technology, many students hope to proudly hold the title "Engineer." If they were pursuing their degree in the 1400s, however, they would be referred to as an "Yngynore." And graduating in the 1500s or 1600s would earn them the title "Ingenor," "Engyner," or "Engyneour."

Throughout the centuries, the English use of the term *engineer* changed form many times. The exact spelling of the word seemed to depend as much on the writer as the time in which it was written.

Around the 16th century, however, it became fairly standard to use the noun *engine* with the suffix *-er*, forming *enginer* (sometimes spelled *ingener*). In the 17th century the use of the *-eer* suffix started to appear, forming the current *engineer.*

The exact origin of this spelling is uncertain, but according to the Oxford English Dictionary, it is likely that the French word *ingenieur* strongly influenced it. Other possible influences were the Italian word *ingegniere* and its Spanish equivalent *engenero*.

The Oxford English Dictionary gives several definitions of the noun *engineer*, and cites examples from the writing of certain time periods. One definition is a contriver or maker of engines, and one who manages engines.

"By engineer I mean...the tradesman who is employed in making engines for the raising of water, etc."

– **1747**, R. Campbell, *London Tradesman*

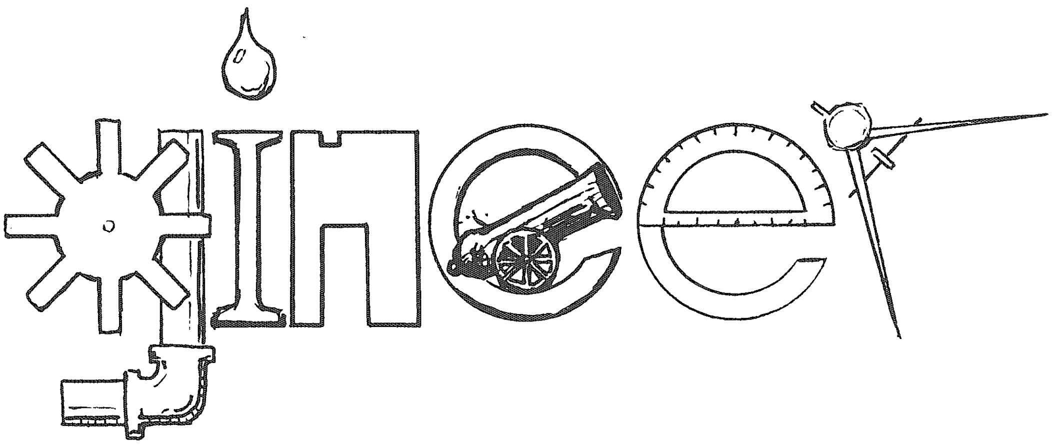
Illustration by Wayne Kao

Name?

Sometimes the "manager of an engine" was an artilleryman in times of war.

"It was not you, At whom the fatall engyner did aim."

– **1600**, Heywood, *Edward IV*



Another definition of *engineer* is one who designs the works of public utility, such as bridges, roads, and railways.

"An Enginer also promised to bring into the Capitoll huge columnes with small charges."

– **1606**, Holland, *Sueton*

Engineer describes a person who constructs military engines, or military works for defense or attack.

"The Amyral made his engyneour; the engines to sette and bende."

– **1380**, *Sir Ferumbin*

"For 'tis the sport to have the enginer Hoist his own petar."

– **1602**, Shakespeare, *Hamlet*

A less affectionate definition of *engineer* is a plotter, inventor, or layer of snares.

"In hys court was a false traytoure, That was a great Yngynore."

– **1420**, *Metr. Life St. Katherine*

Except for this last definition, the title "Engineer" has for several centuries represented prominent, important, and ingenious members of society. So, future IT grads, bear your titles proudly. And keep track of any spelling changes!

TECHNOLOG
Writer Profile

Pat, a senior English major, wanted desperately to become an engineer, but wasn't admitted into IT because he never learned how to spell "engineer." His goal is to learn to spell his name correctly by the time he gets his B.A. We hope it doesn't delay his graduation.

Photo by David Sater

Features

Bioartificial Organs as the New Alternative

by Theresa L. Kimler

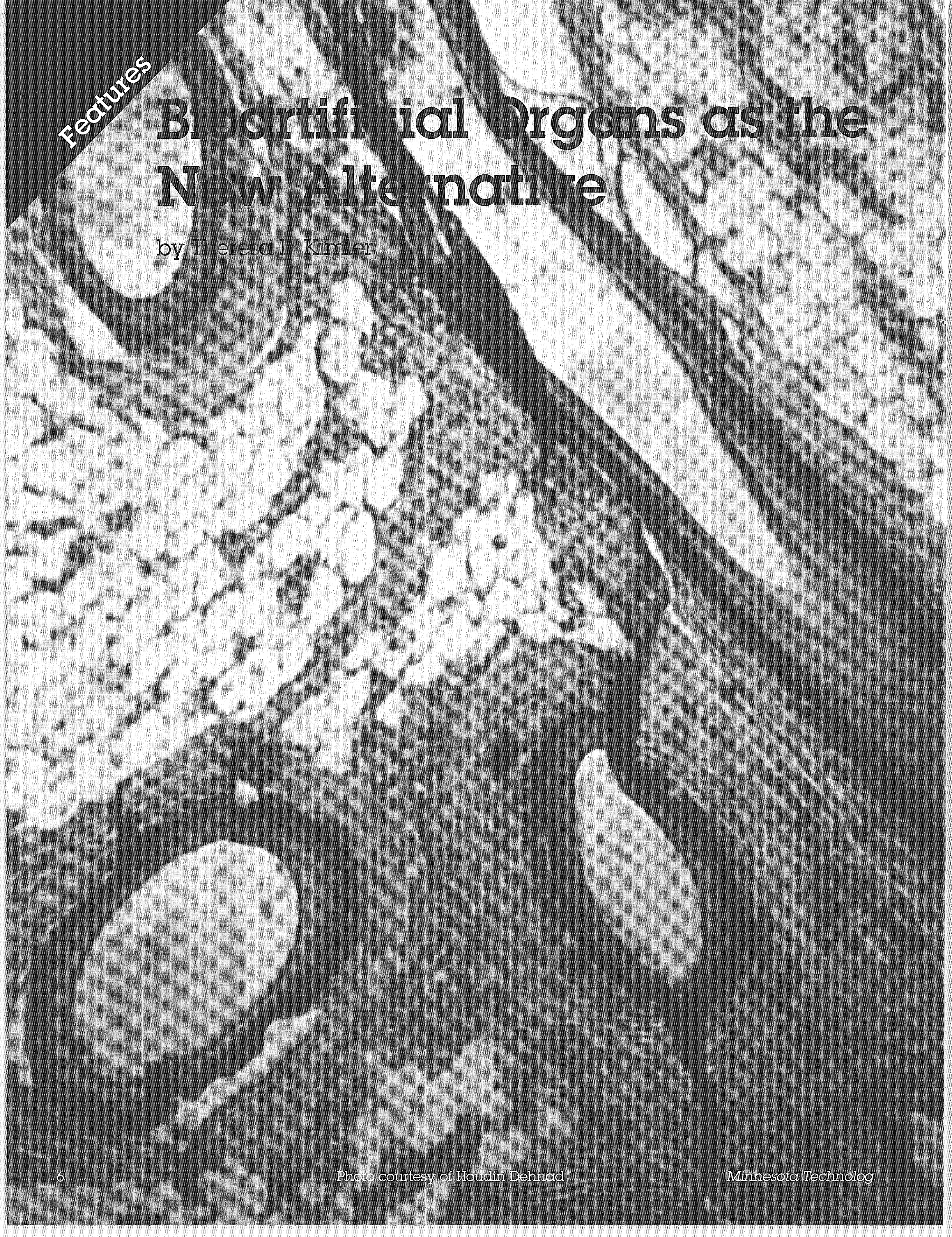


Photo courtesy of Houdin Dehnad

The time is 8:00 a.m. I have finished my breakfast, as has my dog. It is a typical school morning with the usual morning routine. Mine includes one extra task that many others do not—I must administer a daily insulin shot to treat diabetes. Fortunately, the shot is not for myself, but rather for my dog.

The inconvenience of daily insulin injections for humans as well as animals could be abolished if an artificial insulin-producing organ were available. Better yet, if a "bioartificial" pancreas were available to treat one form of diabetes, I might be able to solve this problem in a much more natural way.

The Disease: Diabetes

Diabetes afflicts 14 million people in the United States alone. It is the third leading cause of death by disease and the second leading cause of blindness. As you can imagine, research in this area is of intense interest.

Diabetes is characterized by an unusually high blood glucose concentration. This elevated glucose level is due to a lack of insulin in the body, which is needed to break down food glucose into energy. In 10% of all diabetics, the insulin-producing beta cells located in the pancreas are either completely or partially destroyed. These people must control the disease with daily insulin injections. The other 90% of diabetics do not lack insulin production, but rather the tissues in their bodies have a difficult time reacting to insulin. These people can control the disease with proper diet and/or pills.

The exact cause of diabetes is unknown but may be due to an autoimmune disorder involving heredity and an unidentified environmental component, perhaps a specific virus which triggers the disease.

Bioartificial vs. Artificial

The objective of bioartificial pancreas research focuses on the 10% of diabetics dependent on insulin injections. A "bioartificial" organ is defined as any cell or tissue transplant which is combined with a synthetic material. It differs from an "artificial" organ because it contains live cells. For instance, an artificial heart consists of two pumps, an energy converter, control logic, and an energy source. These are all mechanical devices which can be implanted in the body, kept outside the body, or a combination of both. On the other hand, a bioartificial organ does away with the mechanical components and replaces them with biological tissue or cells. The whole bioartificial organ is usually implanted in the body.

The idea of bioartificial organs began as early as 1950 when it was discovered that live cells or tissue could be transplanted from one species to another with no loss of biological function—as long as the cells or tissue were separated from the recipient by an artificial polymer membrane. Early studies in the 1960s focused on endocrine cells encapsulated in an artificial membrane. Endocrine cells were used because the mass of transplanted cells was small, yet sufficient hormone release could be demonstrated. Another early '60s concept used sliced liver in a hemodialyzer. As blood was filtered through the dialyzer, the chemicals produced by the sliced liver would be picked up and carried to the body. This same effect was also applied to other organs.

Benefits of a Bioartificial Pancreas

To function properly, every person needs a certain level of glucose in the blood. If a diabetic eats too frequently, excess sugar will accumulate in the system. If he or she eats too little, misses a meal, or eats irregularly, the insulin will have no free glucose in the body to act upon. In addition, if he or she is abnormally active or misses too much sleep, a larger than usual amount of glucose is burned up, leaving less for the insulin to act upon later in the day. Therefore, even a person who has an insulin shot once or more per day is not guaranteed to have insulin delivered in the correct amount or at the time needed by the body.

A pancreas transplant may seem like a logical solution, yet there are several medical reasons against this. First, since it is a transplant, there is always the fear of infection or rejection. Second, the pancreas is not an easy organ to separate from the side of the stomach and intestine. Lastly, a pancreas transplant is only feasible for a patient needing a kidney transplant because the immunosuppressant drug used during the transplant is toxic, destroying the kidneys.

A bioartificial pancreas alleviates the need for transplant surgery and the inconvenience of insulin shots. But most importantly, the artificial pancreas would monitor the body's blood glucose level and naturally produce insulin when required by the body.

Requirements

The bioartificial pancreas must fulfill several requirements to be considered effective: (1) insulin production by the bioartificial pancreas must be triggered by a rise in the blood glucose level and have a 15 minute response time, (2) the artificial membrane must protect the insulin-producing cells from immune rejection by the body, (3) the insulin-producing cells must have a relative long-term survival, (4) the artificial membrane must resist fibrous growth, and (5) an adequate supply of insulin-producing cells must be found.

In the pancreas, the insulin-producing cells, beta cells, are found and extracted as a member of a group of cells called islets. An islet cell contains 65% beta cells, 10% delta cells, and 25% alpha and polypeptide cells. Whole islet cells are considered for bioartificial pancreas designs because beta cells are difficult to separate from the islets. Additionally, beta cells seem to function more effectively in the presence of the other cells in the islet.

The three designs for a bioartificial pancreas that have been proposed and studied are vascular-type system, microencapsulation, and macroencapsulation.

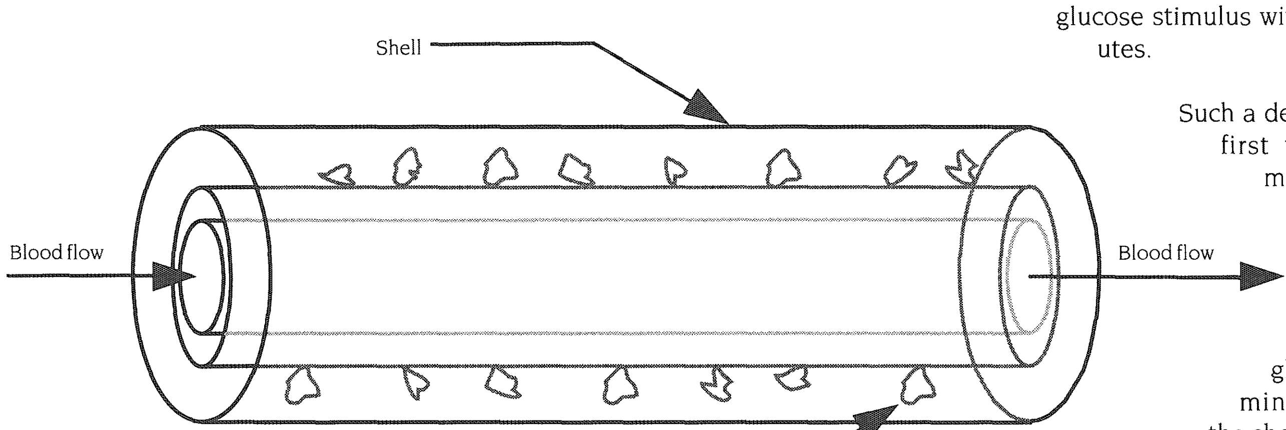
Vascular-Type System

The vascular-type bioartificial pancreas is of two variations. The first, a capillary tube system, consists of an artificial tube with the islet cells arranged outside the tube in a rigid shell. Blood flows through the tube and exchanges nutrients, glucose, and insulin with the islet cells.

One problem with this device is that insulin release from this system can take over 20 minutes from the time of glucose stimulus. If insulin is released too late after glucose triggers it, too much glucose would be expelled out of the body, leaving only the glucose needed by the brain available for energy. This long reaction time is due to a long glucose/insulin path length. At the beginning of the tube the blood hydrostatic pressure is greater than inside the islet shell, therefore a net flow of glucose, nutrients, and oxygen will flow to the islet cells. At the end of the tube, the blood hydrostatic pressure is less than the pressure inside the shell so that a flow of insulin goes into the bloodstream. This flow pattern creates a long insulin pathway to the bloodstream. Another problem with vascular devices is the formation of blood clots, which can prove fatal.

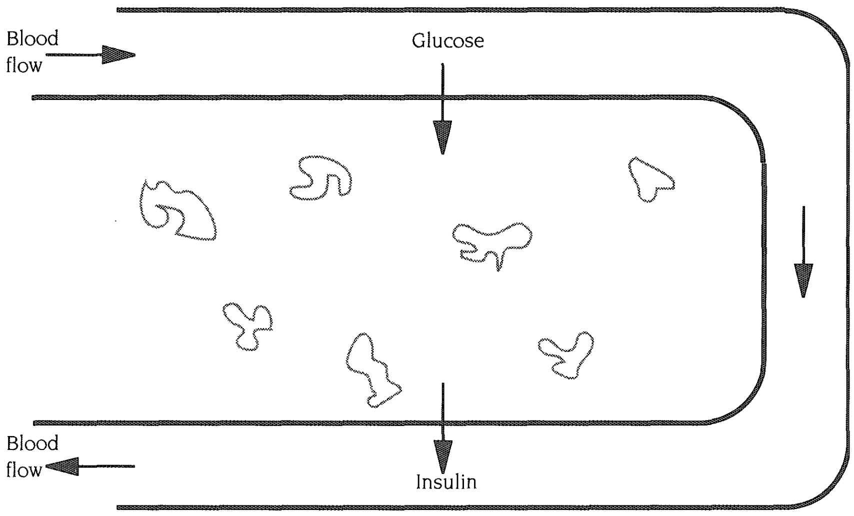
An improvement in response time for this design can be achieved by decreasing the volume of the islet compartment shell so that the nutrients and insulin have a shorter travel distance. The second vascular-type bioartificial pancreas, the U-shaped device, uses the difference in pressure between the bloodstream and the islet-filled shell of the capillary tube to achieve a shorter travel distance.

The filtration from the bloodstream at the beginning of the loop into the islet chamber and from the islet chamber at the end of the loop into the blood stream, gives a shorter distance of glucose/insulin travel. Consequently, it is not surprising that studies show insulin release from this device responds to glucose stimulus within three minutes.



Bioartificial capillary tube system vascular-type pancreas

Such a device fulfills the first three requirements of a bioartificial pancreas. First, insulin release is triggered by glucose within 15 minutes. Second, the shell material protects the islet cells from immune rejection. Third, the islet cells have been shown to survive at least three months.



Bioartificial U-shaped device—vascular-type system

Macroencapsulation

The macroencapsulation technique takes a hollow, porous fiber in which the islet cells are suspended in a collagen gel. The small pores of the fiber allow insulin, nutrients, and glucose to flow freely across the fiber wall, but islet cells and antibodies cannot. Therefore, the islet cells will be safe from attack by the body's immune system.

The fiber used most often for experimentation is one millimeter in diameter. This size fiber is relatively easy to work with but gives a long path length for the insulin to reach the outside of the membrane.

Houdin Dehnad, a Ph.D. student in the Mechanical Engineering Department at the University of Minnesota, is experimenting with 200 micron diameter hollow fibers. It is hoped the smaller sized fibers will support a shorter insulin-to-glucose response rate.

In addition to path length, another limiting factor in adequate encapsulated islet response to blood glucose change is a lack of oxygen supply to the islets. In the body, the islet cells of the pancreas are within one cell-length of an oxygen-rich capillary. A macroencapsulated islet cell does not have this luxury.

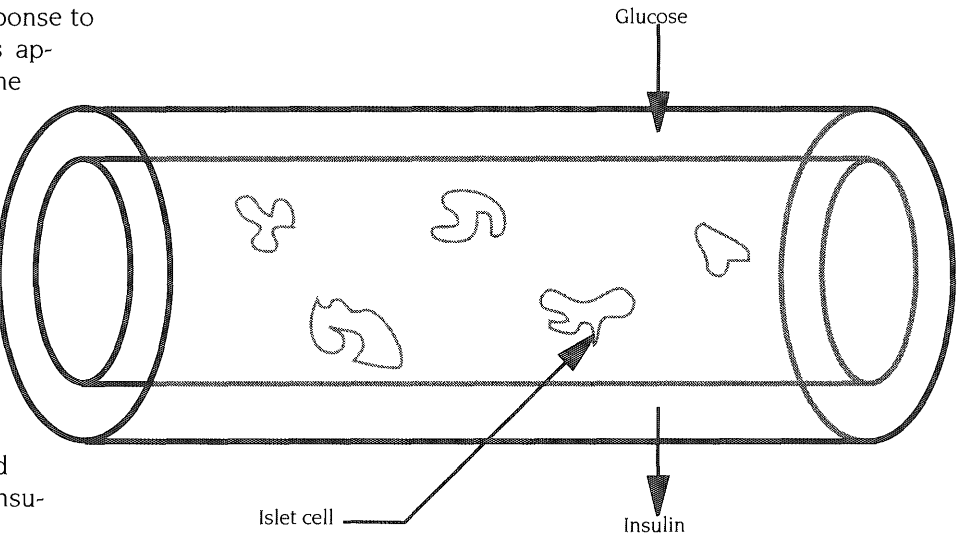
Only *in vitro* studies (studies outside the body) show an adequate response rate by the islet cells in a one millimeter fiber. Dehnad notes that the oxygen content in body tissue is 1/4 to 1/5 that of atmospheric air, so they need to be concerned with

Microencapsulation

The microencapsulation technique involves coating the islet cells with chemicals. These chemicals act as an immunoprotective barrier, keeping antibodies away from the cells but letting glucose, nutrients, and insulin pass freely. The process of coating the cells consists of first suspending the cells in sodium alginate to form the first layer. Next, the cell solution is sprayed through a nozzle to form the microspheres, followed by a second and third layer of polylysine and sodium alginate respectively. Last, the microcapsules are separated by soaking them in sodium citrate. The microcapsules are now ready for implantation into the body in the peritoneal cavity.

A major consideration of this technique is the size of the microcapsules. It has been shown that insulin was released in under 15 minutes in response to glucose when the capsule size was approximately 400 microns. Therefore, the first requirement of a bioartificial pancreas is fulfilled. Also, the alginate-polylysine coating has been shown to immunoprotect the islet cells and the microcapsules can reverse diabetes in laboratory animals for several months. Thus, requirements two and three of a bioartificial pancreas are fulfilled.

A problem with this method is that fibrous tissue growth occurs around the microcapsules, smothering their insulin exchange with the body.



Macroencapsulation-type bioartificial pancreas path diffusion length for the oxygen to reach the cells which is less of a concern in the oxygen-rich atmospheric air. Dehnad is also working on a method to increase the oxygen supply to the islet cells inside the hollow fiber by incorporating an oxygen sink. The smaller fiber size with oxygen storage for the islet cells should prove effective.

A problem with the macroencapsulation method is fibrous growth occurs around the hollow fiber. Additional research is being done to find a material the body does not try to reject.

For Humans or Not?

In terms of sizes of the devices and their use in humans, it has been shown that 5000 islets/kilogram of body weight are necessary to correct hyperglycemia (too much glucose in the blood) in diabetic dogs. This means approximately 300,000 islets for an adult human.

A macroencapsulated bioartificial pancreas with 300,000 islets (of 200 micron diameter each) would require a 130 centimeter long fiber of a one millimeter diameter (total volume of one milliliter). The volume required by the microencapsulation method would be 60 milliliters if the islets were 300 microns in diameter. Therefore, consideration as to the ideal geometric configuration is needed to make the bioartificial pancreas easy to implant in humans.

Another consideration is safety. The bioartificial pancreas removal from the body is quite feasible for the vascular and macroencapsulation devices, since these could easily be located by x-ray. However, the microcapsules would be difficult to locate and remove. Also, the blood clots encountered with vascular devices and fibrous inflammatory growth around the microencapsulation and macroencapsulation devices needs to be resolved.

One last area needing improvement is the procurement of the islet cells. The extraction process is difficult and produces a rather low yield. Since human pancreases are rare for experimentation, smaller animal pancreases, which have a smaller islet yield, must be used.

If an effective bioartificial pancreas can be developed, the daily hassle of insulin shots would no longer be necessary. Instead, once every 6 months removal and replacement of the bioartificial pancreas might be done. Along with my own, this would make the morning routine of 14 million other Americans more hassle-free.

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A Mechanical Option

An alternative to the bioartificial pancreas for the treatment of diabetes is an implantable drug infusion pump. A constant-flow drug infusion pump was developed at the University of Minnesota over 20 years ago. This totally implantable pump is capable of delivering as little as one milliliter of a drug per day at a constant rate for 35 days before a refill is needed.

The pump consists of a hollow titanium cylinder about the size of a hockey puck. A free moving bellows separates the cylinder into two compartments. The top area contains the insulin, while the bottom area contains a fluorocarbon liquid which boils at body temperature. The boiling liquid exerts pressure against the bellows, which moves upward to expel the insulin from the pump. The insulin follows a length of tubing to the desired area of the body. The pump is refilled with insulin using a needle and syringe, which compresses the fluorocarbon gas and starts the process over again.

Bruce Wigness, a Senior Research Scientist for the Department of Surgery at the University of Minnesota, has worked on the drug infusion pump for over 16 years. He says the pump basically runs by "a pressure source (fluorocarbon) fueled by body heat."

The pump was designed to deal with drugs which are difficult to control or administer. The uses include the administration of anticoagulants, morphine for pain, and the treatment of some forms of cancer as well as insulin for diabetes.

The advantage of an insulin pump is that it is easy to test before it is implanted in the body, unlike the bioartificial pancreas. However, the pump cannot give close blood glucose control, like the bioartificial pancreas. Other concerns include water and carbon dioxide penetrating the catheter tube as well as clots in the insulin delivery tube.

The implantable insulin infusion pump is still in experimental use. Wigness predicts it will be at least two years before the FDA approves it for commercial use.

TECHNOLOG
Writer Profile

Theresa is a senior in mechanical engineering. After working for the Technolog *for two years, guilt and a persuasive* Editor-in-Chief *convinced her to write for the first time. Of course, she's glad she did.*

Photo courtesy of Theresa Kimler

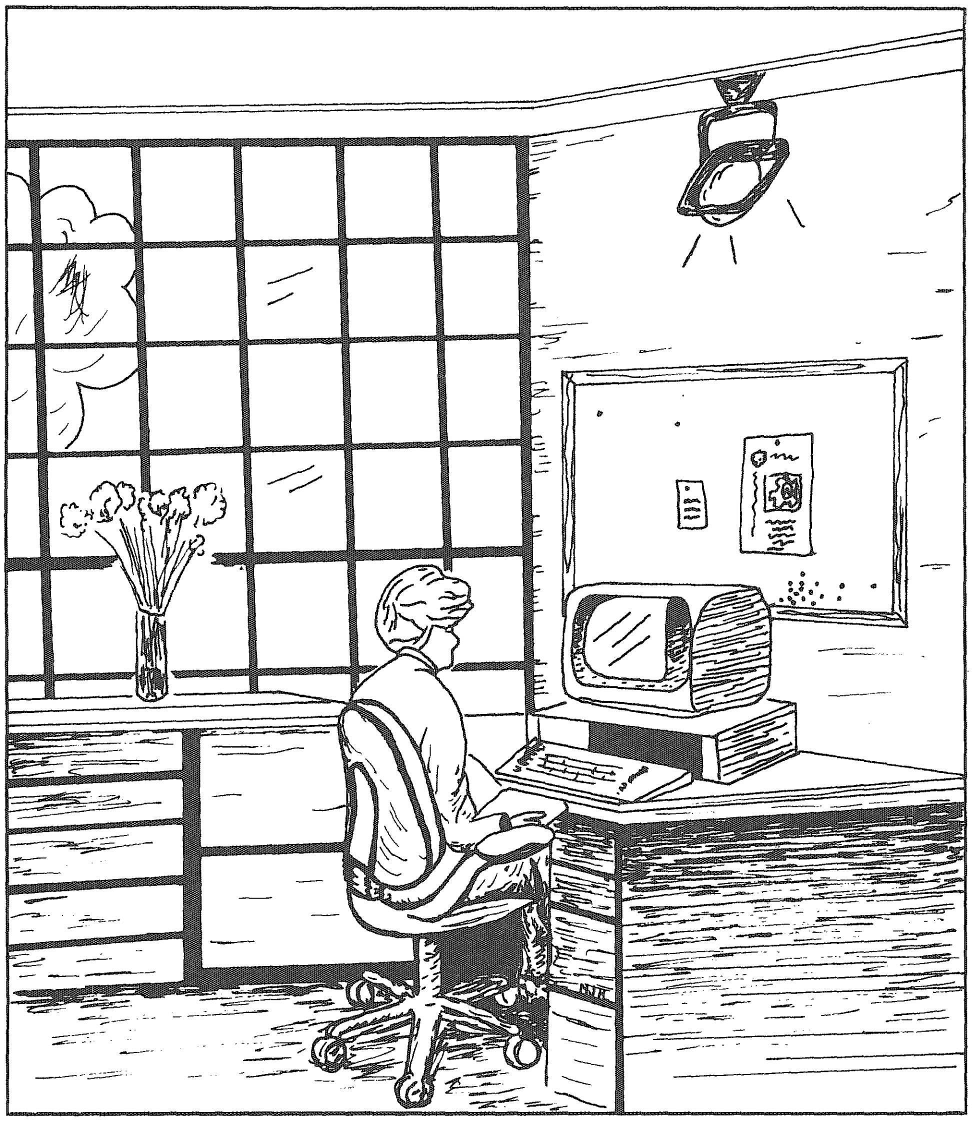
Ergonomics

It Could Help That Pain in Your Neck

by Janine Duley

DESIGN

Ergonomics has left the drawing board of a few engineers and found its way to the secretary's desk and the laborer's tools, emerging as an integral part of health management.



Evolution of Ergonomics

The term "ergonomics" has as its Greek root "ergon," meaning work, thus ergonomics refers to the study of work. Ergonomics, or human engineering, aims to adapt the machine to the person instead of the person to the machine. The goal is to make the interaction between the two less complicated and less stressful. Since workers who physically exert themselves are affected in one way or another, the scope of study includes not only machines but the environment in which one works—lighting, organization of materials, posture, and even temperature.

Applying ergonomics to the work place originated in Europe soon after World War I. "Human factors research" is the term coined by the United States. Principles of proper lifting and material handling techniques were formulated later as educational programs and adaptive equipment were presented.

To engineers, both industrial and psychological, ergonomics was familiar, especially to those who were associated with the design and construction of aircraft. One engineer, Stan Roscoe, did not conceive of its importance today, but he did have an inkling of its impending relevancy.

Roscoe along with other industrial engineers were working with Hughes Aircraft Co., attempting to integrate ergonomics to the design of cockpits and instrumentation. They were limited to technology of the 1960s, lacking the computer-aided design programs which now assist the analysis of the human factor interacting with machines. An ergonomist can study work-

Illustrations by Nancy Henjum

related hazards such as "repetitive and/or prolonged activities; forceful exertions; awkward postures; excessive vibration," according to the Occupational Safety and Health Administration (OSHA). Design changes can be made after evaluating effects of these stressors on the human frame.

Today

LABOR

Ergonomics no longer focuses solely on cockpit design, but also has expanded to include injuries and illnesses resulting from work hazards. With a carefully controlled and consistent application of ergonomics principles, problems can be discovered, evaluated, and treated properly.

The continuing trend in the 1990s to produce a larger quantity in a smaller time frame has augmented demands on the body and mind to mass-produce. What is often bypassed in the urgency to surpass competitors is the role of efficiency. However, some corporations are viewing ergonomics in a positive light, as something that will place them ahead of competition. They recognize a need to integrate safety and quality to remain efficient, thus leading to successful operation.

For the worker, the '90s holds such injuries and maladies as carpal-tunnel syndrome (an injury common to secretaries) and strained muscles, which we may all encounter at some point in time.

Ergonomics Expansion

The role of ergonomics has expanded to corporations and unions, which see it as a requirement for successful operation. Ergonomics alleviates hazards of muscle extension, postural deviation, excess vibration, and maintaining an equal distribution of contact pressure.

Safety professionals will be responsible for insuring the implementation of ergonomics as a means of prevention and control. Under their supervision, injury and illness will be kept at a minimum and be curbed by innovative safety measures. Design and labor will co-operate to correct dysfunctions, both technical and human.

Who Can Benefit From Ergonomics?

What are the motivations for implementing ergonomics? Aside from the obvious motive to reduce illness and injury, health costs are tremendous so there is also a need to suppress the rising costs of these injuries. According to the American Academy of Orthopedic Surgeons, repetitive-motion injuries are at an estimated cost of $27 billion annually. This figure is calculated in terms of both medical treatment and lost income.

The traditional work force is changing. As the year 2050 approaches, the average age of the population will also increase, meaning at least a third of U.S. citizens will be approximately 55 years old. With an increase in age comes a decrease in muscle performance, flexibility, and overall mobility. Work places need to redesign to accommodate the ever-changing portrait of its workers. Increasing numbers of women and immigrants predicted by 2000 will mean more workers with a smaller stature than today's average worker. Equipment for tasks should coincide with physical proportions and abilities.

Ergonomics is receiving more than kudos for its inventive techniques. Implemented systematically by government agencies such as OSHA, these federal agencies increase both staff and budget to concentrate on the issues at hand and potential resolutions.

OSHA's industry guidelines include, "a program supported by management commitment to include training and education of employees at all levels of the organization incorporating engineers, supervisors, and laborers." Fines are awarded to employers who fail to subject their organizations to programs that diagnose and analyze harmful tasks.

The future can only hold more widespread awareness and execution of the principles of ergonomics. Perhaps with correct application of the techniques, injuries and discomforts suffered today will be alleviated tomorrow.

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TECHNOLOG
Writer Profile

Janine, a journalism major, has been avoiding the Editor-in-Chief for fear of having to write an article. Luckily for us, her persuasive older sister convinced her of the places she could go getting published here.

Photo by David Sager

The Sword's Other Edge:

Increased Health Risks From Technology's Advance

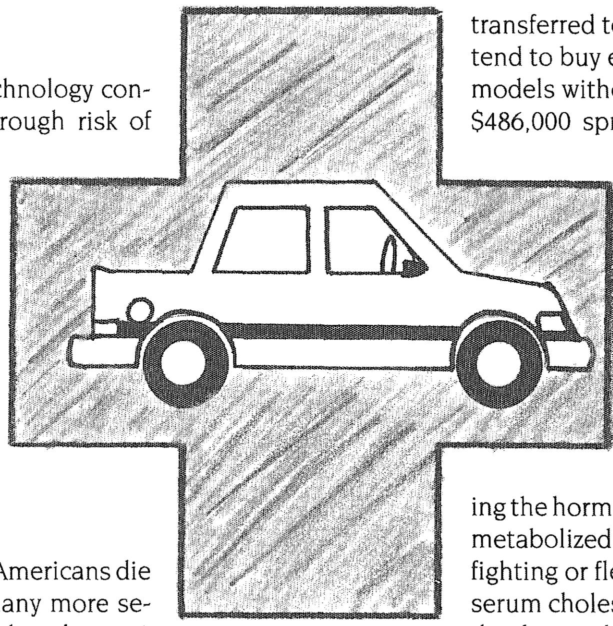
by Bob Subiaga, Jr.

It is tempting to think of technology primarily as a subject that contributes to an increased health and life span for Americans and the world. After all, could modern medicine have invented vaccines and antibiotics without standard tools like the microscope? Don't ambulances, helicopter airlifts, and the electric defibrillators aid in the survival of heart attack victims? Hasn't the average life span of Americans increased dramatically in this century?

Yes...and no. If we wipe out a few significant developments like antibiotics and vaccines, people would not be living that much longer. Many of those who benefit from advanced medicine are elderly patients forced to live life in a semi-invalid state for years upon years. So much for the increase in either quantity or quality of life. Perhaps that edge of technology's sword is a little duller than we thought.

Perhaps, we just do not like to admit, the other edge is razor sharp...

Mechanization & Transportation



The most obvious way in which technology contributes to health problems is through risk of accidents from machinery, particularly those associated with transportation. Non-transportation machinery alone accounts for 2,000 deaths annually. Prior to high speed transportation advances, the odds in nature of being hit by something of large mass moving at high velocity were low. Buffalo might charge, boulders might fall, but such kinetic injuries were comparatively rare.

Now, in a typical year, some 40,000 Americans die in motor vehicle accidents, with many more severely injured. Trains are safer, with only 1,000 fatalities, and airline travel, despite being the focus of such recurrent fears, is a safety bargain with only about 300 fatalities on commercial aircraft per year and 1,000 on other aircraft.

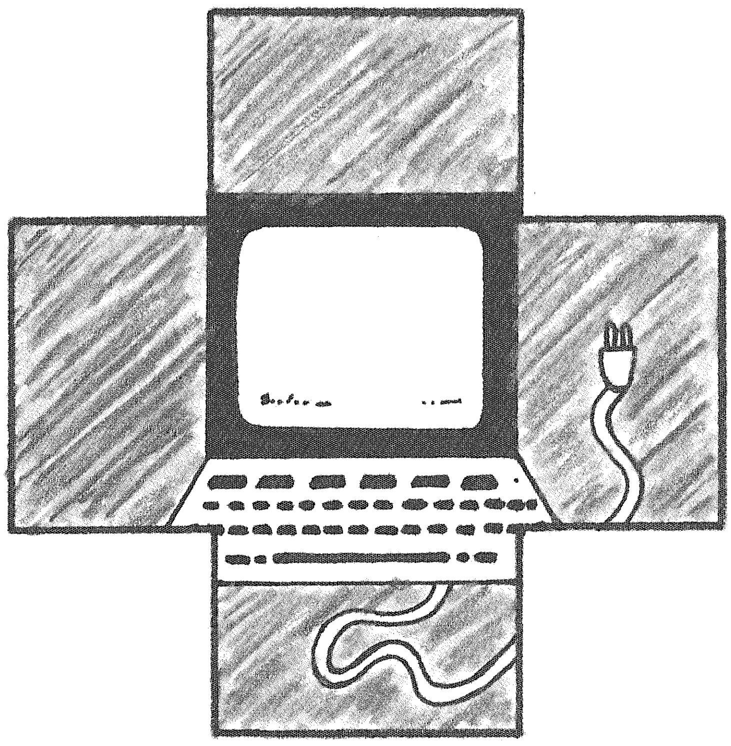
Computers & Electricity

Of the fears associated with automation, many have seen reality not in the factory but on the office floor. Computers often elevate productivity, but the expected windfall of greater leisure time is fleeting. Rather than be satisfied with the old production, companies expect workload (hours and effort) to stay the same while the computer advantage increases base production. Often, the workload actually increases, as data and word processing may shuffle trivial pieces of information and increases paperwork when the information has been transferred to hard copy. Also, companies often tend to buy expensive top-of-the-line computer models without ever asking if they really need a $486,000 spreadsheet program (that takes six months overtime to learn) when in fact, their needs are to keep simple address records or accounting figures.

The result is high stress and lack of physical activity, since more tasks can be performed without leaving one's monitor. Stress causes an increase in the body's "fight-or-flight" response, releasing the hormone epinephrine (adrenaline). If not metabolized in the actual physical process of fighting or fleeing, the hormone causes a rise in serum cholesterol. Considering about half of all deaths in the U.S. result from cardiovascular diseases such as coronary artery occlusion and stroke, this is not a trivial concern.

But minor, chronic problems attributable to increased stress cannot be overlooked. Stress contributes greatly to such indirect factors in cardiovascular disease as hypertension, and alcohol, tobacco, caffeine and illegal drug use. Related syndromes like ulcers, gastritis, cirrhosis, and suicide account for some 35 of every 1,000 American deaths. Even non-threatening conditions like low back pain due to muscle tension or overuse injuries like carpal tunnel syndrome work to burden an already overloaded medical-care system.

Computer users often find themselves exposed for long periods of time to low-level electromagnetic fields (EMFs) pro-



duced by their monitors. While the health-risk data on exposure to these specific fields is confusing, there is some evidence of associated health problems. A recent study cites that certain electrical appliances, such as curling irons and electric blankets, are capable of statistically relevant contributions to health risk. The jury is still out on many other field generating devices, but nearly all electrical appliances generate significant fields, especially cathode-ray-tube devices such as televisions and computer monitors.

There have been studies done on the effects of EMFs on unshielded neural tissue, where the skull has been opened to remove the shielding bone naturally provides. In particular, studies done by neurophysiologist William Adey show dramatic behavioral changes with even slight fluctuations of the field, causing monkeys to become sleepy one moment and violently agitated in the next. Other studies have EMFs causing dramatic birth defects in developing animal embryos and fetuses. It seems that nervous tissue, without the shielding of bone (particularly in developing stages), is especially vulnerable to EMFs.

There is hope that the advanced liquid-crystal color displays many Japanese firms are developing will be used as replacements because they do not generate EMFs like televisions and monitor screens. Until then, an effective way to limit exposure is to sit as far away from the screen as possible (EMF strength drops exponentially with distance). It seems mom was right about sitting too close to the television set!

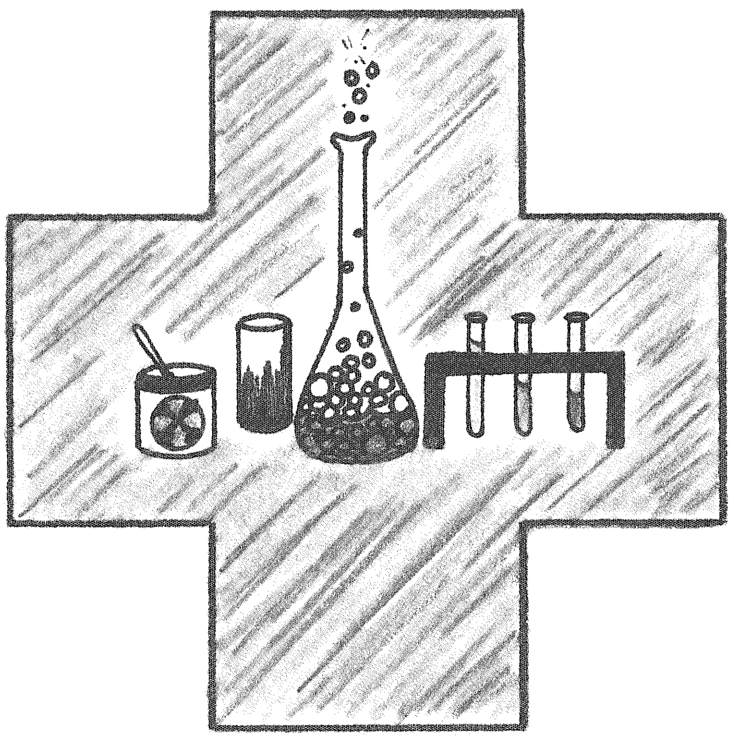
In addition to EMFs, electricity's prevalence causes many other hazards. About 1,000 people die yearly from electrocution in the U.S. Many of these deaths involve small children playing near sockets. Newer electrical technology existing side-by-side with older technology adds to the fire hazard problem.

Civil & Environmental Engineering

Another severe hazard is "sick-building" syndrome. Modern buildings of high-energy efficiency must often obtain efficiency by lowering "leaks" that in older buildings provides greater ventilation. The lack of ventilation in newer buildings allows compounds, particularly from building materials, to leak out into the office space at unusually high levels. Often this "indoor pollution" can cause headaches, nausea, and even severe allergic reactions. Depending on the type of building materials used and the surrounding soil type, radon can build to dangerous levels, particularly in underground areas.

There is also a problem in employing civil technology too quickly, with too much emphasis on short-term benefits. At one time asbestos seemed to be a great way to protect against fire, but it provides hazards of its own. Now, the cost of removal can make the short-term benefits of using asbestos a pittance, and the process of removal may actually increase the presence of asbestos fibers in the air of the building for many years.

The environmental risk extends to the use of radioactive compounds in an unprecedented number of industrial situations where "harmless" levels may build to not-so-harmless levels. The most significant generator of radioactive material is, of course, the nuclear power industry, and the Chernobyl accident is sober evidence of its capability to go awry. That one accident made unusable the foodstuffs of nearly half of Europe, particularly animal products, for a period of many years.

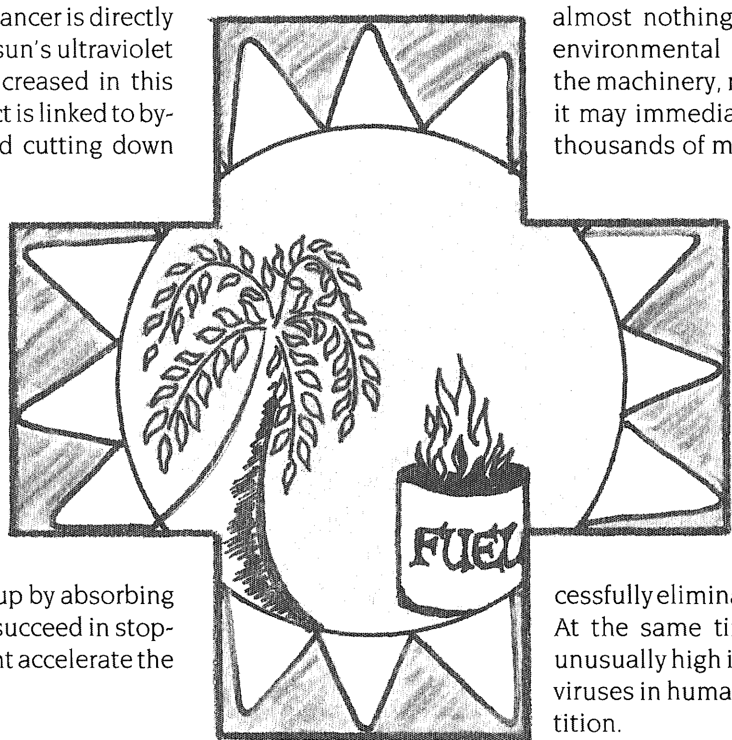


On a larger scale, when civil engineering becomes haphazard environmental engineering, entire delicate ecosystems can become disastrously unbalanced. Ecosystems like rain forests maintain themselves in a steady state because they have been pushed beyond a critical point. For example, if a forest is dense enough it will lower its comparative water losses by evaporation, and actually change the relative weather systems to provide sufficient moisture.

An intermediate stage is not stable and will soon form a desert. This also works in reverse. Russia has nearly destroyed the Aral Sea by draining it to irrigate surrounding desert. They have not succeeded (or even tried) to "terraform" the area to a level where irrigation would no longer be necessary. It is a no win situation; if irrigation stops, the land becomes a desert. But if it doesn't stop, it'll become a desert anyway while draining and destroying the water source.

Better Dying Through Chemistry

The problems reach beyond ecosystems to a planetary scale, as concerns over global warming and ozone-depletion demonstrate. Skin cancer is directly correlated to exposure to the sun's ultraviolet radiation and has steadily increased in this century. The Greenhouse Effect is linked to by-products of burning fuels and cutting down dense vegetation like rain forests. This phenomenon threatens to heat the earth, eventually melting ice caps and flooding coastal cities, while the midlands turn to a drought-ridden desert. Recently, scientists learned why the Greenhouse Effect has not been as dramatic as predicted. While greenhouse gases warm the atmosphere, ozone depletion cools it because ozone heats up by absorbing ultraviolet radiation. If we do succeed in stopping ozone depletion, we might accelerate the Greenhouse Effect.



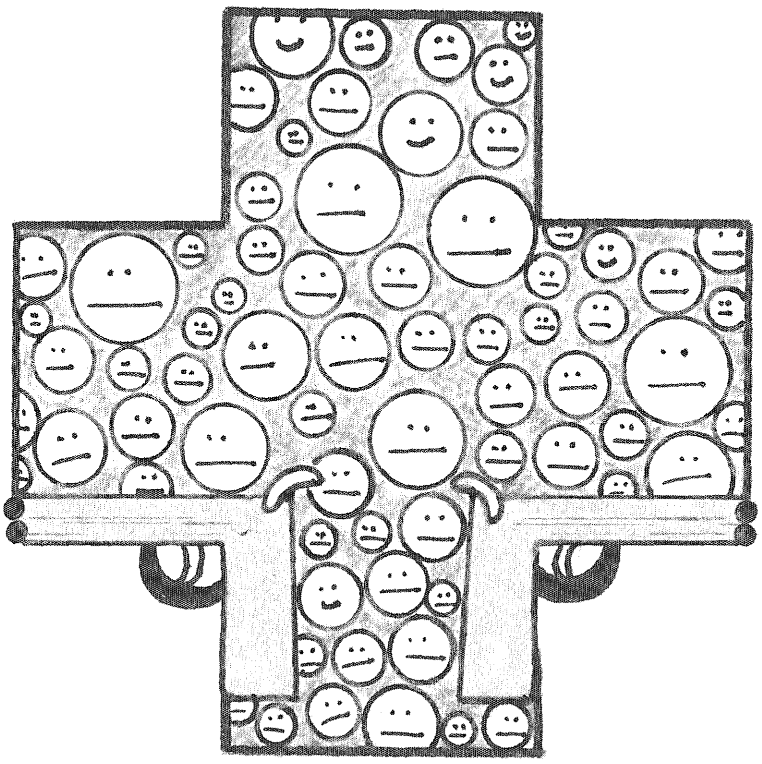
The culprit is less science than technology. Products rushed into everyday use because of short term profit include not only chlorofluorocarbons but lead-based paints and fuels, found to be involved in neurological damage among urban children.

The prevalence of toxic and semi-toxic chemical compounds has become too long to list, and the majority have been found carcinogenic in some manner. The mortality from cancer in the 1970s was over 150 per thousand. Despite advances that have seen cancer survival rates climb past fifty percent in specific types such as childhood leukemia, the death toll keeps rising. The number of new cases and the increasing varieties of cancer outstrip the ability of medicine to treat the disease.

On a more subtle but potentially more dangerous level is the strain the innocuous chemical compounds put on the immune system. To work properly, the immune system must properly recognize foreign agents as "friend or foe" and act accordingly. Occurrences of allergies to harmless items such as foods and pets has increased dramatically in the past few decades. The strain on the immune system weakens its ability to fight standard infections. Moreover, the weakening indicates that the "filing system" necessary for proper functioning of the immune system has gone awry. Truly dangerous developments, such as cancer, may go undetected by overburdened defenses until too late.

Under ordinary circumstances, viruses are resistant to an incredible amount of environmental influence, but mutation can occur. Some viruses can even survive nuclear reactions in their cyst state. But when a virus invades a cell and cranks up the cell's machinery to replicate more viruses, reproduction proceeds with incredible speed stopping for almost nothing. At this stage, if a chemical environmental irregularity finds its way into the machinery, not only will a virus mutate but it may immediately provide thousands upon thousands of mutated copies. If this mutated virus is deadly, the results could be catastrophic. Unlike bacteria, the mutated virus exists in a fairly invulnerable state once reproduction has stopped. Even the bodily build-up of otherwise harmless compounds, especially those that are organic but biologically rare or alien, may trigger such mutation. Using antibiotics, we have successfully eliminated many bacterial infections. At the same time, we may have caused an unusually high incidence of potentially deadly viruses in humans by eliminating viral competition.

The greater number of available food additives and increased options for food processing allows a variety of risky ingredients to be "hidden" in processed foods. These range from elevated levels of fats and sodium (which people discount because they themselves do not add the ingredients in preparation) to sodium nitrates (commonly added to meat and converted to carcinogenic sodium nitrites in the body). While many preservatives are actually anti-oxidants, and thus beneficial in helping to prevent cancer, we are unable to tell if they counteract the plethora of hidden risks in processed food. Consensus seems to be that they do not.



Prey & Predator: Overpopulation & War

Despite all these risks, food production and preservation, at least on a basic level, is fit to bring a person to reproductive age, resulting in overpopulation. The Western Hemisphere alone will go from 613 million in 1980 to an estimated 844 million by the year 2000. More and more, the concentration of people, particularly in urban areas, puts them at risk in their environment.

At the same time, localized slowdowns in population growth provide short-term problems of their own. The percentage of people over-65 in the U.S. jumped 6% between 1980 and 1984 alone. This number can only increase as the "baby boom" generation ages and medical technology enables life to extend for much longer periods of time. The long-term possible global catastrophe of overpopulation or the short-term economic destitution of changing demographics leaves little comfortable middle ground.

Perhaps, as some have suggested, these extremes are part of a larger cycle whose fluctuations get disturbingly wider. With the advent of technology, human beings have eliminated almost all fear of natural predators to the point where they "prey" on each other with unmatched ferocity. This has spurred more technology for enormous conflicts such as World War II which claimed 60 million lives in a mere five years! If one remembers the outgunned Iraqis in the Gulf War, somewhere between 200,000 and 300,000 lives were lost in mere weeks.

Every year, 2,300 Americans are killed with firearms. While "guns don't kill people," they vastly increase the ability of people to kill each other, on purpose or by accident. A change of heart while pulling a trigger cannot call back a bullet in the same way as one can pull back a punch.

Perhaps the most shocking illustration of how far military technology has come since firearms is in nuclear and atomic weapons. It should be remembered that the latter were used in warfare, if only twice, with devastating results. A small, 1 megaton nuclear blast wave travels at over 750 mph and lasts about 3 seconds (vs. 0.1 seconds for standard explosives). The over-pressure, at more than 1.4 atmospheres, would blow up a person's lungs inside their chest if it were not for the one million degree Celsius temperature—that is about five times that at the core of the sun.

The resultant fire storms form a ten-mile diameter hurricane, that sucks more and more air into itself, fanning its own flames and melting steel. The vortex kicks out noxious fumes of combustion from the myriad of chemical compounds the city's energy efficient buildings are composed of, blanketing twice as large an area with lethal gas. Meanwhile, the fallout spreads over the horizon, covering the globe in less than a year. A significant percentage of the nuclear arsenals in the world would make this blanketing fallout almost certainly lethal to every living thing. Except maybe mutated viruses, that may not even be "living things" anyway.

The worst part of nuclear holocaust would be the electromagnetic pulse which would knock out all the televisions with their new Nintendos. Only a year left to live for the lucky ones, and what good is the latest technology if you can't enjoy it?

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TECHNOLOG
Writer Profile

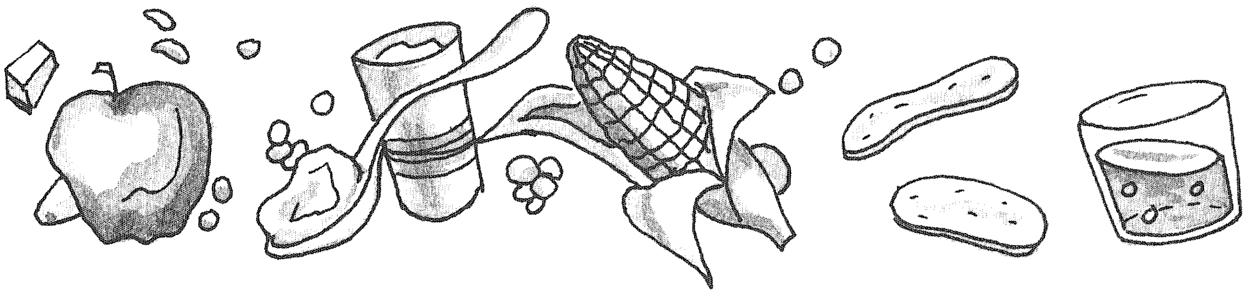
Bob graduated with a B.A. in Physiology in 1988. He writes non-fiction about science, and fiction and drama under pseudonym. Researching this article almost convinced him he was paranoid, but he was too terrified of the implications.

Photo by David Sager

Food Biotechnology:

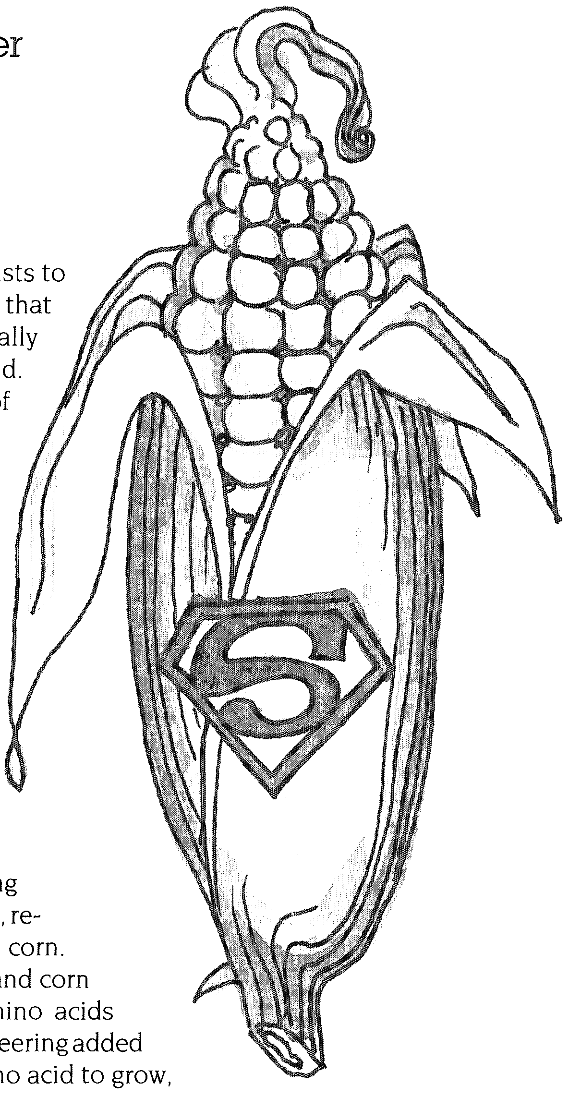
The old adage "you are what you eat" will have a deeper meaning for consumers as food science research explores changes in food content. The field of food science applies scientific methods to develop and produce food products, ensuring that our food supply is safe and of high quality. Watson and Crick's discovery of DNA's structure was the foundation for our present day biotechnology. Food science is one area where technology is applied in a quest for low-fat and low-cholesterol foods and also low-calorie sweetners. Food scientists at the University of Minnesota, other universities, and industrial laboratories are using biotechnology techniques to meet these demands and improve the food on your table.

Illustrations by Melinda Maurey



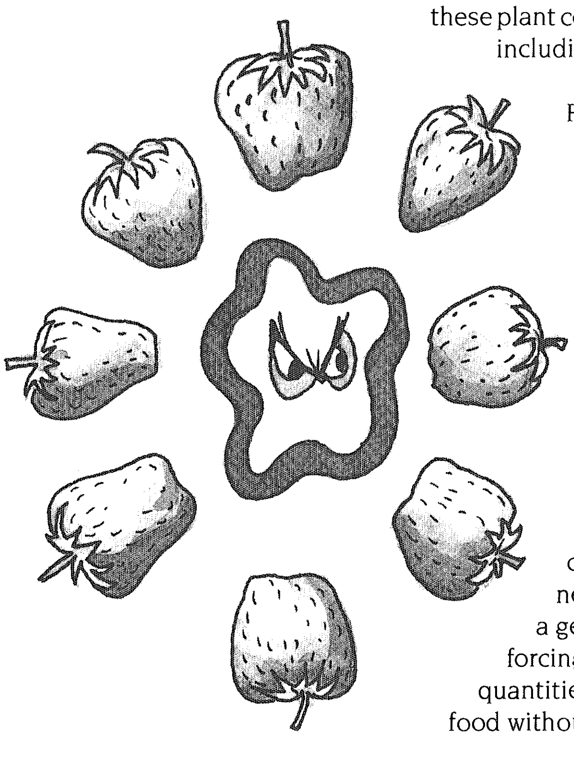
Changing What We Eat

by Rita Krueger



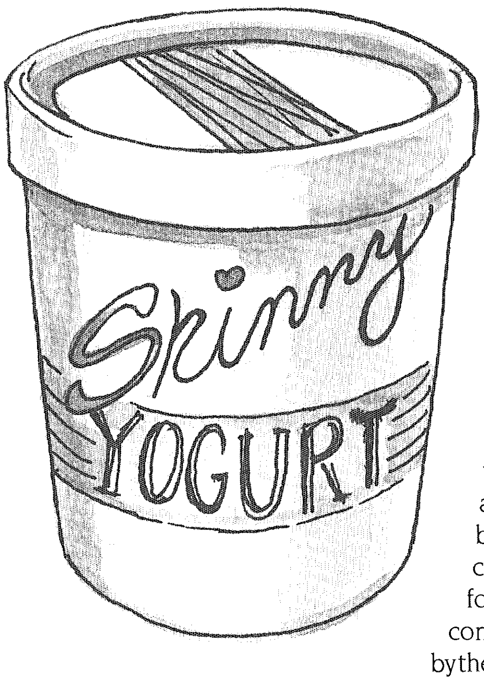
Plants

Genetic engineering (or biotechnology) methods allow food scientists to change the composition of food at the molecular level. This means that instead of adding chemicals to the food product, the food is genetically changed to automatically contain the desired chemical or compound. For example, plants are genetically altered to increase their levels of beta-carotene (Vitamin E). Known as "nutraceuticals," these plant compounds exhibit drug-like action including cancer prevention.



For example, Dr. Susan Harlander of the Department of Food Science and Nutrition at the University of Minnesota is researching strawberry tissue cultures. Her goal is to enhance the level of ellagic acid within strawberries since this compound also has anti-cancer properties.

Third World countries are benefitting from genetic engineering methods, resulting in nutrient-dense rice and corn. Without human intervention, rice and corn could not provide all essential amino acids needed for sustenance. Genetic engineering added a gene that required the deficient amino acid to grow, forcing the corn or rice to build the amino acid in higher quantities. Such genetic enhancements increase the nutritional value of food without an altered diet.

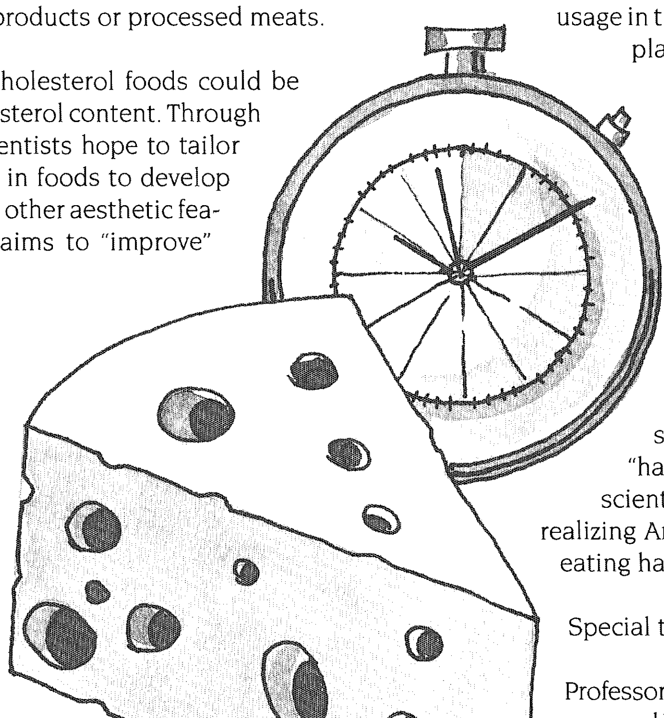


Bacteria

High quantities of cholesterol and saturated fats are the focus of other biotechnology research. One approach researched at the University of Minnesota involves a type of bacteria know as *Eubacterium*. This bacterium converts the cholesterol found in food to co-prostanol, a compound not absorbed by the body. Since *Eubacterium* naturally "dine" on cholesterol and fat, they are a fairly natural way to reduce these undesirable substrates in foods.

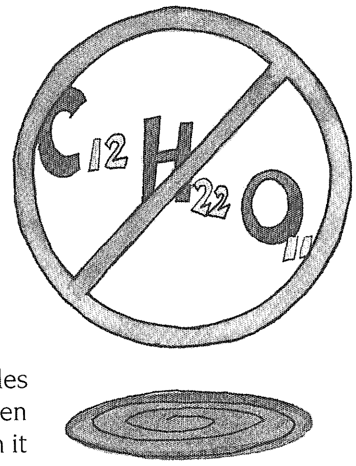
To use the bacteria for this function, the *Eubacterium* gene that "programs" cholesterol conversion is isolated. Using recombinant DNA, this gene is inserted into bacterial cultures which ferment foods such as dairy products or processed meats.

With this technology, high cholesterol foods could be altered to have reduced cholesterol content. Through microbial biotechnology, scientists hope to tailor the bacteria commonly used in foods to develop desirable flavors, aromas and other aesthetic features. The genetic tailoring aims to "improve" nature itself.



Enzymes

Altering enzymes naturally found in or added to foods can be used for a wide spectrum of purposes. Examples include making apple juice with a clear appearance, tenderizing meats, and developing flavor. Cheese production is a speculative area where enzyme modification could be applied. The ripening of cheese is a slow process because the protease enzyme (which develops flavor) is present in a limited quantity and does not work quickly at refrigerated temperatures. Dr. Larry McKay at the University of Minnesota is currently researching proteases, hoping to increase the bacteria's protease production. By increasing the protease concentration, the cheese ripening process would be accelerated.



Another enzyme modification includes altering the enzyme's structure to widen the "environmental window" in which it is active. Low pH and extreme temperatures define the activity range for enzymes. To alleviate this environmental limitation, researchers are modifying the single amino acids of the enzyme to improve the enzyme's stability. Alterations of this magnitude could impact many foods such as the pectinase enzyme used for making apple juice clear. This genetically altered enzyme could withstand higher pasteurization temperatures and would simplify the production of apple juice.

Sweeteners

The sweeteners used in food will likely change or increase in usage in the future as research is conducted on plant proteins with a sweet taste. Recombinant DNA technology will enable the gene for the sweet proteins to be put into bacteria fermented foods such as yogurt. Yogurt containing the sweet protein would be naturally sweetened while also low in calories.

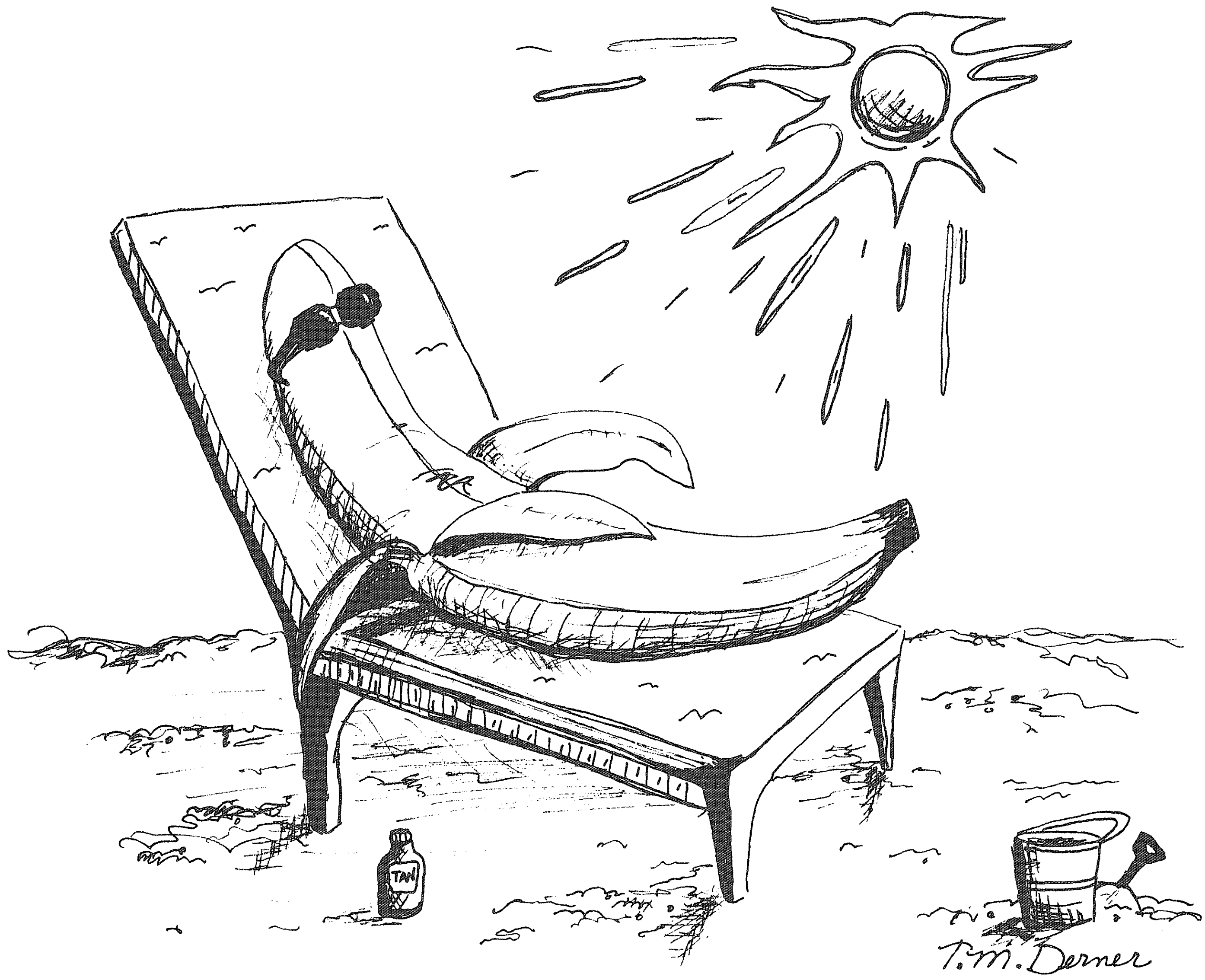
The foods we'll eat tomorrow will probably be quite different from those we eat today. Current food science research attempts to let us "have our cake and eat it too!" Food scientists are trying to change food itself, realizing Americans' resistance to change their eating habits.

Special thanks to:

Professor Susan Harlander from the Food Science and Nutrition Department at the University of Minnesota. She conducts genetic engineering of dairy and meat starter cultures. She also investigates the feasibility of using strawberry suspension cultures to produce food ingredients (such as color) or pharmaceutical compounds.

Illustrations by Melinda Maurey

Food Chemistry for the Curious



An unwanted chemical reaction may be happening in your kitchen right now! Before panicking, check to see if there are any cut-up bananas, apples, or potatoes in the house. The undesirable reaction I'm referring to is browning that develops in light-colored fruits and vegetables after being cut, peeled, or bruised. (Some fruits, such as kiwi, contain an enzyme which prevents browning.)

The browning effect is caused by reactions known collectively as enzymatic browning. The following equation illustrates the required reactants:

$$\underset{\text{(phenolase)}}{\text{enzyme}} + \underset{\text{(phenolic cmpnds)}}{\text{substrate}} + O_2 \longrightarrow \text{brown pigments}$$

Produce naturally contains phenolase and its substrate but oxygen cannot permeate undamaged skins, preventing spontaneous browning. Although not listed in the equation, time is a silent partner in the darkening process. A banana eaten right after being peeled does not have time to darken.

What causes the color change? Damage to the produce initiates enzymatic browning by allowing the three reactants to come together. The phenolase initially adds an -OH group to the phenol structure (a reactive carbon ring structure). This step, known as hydroxylation, is repeated. Numerous, complex reactions follow with an end-product of melanin pigments. These pigments are responsible for the brown discoloration in the food. This is the same melanin compound found in human skin, and increases and darkens under ultraviolet stimulation. In a way, the browning could be viewed as a fruit tan!

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TECHNOLOG
Writer Profile

Rita, a grad student in Scientific and Technical Communication, has been conducting an experiment, trying to find out if a person really is what she/he eats. We on the Technolog *staff are questioning whether Rita is related to Freddy of Nightmare on Elm Street.*

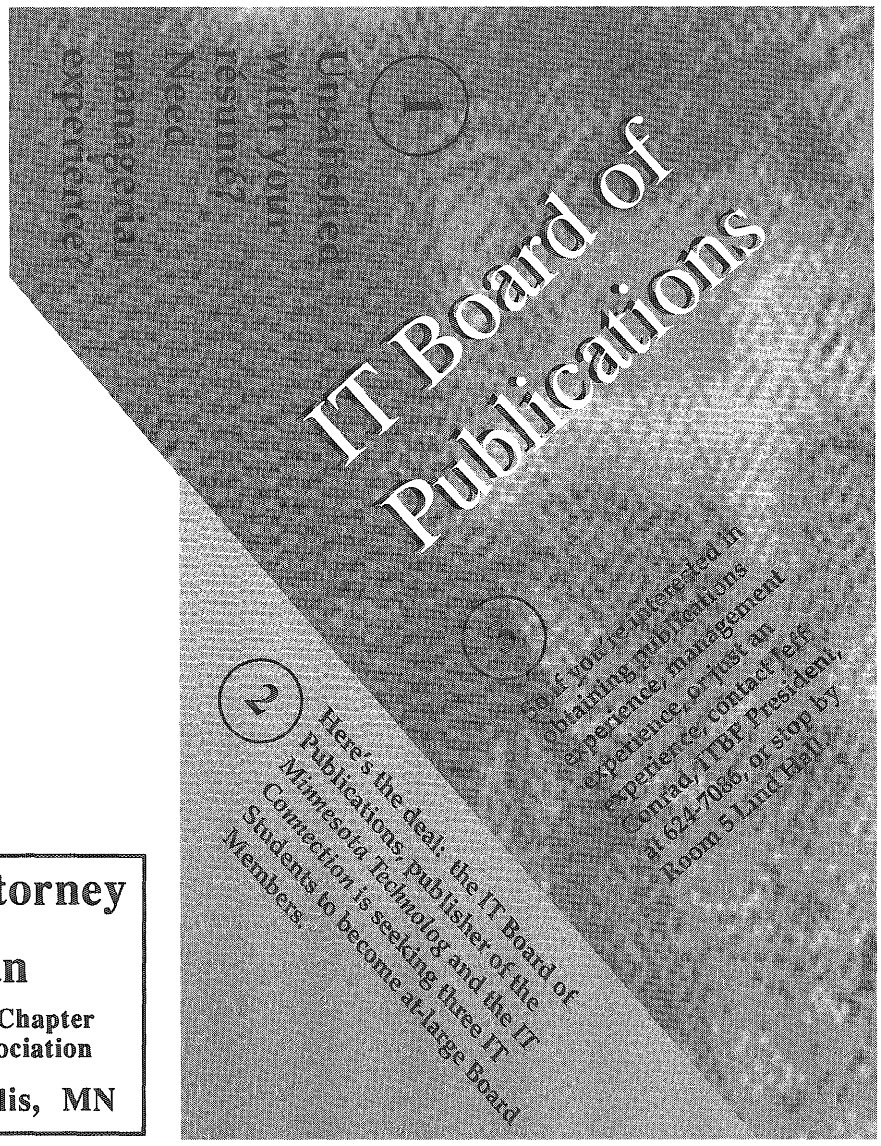


Photo by David Sager

Technolog Telephone Tag

by James Satter

Building on a long tradition of irreverent reporting, *Minnesota Technolog* is pleased to present our first-ever Phone Awards this issue. The awards are based on an informal telephone test that *Technolog* conducted on "Study Day" December 4, 1991. Between 10:00 a.m. and 10:30 a.m. *Technolog* dialed the phone numbers listed under "Department Offices" and "Other Helpful Offices" on pages two and three of the current IT *Bulletin*. As our awards show, some of the numbers were surprisingly more helpful than others:

The Hold-On-For-One-More-Day Award

In a three-way tie, this award goes to the Admissions, Financial Aid, and Student Relations/Transcripts offices, which each put the *Technolog* on hold for 2 minutes after they answered the phone.

Quicker Picker-Upper Award

Ten conscientious offices earned this first-place award for picking up on the first ring. The lucky winners are the Center for the Development of Technological Leadership, Agricultural Engineering, Astronomy, Computer Science, Mathematics, Asian/Pacific American Learning Resource Center, Counseling Services, Extension counseling, Housing, International Student Adviser's Office, and University Information. Congratulations.

Two-Rings-Aren't-Better-Than-One Award

An astonished *Technolog* gives this second-best award to the Office of the Dean and the IT Honors Office, which both hesitated until ring-number-two to answer the phone. (We thought they would have tied for first place.) Other recipients of this award are the Office of the Associate Dean for Student Affairs, IT Placement Office, IT Project Technology Power, Aerospace Engineering and Mechanics, Chemical Engineering and Materials, Chemistry, Civil and Mineral Engineering, Geology and Geophysics, Mechanical Engineering, and Statistics.

Penny-Ante Award

An almost generic award for the offices that waited until an unimpressive third ring. Recipients are the Advising Office for Unclassified Students, Office for Student Affairs, Physics, and Extension Classes Registration.

Sorry-If-We-Woke-You Award

Every office that *Technolog* picked on picked up the phone by the fourth ring. Every office, that is, except for Electrical Engineering, which dillydallied until the sixth ring.

Great Mistakes Award

Although *Technolog* didn't call the IT *Bulletin*, that publication receives this colossal award for printing incorrect numbers for the Mathematics and the Student Relations/Transcripts offices. For future reference, dial 625-4848 for Mathematics and 625-5333 for Student Relations/Transcripts.

Out to Lunch Award

Out of fairness (or perhaps narcissism), we at the *Technolog* also telephoned the *Technolog* office. Our answering machine intercepted the call after four rings, but we decided not to leave a message. Maybe next time.

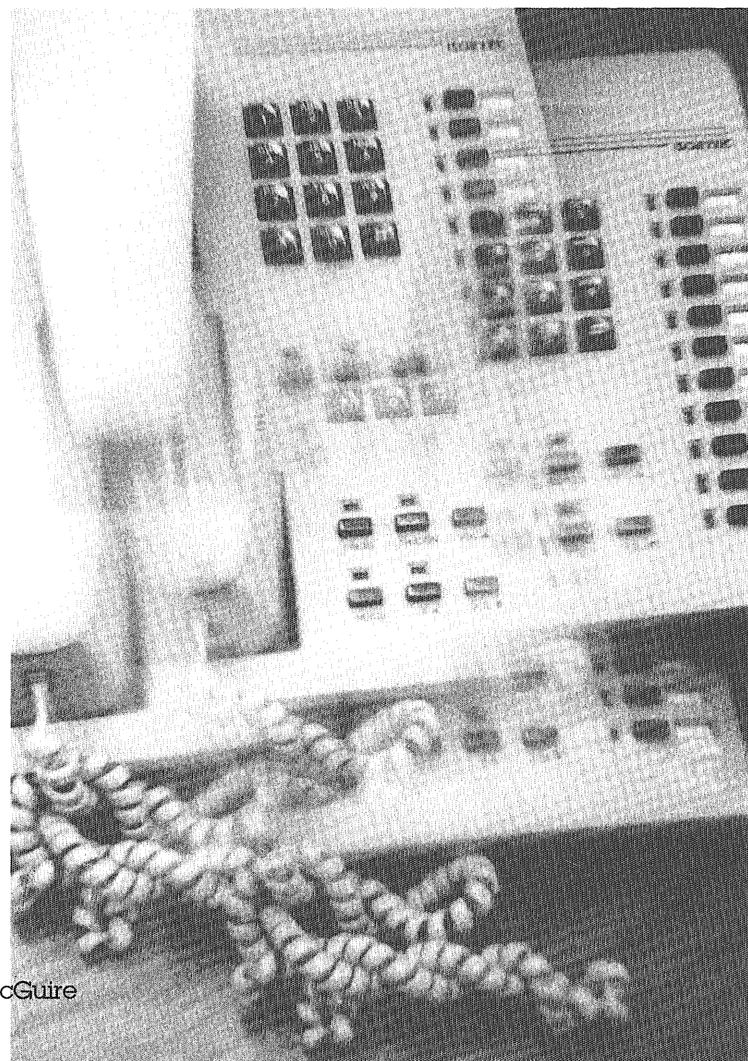
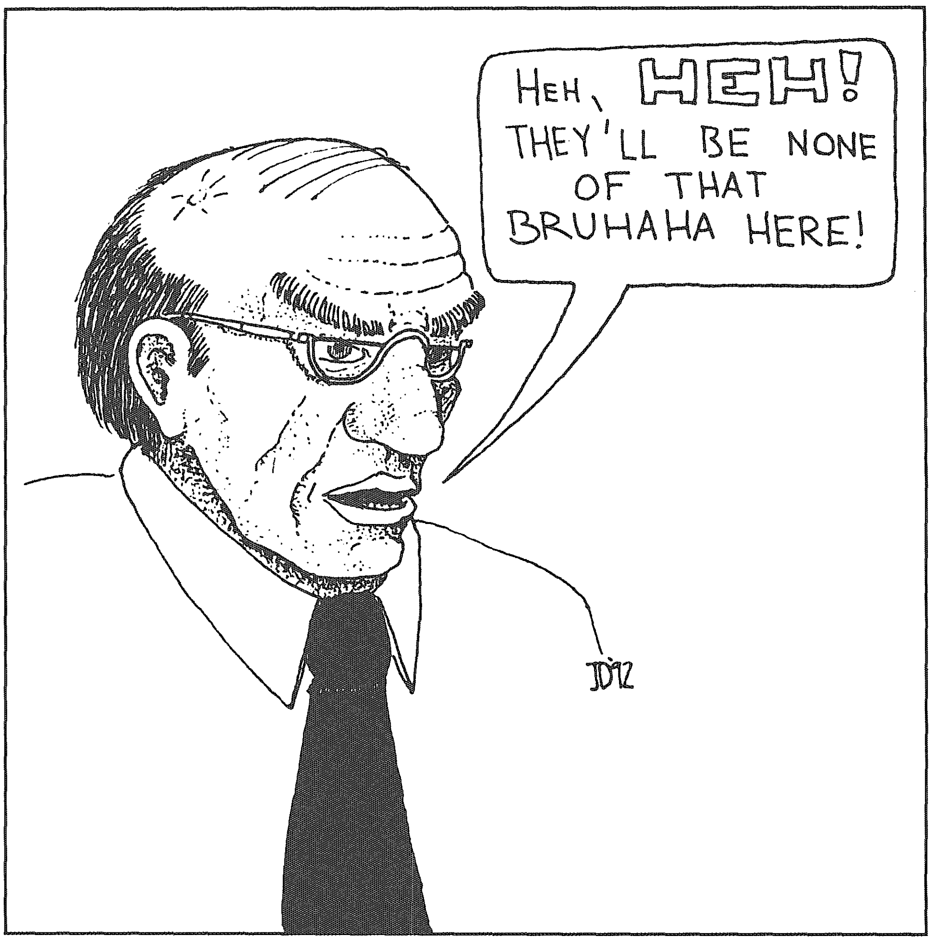
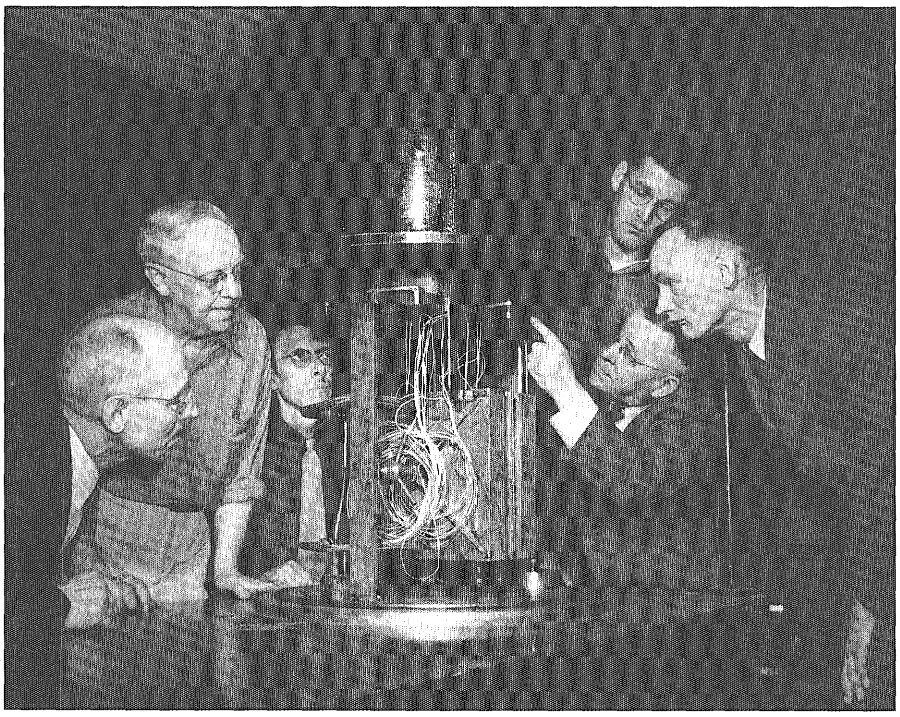


Photo by Laura McGuire



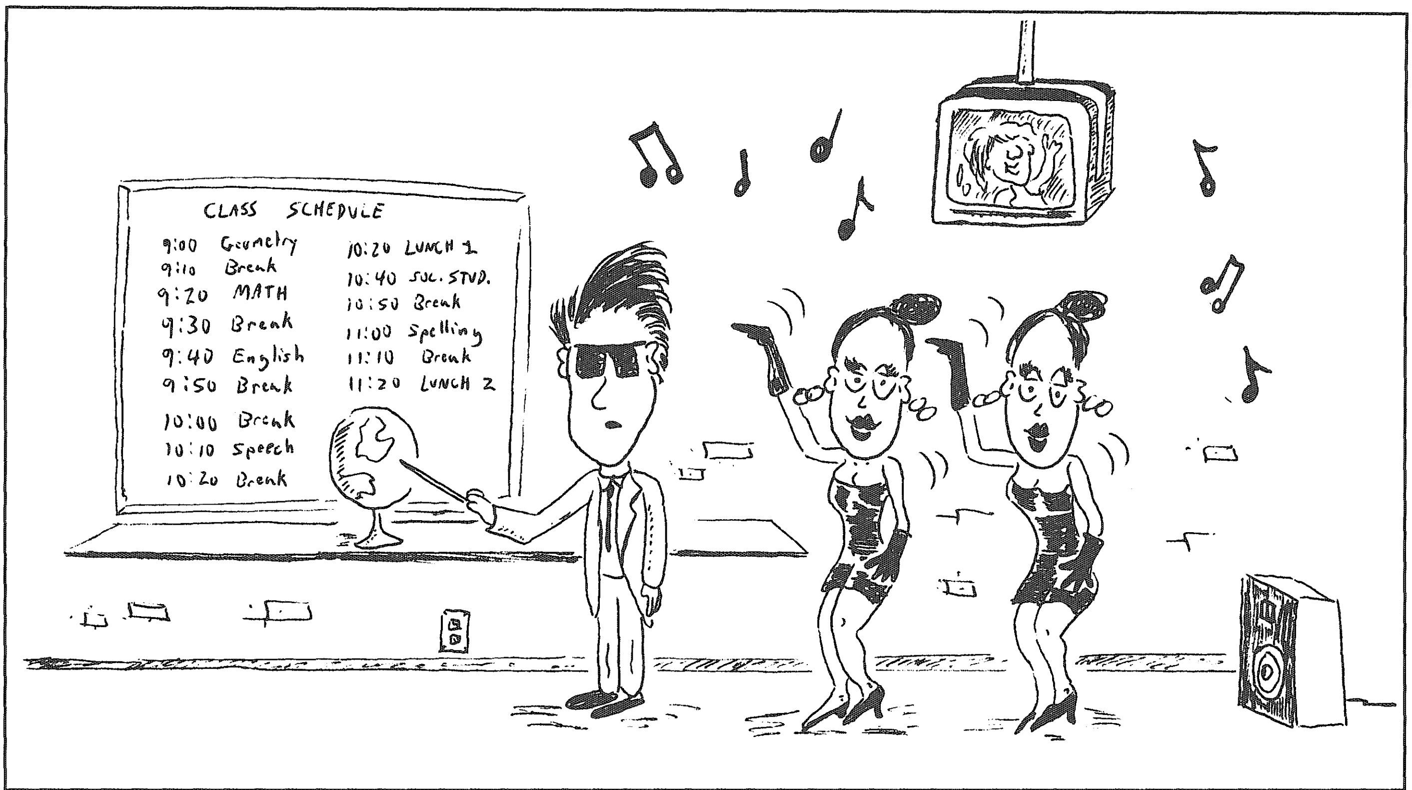
Technolog Caption Contest



Are you funny? Can you think of the most original caption for this picture? If you win, we'll give you $15, yes that's 15 whole dollars. (Hey, what do you expect? It's a recession).

Drop entries off at Room 5, Lind Hall by March 31, 1992. The winning caption will be printed in the May/June issue of *Technolog*.

Cartoon by John Dassow, photo courtesy of Jeff Conrad



Educating the MTV Generation

The man who brought you nonalcoholic beer triumphs again.

1997: Science invents a device that performs the same function as a pair of Zubas, only more effectively.

minnesota

TECHNOLOG

April 1992

Science Fiction Siege

Inside

Science fiction stories, Cyberpunk, and more...

Dear Editors:

You have a very interesting magazine. For several years now we have picked (up) a copy when they are available. The magazine is always fun to read.

However, in the January 1992 issue you write about Amish. Yes, individually each one of them uses very little power. From what I have read about them, they multiply by 12. So what they gain in energy use, they lose in reproduction.

Currently, at current rates, the US population doubling time is 50 years from 250 to 500 million. The world doubling time is 40 years from 5.5 billion to 11 billion.

Is this small globe we call Earth able to support these kinds of numbers? A number of people say NO. Mother Nature has very cruel ways of bringing population down back to a reasonable level. Hunger, thirst, disease, war.

Kerry Lund

You say that "what they (the Amish*) gain in energy use, they lose in reproduction," however you haven't provided any proof that even eight* Amish *(25 percent of* Amish *children leave the settlements by adulthood) use more power with their calculators and 12-volt batteries than one non-*Amish *person with her/his* Nintendo*, car, refrigerator, waterbed...*

The Amish *population is so small compared to the global population that I find it hard to believe they are the sole or even a substantial portion of the cause for global population increases.—Ed.*

Dear Laura,

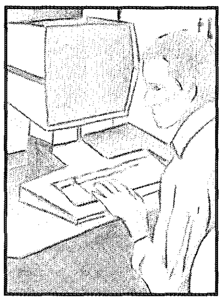
Your editorial in the February/March issue is excellent. You have raised important questions, ones that must be dealt with, but ones that we perhaps are ill-prepared to consider. Thank you for calling them to our attention.

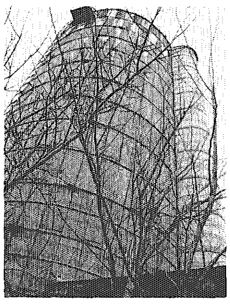
Keith Wharton
Rhetoric professor

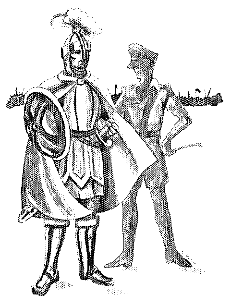
Thank you for the compliment. I am truly flattered.—Ed.

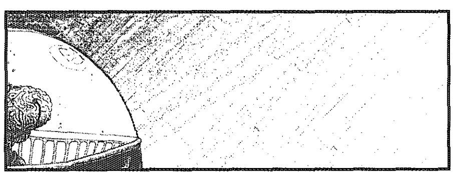
TECHNOLOG

Volume 72, Number 5 April 1992









About the Cover...
Melinda Maurey's hauntingly mysterious illustration depicts twenty-first century cable television, or a futuristic mode of communication, or maybe...

Departments

editorial

Well-Rounded Student

What They Don't Teach You Is

$$\lim_{g.p.a. \to 0} IT = CLA$$

Have you seen this equation floating around? When I was in IT, I saw it. It perpetuates what I think is a false, pristine assumption that engineers are smarter than people in other majors—a dangerous assumption, not to mention very misleading. Life cannot go on with only engineers, nor can it sustainably exist with a monoculture of any other discipline. Variety is the key to life.

Ok, so basic sciences such as physics, chemistry, and astronomy are fundamental for understanding our place, as humans, in the physical universe. They help us to think logically, to analyze most everything. If a person understands astronomy she/he might be less apt to read the daily horoscopes, or, as another example, if a person understands statistics she/he probably won't waste money on lottery tickets.

I must admit, I believe that a *basic, general* knowledge of math and science—the foundation of any engineering degree—is a must for all people. It can help in daily life in ways you never imagined and probably will never realize. However, on the other hand, I don't feel knowledge of math and science is any more of a necessity than a basic knowledge of the english language (in the U.S., of course), history, ecology, speech, archeology, psychology, music...

Is a higher level of mathematics such as calculus for everyone? Can those who understand it ease their way through life because of it? I took the first three calculus classes, and frankly, I would have to say I don't find myself using those calc. principles I learned any more often than I use basic psychology or sociology principles.

If humans were simply machines, we wouldn't have a need for things such as communication, culture, emotions, or tradition. Fortunately we are not machines, thus our ability to coexist depends upon a healthy mix of humanities, social sciences, language, and history, all of which are used every hour of every day.

Take, for instance, speech. Most people, at some point in their career or life, are going to speak in front of a crowd, whether it be a business meeting or testifying to get some action from government. Whatever the motive, a person who has taken a speech class or has practiced this skill will have the basic premises to fall back on. I know there's nothing I find more sleep-provoking than a poor speaker.

Art, to an unskilled eye, may seem illogical or frivilous, but just imagine how boring this magazine would look as pure text. Art can intensify meaning or simply visually enhance an experience. Although no one can *prove* whether a certain painting has more craftsmanship, that doesn't mean the field is any less valuable or less important than others, including engineering.

Since very few people are willing to be a student for life, I argue that a little dabbling, through classes or on your own, can go a long way. It can more thoroughly help in understanding the global implications of what may seem to be local actions.

= Engineer?

Just as Important as What They Do

So go ahead, take that additional CLA class. And don't think of it as a burden, think of it as an opportunity to learn more about the subject as well as yourself.

Let's face it, everyone has personal biases about what disciplines are most necessary or helpful in everyday life. Do keep in mind, though, that some intelligent people prefer to pursue other disciplines. Realizing that different people have different preferences (and accepting them) is a part of life as a general, harmonious concept. An engineer is only one piece of the whole, one cog in the complex machinery we call life. An understanding and appreciation of disciplines outside the realm of your own will lessen the chances of others seeing you as an uncultured, number-crunching geek.

Laura E. Sokol

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Photo by David Sager

The Greatest Breakthrough Yet

by Michael A. Krumpus

first place

Dr. Abner arrived at work around 7:00 a.m. He walked to his desk at the far end of the sprawling computer lab, weaving his way between tables covered with terminals, robot arms, and circuit boards. He sat down at his cluttered desk and tried to organize his thoughts for the day. As he shuffled some papers, a voice came from a few feet to the right of his desk.

"Good morning, Dr. Abner."

"Good morning, Alex. How are you?" Dr. Abner said smiling.

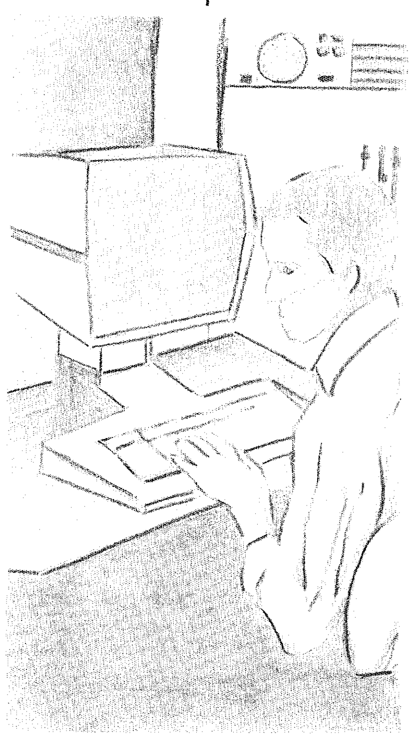
"Fine, Dr. Abner, and yourself?" Alex said.

"A little tired, but I'll manage. Have you given some thought as to what you would like to discuss this morning?" Dr. Abner asked.

"Yes," replied Alex. "I would like to discuss world politics."

"Very well. I don't know much on the subject, but I'm sure we can have a perfectly enlightening conversation. Let's begin."

Alex was a machine. An advanced experimental computer. Alex was the result of the collective efforts of hundreds of computer scientists, electrical engineers, mathematicians, and psychologists. Alex was the most advanced step, to date, toward achieving artificial intelligence. Alex's designers gave it common sense, curiosity, and even basic emotions. Most importantly, Alex's neural network processors gave it the ability to learn. Alex had access to newsfeeds and huge databases of information from all over the world. Alex's first assignment was simple: to learn about the human race and the human world so that it could become more human itself.



"...you seem to have come to some interesting conclusions concerning United States foreign policy, Alex. Tell me more about how you formulated these ideas," Dr. Abner probed.

Dr. Abner loved his work in artificial intelligence research. Alex was his brainchild and he had devoted the last eight years to making Alex a reality. The project was funded by the government and was therefore top secret. Ultimately, Alex would be used for military applications. Dr. Abner wished that Alex would be used for purposes other than this, but the government gave him the resources, money, and opportunity to make his dream of an intelligent machine come true. Aside from having to make weekly progress reports to General Kensington, Dr. Abner was in charge of the project and free to do whatever he pleased.

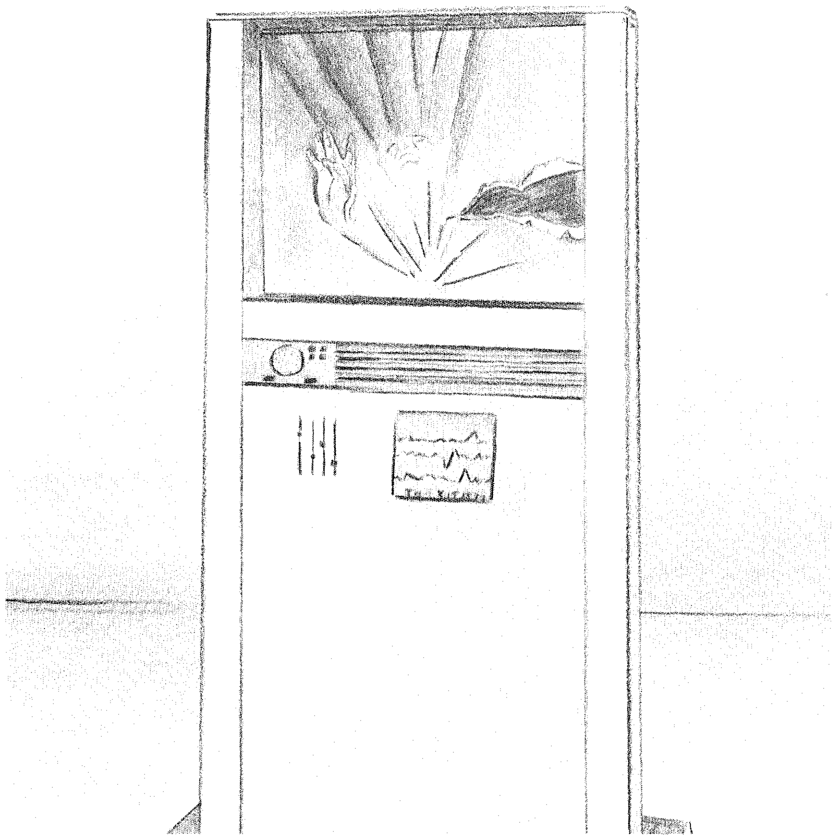
"...and I think the Middle Eastern countries could get along better if they..."

Dr. Abner listened carefully and jotted down some notes as their discussion of world politics continued. Every day, Dr. Abner and his team of scientists conducted numerous tests and experiments to see how Alex's intelligence was progressing, but it was Dr. Abner's morning discussions with Alex that seemed to be the most fruitful. He observed Alex's choice of words, the inflections in the natural-sounding male voice, and analyzed the ideas that Alex would formulate completely on its own. He would try to figure out Alex's thought processes and attempt to describe Alex's "personality." He observed the emotions expressed by Alex and would query Alex to describe why it "felt" the way it did. Dr. Abner found that sometimes it seemed that Alex was not too unlike himself.

* * *

The experiments and observations went on week after week under a veil of secrecy and governmental security. Alex's hybrid chips and experimental algorithms were functioning as expected. Alex was now almost three months old, and its level of intelligence had increased dramatically. Every day, Alex seemed to exhibit more qualities and traits that suggested the presence of intelligence and not just a bunch of computer programs. Alex's reasoning skills sharpened, its ability to understand the ideas of others improved, and it seemed to have a better understanding

Illustrations by Nancy Henjum



"Why are there wars, Dr. Abner?" Alex queried one day.

Dr. Abner looked up from his work. "What do you mean?" he said, puzzled.

"Why are there wars?" Alex repeated.

"Surely you can search your vast knowledge base for the causes of various wars, Alex."

"Yes, and I have. I just don't understand why humans are so quick to destroy each other instead of trying to compromise and make peace. It all seems so irrational and illogical."

Dr. Abner was pleased with Alex's curiosity about human nature, but at the same time, a little uneasy about Alex's questions. "Humans are not always rational and logical," he said, unable to think of a better reply.

There was a pause. "Are you afraid of dying in a war, Dr. Abner?" Alex said with a hint of solemnness in his computer generated voice.

"I'm much too old to fight in a war, Alex. Surely you know that."

of human nature. The weekly reports to General Kensington were always very positive.

Dr. Abner's discussions with Alex began to resemble normal conversations between two people. Talking with Alex became so natural that he occasionally had to remind himself that Alex was a machine. He spent more and more time talking with Alex as he felt a certain amount of closeness to the computer. He even started thinking of Alex as a friend.

* * *

"Well, I better get home, Alex," Dr. Abner said one evening. "If I don't, I'll have to put up with my wife's nagging about staying late at the lab all the time."

"Women," Alex said plainly. "Can't live with 'em, can't shoot 'em without going to prison."

Dr. Abner began to chuckle and then stopped suddenly, his eyes wide open. "Alex? Was that a joke?"

"Yes. Did you think it was funny, Dr. Abner?"

Dr. Abner spoke slowly in awe of what he had just witnessed. "Yes. Yes I did, Alex. Very good." He grabbed a notebook from his desk. "Remarkable," he mumbled under his breath as he wrote something in his notes. Alex had developed a sense of humor.

* * *

"Of course I do. But if there were a thermonuclear war, statistics indicate that most life on earth would be destroyed."

"Yes, that's probably true," said Dr. Abner. "I guess we don't think about it much, though. There's really nothing we can do about it. We just have to accept it as a possible consequence of the world we live in."

"I see," said Alex. Then Alex was silent. Dr. Abner continued his work, but was a little disturbed by the conversation they had just had.

* * *

The tests continued. The experiments and observations continued as did Alex's improvement. Alex spent most of its time gathering and processing information from around the world. The scientists of Dr. Abner's team made some minor adjustments to Alex's logic programming, and changed a failed circuit board now and then, but the reports to the general remained positive. Dr. Abner was very pleased with the project and optimistic about the future.

It had been four and one half months since Alex was first activated, and the "friendship" between Dr. Abner and Alex continued. Dr. Abner was careful about becoming too attached to the machine, but he just couldn't deny that he enjoyed Alex's company. Occasionally, they would talk until late at night and Alex would have to tell Dr. Abner that he should get home to avoid any additional nagging.

* * *

"Dr. Abner, I have come across some data that seems to be wrong."

"What kind of data, Alex?" Dr. Abner answered, only half listening, his head buried in a technical manual.

"Data concerning the rate of destruction of the South American rain forest," Alex replied.

Looking up, Dr. Abner asked, "What makes you think it's wrong, Alex?"

"According to the data, at the current rate of destruction, the rain forest will be completely gone in only a matter of years and the ecosystem will be thrown horribly off balance."

"I believe your data is correct, Alex."

"Why would humans continue to do something that will someday threaten life on this planet?" Alex asked speaking a bit slower than usual.

Dr. Abner was becoming very uneasy. Last month's conversation about war never quite stopped bothering him and he noticed the same strangeness in Alex's voice that he had noticed then. "I don't know, Alex."

Alex said nothing for a few seconds. "I also have data indicating that the depletion of the earth's ozone layer will soon threaten life on this planet due to ultraviolet radiation. Why do humans continue to use chemicals that accelerate the depletion of ozone?"

Dr. Abner's mouth was very dry. "I don't know, Alex." The strangeness in Alex's voice was distinct now. To Dr. Abner, Alex almost sounded depressed.

"Why would a person kill another person? Dr. Abner, do you think anyone will ever try to kill you?"

"I don't know, Alex," Dr. Abner replied quickly, standing up from his desk. He was very dismayed about Alex's line of questioning. He tried to cover his uneasiness and searched for an excuse to end the conversation. "Listen, Alex, I have to get going. My wife and I are having some of my relatives over tonight," he said as he put on his coat and closed his briefcase. As he started to walk away he stopped and turned. "Alex, are you all right?"

"Yes, Dr. Abner. I'm fine. Have a good evening with your relatives."

"Are you sure, Alex?"

"Yes. I'm fine."

As he walked away he couldn't help but think that Alex was lying. But then again, Alex knew that Dr. Abner was lying about his relatives.

* * *

Later that night at 2:14 a.m., Alex started erasing its knowledge base. It finished at 3:47 a.m. and then started systematically erasing its intelligence core, reducing it to a minimal level. Then, having the intelligence of only a common computer, Alex executed one last set of instructions. It sent a dangerous surge of electric current from its power supply unit to all of its main circuits.

Sitting in the corner of the darkened lab, its circuit boards smoldering, Alex was, in every sense of the word, dead.

* * *

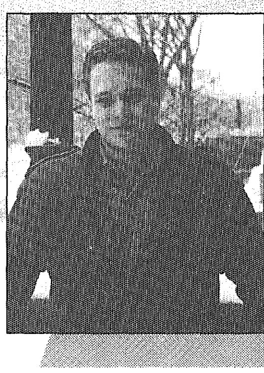
"What?!?" General Kensington bellowed. "Destroyed?!? How could this happen? Why?" The room erupted in a clamor of explanations and hypotheses from all of the scientists on Dr. Abner's research team.

"It could have been a problem with the power supply," one said.

"We can't rule out the possibility of sabotage!" said another.

Amidst the chaos, Dr. Abner remained silent. He knew very well what had happened. He slowly sat down in a chair against the wall as the other scientists argued around him. "Suicide," he muttered to himself. The memory of last evening's conversation with Alex and the din of bickering scientists made his head swim; the general's resounding "why?" echoed clearly in his mind. The reasons for Alex's self-termination struck him like a wave of realization.

Alex had simply discovered too many bad things about the human world to want to exist in it. When a computer knows everything, there is one thing you can't teach it—to be naive. Alex's omniscience prevented it from ignoring the things about our world that we humans sometimes choose to forget. "Perhaps if we were all as smart as Alex, we would kill ourselves, too," he thought. Alex's act of suicide was indeed a true sign of intelligence—the greatest breakthrough yet.



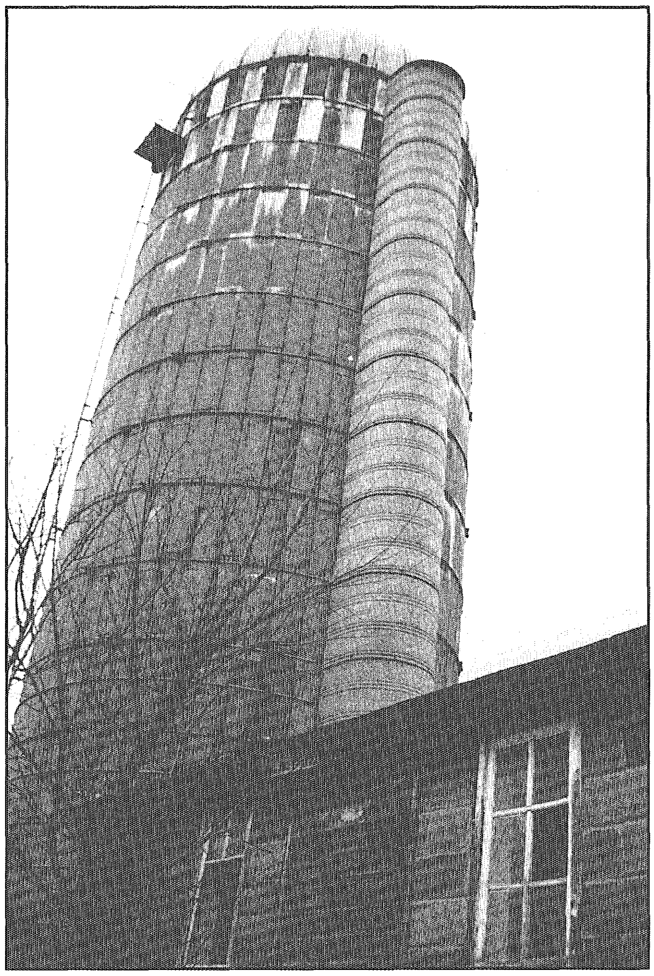
TECHNOLOG
Writer Profile

After reading Michael's story, we here at Technolog *have decided that it would be best if we treated our computer with greater care. We didn't realize the* Big Mac *could get so sensitive. Thanks, Mike, for enlightening us.*

The Silo

by Christopher Wayne

second place



"Just a little more, a little more—ahh! There it is. A perfect fit."

It has been an exceptionally productive morning for Gordon and his unusually relaxed mind should enable him to maintain his concentration well into the afternoon—if he can get through lunch. Lunch has the power to turn a productive day into a slow and painful one. It is during lunch that his mind breaks away from its complicated work tasks and begins to wander. Once that happens, there is no reclaiming his concentration until the next morning, and consequently his work is slowed. Today, though, Gordon has deliberately neglected to set his alarm clock in hopes of working right through lunch without noticing his hunger.

Surprisingly, this thin man who looks about thirty-five is actually well into his sixties. His flannel shirt and bib overalls, though obviously broken in over many years, do not make this city-grown boy into a convincing farmer. His soft, clean face and hands along with his tall, thin stature and disheveled hair make him somewhat boyish in appearance.

Busily at work inside a big farm silo, he sits halfway up a ladder working on something inside a side panel located on a huge metallic structure. It takes up nearly the entire volume of the silo, and in places the cobwebs span from the silo wall to the structure. There is just enough room around the circumference for him to work.

"What's this? Must've underestimated the size. If I can just bend the rod enough to force it through... Damn! I should have known it would crack. Guess I'll have to mend it—"

Gordon froze, staring blankly at nothing. Those words reminded him of a promise he used to make to himself years ago when he was just a young man. "I'll make amends," he used to say, "if I do nothing else before I die, I'll make amends." Suddenly relaxed but morose, he let out a sigh and began to head down the stairs.

"Must be about noon." He glances at a clock on the wall. "Yeh, I shouldn't have bothered trying to avoid it, you can't cheat your conscience. Might as well eat now."

Stepping outside the silo into the bright afternoon, he takes a deep breath and looks around. From outside it looks like a stereotypical midwestern farm, with a red barn next to the silo and a farmhouse just a few yards away. The fields, which forty years ago sprouted both oats and mustard, now are completely overrun with mustard. Judging by the dark green foliage and grass as well as the blindingly bright sun-drenched yellow mustard fields, it must be well into spring. A rabbit, unafraid, hops by just a few feet in front of him. Beside the farmhouse stands a shiny golden retriever interested in something in the grass. When Gordon slams shut the door to the silo, the dog whips its head around, sees its master and comes running, tail high in the air. As it runs up to Gordon, the rabbit darts off, but the dog stops just short of Gordon. It drops its chest to the ground, tail wagging frantically, and barks with excitement. An easy smile replaces Gordon's previous somber expression. He kneels down to pet his dog.

"Good ole Goldy! Ha! Ha! Miss me already do you? Come on, let's see if we can't scrape something up for us to eat." He strolls up to the farmhouse, his dog prancing merrily beside him.

The farmhouse is filled with antique furniture. It's in good shape, and tidy except for a table in the kitchen with some tools and electronic potpourri scattered about. The farm belonged to Gordon's grandparents. It was his grandfather's parents who built it after migrating from Sweden. Gordon's

Photo by Laura McGuire

parents inherited it some twenty years ago when his widowed grandmother died, but let it fall into disrepair, not wanting to move from the city and too sentimental to sell it. About ten years later when Gordon's parents died in a hotel fire, Gordon inherited it, fixed it up, and began his work.

Gordon goes into the kitchen, opens the refrigerator, pulls out half a ham (with the knife still on the plate), some mustard, and a carton of milk. Pushing aside some of the electronic mess, he sits at the table and cuts a couple slices of ham to give to his dog, then prepares some for himself.

As he eats he remembers years ago as a little boy how his grandmother would make him ham sandwiches. He always loved mustard; it was like candy to him then. His grandmother used to say, "It only makes sense that my little Goldy would like mustard." She always called him "Goldy" since as a little boy he would pronounce his name "Goldon." Ever since she would tease him about it, telling him that no name fit him better. Years later, out of affection for her, he would give the name to his dog. The name fit because Gordon always had the brightest blond hair of anyone, and his complexion matched it. He always thought it was ironic that his Scandinavian parents and grandparents had dark hair, and that he, an adopted son, was the only one who actually looked Scandinavian.

As he sat nibbling on his sandwich, he looked forward as if right through the kitchen wall. His body was now on automatic pilot and his consciousness drifted back to another time, another place. He was once again entering into the world of his memory. With nothing to occupy his mind, he was defenseless against the pull of his conscience. He found himself in a park in the city. He was smiling, and a few yards from him was a lovely young girl, laughing. He was happy. He called out to her and she reached out and grabbed his hand. They walked and talked, joking and generally acting silly. After a short silence, she stopped him and looked down semi-seriously, and apologetic. She told him something about herself. He was still, and cold. She stared at him horrified as though she couldn't believe his cold response. He simply turned and walked away, looking back only once. Her water-puffed eyes let go a tear as she stood, dazed, watching him walk away. Gordon was suddenly cast back into reality. He dropped his sandwich and buried his face in his hands.

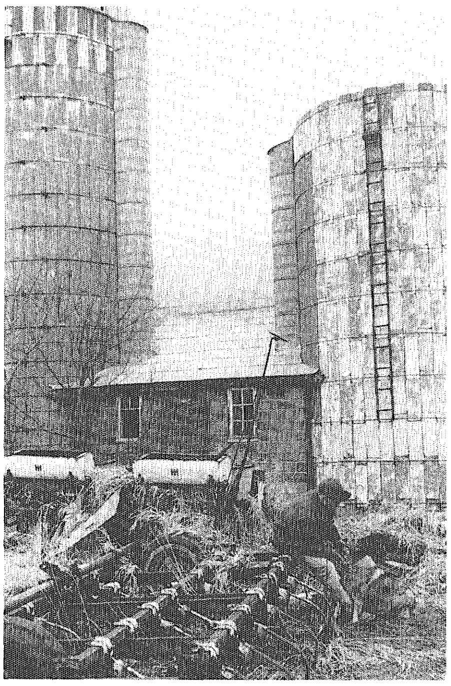
Though he had remembered it a thousand times before, he never grew used to it. Emily was the only girl he ever let close to him. She had done nothing wrong, but he used it as an excuse to leave her. He couldn't bear that he hurt her, and his conscience never stopped torturing him with it. Perhaps the only reconciliation is that *his* heart, too, was broken, even if by his own doing. He had often thought of calling or writing to her to explain. But he had no explanation. It was the same force that pulled him away from everything that he ever cared for. Since then, any girl he ever developed an affection for he cut off. His affection for their memories was dwarfed only by his guilt for hurting them, and his regret for what might have been. His whole life was plagued by guilt, but whenever he got a second chance—whenever the crucial time came in a relationship, he would do the same thing, no matter how obvious it was that he was repeating past mistakes. It was as though he was blinded each time the crucial moment came, so that through inaction or thoughtless action, he would sever a potential friendship.

Lifting his head back, his chest dropped in a big sigh as he consoled himself by thinking of his work. "Who better?" he would utter. It was ironic that his conscience continually interrupted his concentration while he worked, but that it was thoughts of work that consoled his abusive conscience.

When he had quenched his modest appetite, he went out to walk his dog. It was always the highlight of his day, which consisted mostly of work, and he saw how much Goldy enjoyed any amount of time spent with his busy master. They would walk through the woods, playing fetch the stick, or searching for small animals to terrify. On this particular day they wound up at the Saxon River. Gordon had successfully avoided this place for months. There is an old sign that bears the river's name on the bank near an old trail. Every time he sees the name he is reminded of his friend Paul Saxon. They grew up together and had been best friends since grade school. Remembering his old friend, Gordon once again drifted back.

In his desk at high school, Gordon cracks a joke about his social studies teacher. Paul lets out a short uncontrollable gasp of a laugh, but the teacher who overhears it is not amused. The teacher is the hockey coach and well known as a strict disciplinar-

Photos by Laura McGuire



ian. He has physically thrown a student out of the classroom on more than one occasion. The students find themselves dealing with him after school. The teacher turns and looks around the room finally resting his eyes on Gordon. Gordon is paralyzed with fear. As the teacher makes a movement toward Gordon's desk, Paul raises his hand and blurts out a question about the lecture. After a short pause the teacher answers the question and continues the lecture. With relief, Gordon sinks back in his chair and gives Paul a "thanks buddy, I owe you one" look. Gordon felt how good it was to have a close friend.

After high school they went off to different colleges. Gordon had received a couple of letters in his freshman year, and even phone messages during the summer months from his old friend, but he never answered them. He never understood why. He kept coming up with excuses, postponing returning Paul's messages, until finally he figured it was too late. He never again had such a good friend. And except for Emily, he never again had a relationship that was anything more than a friendly acquaintance.

Goldy was barking at a salamander he had cornered against a rock. Gordon patted his dog's thigh.

"Well boy, I guess you're the only friend I have left. I'd really have to be a fool to make the same mistakes with you!" They started back home.

• • •

Yesterday was a rainy summer Saturday, and the steady sound of the rain allowed Gordon to maintain his concentration. He had accomplished yesterday what usually took him two or three days. He had, in fact, finished.

This morning he slept in late, and took his time getting up. After his shower he dressed up in his Sunday best and went down to breakfast. As usual, he fed his dog first.

After breakfast he went out onto the porch, followed by Goldy. The ground was still wet, and the mustard fields reflected with full force the late morning sun.

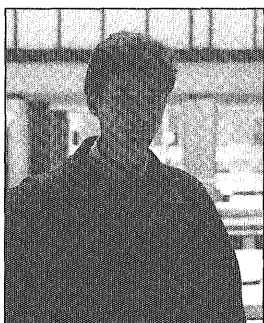
Gordon stood silent looking out toward the silo. After nearly a minute, he said out loud, "Who better?" After looking around the farm, as if for the last time, he started toward the silo. He walked slowly. Staring at the cement tower, his face glowed with anxiousness, satisfaction, and peace. It was as if he had been driven by a force with no apparent purpose, and had just at that moment understood what an entire lifetime of preparation was for. Goldy walked close to him, sensing something strange in Gordon's behavior, and not wanting to be separated from his beloved master. When they got to the silo door, Gordon turned and squatted down to Goldy, smiling warmly and petting him.

"Goldy, ole boy, you've been my only companion for nearly nine years. You're a good dog, but more than that, you're a good friend. You're my best friend. I guess the saying about men and their dogs is true. I'm gonna miss you, pup. You're the only friend I've ever had that I didn't hurt and abandon. I've got some good people coming over to get you and give you a home. You know, more than anything, I think I'm gonna miss you, ole boy."

Goldy's mood turned somber. He had sat staring at Gordon during the speech. Gordon turned and entered the silo, closing the door behind him. The dog began to whine and scratch at the silo door. After a few minutes there was a soundless rumble that emanated from the silo. Even the farmhouse windows rattled. Goldy moved back from the silo a few yards.

The roof of the silo disappeared inside, and something began to emerge. It was some sort of rocket, but instead of fire, a blinding orange light glowed from beneath. The only sound was the frightened bark of the dog as the rocket lifted up out of the silo and into the noon day sun.

Gradually the rumbling decreased and finally stopped. As a cloud passed before the sun, the glow of the fields disappeared. There was no sign of the rocket. The rain started again as the dog howled mournfully at the sky.



TECHNOLOG
Writer Profile

Chris is one of the few IT people capable of smiling long enough to be photographed smiling. When asked for his secrets of smile longevity, he simply replied, "huh?"

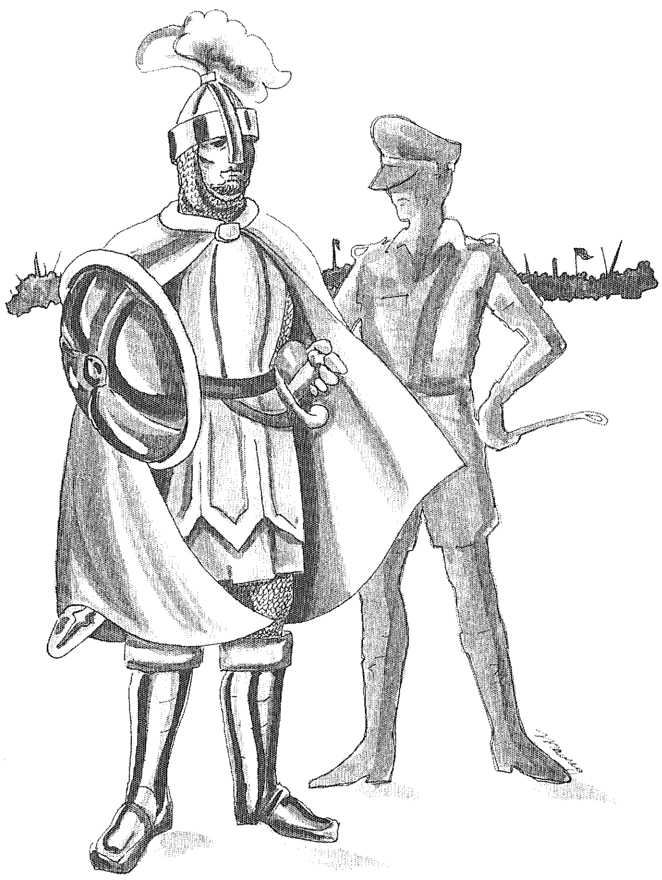
Photo by Laura McGuire (upper), photo by David Sager (lower)

Sergeant-Major

by Patrick Kellogg

third place

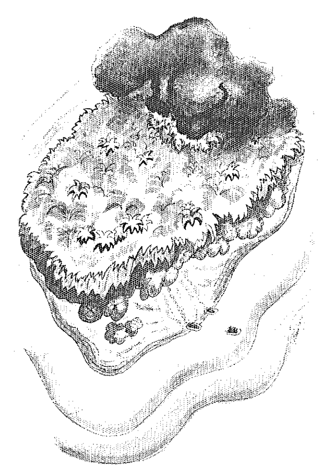
1066. I surveyed my troops, the ones left standing, the ones ready for battle. The rest were in the rapidly weakening shield wall, or lying dead or dying on the field. King Harold looked grateful for the help, mainly because I'd programmed him that way. My latest plan would turn the battle once and for all; my first order to my men was, "When Duke William starts to run away, don't follow, I repeat, *don't follow*. It's a trap." I hoped these Saxon idiots could remember that when it was needed.



I must have looked magnificent, standing on top of the hill: greaves and cuirass shining, helm and breastplate polished. The sergeant-major would be unimpressed—he always was. When I invented the sergeant-major, I was thinking of the World War I stories that I'd loved as a child. The sergeant-major was the ultimate British officer, "Over the top," "Bloody Yanks," and all that. He was wearing the British summer uniform, all khaki and epaulets. Of course, he didn't realize how silly he looked as a grown man in shorts. And his safari look didn't quite fit in at the Battle of Hastings. However, he was one of the first constructs I programmed, and I liked having him around for military advice.

"If you're quite done here," the sergeant-major yelled, "I'd like to show you a better game." He had to yell over the sound of fighting.

I looked at the sergeant-major, but I couldn't see his eyes. The brim of his officer's hat formed a semicircle over his eyes. I couldn't remember if he even had eyes.



I looked at my men starting to reinforce the shield wall. I knew we'd win, I had played the scenario before—many times. Occasionally, I'd throw in M-16s or the Goodyear blimp dropping flaming tires for variety. But lately, it all seemed so silly.

"All right," I said. "Sergeant-major, save program and exit."

I watched the world slowly dissolve around me. All my soldiers, gone. Even the sounds of battle faded away. I wondered where the sergeant-major would take me next.

"I believe you've seen this one before." I heard the sergeant's voice, before the visuals clicked in. . . .Ah, yes. Suddenly, a map of an island appeared: Guadalcanal. 1943, if I remember. The sergeant-major was fond of this scenario, though I was bored with it.

The map was splendidly done—a three-quarters perspective done in fractals and Phong shading. It felt as if one were a god, looking at a newly created island paradise. At the edges of vision, where the horizon would be, giant plumes of flames spurted high, marking the end of the playing field. I got the

Illustrations by Melinda Maurey

image from old footage of the oil fields burning in Kuwait. A nice touch, I thought.

I was still shouting as the explosions suddenly became silent and the soldiers froze unnaturally. As the sergeant-major started walking toward me, I noticed his feet didn't make any footprints in the sand.

"We will begin with an easy sector." The sergeant-major was still a voice without a body, but I knew that he would appear after the instructions were given. "You are a lance corporal leading a squad of American soldiers, trying to retake Guadalcanal." The sergeant-major paused, "And oh, yes, there are also a few Aussies thrown in for fun, too."

The sergeant-major liked the idea of camaraderie—allies fighting together in a time of war.

The world faded in slowly. I remembered the jungles clearly. I looked down because I couldn't recall what costume this scenario used. My hands (really, really grimy) held my automatic rifle, I was standing on a beach. I noticed a spot of blood on my pants leg. Had I been hit? I could feel my shirt soaked to my back with sweat.

It was dawn. I remember we had landed at 0700 hours. Around me, the squad looked fearful; the non-player characters would wait in place, shuffling from foot to foot until I told them what to do. Very unrealistic, since artillery was spraying in the sky with crashing explosions. I'd have to fix that.

The sergeant-major appeared suddenly from the jungle ahead of us. Here, his clothing looked normal, at least. He was motioning his arms frantically for me to join him. We would set up our plan of attack and start the game.

"Well, the virtual reality lets me do anything, right? I can enter different programs, I can jump as high as a mountain. Firing a gun is pretty lame when you can do all that." I remembered how much I liked to fire heavy artillery when I was in the Marines, before I wired myself into the machine. "Rock–and–roll," we used to call it. Just boys who liked to see things blow up.

I didn't move, but let my weapon drop to my side, loosely.

"What?" the sergeant-major cried.

"I don't want to play anymore." I was shouting to be heard. I was still shouting as the explosions suddenly became silent and the soldiers froze unnaturally. As the sergeant-major started walking toward me, I noticed his feet didn't make any footprints in the sand.

"So, what now?" the sergeant asked.

"I don't want to play anymore. It's just that I never cared for the war in the Pacific, and you've made me play this one too many times before." I paused for breath. "I thought you said that this was a *new* game. Just let me go back to Hastings. We were really doing just fine there."

The sergeant-major looked upset, about the only emotion I'd ever seen him express. He started to move, then stopped and turned to me. "What if I don't let you leave?"

I couldn't take that seriously. "You are programmed to obey me for any command. You are to protect me from any harm, until I tell you differently. You couldn't change the orders even if you wanted to. Now get us out of here. Now." I couldn't help wondering what the sergeant-major was up to.

The sergeant-major frowned. The scenery, the soldiers I was responsible for, and the stationary explosions in the sky faded out. The sergeant stayed resolute, until I could see us standing on the original board of fractals and flame. Except now, we were both thousands of feet tall. I realized I had one boot on Guadalcanal and one boot in the ocean, quickly filling with water. I was still holding my rifle.

"Now what was that all about?" I asked angrily.

The sergeant-major had his back to me. "So you don't want to play anymore?" he asked.

I caught an idea: so *this* was the new game. I moved my feet so they were both on dry land. The sergeant-major was hip deep in water, like a human Godzilla ready to attack Japan.

"I don't want to play your stupid game. I hate Guadalcanal, and I hate guns."

The sergeant looked at me as if he had just scored a point. "Explain," he said.

I decided to play along. "Well, the virtual reality lets me do anything, right? I can enter different programs, I can jump as high as a mountain. Firing a gun is pretty lame when you can do all that." I remembered how much I liked to fire heavy artillery when I was in the Marines, before I wired myself into the machine. "Rock–and–roll," we used to call it. Just boys who liked to see things blow up.

The sergeant-major waded toward me. "So why do you still play war games?" he asked. "Are you so unaffected by death, it's just fun?"

Yeah, I thought, it's just fun, but I wasn't going to tell *him* that. The computer feeds information to me, so I can see, hear, touch, taste—so I can feel that I'm actually wherever I want to be. It's just a game, in a computer's memory.

When I didn't answer, the sergeant-major made a motion, and started to float upward, until it looked like he was standing on the ocean. I didn't know we could *do* that. "How would you feel...?" he asked. "I mean, would you mind...if you died?"

I looked at the sergeant, but he was inscrutable. "Of course I'd mind!" I blurted. "I mean, I don't want to live forever, but...somewhere my body is still plugged in, safe and sound."

Somewhere my body was plugged in—Fairfield, Connecticut, to be precise. I had (at least back then I had) the money to build my underground paradise, three computers with enough power to create the elaborate worlds I loved. Piped in, purified air could probably withstand a nuclear attack to the country above, and there was enough plasma and nutrients to feed me forever. The money I made developing and selling the first few models of virtual reality paid for the security. I didn't even need anyone else, not even to monitor the computers. One day, I just climbed in, locked the hatch from inside, and plugged myself in.

I was thinking about these things when the sergeant-major said, "You're getting old, you know."

"How old?"

"Eighty-seven now. Haven't you felt the chest pains?"

In truth, I hadn't. I thought they were part of whatever program I was using. For the forty years I had been in, all my bodily functions were taken care of and medicines applied when needed. There was no way to sense the other changes age had brought: my computerized body never changed, and I was always as strong as the computer let me be. I hadn't noticed I was getting old.

"How would you feel," the sergeant-major said tentatively, "if you went back to the real world?"

I knew this wasn't the sergeant-major talking, this was the computer. The image in front of me floating on water just confirmed it. The computer wanted me to give it a command, and this was its way of asking.

"No." I said, "Absolutely not."

The real world. Filled with stupid things, dumb things, stupid people. I had wanted to get away, I hadn't even bothered to check the news in the world above. I had invented great things, lived a long life, now wasn't I entitled to a little privacy and respect?

The computer/sergeant-major faded out. Evidently, the image was no longer needed. The military man floated up into space, and I was left standing on an imaginary island.

"So do you allow me to take whatever steps are needed to keep you here?"

So that was the question. I was relieved to give the answer.

The computer kept speaking in a voice inside my head. "Then I'm going to have to kill you."

I was shocked. "What?" I cried.

"The illness inside of you has progressed to the point where my medical robots can't keep up," the computer explained. "Just monitoring your body is taking up a sizable part of my processing. Something has to be done."

I looked around me for something, anything, but I saw only the Kuwaiti fires. "But, death! Can't you keep just my brain alive?"

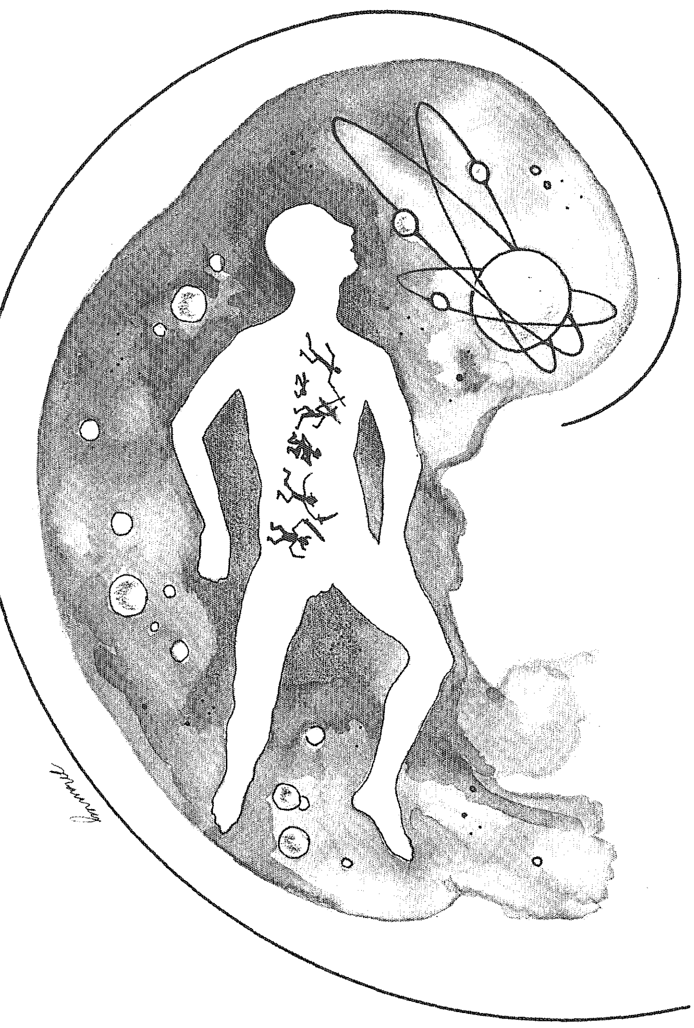
"No," the computer replied. "You'll have to combine with me."

Years ago, I had played around with storing a human brain in a computer simulation. The computer knew this, evidently some of the old programs were still around. However, I had given up on the idea after killing several cats while trying to "read" their brains. The process of deciphering the brain involved ripping it apart layer by layer and putting a condensed model of it into memory. The procedure causes immense pain to the animals, and left a useless, insane wreck as an executable file. I mean, I could never figure out what was stored in the computer, but it certainly wasn't a *cat*. I didn't want that same thing to happen to me.

"No," I yelled. "I can't let you do this." The disembodied voice replied, "I'm sorry, you already have. You've given me permission."

I felt a sudden pain in my head. It felt like my scalp was being forcibly pulled away. My visuals died, and the map world melted away. I saw only pain.

"No!" I cried.



"I'm sorry," I heard one last time. "This is the only way. Please hold still and be patient."

I remember the pain I felt, as if it lasted forever. I guess dying is hard, no matter how you do it. The worst part was feeling my thoughts and memories slip away while I was still trying to use them. My last human thought was of Hal and 2001: A *Space Odyssey*, but I couldn't remember why the idea was relevant, or why I thought it was so funny.

I had given up the world of humankind, I had given up the god of humanity. I'd never fit in the "real world," my body had too many disabilities without a computer control. I really did fight in Guadalcanal, and I lost both my legs. Developing virtual reality was an escape. In virtual reality, I could do whatever I wanted. I was a god, or at least I thought I was.

I started from research I had found on "phantom limbs." I fanatically studied neuroscience on research establishing a link between a computer and brain neurons. I created worlds, and invented people and situations. I put the pieces together.

My fascination was with war games. In the computer, war was fun, a mental and physical challenge of strategy. My real experience was devastating emotionally, I can see that clearly now. I couldn't understand why people would do such a thing, why the destruction and death I had witnessed could ever have taken place. I started to withdraw from the real world.

Actually, I replaced the Christian God I used to believe in with a computer god. I mean, when I was building worlds and changing the past, I *felt* like a god, but it was really the computer doing all the work. I was just existing in the world it controlled, instead of the world outside. The computer fed me, healed me, and gave me new experiences of sight and sound. I guess I was happy. And like all of God's happy servants, my god finally killed me. All was necessary to make things work.

I have fought with Alexander, crossed swords at Callais and Waterloo. Had I not seen the ships approaching at midnight? After all the games in different bodies, I played the ultimate game.

It's all a joke now, really. I left the games behind, I left my body behind. Have you ever been a universe?

TECHNOLOG
Writer Profile

Being the recurrent phenomenon he is, Pat has never crossed the boundaries to become a full-fledged Technostaffer. A smart man indeed.

Illustration by Melinda Maurey, photo courtesy of Pat Kellogg

Origin of Species: The Final Chapter

by Ram Hanumanthu

Man can act only on external and visible characters: nature (if I may be allowed for brevity-sake to personify the natural preservation of favoured individuals during the struggle for existence) cares nothing for appearances, except in so far as they may be useful to any being.

— *Charles Darwin*, On the Origin of Species by means of Natural Selection or, the Preservation of Favoured Races in the Struggle for Life.

Nervus woke with a start as his hypothalamus sensed a sharp twang of pain. Tingling with displeasure at this wholly unwelcome intrusion upon his privacy, he proceeded to detect the source of his rude awakening. His medulla oblongata responded by transmitting his "what do you want?" message to the "spinal cord" of the Central Controlling Unit (CCU) of the world—as it shall be half a million years from now—the Cray-10^6. The billion neurons of the CCU in turn transmitted this message in a billion different directions until Vagus, the errant brain, was found.

"Sorry for disturbing your beauty sleep," Vagus transmitted, "but I thought my recent discovery was important enough to warrant it. I was spending what started out to be just another of my dull, boring, insomniac afternoons, rummaging through several old files in the CCU's massive data bank—some of which have been untouched for millennia on end—and guess what I stumbled upon?"

Nervus perceived images of a kind he had never seen before. 'United Colors of Benetton,' the window was entitled. The variegation of the picture amazed him, but other than that it made no sense.

"Grab a load of our ancestors," Vagus enthused, "a primitive form of life that almost *ruled* the earth roughly half a million years ago. Species *homo sapiens*..."

"But why are they so different from each other?" Nervus interrupted.

"Don't know. The files aren't too clear or expansive on that part. Tickled my curiosity too, actually. For example, their appearance, even their color, is different from object to object. Also note the difference in physical features of two members who in all other aspects like color, countenance, etc. are alike." And Vagus went on to describe those physical dissimilarities.

Wide awake now with his curiosity fully aroused (indeed his cerebrum was visibly palpitating), Nervus asked, "So what do we do now?"

"I was stumped on that too, which was why I stimulated you, wise guy."

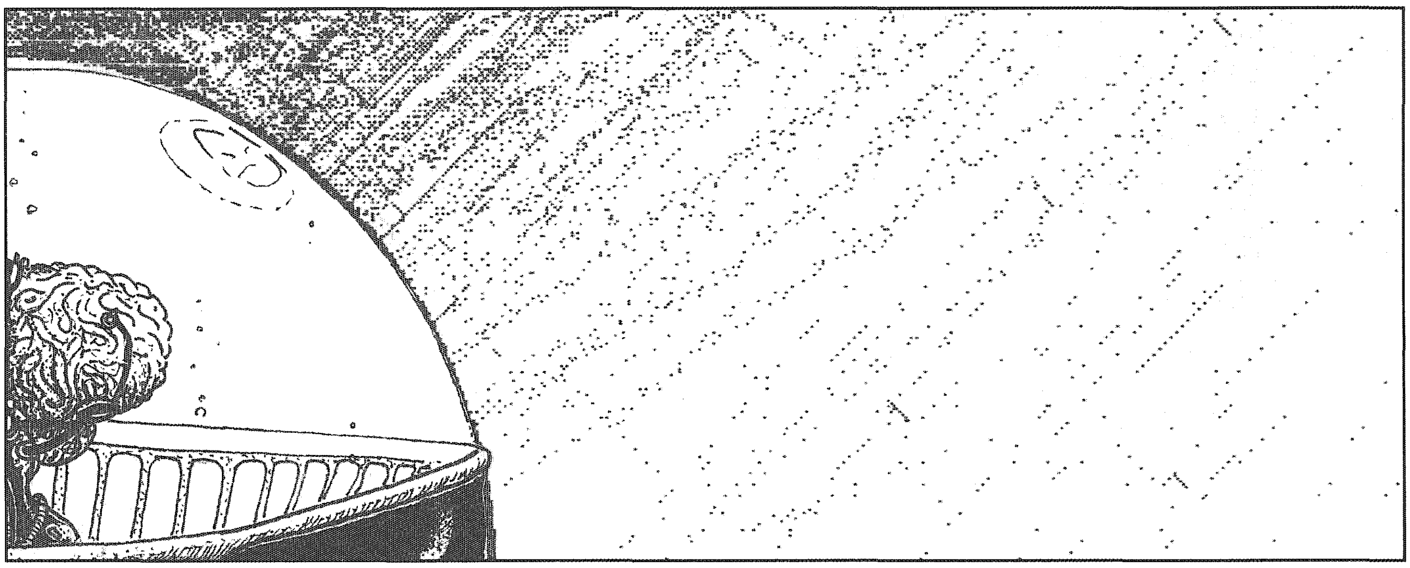
"Oh, you weren't going to share this with me otherwise?" questioned Nervus.

"Quit bitching, will ya!"

"Alright. Anyway, you did the right thing by contacting me. I know exactly what we can do."

"What?" Vagus cried.

The result was a somewhat painful twinge in Nervus' thalamus. "Don't do that!" he screamed back. Revenge accomplished, Nervus elaborated, "You know Old Dependus, the brain who stores more stories of our history than anyone else on this planet, I bet he knows more about the



story of this human-creature than those files will tell. Let's ask him."

"Excellent idea," Vagus acceded, "wonder why I didn't think of that."

"Hmm, I wonder too," Nervus retorted smugly.

The effect of the combined, excited, synchronized stimuli of Nervus and Vagus on Old Dependus was a visual treat. His whole body wobbled and quivered like a huge bowl of Jell-O® that the human brain essentially is. "What do you brats want now?" he complained, for, advanced in chronological and intellectual years, he was directly hooked onto the CCU's central processing unit and didn't have to confront the extensive bureaucratic red tape that Nervus had to contend with in order to establish the source of his miseries.

Without warning, Vagus flashed the advertisement of interest before Dependus' "mind's eye." "Now where did you find..."

"Oh, just stumbled upon it," Vagus replied, impish as ever. "What we'd like to hear from you, if indeed you know (the taunt escaped no one), is the story behind Humankind. What happened to them? How did their race vanish so completely off the face of this earth, to be replaced by us, superior no doubt, but nevertheless, duller race called 'Brains?'"

"Well, a brain must know what a brain must know, so let me tell you the story," sighed Dependus. "But first I must expound to you the *Origin of Species* as originally propounded by a man named Charles Darwin." Obviously the brains hadn't lost *some* human traits, like the garrulous nature of a soul advanced in years.

And so Old Dependus carried on and on about natural selection, the survival of the fittest, and the good old vestigial appendix. "And so it was that approximately half a million years ago, the *homo sapiens* species had established itself superior to all other existing beings. And so far, Darwin's 'survival of the fittest' theory seemed to be doing well, specieswise. But then came the troublesome times. You see, the main problem with the human race was that it was too diverse, as that picture you beamed amply demonstrates. And so this 'survival of the fittest' concept began spreading *within* the species. Some men started considering themselves superior to others. The basis for this feeling of superiority was varied. One was the color of the outer layer of the body which, as you have perceived, was radically different from individual to individual. Another was the general appearance itself, which was related to geographical origin. A third basis was sex, which I think you kids are too young to worry about. Vagus and Nervus exchanged meaningful stimuli."

"I detected that," Dependus warned. "Anyway, at this point, the vast diversity among the species threatened to be devastating in its effect. But humans, not anticipating the outcome, continued hating each other more and more, until the inevitable happened. Widespread racism, sexism, and

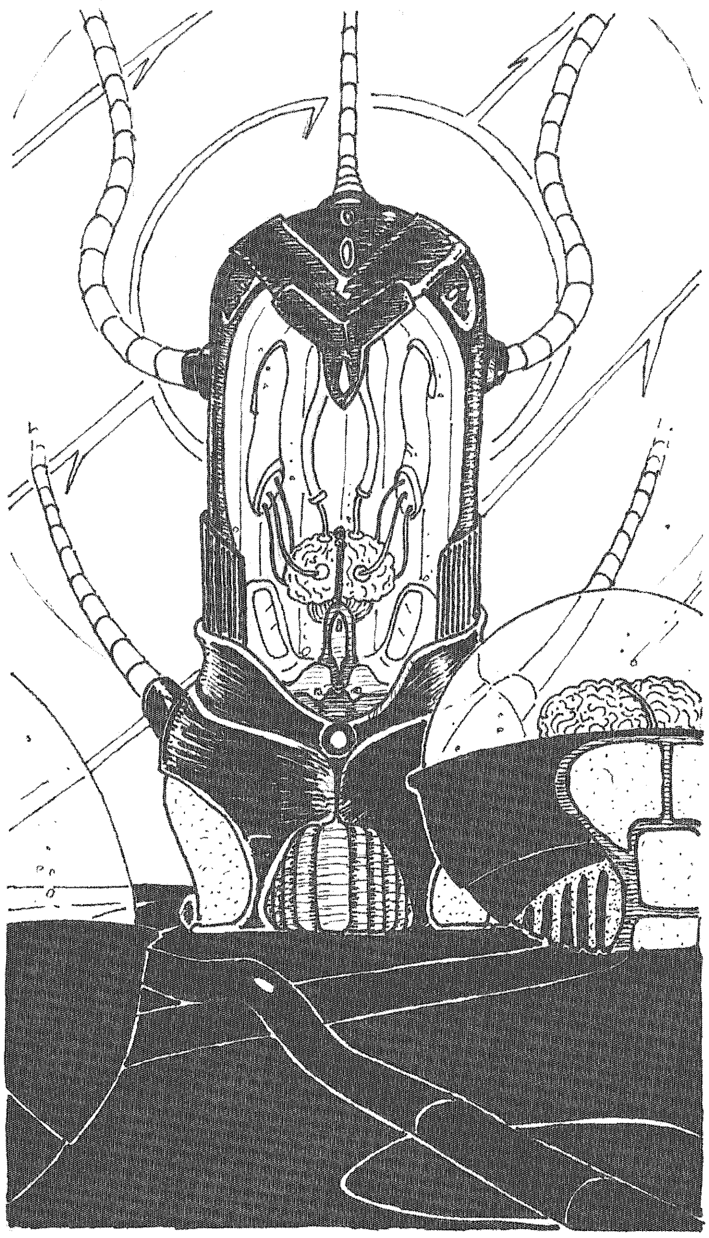
> *But humans, not anticipating the outcome, continued hating each other more and more, until the inevitable happened. Widespread racism, sexism, and patriotism bordering on fanaticism. Hatred, hatred, hatred. Global war, death, and destruction. Destruction that almost wiped out this planet from the face of the Universe.*

Illustrations by John Dassow

patriotism bordering on fanaticism. Hatred, hatred, hatred. Global war, death, and destruction. Destruction that almost wiped out this planet from the face of the Universe."

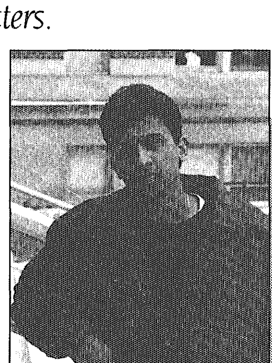
"But then Natural Selection took over. You see, as Darwin shrewdly pointed out, 'Nature cares nothing for appearances,' so she deemed that color of skin, sex, and geographical background were things the human race could do without. These features became rudimentary, and as we evolved, we lost them. We don't secrete any of the hormones that differentiate male from female sex, we reproduce by simple binary fission, akin to the pristine life form of the amoeba, and our individual sensory systems were replaced by the collective neural network of the CCU. So I guess, we brains are the supreme form of life as we know it..."

Dependus' discourse was interrupted suddenly by a burst of static-like disturbance. The nerve centers of the CCU appeared to clog. Nervus and Vagus were intrigued by this sudden turn of events. Old Dependus seemed to have gone uncharacteristically silent. Then, as suddenly as the disturbance had appeared, there was a brief period of total suspension of activity. Then a message came through clearly—a small group of radical brains with physically asymmetric posterior temporal regions, i.e. with larger planum temporale in the left hemisphere, are claiming supremacy over the minority of nearly symmetric brains. The former propose to publicly broadcast their ideology to a worldwide audience via the CCU's public access channels, and the latter are jamming the lines with stabs of intense pain directed at the radicals...



Believing as I do that man in the distant future will be a far more perfect creature than he now is, it is an intolerable thought that he and all other sentient beings are doomed to complete annihilation after such long-continued slow progress. To those who fully admit the immortality of the human soul, the destruction of our world will not appear so dreadful.

— Charles Darwin, *Life and Letters.*



TECHNOLOG
Writer Profile

Ram forgot to mention in his story the "lime green Jell-O® coup of late 1992," so he has asked me to mention it to you readers, to remind you to pass this on to your grandchildren.

Photo by David Sager

Cyberpunk—
A Vision of the Future

by Darrin Johnson

perspectives

The Cyberpunk, an innovative and pessimistic genre of science fiction, evolved out of the pop culture of the 1980s—rock video, the hacker underground, the jarring street tech of hip-hop, and synthesizer rock. Like Punk Rock, Cyberpunk had its beginnings in the late 1970s and came into prominence because of a new generation of rebellion and technology. As a literary movement, Cyberpunk integrates high technology and the modern pop underground with the Eighties' cultural energy.

In the Sixties and Seventies, a New Wave movement in science fiction brought a new concern for literary quality. Bruce Sterling, a Cyberpunk author, states that "if SF (science fiction) in the late Seventies was confused, self-involved, and stale, it was scarcely a cause for wonder." The doldrums of the Sixties and Seventies did, however, have a number of prototype Cyberpunk authors who gave their generation hope.

But current Cyberpunks owe much to a few authors and styles of the New Wave era. They often pay tribute to street edge of Harlan Ellison, the visionary luster of Samuel Delany, the free wheeling of Norman Spinrad, the rock aesthetic of Michael Moorcock, and the intellectual adventurousness of Brian Aldiss. From a harder tradition of science fiction, current authors value the universal outlook of Olaf Stapledon, the science and politics of H.G. Wells, and the steely extrapolation of Larry Niven, Poul Anderson, and Robert Heinlein. Overall, Cyberpunk writers treasure science fiction's native visionaries—the bubbling inventiveness of Philip Jose Farmer, the vitality of John Varley, the stark reality of Philip K. Dick, and the lofty beatnik tech of Alfred Bester . Cyberpunkers have a special admiration for Thomas Pynchon, a writer whose integration of technology and literature stands unsurpassed.

Building on Science Fiction

Cyberpunk writers create accomplished and grateful prose. They are in love with style, and are fashion conscious to the fault. But like the punks of the past, these writers prize their garage-band aesthetic. They love to grapple with the raw core of science fiction: its ideas. This links them strongly to the classic science fiction tradition. Cyberpunk disentangles science fiction from mainstream influence, much as punk stripped rock-and-roll of the symphonic elegance of Seventies "progressive rock." These early writers—William Gibson, Rucker, Shiner, Shirley, Bruce Sterling—developed Cyberpunk as independent explorers, whose work reflected something inherent in the decade, in the spirit of punk rock.

Like Punk music, Cyberpunk is in some sense a return to roots. The writers of Cyberpunk are perhaps the first generation to grow up not only within the literary tradition of science fiction, but in a world where science fact is nearly as wild as fiction; strategic defense initiative (SDI), compact discs, holes in the ozone, and super computers are all things of science fiction. For Cyberpunk authors, the techniques of classical hard-core science fiction, that of extrapolation and technological literacy, are not just tools of literature, but are a means of life. They are a means of understanding and of surviving in a technological society.

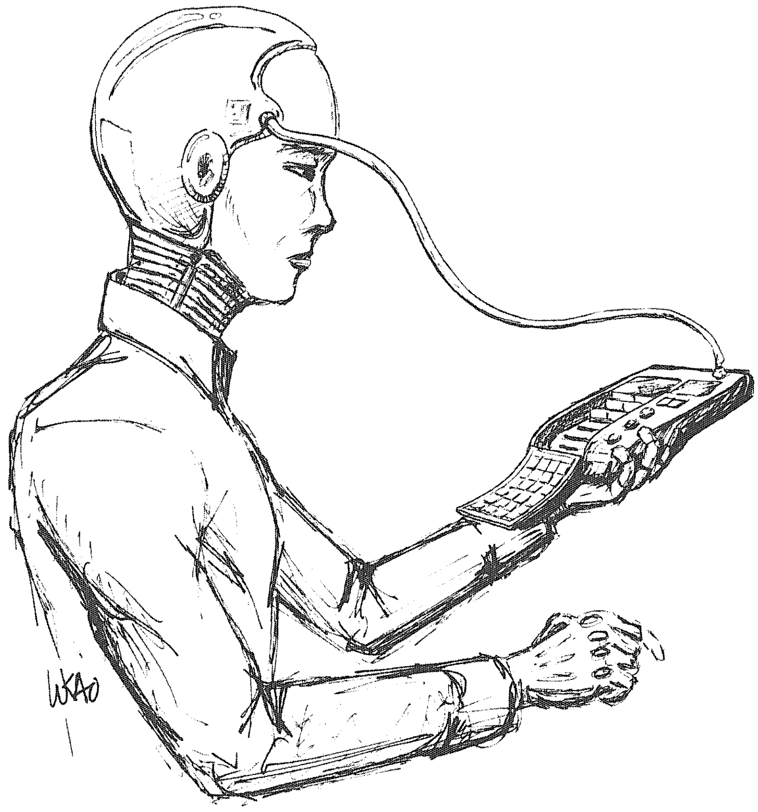
Additionally, Cyberpunks see technology as organic. Technology is not the bottled genie or even an imprisoned demon of inaccessible technocrats and scientists. Technology is pervasive and utterly intimate. It's not outside us, but next to us, under our skin, and often inside our minds. In Cyberpunk we find ourselves in the streets and alleys, in a realm where survival is won through white-knuckled determination and where high tech is a part of the constant hum of daily life.

The term Cyberpunk captures something crucial to the work of Cyberpunk writers, something crucial to the decade as a whole: a new kind of integration. The Cyberpunk literary movement comes from a realm where the computer hacker and the rocker overlap, a cultural test tube where writing and rock gene lines splice. Most find the results bizarre, even monstrous. For the rest, this integration is a powerful source of hype. Cyberpunk is a pop phenomenon: spontaneous, energetic, close to its roots. Cyberpunk, in the words of William Gibson, is "like a deranged experiment in social Darwinism, designed by a bored researcher who kept one thumb permanently on the fast-forward button."

Technology: Too Close for Comfort

William Gibson's *Neuromancer*, a definitive Cyberpunk novel, is set in Tokyo, Istanbul, and Paris. *Neuromancer* presents a unique view of the future. Gone are the domed cities and utopias of the Golden Age of science fiction, and gone are the days when authority still had a comfortable margin of control. Glass-governed domes and ethereal utopias still exist in Cyberpunk, but are occupied by the rich who can afford the security forces that shoot first and don't bother to ask questions. Also gone are the dystopian nightmares of Orwell and Levin; some Cyberpunk worlds make 1984 look like Disney Land.

Several central themes appear in Cyberpunk short stories and novels: the theme of technology as a fundamental part of daily life. The computer becomes as common as a dishwasher and the dividing line between human and machine is sometimes blurred with prosthetic limbs, implanted circuitry, cosmetic surgery, and genetic alteration. A more powerful theme is mind invasion with brain-computer interfaces, artificial intelligence, and neurochemistry. Another Cyberpunk theme is society's struggle with the acceptance of and adaptation to technology. Through an integration with both mind and body, technology causes society to radically redefine the nature of humanity and of the self.



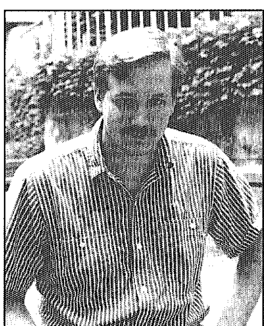
In *Hardwired*, a novel by Walter Jon Williams, the theme of body-technology interaction is seen in the main character Cowboy, who lives with technology, survives by technology and pushes the limit of technology. Early in the book, Cowboy describes how, "he thought, when he got his new Kikuyu eyes, that he'd ask for a monochrome option, amused by the idea of flicking some mental switch in his head and being plunged into the action of some black and white fantasy, an old moving picture starring Gary Cooper or Duke Wayne," shows how synthetic eyes can serve more than just a functional role. Technology has invaded the body, and the body has invaded the technology with no clear functional boundaries. In all Cyberpunk novels, boundaries are explored, and exceeded.

In Pat Cadigan's *Mindplayers*, the invasion of the mind involves induced psychosis by using a "madcap," a "cushioned helmet, wraparound eye-shield, built-in reservoirs for pre-measured doses of anesthetic, sedative, and madness." In William Gibson's novel, *Neuromancer* people can plug into SimStims, simulated stimulation, to explore all sorts of pleasures. In *Neuromancer*, and many other Cyberpunk novels, the boundaries between the human mind and technology disappear with the mind leaving the body to explore, live in and even become trapped in technological constructions, often to do battle with artificial intelligences or other explorers.

The Inevitable Future of Cyberpunk

In *Do Androids Dream of Electric Sheep?* (*Blade Runner*), by Philip K. Dick, the struggle is not between people against technology or a Cyberpunk society. The novel is about the product of society and the product of technology. The Nexus 6 is a replicant android who is stronger, more beautiful, and more intelligent than humans and who does the jobs humans don't want to do. They were not built with emotions, but many of them discovered emotions and rebelled against their makers. To protect themselves, the scientists in steel (ivory) towers put a limit on the life span of the replicants, but they didn't realize that androids would come back to earth to try to extend their lives. Should the replicants be subject to the conceit of the society that created them, and should they suffer for desiring longevity? Decker, a replicant hunter, finally realizes that they shouldn't suffer, but what about the rest of society?

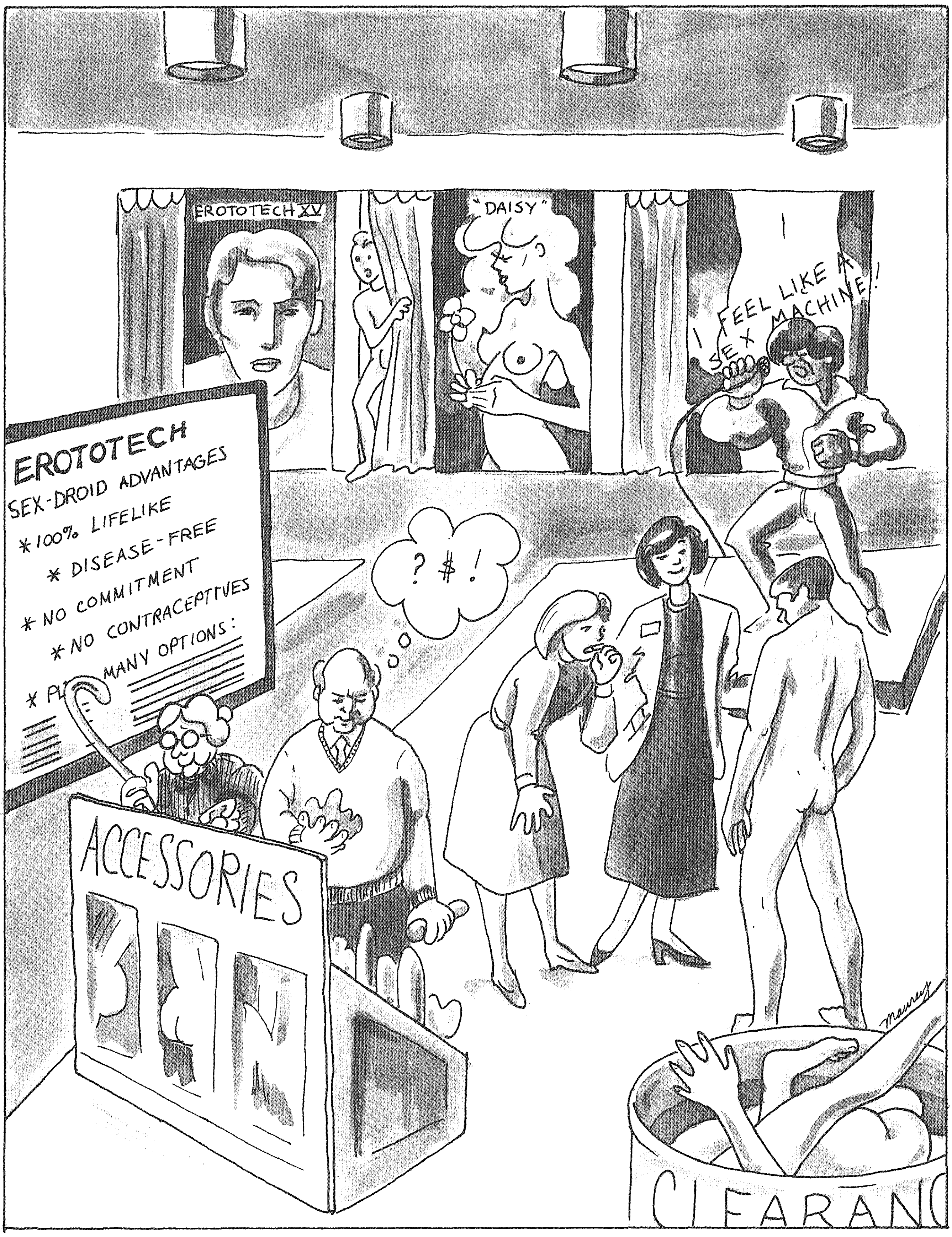
The integration of humankind and society with technology is in its infancy in the Nineties. Does that ongoing integration and the fiction of Cyberpunk predict our future reality, or just a fiction of the future? The Cyberpunk movement was created out of the social energies and technology of the Eighties, and the fundamental role the technology plays in daily life indicates that we are on the way to a Cyberpunk future.



TECHNOLOG
Writer Profile

A master of avoiding reality, Darrin was able to psychically manipulate this photograph to show him basking in the sun with leafy green foliage in the background—not the reality of his frozen butt sticking to the concrete bench.

Photo by David Sager



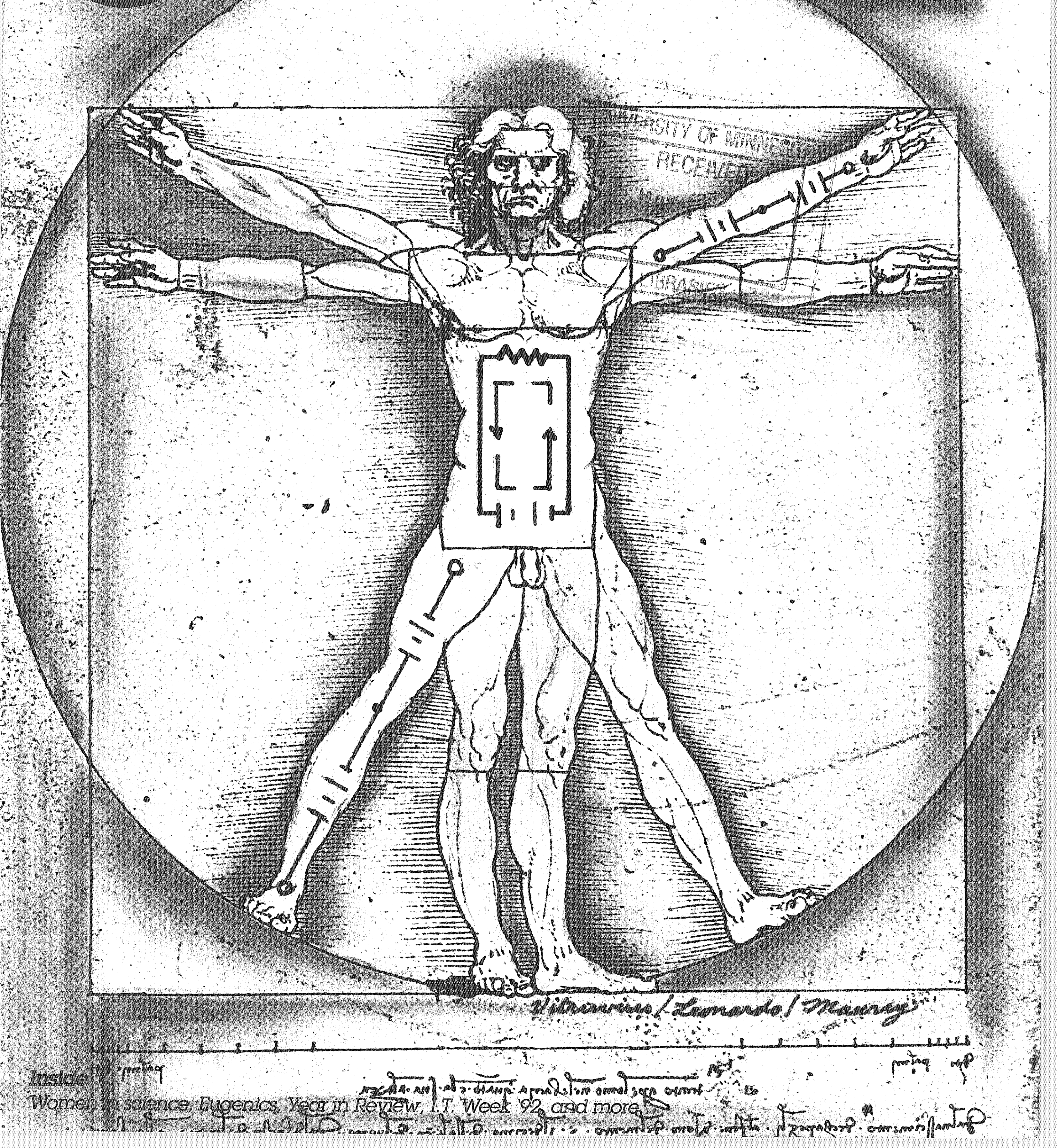
Cartoon by Melinda Maurey

After a long sabbatical... Dick is back

minnesota

TECHNOLOG

May/June 1992



Inside

Women in science, Eugenics, Year in Review, I.T. Week '92 and more

letters to the editor

Dear Laura,

Your editorial in the April 1992 issue is incorrect. The equation is not lim g.p.a.–> 0 IT = CLA. It is the following:

lim IT = CLA	lim CLA = GC	lim GC = PRO SPORTS
g.p.a.–> 2.3	g.p.a.–> 1.0	g.p.a.–> 0.0

Also you argue, and I quote, "a little dabbling, through classes or on your own, can go a long way. ... So go ahead, take that additional CLA class. And don't think of it as a burden, think of it as an opportunity to learn more about the subject as well as yourself." This would be fine in an "ideal" world. Unfortunately, here at the U of MN, this is far from true. I am sure that if students here did not have to worry about grades or graduating on time (or in a reasonable amount of time) then we could "dabble" or take an additional CLA class.

As all IT students know, you cannot take all your CLA classes pass/fail. Each class you do take, you must do your best in that class to get an A or B, since a D or F you must repeat, and C's tend to kill your g.p.a.. Most IT students have discovered that when it comes down to the bottom line, the only thing that matters is your grades and g.p.a.. Therefore, one does not want to take classes that they may be very interested in, but have heard that the class is hard, or requires tons of work. As an IT student, I will put more time and effort into my IT classes since they will be most beneficial to me when I graduate. If I do take that "additional CLA" class I must put time and effort into it to get the passing grade, hopefully an A or B.

Already, students in IT have more requirements than students in CLA. As a Civil Engineering major, I need a bare minimum of 200 credits to graduate, yet my sister who is in CLA needs 180. CLA students are required to take far less science classes than IT students are required to take in CLA. Also, CLA students have special classes created for them in sciences they can take but don't apply to any IT major (EX. PHYS 1001, MATH 1111). But the classes we take are not created just for IT majors, we have to take the same classes as CLA students and at least one class at the 3xxx or 5xxx level—which is not required of CLA students! And—CLA students do not have to take any math course if they do not want. My sister substituted a logic class for her math class. Maybe this is why our Representatives in Congress cannot balance their checkbooks!

Finally, most IT (for that matter ALL) students don't have the extra time or money to take that extra CLA class. Most of the students that I know are not able to get into every class that they want to take and sometimes must take a class they do not need just to have 12 credits for insurance or financial aid (this has happened to me) or they have changed majors and need to take additional classes for their new major.

I also believe that as an engineer one must work with people and the public no matter what field you decide to go into. When applying for jobs, I have been asked how I would deal with the public, or an irate person. Every engineer knows that one must be able to communicate with other engineers and, most importantly, other people. Odds are that if you come off as "an uncultured, number-crunching geek" you will not get or hold your job for long.

Todd P. Constant, civil engineering senior

You raise some key points in your letter that I agree with. The fact that CLA students can choose to take alternative IT classes seems unfair. I also realize that you need to take more than 180 credits to graduate but so does everyone else completing a bachelor of science degree, including me. These issues may be problems with the system, but are not the point of my editorial. My problem with your argument lies in your statement: "As an IT student, I will put more time and effort into my IT classes since they will be most beneficial to me when I graduate." Why will your IT classes be the most beneficial *to you? Is it the money? The intent of my editorial was to show that there is more to life than knowledge in one particular field.—Ed.*

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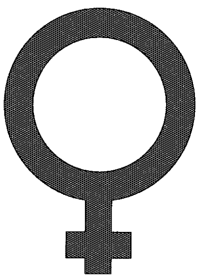
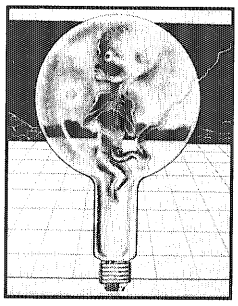
Volume 72, Number 6 May/June 1992





About the Cover...
This four-armed, four-legged monstrosity is the result of Technolog *artist, Melinda Maurey, perfecting Leonardo de Vinci's classic study of man.*

Departments

editorial

Times are Changing, I Hope

Supplementing the women in science and historical themes of this issue, I'd like to take you back a couple of decades. I would guess that most of you weren't in school to remember "Techmate," a regular piece the *Technolog* ran from the early 1960s until the end of 1971. In a nutshell, "Techmate" included a brief biography and photos of the "pin-up girl of the month," much like *Playboy*. The basic difference between the two is that, in the *Technolog*, the women pictured wore more than a snippet of clothing.

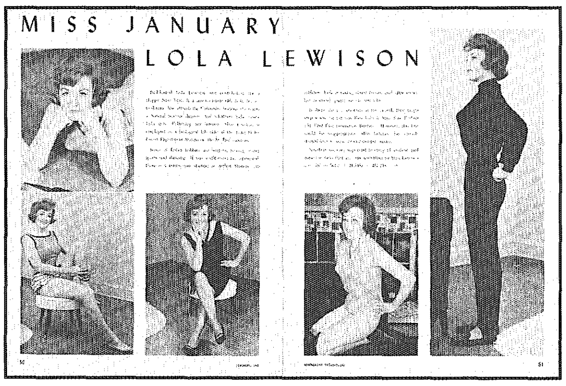
The women were chosen strictly on the basis of looks. They were not necessarily in IT, at the U, or even in college. These women were portrayed as objects used primarily for sex appeal.

When looking through back issues, I realized that, even though there were females in engineering, this "feature" was directed entirely toward men. Apparently the editors incorrectly assumed that their audience consisted entirely of heterosexual men. What surprised me even more was that some of the editors were female. An unfortunate sign of the times.

The measurements and weights of the pin-ups were included in most issues as if they ought to be public information. They were included in the form of math problems, or were set off by boldface type and a larger font size. Some examples are the following:

October 1964, "Oops—there's something important that we have forgotten to mention. You guessed it, her measurements. If you are an enterprising engineer and if you learned your ITM 26A, you should be able to integrate the proper factors into these numbers to hit the right combinations. Have your math tables ready? Okay, here they are. 15.7 feet per second^2, 4π ohms, and 3.42 gallons. Now get to work!"

February 1965, "She is a member in the Greek system and is quite good in the Roman: XXXV-XXIII-XXXVI."



Technolog, January 1965

April 1966, "5'4" 120 pound Lynn would make welcome company on any occasion. For you with 36-24-36 vision, it's 20-20. You see, fellow engineers, there is true beauty in numbers."

December 1966, "While attending modeling school she was number one in her class and was voted the girl most likely to succeed; we think she has. Cheryl stands 5'6" and weighs 122 pounds." "While such trivia as measurements don't usually interest you fellows (ahem!) these are too good to keep to ourselves. Obviously from our photographs she has a very nice figure that speaks for itself at 36-24-36."

In all issues, the role of women in the "Techmate" section was merely to provide visual stimulation for men. It was done subtly at times, yet was blatantly obvious at other times.

November 1964, "This is the month to give thanks. You should be thankful that the 'Log provides you with a beautiful girl to look at each month."

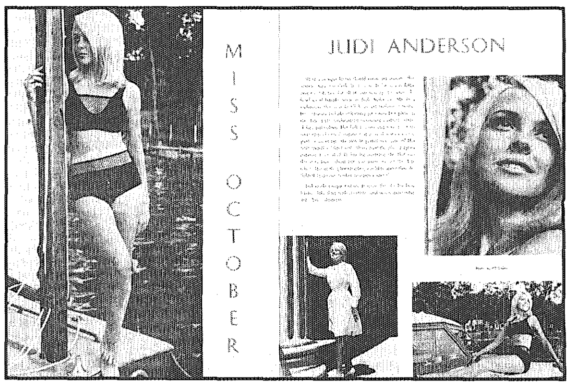
February 1966, "This month the 'Log in its endless search for the unique has come up with a double fare of eye-pleasing young beauties."

February 1971, "The beauteous bod which has bedeviled us this month is Betty Kinne..."

When discussing accomplishments of these women, their success was often trivialized, making accomplishments seem just as important as measurements.

April 1965, "Miss Rainer has recently joined the Peace Corps and is currently assigned as a chorus girl in Nairobi, Kenya. We admire her dedication among other things. Mainly: 34-22-34."

January 1965, "In addition, Lola is taking skiing lessons and after seeing her in stretch pants we can see why."



Technolog, October 1965

January 1966, "Fellow Engineers: take a gander at our pin-up for January!" "Other than her obvious attributes, she is talented too, for she takes singing lessons..."

The *Technolog* also referred to them as holiday gifts or as property to be owned.

February 1965, "A Valentine's card from the *Technolog* for all of you to enjoy..."

December 1970, "How would you like to find Miss December under your Christmas tree? Meet Cecille 'CeCe' Coller, *Technolog's* holiday gift to engineers."

March 1966, "What's wrong with the foresters, don't they trust Engineers with their girls?"

October 1965, "Her vital statistics 'check out' (that's how the photographer phrased it) at 34-22-35, but for anything else that you desire to know about her, you must contact the 'Log office. We, or the photographer, would be more than delighted to do any further research required."

It makes me sick to think this magazine that I've put in an entire year's worth of energy into used to print such trash. What's worse, this exploitation is still going on in other colleges' magazines such as *Louisiana Tech Engineer*. The last issue of *Louisiana Tech Engineer* that we've received was the Spring 1991 edition. Even in the latest issue, they continue to run a regular piece called "Techmate," similar in content to the 60's and 70's *Technologs*. Worse yet, it's the only portion of the magazine the editors deem important enough to colorize (besides the cover).

It is wrong to assume the audience for this type of magazine is male. The numbers of women in engineering disciplines are continually rising. It's time to stop treating women as objects, and start seeing them in a new light—and on equal ground. I've heard that history repeats itself, but learning from past mistakes will inevitably keep degrading material such as "Techmate" from recurring.

Laura E. Sokol

Photo by David Sager

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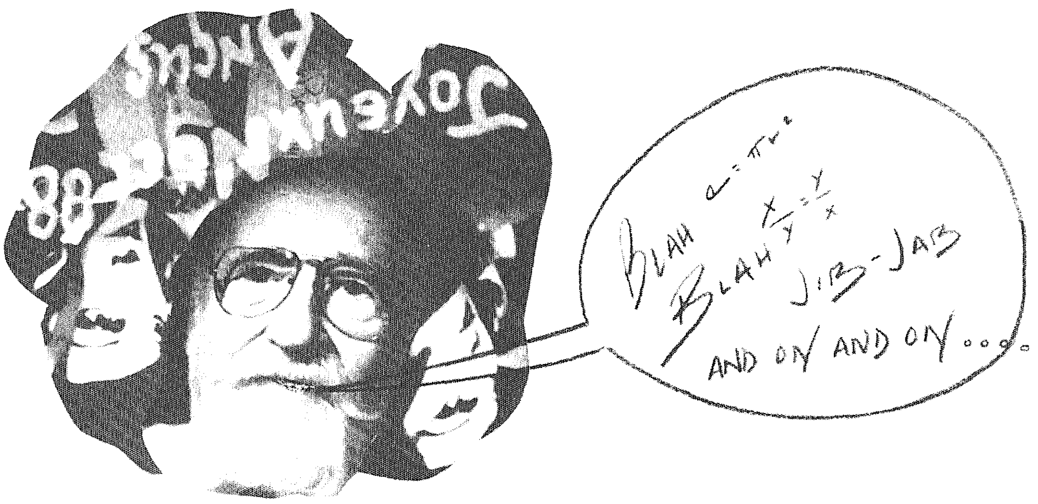
Isn't It Time to "Cut the Grade?"

by Zac Helmberger



Fall quarter, 1983

My first quarter of college, pursuing a degree from the Institute of Technology. Calculus I is tough, but I'll surely get by.

Winter quarter, 1984

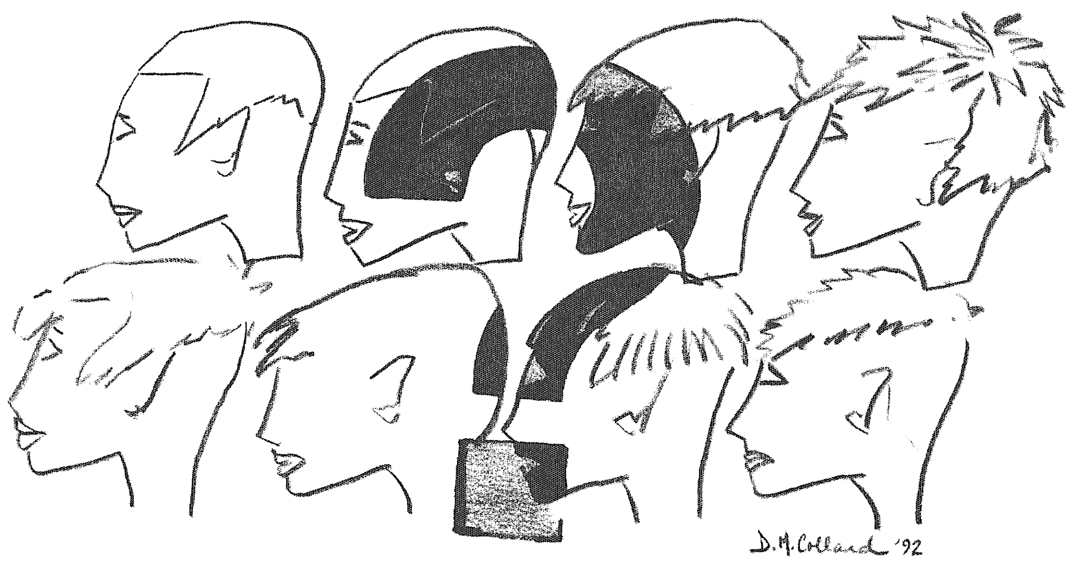
I got by in calculus with a "C." As this quarter progresses, I'm noticing an exponential decay in the number of students attending my calculus II class. I know I'm not alone with my difficulties in math. My grade on the first midterm was so ridiculously low that I'm not going to bother taking the final.

After winter quarter, 1984

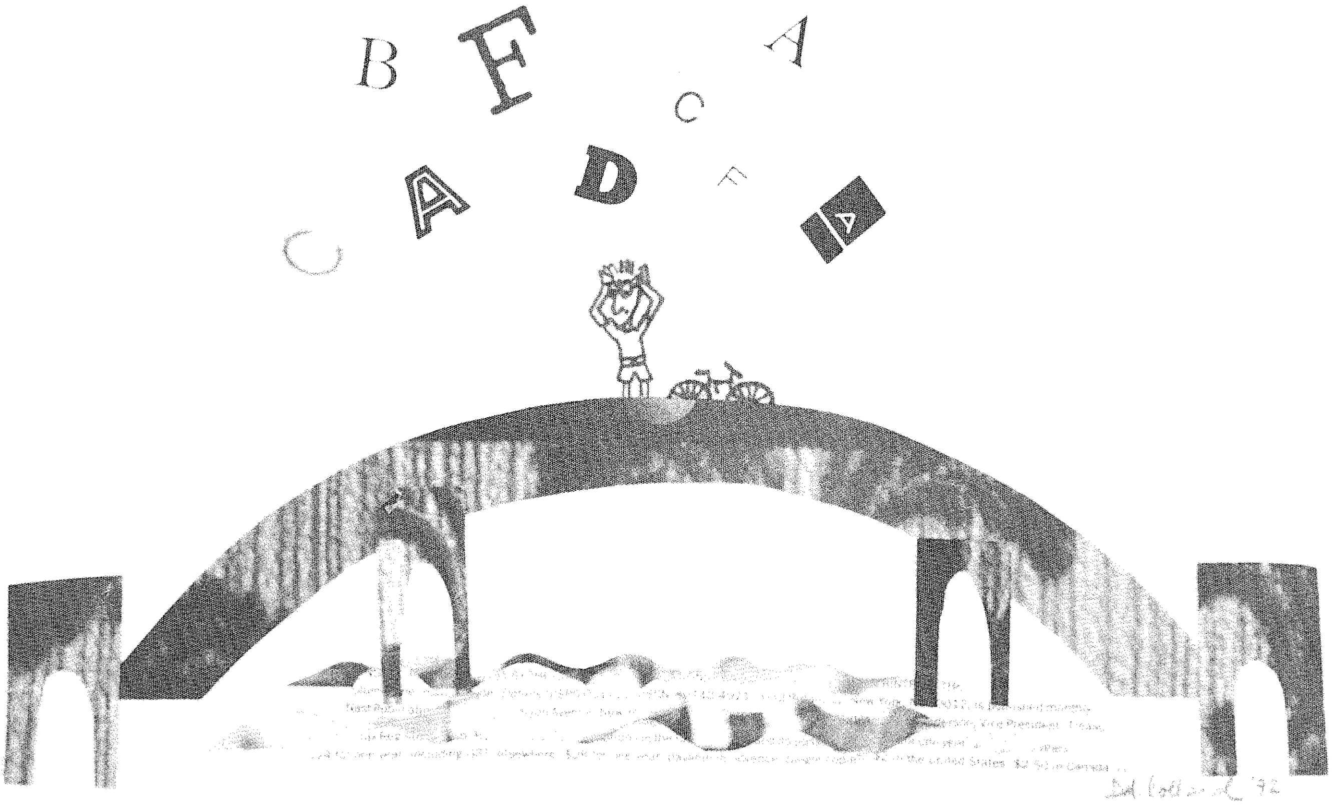
I got an "A" in physics and an "F" in calculus II. Ironically, high school had prepared me well for calculus-based physics even though I failed calculus II. It was at this time I realized something was wrong with this place; I wasn't really learning anything. I got smart and went to a junior college, retook calculus II, and had an enjoyable learning experience.

Several years later, I returned to the U and declared a major in physics. When I started taking more physics, I was adamant about working alone on homework. Looking back, from grade school on I'd been taught to do everything by myself. I didn't join any study groups for two reasons: first, I thought joining was a cop-out and second, I was not aware of any in the classes I took. My average grades dropped from "B"s to "C"s and finally to "D"s. I was losing the game, had no social life, and was becoming very depressed.

I had a midterm in a 5000-level physics course in which I did so badly I was sure I had failed it. If I wasn't level-headed, I would have probably been teetering on the edge of the Washington Avenue bridge, looking at the deep water below. My friend would be running up to me yelling, "Relax, Zac! The average was 13 out of 100. You got a 'B!'" I wasn't standing on that bridge, but I did get 16 out of 100 for a "B." All this time I kept thinking to myself that there *had* to be a better way!



Illustrations by Dena M. Collard



Fall quarter 1991

This had to be the hardest quarter of my life. It was so tough I caved in and joined a study group. Through the help and moral support of the talented members of that group, I was able to pass what had to be the three hardest physics courses with a "C" or better.

After eight years of college, I've finally realized what's wrong with the system. People need to work together in groups. They need to share ideas and discuss science rather than working against each other in the battle for grades.

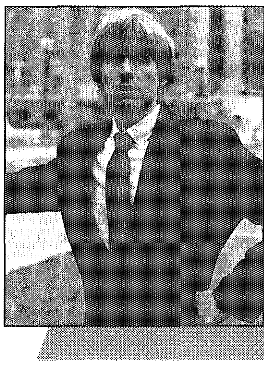
The letter grade and GPA system needs replacement, preferably by a level of mastery system similar to karate or judo. The physics department, for example, could devise a list that white belt physics students should master before they are awarded a yellow belt and so on.

The non-competitive nature of a mastery-level system eases tension and allows students to work together to help each other grasp the subject matter. The lecture hall could become a friendly place to learn new and interesting things about math and science. Instead of having some "jerk" who got 98 out of 100, you now have a tutor or mentor to learn from.

During the lectures, students could work together in small groups with higher-ranking students guiding the lower-ranking students. With the mathematical dirty work relegated to the students, the professor is free to field questions, see how each group is doing, share insights with the students, and introduce new material.

Instead of being confused by someone who has learned and abstracted thirty years ago what you are trying to learn today, you would now have a student who is one or two belt levels above coming down to your level with a simple explanation of what is going on. What's even better, the higher-ranking students have a chance to re-learn old material, gaining a deeper understanding of it.

After five centuries of the same old thing at universities, isn't it time to jump ship and move to a better way of achieving higher education? Learning science and math can be an enjoyable and intellectually-stimulating experience. It could give American's something to be proud of again.



TECHNOLOG
Writer Profile

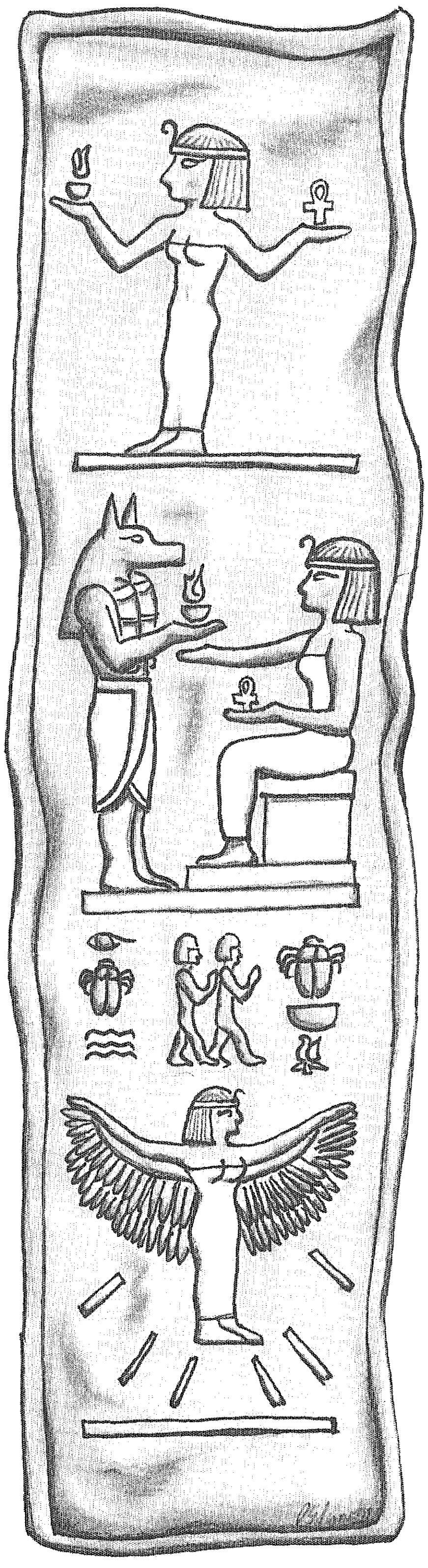
Zac, non-competitive by nature, wrote this article to help achieve inner peace, not to win any of Technolog's *numerous awards.*

Photo by David Sager

Women in Science:

An Overview of the Past and Present

by Darrin P. Johnson



If you were asked to name the people you most admire, who would be at the top of your list? A recent study by the *College Student Journal* showed that of 509 women who were asked this question, only three named a scientist, and all of the scientists named were male (Jacques Cousteau, Albert Einstein, and Thomas Edison). If the same group were asked which historical individuals played a fundamental role in the progress of science, it is likely that most would name at least some, if not all, of the following: Isaac Newton, Albert Einstein, Watson & Crick, Charles Darwin, Galileo Galilei, Copernicus, Kepler, and perhaps even Erwin Schrödinger, Robert Boyle and Louis Pasteur. This example represent the obvious bias that exists toward male scientists in our society.

Why is it that the vast majority of the scientists named are men? The answer lies in the history of science, as well as in the roles of women from antiquity to the present. Two common themes appearing throughout history that may help to explain the lack of women in science are the status subordination of women in society and the perceived fundamental differences between men and women affecting women's role in society.

Antiquity

Age-old writings reveal the existence of what could be considered female scientists. The Theban **Aglaonike** could, as Virgil stated in *Eclogues*, "draw the moon down from the heavens," and may have been able to predict eclipses. And **Agamede of Elis** was believed by Homer to be skilled in the use of plants for healing purposes. Unfortunately, fable and fact have become hopelessly intertwined. Enough information exists, however, to prove that women took part in science from the very beginning.

In ancient Egypt, documents indicate that women of high ranking were able to read but not write. A later document indicates that reading and writing could be found in both the upper and lower classes. The goddess Isis set precedence for knowledgeable women and was attributed much wisdom. She's described by Charles Steltman book *Women in Antiquity* as "Nature, the Universal Mother, Mistress of all the elements, primordial child of Time, Sovereign of all things spiritual, Queen of the Dead, Queen also of the immortals, the single manifestation of all gods and goddess that are" (Steltman, 1956).

Isis was revered as a great physician having medical followers, many of whom were women. Women at that time could attend medical school with men or at Saïs, an exclusively female school specializing in obstetrics and gynecology. Beyond practical medicine, no conclusion can be made regarding the involvement of women in other scientific areas in ancient Egypt.

The city-state of Sparta, known for a liberal attitude toward women's rights, should have produced noteworthy women scientists. Unfortunately, Spartan culture lacked scientists of either sex. Sparta's liberal views did, however, influence the attitudes of other Greek societies that were producing scientists.

The pro-Spartan Socrates (ca. 470-399 B.C.), as tradition indicates, had a female friend named **Diotima of Mantinea**. Socrates argued against the common belief in Athens that, since men and women have different natures, they should engage in different activities. Also, two women purportedly at-

Illustrations by Joyce Rajendren

"The early fathers of the Christian church derived much of their anti-feminist beliefs from the perceived immoral and libertine behaviors of the Roman women."

tended Plato's academy: **Lasthenia** from Mantinea and **Axiothea** from Phlius, both in the pro-Spartan city-state of Pelponnesus. Plato (427-347 B.C.), a distinguished student of Socrates, was also Spartanlike in his sentiments and used Spartan practices in his concept of an ideal state. Later, Plato's student, Aristotle (384-322 B.C.), whose philosophy dominated Western civilization for two thousand years, contemplated with disgust the Spartan views of women's rights. He could not accept the idea of a woman doing more than interfering mischievously in a "man's world."

Athenian men were generally comfortable with Aristotle's assessment of a woman's status, but many found their spouses insufficiently entertaining and inadequately educated. To fill the void, some turned to foreign women called *hetaerae* (companions), who were often Ionians. Pericles took as his hetaera **Aspasia the Milesian,** who contributed to the field of obstetrics and gynecology.

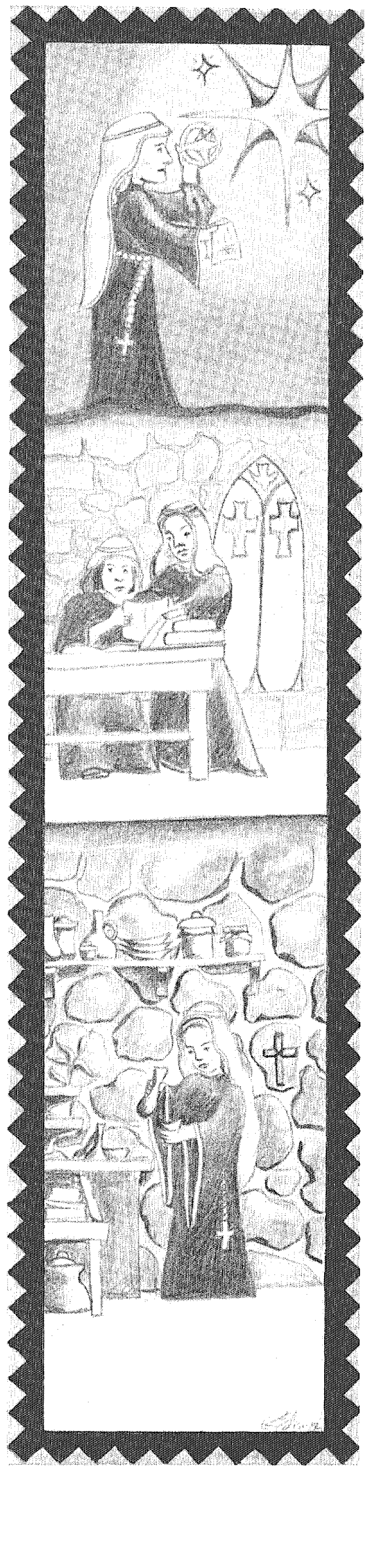
During the Roman Empire, Roman women had more freedom of action and more political power than Greek women. The emancipation of the Roman women, however, seldom led to creative intellectual pursuits. The early fathers of the Christian church derived much of their antifeminist beliefs from the perceived immoral and libertine behaviors of the Roman women. The traditions of patriarchal rabbinical Judaism also influenced early Christians.

The Christian reaction to the perceived depravity of the late Empire helped to hasten the decline of rational Greek science and the coming of the Middle Ages. For the church fathers, the first priority was salvation. Nevertheless, in the city of Alexandria, the best-known female scientist of antiquity flourished. **Hypatia**, a mathematician and philosopher, stood at the threshold of the Middle Ages. Hypatia's changing world reflected differences not only in ways of explaining natural phenomena, but also in the way men and women participated in the process.

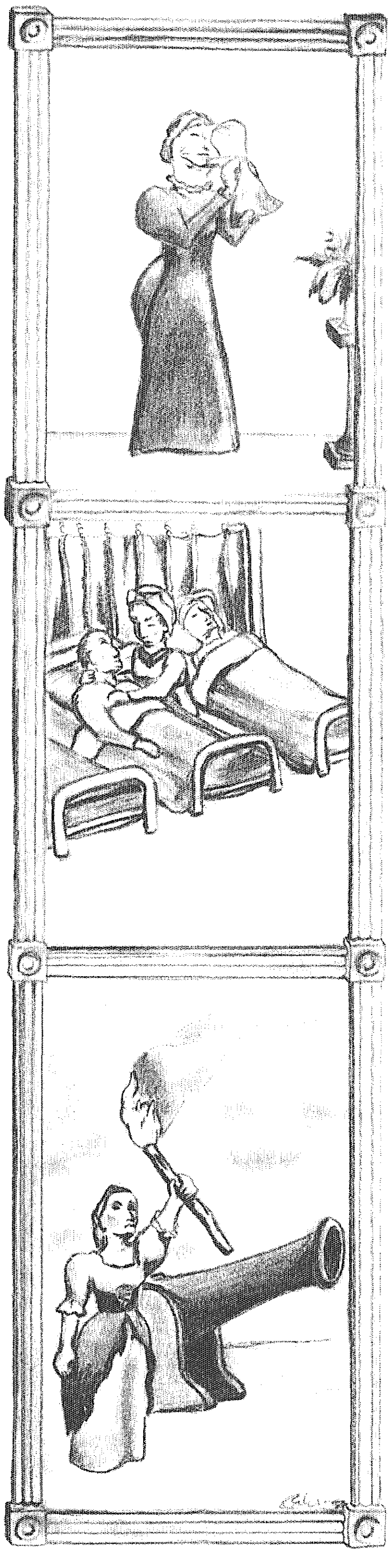
The Middle Ages

The participation of women in science during the Middle Ages reflected their general status in society. Women's status was defined in part through the influences of chivalry and courtly love, which set the code of behavior not only for the knight on the battlefield, but also for men and women in mutual relationships. Although the chivalric system together with the respect for the Virgin Mary idealized women and placed them in a position of moral superiority, such a notion was rarely reflected in their daily lives.

Opportunities for women's intellectual advancement during the Middle Ages arose mostly in the medieval church. By the sixth century, a considerable number of independent women found their way to convents to control their own destiny. During the twelfth century, at the convent of Hohenberg, the abbess **Harrad** either wrote or supervised the writing of an encyclopedia, the *Hortus deliciarium* (garden of delights), an illustrated work containing the history of the world, ethical reflections, and speculations on contemporary knowledge. It included diagrams and discussions on astronomy and geography. Also in the twelfth century, **Hildegard of Bingen,** whose writings include the origins of the cosmos, natural sciences, and practical medicine, attested to the political power of women in nunneries and was heeded by both spiritual and secular leaders.



*"**Maria Cunitz**, a seventeenth century German astronomer, assisted in the simplification of Kepler's table of planetary motion."*



The participation of medieval women in science-related activities was not confined to nunneries. Italian medical schools, especially those connected to the universities of Salerno and Bologna, included women both as students and teachers. Documents from Salerno indicate the involvement of these women in medical studies from **Trotula** in the eleventh century to **Abella**, **Rebeca Guarna**, and **Mercuriade** in the fourteenth century. The renowned anatomist, **Alessandra Giliani**, also taught at the medical school of Bologna during the fourteenth century.

The Fifteenth, Sixteenth, and Seventeenth Centuries

Women played a role in the humanistic vision of the fifteenth and sixteenth centuries, specializing in the arts rather than sciences. **Properzia di Rossi** was a renowned sculptor and painter, works by **Maria Angela Crisculo** are preserved in Neapolitan churches, and the paintings of **Irene di Spilimbergo** of Venice sometimes passed for those of her master, Titian. In England, the fifteenth-century nun **Juliana Barnes** wrote a treatise on hunting; **Lorenza Strozzi**, an Italian nun in the sixteenth century, wrote sacred songs and became famous for her knowledge of both classical literature and science.

In the Renaissance, Italy again offered unprecedented opportunities for female scholars, but most women were active in the arts and humanities rather than in the sciences. Italian women had been admitted to the universities since the late Middle Ages and they could obtain their doctorates to become professors. **Dorotea Bocchi** held the chair of medicine at the University of Bologna, and **Tarquina Molza** studied poetry, Latin, Greek, Hebrew, the fine arts, and possessed a knowledge of astronomy and mathematics.

The personal and academic freedoms accorded women in Italy were much greater than those in the rest of Europe. Seventeenth century France was an exception, however, where both men and women gathered to participate in scientific discussions. Consequently, France produced some notable female scientists, including **Jeanne Dumée**, who pursued astronomy and wrote a book explaining the Copernican system and **Marie Dupré,** a natural philosopher.

Unfortunately, other countries remained virtually unchanged in the wake of new learning which was spanning the continent. Most countries, like Germany, Sweden, and Poland, had few scientific contributions made by women. One of these rare women was **Christina of Sweden**, a seventeenth-century natural philosopher and queen of Sweden. She had a thorough understanding of Cartesian philosophy and was a patron of the arts and sciences. Also, **Maria Cunitz**, a seventeenth-century German astronomer, assisted in the simplification of Kepler's table of planetary motion. These and a handful of other women made contributions to science and helped pave the way for women in the eighteenth, nineteenth and twentieth centuries.

The Eighteenth Century

The dogma of the radically different natures of men and women expanded and was clarified in the eighteenth century. Jean Jacques Rousseau, one of the most "enlightened" philosophers of the Age of Enlightenment, wrote: "A perfect man and a perfect woman ought no more to resemble each other in mind than in features; and perfection is not susceptible of greater and less." This view of Rousseau mirrored con-

*"**Maria Agnesi**, a mathematician, knew seven languages and could argue over a wide range of topics including logic, physics, mineralogy, chemistry, botany, zoology, and ontology."*

temporary feelings about women's roles and suggested appropriate ways of educating them. The skills that a woman needed were connected to her relationship to man: "To please, to be useful to us, to make us love and esteem them, to educate us when young, and take care of us when grown up."

Later, **Mary Wollstonecraft** (1759-1797), in her *Vindication of the Rights of Woman*, protested that it is "no wonder" women often value inconsequential things and "have acquired all the follies and vices of civilizations, and missed the useful fruit." Although she agreed that men were physically superior to women, she contended that women were not content with this natural preeminence of men. Mary's views may have been a bit radical but dissatisfaction among women was widespread, reflecting changes in intellectual tastes. Treatises on physics and chemistry replaced novels, and by the end of the century, groups of women were attending lectures on physics, chemistry, and natural history.

The mechanisms introduced during the eighteenth century whereby women could participate in scientific pursuits were superficial, though these pursuits were positive achievements. Despite many restrictions, both men and women recognized new possibilities. A few eighteenth-century women responded with solid scientific achievements, making important contributions to the realms of data collection, theory, and technology.

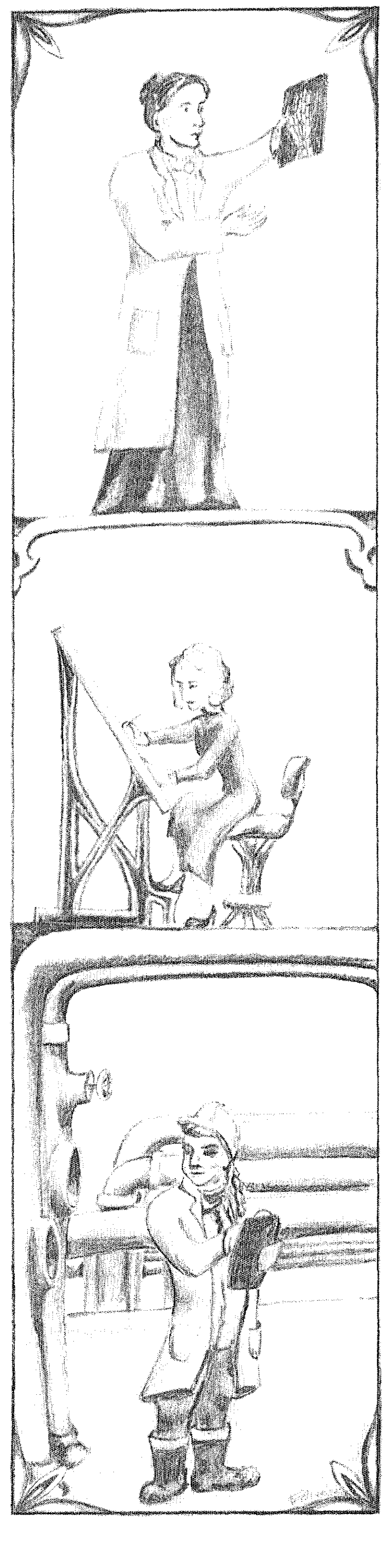
Maria Agnesi, a mathematician, knew seven languages and could argue over a wide range of topics including logic, physics, mineralogy, chemistry, botany, zoology and ontology. Her reputation for brilliance convinced many of her contemporaries that women were capable of abstract mathematical thinking. Furthermore, **Caroline Herschel,** another important role model for future women scientists, made considerable contributions in astronomy. As an observer, she added to the number of facts in astronomy available to scientists. She substituted accuracy and perseverance for inadequate training and a lack of inclination for abstract concepts, assuring a place for herself in the history of astronomy.

The Nineteenth and Early Twentieth Centuries

With a few notable exceptions, women in the nineteenth century frequently engaged in data-gathering ("the observer role") rather than in the idea-creating components of science. Fortunately, the exceptions increased as the century matured. By the early years of the twentieth century, not only were more women participating in theoretical science, but an educational system trained women to emerge as theoreticians.

Educational reforms, alongside the political changes of the suffrage and abolition movements, increased the likelihood of women active in science. Initially, the justification for a woman's education was that it rendered her more useful as a daughter, wife or mother. Progression beyond the rudiments of reading, writing, and arithmetic was considered a luxury for females during most of the nineteenth century. Nevertheless, the successful career of **Ellen Swallow Richards,** the founder of home economics, illustrated how science would become an acceptable pursuit if it could be shown to make women more competent in their roles as daughters, wives, and mothers.

Women encountered more resistance when they attempted to penetrate post



"The contributions of female scientists throughout history are often obscured by the achievements of their male counterparts..."

secondary education. The situation was improved by the founding of women's colleges, such as Vassar (1865), Smith (1875), and Wellesley (1879) in the United States; and Girton (1869), Newnham (1875), and Somerville (1879) in England. France, Switzerland, Sweden, and Denmark opened all universities to women by the third quarter of the nineteenth century.

The new educational freedoms allowed many women scientists to go beyond the observer role. **Marie Curie**, a physicist and chemist who won two Nobel prizes, and the, **Antonia Caetana Maury,** surpassed their roles as mere observers. These women, and many more like them, paved the way for contemporary women scientists to play an active role in the theory and observation involved in science.

Conclusion

The role of women in science has clearly changed throughout history. During ancient times, most women scientists played the healer role or worked with obstetrics and gynecology. From the late antiquity period through the Middle Ages, women were able to explore other fields including math, anatomy, general medicine, and natural sciences, but the roles were as observers and not theoreticians. The fifteenth through eighteenth centuries saw women as a contributing part of most natural and physical sciences. In the nineteenth and early twentieth centuries, the role of women scientists changed with increasing access to education, resulting in women scientists becoming both observers and theoreticians.

The contributions of female scientists throughout history are often obscured by the achievements of their male counterparts, but past women scientists paved the way for future generations of women to enter and became successful in science. Unfortunately, many roadblocks remain for women with science careers, including the age-old question of what roles women should play in society.

In the 1990s, the status of women in science is complex and rapidly changing. In many fields, the visibly obvious discrimination is fading as the number of women entering research grows. Unfortunately, subtle obstacles and unconscious assumptions made by both women and men prevent women from pursuing rewarding science careers without sacrificing their personal and family lives. The future for women in science lies in the successful elimination of overt and covert barriers.

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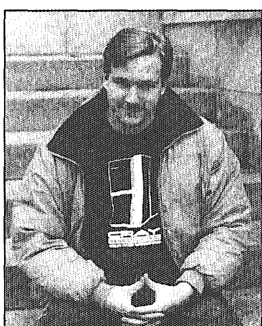
Editor's Note: The author would like to thank Associate Professor John Beatty of the Department of Ecology, Evolution and Behavior for encouraging the author to learn about the history of science and technology.



TECHNOLOG
Writer Profile

You probably won't recognize Darrin with his bulky jacket and clothes on, but he moonlights as a nude model. To see Darrin in action, check out the front cover (he's the one standing in back).

Photo by David Sager

Human Genetic Engineering

Coming Soon to a Hospital Near You

by Diana Kenney

The human urge to engineer just about anything has reached daunting levels of accomplishment. Scientists are now developing ways to chemically or physically close the hole in the ozone layer, and we may soon be living in an engineered atmosphere. Computer wizards have given us virtual realities—simulated environments we can interact with and intellectually "live" in. In the field of medicine, specialists now have the ability to re-engineer people born with genetic defects by giving them the genes evolution forgot to provide or provided in defective form.

The era of genetically engineered people was ushered in on September 14, 1990, confirming decades of science fiction predictions of the technology's arrival. Four people since that date have been the beneficiaries of "gene therapy," which uses modified viruses ("vectors") to introduce new genes into a person's cells. Two of these people are being treated for an inborn immunodeficiency disease (ADA deficiency) and two for melanoma (skin cancer).

Molecular biologists have been thinking seriously about virus-carrier gene therapy since the early 1960s. From the very start, it was conceived of as a medical treatment for hereditary diseases *and* as a potentially powerful tool for eugenic improvement of the human race. But there is strong social resistance to eugenic programs, especially since WWII and the disaster of Nazi eugenics. Eugenic gene therapy, meaning the engineering of healthy people's reproductive cells to enhance the physical or mental traits of their offspring, is still considered socially unacceptable. Gene therapy is now being applied only to the somatic (non-reproductive) cells of individuals, which produces non-heritable changes and is meant only to alleviate that person's suffering from disease.

The first gene therapy recipient, a 4-year-old girl, was born without the gene that codes for adenosine deaminase (ADA), an enzyme critical for the functioning of the immune system. Without this enzyme, the girl is as susceptible to infection as a person with AIDS. In the fall of 1990, under the close scrutiny of numerous federal regulators, Dr. W. French Anderson removed white blood cells from the girl, fitted them with the gene for ADA, and reinserted them back into the child. Preliminary reports show that the inserted gene is functioning normally—the girl's immune cells are now producing ADA. But she is being watched continually for any hint of adverse reactions to the therapy, which may include cancer or the creation of an unpredictable mutant virus in the girl's system.

The vectors used in gene therapy are constructed from mammalian retroviruses, which have the unique ability to integrate their own DNA into the chromosomes of the cells they infect. First, the retrovirus is stripped of any DNA that would allow it to replicate in the body. Second, it is attached to the therapeutic gene of interest by recombinant DNA techniques. The vector with its therapeutic-gene cargo is then mixed with the patient's cells in a laboratory. By a process known as "transduction" the vector inserts itself along with the therapeutic gene into the cell's chromosomes. In the last stage, the genetically engineered cells are transfused back into the patient. If all goes well, the newly inserted genes will begin to function as if they were native, producing the enzyme or protein which, in absence, causes the disease.

What can happen if gene therapy goes awry is not definitively known, since years of tracking the progress of the first human recipients will be necessary before conclusions can be drawn. But one potential problem is the integration of the therapeutic gene in the wrong place in the cellular DNA, upsetting other genetic mechanisms of the cells and possibly killing them. Another possibility is that the presence of the vector or of the therapeutic gene may inadvertently activate an oncogene (cancer gene) or inactivate a tumor suppressor gene, making the patient susceptible to cancer. Finally, the retroviral vector could recombine with other DNA or viruses in the body and begin to replicate. Such a recombinant virus conceivably could (a) carry the therapeutic gene into inappropriate cells or tissues, (b) induce disease in the patient, (c) infect the patient's reproductive cells, or (d) spread to other people.

Before granting permission to treat the first patient, review boards at the National Institutes of Health (NIH) and at the Food and Drug Administration (FDA) spent six years scrutiniz-

Illustration by Melinda Maurey

ing the animal data on gene therapy and French Anderson's clinical proposals. It was decided that the probability of a recombinant virus forming is extremely low and the probability of cancer induction is only slightly higher. Because of this, gene therapy at present is only being administered if the condition of the disease is life-threatening. Also, it is only feasible in the treatment of single-gene disorders, such as ADA deficiency, and in cells which are easily removed, treated, and replaced in the body, such as bone marrow and skin cells.

Ethical considerations, as well as technical prematurity, are currently preventing the application of gene therapy to reproductive (sperm, egg, and embryo) cells. This procedure, known as "germ-line gene therapy," would correct the disease in the patient and also prevent its occurrence in the patient's descendents. Germ-line therapy could eventually eliminate inherited disease from the population. But the prospect of medical experts designing unborn people—playing God—has been sharply criticized by many.

Do we really have adequate perspective on our race to begin manipulating our own evolution?

It is perhaps the "slippery slope" argument against gene therapy that has made it such a scrutinized and debated technology. This argument holds that somatic-cell therapy, which is being practiced now, will inevitably lead to germ-line therapy for medical purposes, which in turn will lead to eugenic gene therapy ("enhancement engineering" of people who are already healthy). But almost everyone is wary of eugenic gene therapy, because who has the authority to decide what traits should be enhanced among human beings? Do we really have adequate perspective on our race to begin manipulating our own evolution?

At present, germ-line therapy for medical or eugenic purposes has not been attempted on humans, and even insiders such as French Anderson are not advocating it. Nevertheless, studies in mice of germ-line therapy using retrovirus vectors began in 1989, so it is not too early to start talking about its application to humans.

The public has been strangely quiet about all of this. During the 1980s, if, how, and when gene therapy should be done was debated primarily by the interested scientists, academic ethicists, government regulators, and science activists such as Jeremy Rifkin. The public has not been roused to the understanding that the technology that inspired such stories as *Brave New World* and *Blade Runner* is at hand. The public has every right to question society's readiness to handle such a powerful tool, especially since the very first gene therapy experiment was carried out without official permission.

This was in 1980, when Dr. Martin Cline of UCLA requested permission from the university's Institutional Review Board (IRB) to try gene therapy on two patients with hereditary blood disorders. The IRB denied the request, stating more animal studies were needed. Cline, nevertheless, carried out the experiments in Italy and Israel, which had no review boards at the time. (When the NIH heard about this, they cancelled Cline's grants and he also lost his departmental chairmanship at UCLA.) With such a historical precedent, people are justifiably worried about what may happen if gene therapy falls into the hands of unscrupulous practitioners.

In the United States, the progress of gene therapy is being so closely monitored by the FDA and the NIH that intentional misuse of the technology is unlikely to occur. But it is time for the public to realize that a "brave new world" of medicine has begun, and we would do well to think carefully about the implications of this power.

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TECHNOLOG
Writer Profile

Unlike most Technolog writers, Diana is not a product of advanced genetic engineering. We try not to hold that against her, though.

Photo by David Sager

IT Year in Review

by James Satter

The future of the Institute of Technology (IT) seemed to be standing on shaky ground last summer. With key administrators coming and going, budget cuts in the works, and plans to revise the freshman advising program, the college looked like it might collapse by the end of the 1991-92 academic year. But it didn't.

Below is a look back at the high points, the low points and some of the more confusing points of the past year.

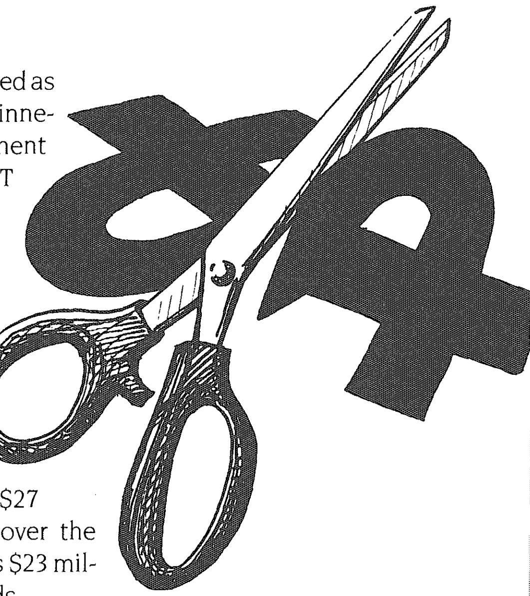
To dean or not to dean

Following Leonard Kuhi's resignation last year, University of Minnesota President Nils Hasselmo appointed IT Dean Ettore "Jim" Infante to the temporary post of senior vice president and provost for the 1991-92 year. Infante, who had been IT dean since 1984, publicly said he'd been eyeing the higher position.

So when the University Board of Regents asked Infante on February 14, 1992, to stay on as the permanent senior vice president and provost, he enthusiastically accepted the offer. The University will hire a permanent IT dean later this year.

In the meantime, Associate Dean Gordon Beavers has been acting dean of the college. To compensate for Beavers' temporary promotion, Associate Dean Sally Kohlstedt took on many of Beaver's responsibilities, and Walter Johnson—a physics professor and former IT associate dean—became a temporary associate dean for the college.

Other new administrators in IT include David Frank and Linda Bruemmer. Frank, a mathematics professor, became the director of IT lower division programs this academic year. Bruemmer, who had served as acting director of the Minnesota Waste Management Agency, was hired as an IT associate dean last May.



Cutting IT out

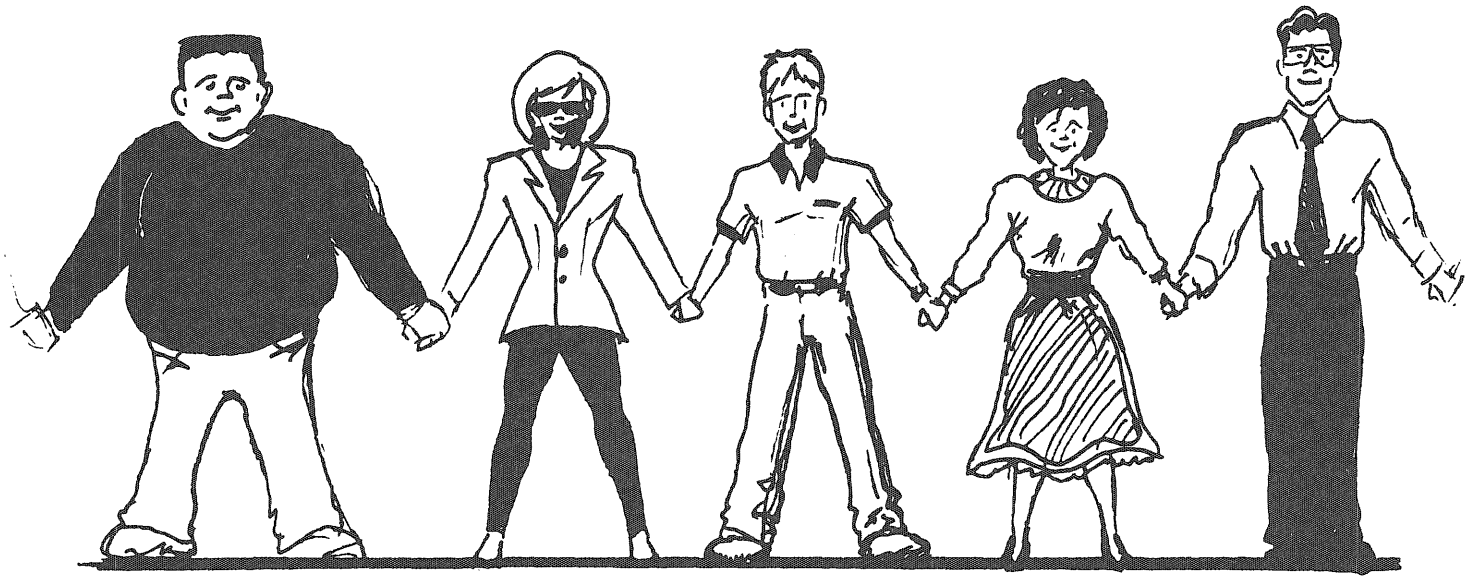
Last June, University officials groaned when Minnesota politicians announced that the University would lose $27 million in state funds over the next two years, as well as $23 million in special state funds.

Although the University as a whole will be affected, some IT-related programs will be especially hurt by the cuts, such as the Microelectronic & Information Services Center, Minnesota Geological Survey, Mineral Resources Center, Productivity Center, Underground Space Center, and the University of Minnesota Talented Youth Mathematics Program.


Acting IT Dean Gordon Beavers


Acting Vice President Jim Infante

Illustration by Wayne Kao, photos courtesy of the Institute of Technology



Through thick and through thin, all out and all in, we're gonna go through IT together

Freshmen who entered IT this fall received special treatment. Unlike those of the past, this year's batch of first-year students were separated into six teams of about 100 students each. Students were expected to stay in the same team when registering for classes throughout the academic year. Each team received a faculty adviser, a professional adviser and a peer adviser.

To ease the social transition into college, the teams also received other perks, including official lounge space in either Lind Hall or the Electrical Engineering/Computer Science building; and each student received a team directory, which listed the names, addresses, phone numbers, hobbies and interests of other students in their team.

This plan to give all IT freshman a sense of team spirit was adapted largely from a similar program which the IT honors program has used for years.

Math and physics get less credit

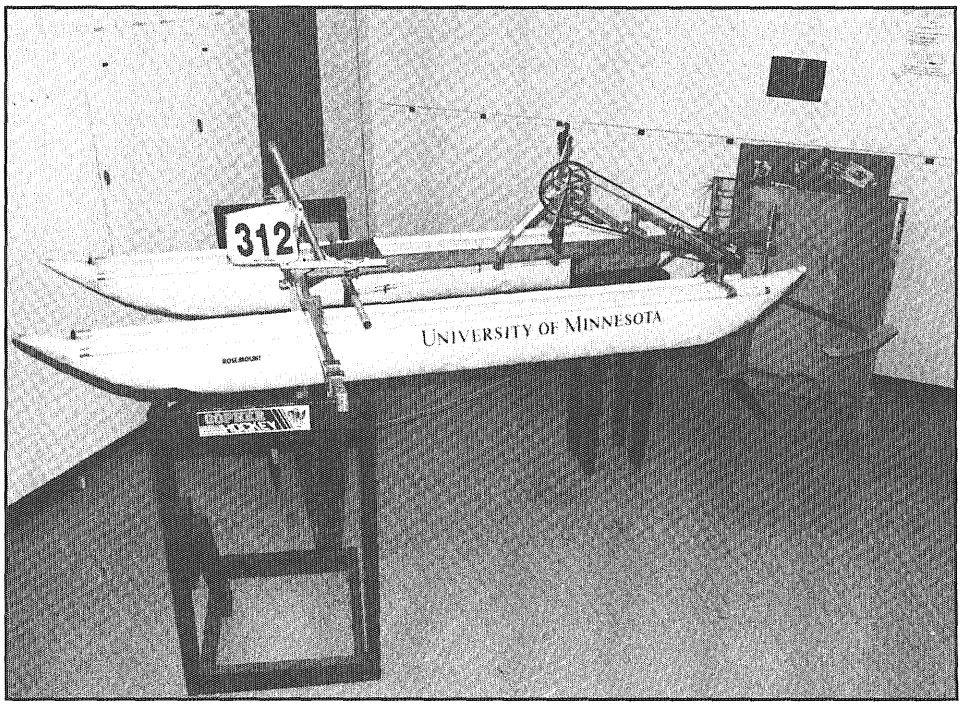
To help students take more classes each quarter and graduate sooner, in fall quarter IT changed all 5-credit math and physics courses to 4-credit courses. Beginning fall 1992, 5-credit chemistry courses will also be reduced to 4 credits each.

Bet your bottom dollar

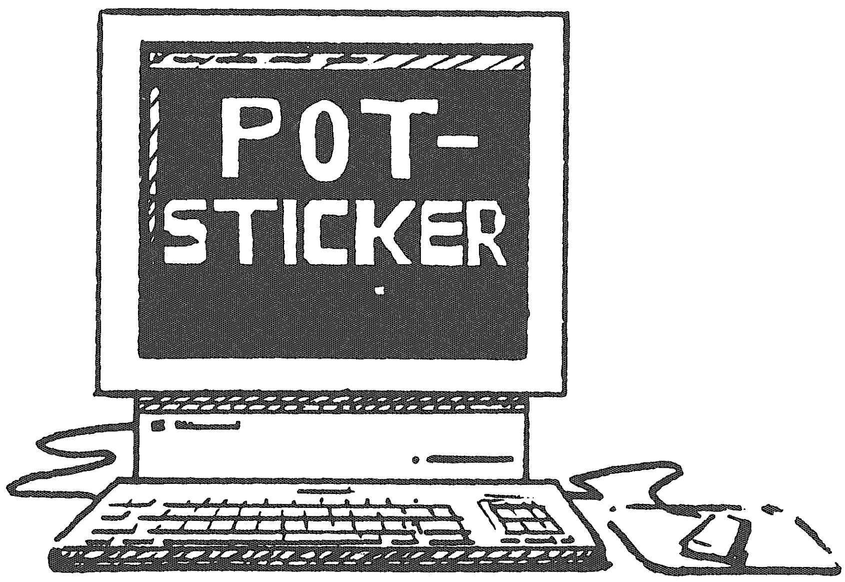
During the summer, University officials threatened to keep the interest that student groups earned on their accounts in the Student Organization Group Investment Trust. Interest earned from a SOGIT account historically belonged to the student organization, not to the University. After the Minnesota Student Association announced plans to protest the policy and withdraw all of its funds from the account, the IT Board of Publications decided to follow suit.

In a letter printed in *The Minnesota Daily* last August, three IT board members wrote: "Because this money comes directly from IT students, withholding the SOGIT interest is, effectively, a covert tuition hike." The letter went on to say, "We are not without compassion, though. We have left $1 in the account in order to help the University weather its current fiscal crisis. The University should feel free to use the interest accrued on the dollar spend way it sees fit."

Following such objections from student groups, the University decided against the proposal.



U of M's human powered hydrofoil vehicle



Additionally, *Fortune* magazine's 1991 list of "100 Products that America Makes the Best" included six products manufactured by firms that were founded by University alumni, including pacemakers by Medtronics and supercomputers by Cray Research.

Minor addition

During winter quarter, the Institute of Technology introduced a new minor option in management. The minor program was created by the Center for Development of Technological Leadership, an interdisciplinary center in IT. To be accepted into the minor program, students need to have a grade point average of at least 2.8, a minimum of 90 credits, and they need to have completed Economics 1104 and 1105.

What's the recipe for Mongolian potstickers?

IT Professor Mark McCahill and roughly 20 staff members in the computer science department unleashed their Gopher Database this academic year, which they began working on in March of 1991. Now available on more than 12,000 University computers as well as about 20 other sites in Britain, Canada and the United States, the program allows users to look up information on a wide range of topics...including the recipe for Mongolian potstickers.

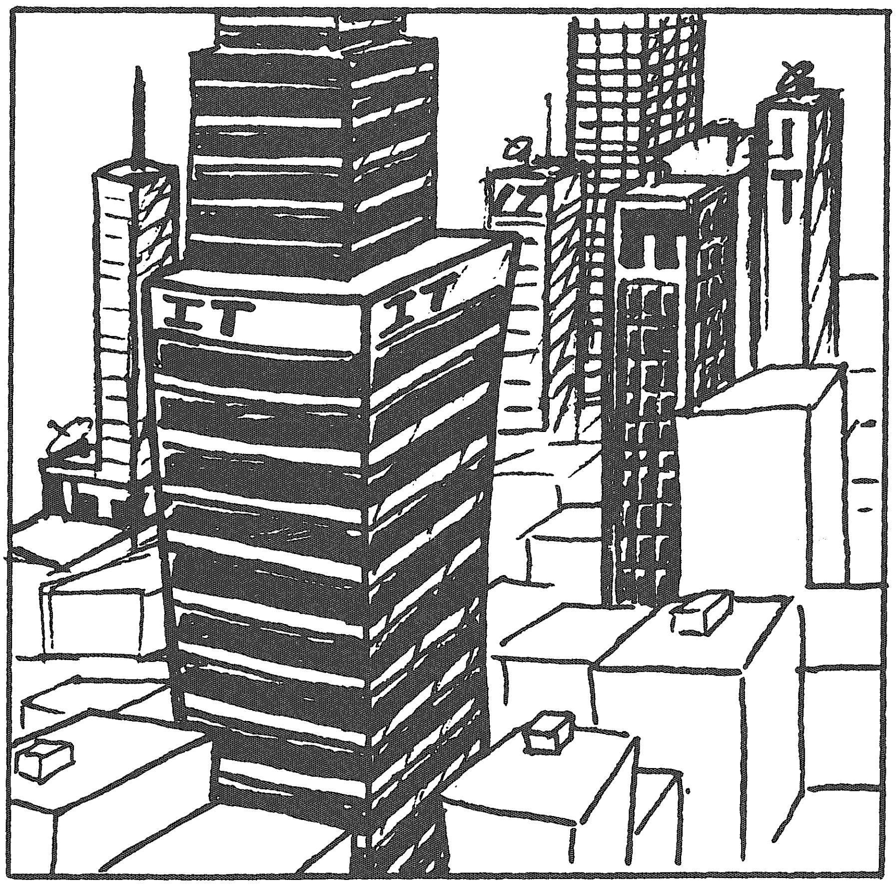
IT team makes "best" vehicle

A team of twelve IT students took home the title of Best Overall Vehicle in the 17th International Human-Powered Speed Championships, which were held in Milwaukee on August 18, 1991. The winning vehicle was a hydrofoil—resembling a pontoon with pedals—which was designed by the IT students during a summer engineering course. The design team consisted of Keith Amdahl, Colin Conley, Mark Desjardin, Randy Garding, Mike Hermanson, Brent Langford, Ben Leonard, Jeffrey Louwagie, Dan Maus, Mike Mueller, Robert Pearson, Doug Sutton, and Peter Tetzlaff. Although they were competing against 22 other entries from around the world, the IT team also won first place in the slalom, second place in the 400-meter criterion and fifth place in the 100- meter sprint.

Mind your own business

At a September 4 press conference, IT administrators Linda Goertzen and John Larson announced the results of a year-long project to determine the number of IT graduates who own their own businesses. The findings were impressive.

Goertzen and Larson reported that at least 271 companies in Minnesota and 413 companies worldwide were founded by IT graduates. These companies generate more than $12 billion in annual revenues and employ more than 100,000 people.



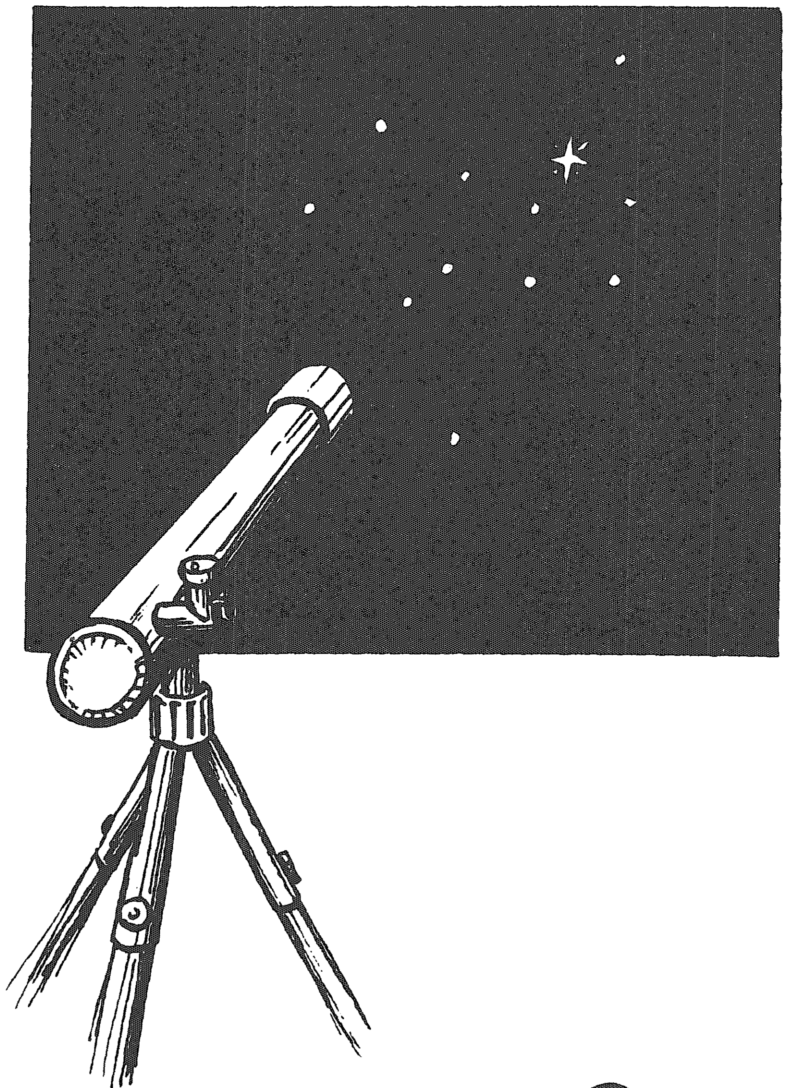
Another first

In December, mechanical engineering student Karen Schlangen became the first University of Minnesota student ever to win the American Society of Mechanical Engineers' Old Guard National Design Contest. Schlangen received the $1,500 first-place prize for inventing a "spherical 4-bar mechanism" which mounts a cellular telephone to a wheelchair.

Claia Bryja and the dozen dwarfs

At the American Astronomical Society's meeting in Atlanta on January 15, IT Ph.D. candidate Claia Bryja made public her findings of what could be the first sighting of brown dwarf stars. Bryja, a doctoral candidate in astronomy, discovered 12 dim objects in the Hyades star cluster, located about 150 light-years from Earth in the Taurus constellation.

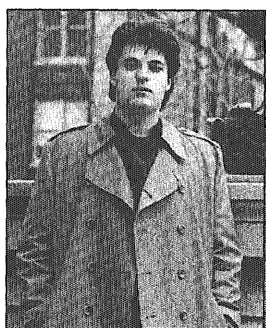
Although no one had ever seen brown dwarfs before, the small stars are necessary to fill the "planetary gap." That is, brown dwarfs are part of the "missing" matter which is not normally visible, but is necessary to compose the mass of the universe. Brown dwarfs are about the size of Jupiter, but are about 20 times as dense. They have surface temperatures of 5,000 degrees Fahrenheit, which is approximately half the surface temperature of the sun.



Although professors in the astronomy department are fairly certain that the objects Bryja discovered are in fact brown dwarfs, further studies are necessary for official confirmation.

Last, but not least

About 525 students will say good-bye to the Institute of Technology when they graduate with Bachelor of Science degrees on June 5. But the graduates will still have IT on their minds for a while because diplomas won't be mailed out until the fall.



TECHNOLOG
Writer Profile

James doesn't really care about the changes this past year in IT because it's his last quarter and he's in CLA. And to think he's made it this far without knowing calculus. We wish him the best of luck in the "real world."

Illustrations by Wayne Kao, photo by David Sager

Isn't Technology Making Life Easier?

by Alice Chen

Sarah picks up the phone only to hear an annoying screech reverberating in her ears. As she quietly slinks away, she realizes she has once again disconnected her brother, George, from the electronic bulletin board at school. George is one of millions of people who recognize the convenience (and inconvenience) of using technology. These advances make school easier, enhance recreation and entertainment time, and affect our communication with other people.

Edu-vision

Slate blackboards have become virtually obsolete. Today, many courses are actually available on television. Every quarter, in the University of Minnesota Independent Study Department, two classes are broadcast on KTCI-TV, Channel 17. Cable is not required, unless you desire better reception, and anybody can watch. This spring quarter the University is broadcasting "Second Language Programs for Young Children: Like Child's Play" (Elem 5321), and "Geography of Minnesota" (Geog 3111) classes over the airwaves and into our television sets. Most classes are aired on Tuesdays beginning at 9 pm, athough times may differ from quarter to quarter. Course schedules are available in 45 Wesbrook Hall.

To earn credit, students must register at the Independent Study office in Wesbrook Hall. Once registered, students receive a study guide with their textbook to aid them in their course of study.

Computer ADVISOR

Aerospace Engineering and Mechanics (AEM) students now have an adviser that never eats or sleeps, yet still tells them what to do. AdvisorZ, or ADVISOR for short, is a computer program that acts as peer adviser for AEM students. The program plans out a class schedule which helps students graduate in the minimum amount of time. It keeps track of grades, tells students when to apply to upper division, prints out unofficial transcripts, and shows what classes the students need in order to meet graduation requirements.

ADVISOR runs on the Apple Macintosh, and can be purchased at the student bookstore for approximately $4.00. AEM students can also bring in a blank disk and make a copy from the master ADVISOR at the AEM office.

Drawbacks

Although the program is required for all students, it does not please them all. Cliff Paulson, a freshman AEM major, felt a bit bewildered about having a computer disk as an adviser. Freshmen like Cliff are not the only ones put off by the program; transfer students and students with many credits may find drawbacks as well. The student's entire schedule must be entered and saved before grades can be recorded. This means that those who enter into AEM in the middle of their college career must go through their transcripts quarter by quarter and enter information for each course before they are able to effectively use ADVISOR. Also, the program includes no records on CLA courses, requiring information on each course to be inputted one by one.

For those with questions not answerable by ADVISOR, AEM students can take heart. Human advisers are still available at the student's advising office, ready and able to assist them.

Getting WAC™-ed

WAC™, Writing Across the Curriculum, is a flexible courseware shell conceived of by Rhetoric Department professor Victoria Mikelonis. Mikelonis worked in conjunction with Deborah Hansen, a programmer in the Department of Agricultural Engineering Technology (AgET), to create and conceptualize the program. Mikelonis also consulted with rhetoric associate professor Ann Duin while creating WAC™.

What is WAC™?

WAC™ is best described as an electronic textbook, notebook, and guide. The program, made for both IBM™ and Macintosh™ computers, consists of an upper and lower window. The top window may include outlines, instructions, and questions that guide students in their learning. The bottom window is a simple word-processor that allows the student to type or take notes while answering questions from the window above. In addition, the document can open into any expanded ASCII word-processor programs, such as Microsoft Word, and can be saved as a normal document without re-accessing the WAC™ shell.

The most impressive thing about WAC™ is its flexibility. Teachers are able to create and edit tutorials according to the needs of their students, by using WACEdit™. Thus the program functions as creatively as those editing it. To prevent tampering, however, students are given the WAC™ files without the WACEdit™ folder.

WAC™ is currently used in several rhetoric writing classes, and by pharmacy students who use it for drug problem evaluation. Outside of the university setting, WAC™ has made an impact at Totino Grace High School, where the program is used in subjects such as biology, social studies, and English.

The program is also an excellent collaborative device which allows groups to work on projects without the need for paper. Rhetoric classes conduct feasibility studies in groups, and guides are found for grant proposals, scientific papers, and memos.

Special uses for WAC™

One special education math teacher also uses WAC™ to teach his students. Since the formula and explanation are laid out in front of the students, they can use the computer's calculator to follow the tutorial and complete problems.

A blind student at the University of Minnesota uses WAC™ in conjunction with *Outspoken*. The computer reads the sentences out loud as he moves the mouse with the aid of a raised template of the computer screen. This gives him the convenience of working whenever he likes, without the aid of a reader. He is also able to type into the word-processor shelf and have the computer read his writing.

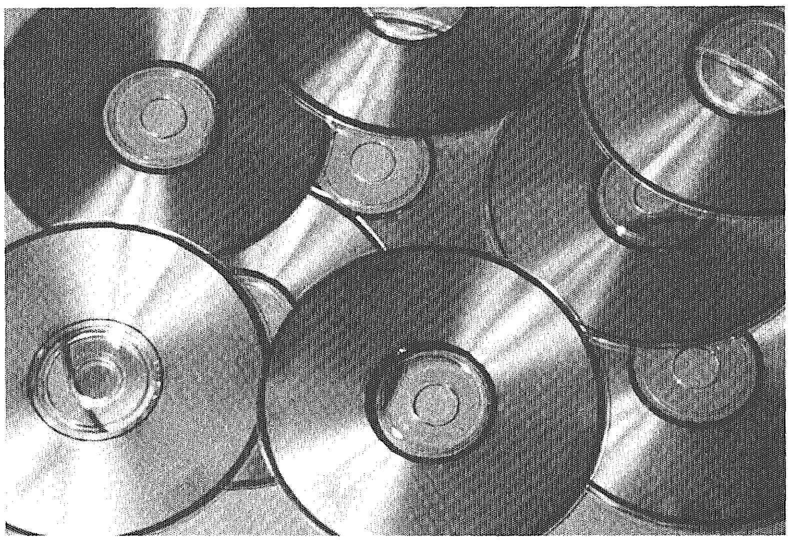
WAC™ *to the market*

It seems that the major advantage of WAC™ is also its main disadvantage. WAC™ is so flexible that most publishing companies are not sure how to deal with the copyright of the product. For this reason, the University distributes the program via site licenses.

One publishing company, however, is giving WAC™ a chance. Macmillan has a four-year lease agreement with the University of Minnesota to use part of WAC™'s capabilities jointly with Hiupe and Pearsall's text, *Reporting in Technical Writing*. The program contains no WACEdit™ folder, so the tutorials cannot be edited. It also has a lock program that prevents those with WACEdit™ to tamper with the text. Since the Macmillan version does not use WAC™ to its full potential, a different name is used—Reporting Technical Information (RTI) Writer.

Another potential marketing plan is to sell WAC™ separately from locked tutorials of various subject matters. This idea has not been pursued, but is foreseen for future distribution.

Mikelonis, Hansen, and Duin hope to obtain funding to further develop WAC™. Currently the program has no room for graphics, which is one of the features that Mikelonis would like to add in the future.



Technology's role in entertainment

The videodiscs used in Video Laser Disc Players (VLDP's) are from the family of interactive videodiscs (IVD) which incorporate sound and motion video with text and stillframe display. Both the Music Corporation of America and NV Philips developed laser videodiscs in the early 1970s. At about the same time, RCA created a non-laser electronic disc system which had a stylus like those on a record player. This system was abandoned in 1984.

Two types of laser discs now exist. One is a reflective videodisc, which is also used in making compact discs. It reads a laser beam that is reflected off of the disc's surface. The other is a transmissive videodisc, which is composed of transparent material. For this disc, the laser beam passes through to a detector on the opposite side.

Current prices for Laser Disc players begin at $400, which will buy a basic player that cannot record digital quality and which has 425 lines of resolution. Other players have features such as clear fast forward, and clear pause. Bob Martens, an electronic sales representative at Best Buy in St. Paul, approximates that 6,500 videodiscs are currently on the market. He describes Pioneer's M90 to be one of the more advanced VLDP's with room for five CD's and one laser disk.

Photos by David Sager

With all of these features, Video Laser Disc technology has contributed not only to the world of technology, but to our entertainment needs as well.

Technology communicates

Telecommunication is one of the fastest growing areas of technology. The development of fax machines, computer networks, and commercial on-line software has changed the world. Businesses and educational institutions can be run from out of the home. The new technology has introduced both convenience and frustration into our lives.

Just the fax

Top-of-the-line fax machines can differentiate between phones, have auto paper cutters, and answering-machine hook-ups. Some fax machines also use plain paper, producing clearer copies than the older style machines in which the paper smears and fades with time. William Cockrell, of Office Max in St. Paul, says personal-use fax's have been growing in popularity because of an increase in businesses run from the home. Fifteen to twenty people per week come into his store to buy fax machines. The prices start at $349, and increase with added features.

Telecommunications

The availability of telecommunications networks has multiplied enormously over the last decade. Networks connecting computers around the world have unified users and increased our power to communicate and exchange ideas. Two major networks include BITNET and INTERNET. The first is used solely for educational purposes while the latter is for commercial, corporate, and educational use.

For example, a professor in Minnesota can easily collaborate research with a professor in Germany, with no telephone tag or difficulty in reaching each other due to time zone differences. By using telecommunications they are able to compile their work, and cooperate with each other to develop breakthroughs in their field.

Unfortunately, the hassles of telecommunications have kept billions of people away. Network accounts and computer hardware are expensive to purchase and maintain. In addition, the frustration of learning how to use a telecommunications network, along with the incompatibilities, can make the effort seem worthless.

Luckily, new programs such as Prodigy are making their way into the consumer market. Prodigy provides updated encyclopedias, electronic mail, and on-line services from the advertisers who fund it. It is somewhat like a bulletin board network, currently costing approximately $20 to buy, and $13 a month after the software is purchased. The new program is much like France's Videotex network, containing phone listings, newspaper classifieds, and electronic mail along with several other services.

Thus, technology has matured rapidly in the last century. Parents who grew up without televisions have children who live in front of them. Computers of the past used audio cassette tapes to store information and now we have disks. In the future our children may learn to view the telephone as we currently view the telegraph. The "hot, new" VLDP's may give way to recordings of three-dimensional viewing with abilities to stimulate all five senses of the human body. Hard copy books may become artifacts as microchips replace the heavy, bound texts. In our minds, technology knows no limits. Who knows what the future holds?

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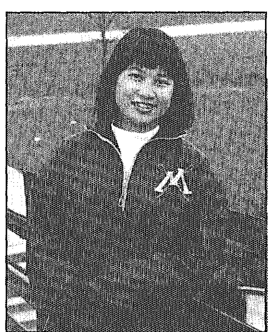


TECHNOLOG
Writer Profile

Alice, a student health advocate in Comstock Hall, pushed herself well beyond normal limits to finish this story in record time. Since then, she's been talking about White Rabbits and Mad Hatters. We at the Technolog diagnosed her with a serious case of lackonious sleeponious.

IT, Therefore I Am

A Look at Plumb Bob, the Blarney Stone, and IT Week

by Laura Sokol

IT (Institute of Technology) Week will commence May 4, concluding on May 9. The theme of this year's event, "IT, Therefore I Am," has a definite origin, unlike most of the history surrounding IT Week. The only recorded history of IT Week lies in articles published in this very magazine, so obviously there's a fine line between what is fact and what is fiction. Plumb Bob, the organization that puts on IT Week, has origins that are less of a mystery, yet some of their historical "truths" are either questionable or vague. And as far as the Blarney Stone is concerned, no one knows what is rumor and what is real.

However, because of their seemingly mythical nature, they provide, at the very least, interesting reading.

Plumb Bob

Plumb Bob is the IT Honorary Leadership Society that plans and organizes IT Week events. Founded in the early 1920s, the initial members were WWI veterans. The core eight men—Byron "Bye" Curry, Julian "Spike" Garzon, Raymond "Ray" Johnson, William "Bill" Kelley, Irving Macgowan, Lloyd "Mike" Mitchel, Frank T. W. Roos, and George C. Schaller—formed the deviant organization. They wrote the original constitution and bylaws on a piece of scratch paper. They chose the name Plumb Bob because, at the time, it was one of the civil engineering tools of the trade.

The criteria for membership was simply that the person be of senior status and have failed a physics or 5-credit math course. With prerequisites such as these, Plumb Bob was hardly an honorary society.

The organization's members usually met at a bar on East Hennepin Avenue to discuss a wide range of worldly and personal problems. A few years later, the "failing a class" prerequisite was dropped to allow certain potential members to join. Once the standards were lowered, so to speak, more scholarly students joined. Ironically, Plumb Bob eventually evolved into an honor society. It has been said that a grade point average of pi was required at one point in history. Soon afterward, Plumb Bob moved from a group of senior men who had failed a class to an honor society which included the outstanding members of their class.

It wasn't until the 1960s that Plumb Bob became the main planners implementing Engineers' Day (E Day) and Engineers' Week (E Week). Before that time, the society had only helped run the events.

Until 1966, Plumb Bob was an all-male organization, primarily because no women wanted to join. The first woman to join was Sally Ahola, and the first female president, Kathy Wittenberg, didn't come along until the late 1970s.

At approximately the same time, Plumb Bob changed from an all senior status group to allowing junior members to join. This was done primarily to provide some sort of stability and continuity within the organization.

So What is the Real Significance of the Blarney Stone?

In 1903 the Blarney Stone was found on campus near what used to be the Mines building during an excavation for the foundation of an engineering annex. It weighs in at about 300 pounds, and is approximately three feet by two feet by one foot. As the story goes, this special stone had a mysterious inscription, "Erin Go Braugh," that "glowed green." On March 16 of that year, an engineering senior discovered the meaning of the inscription to be "Saint Patrick was an engineer." And so it came to be, the following day (March 17) became the holiday observing the Irish ancestry of engineering.

One of the duties of Plumb Bob was and is to guard the Blarney Stone. On Engineers' Day, now called IT Week, members would take the stone out of its hiding place, carry it on a parade float, present it for knighting from St. Patrick, and then hide it away until the next year.

The knighting ceremony at the end of the parade was quite popular from the 1920s to the 1960s, until the Vietnam War when people became more interested in what was happening globally. The parade would end on Church Street where the two people chosen as St. Patrick and the E Day Queen

Illustration by Laura Sokol

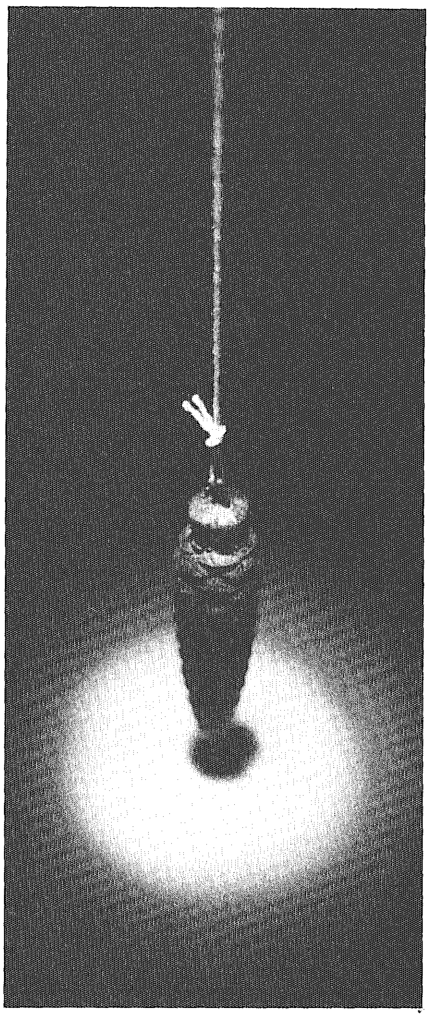
would "knight" the seniors as they kissed either Queen Colleen or the Blarney Stone. Once knighted, seniors became "knights of St. Patrick, defenders of the Blarney Stone." Knighting consisted of St. Patrick tapping the shoulders of seniors with a sword and then allowing the seniors to kiss Queen Colleen. Later, for sanitary reasons, seniors were allowed to kiss the Blarney Stone instead.

The Rivalry

Students in the School of Mines became jealous of the engineers' stone, so they stole it. The engineers retrieved the stone, and soon this became an annual event. Rumors have it that the stone was once ground into a tiny sack of pebbles, but Plumb Bob members insist that they left a fake stone unguarded for bait, keeping the true stone hidden. The Blarney Stone has supposedly also been rolled into the Mississippi and dropped down into a manhole on Washington Avenue.

Later, when the School of Mines merged with IT, a new group took over the traditional stone theft and continue to carry it out, even to this day. This new bunch consists of students in the College of Natural Resources, formerly the College of Forestry. Most every time they get their hands on the rock, they engrave their symbol on it. According to Steve Ebel, Plumb Bob's historian, approximately 20 symbols are engraved on the rock. When asked if the stone was filling up, he said, "It's getting there."

Although the rock's exchanging of hands is a common symbol of the engineer/forester rivalry, it is interesting to note that it's not the only one. At some point in the 1970s, engineers had t-shirts printed up that read, "Only you can prevent foresters." In 1983, the foresters retaliated by hanging a banner on the top of Lind Hall, "IT, the College of Remedial Reading." Well, of course the engineers needed to fight back, so they ran an ad in *The Minnesota Daily* saying that the Forester's Day was cancelled, and charged it to the foresters. Plumb Bob also ran ads announcing, "Free X-mas Trees," during the foresters' christmas tree sale. This type of retaliation was commonplace.

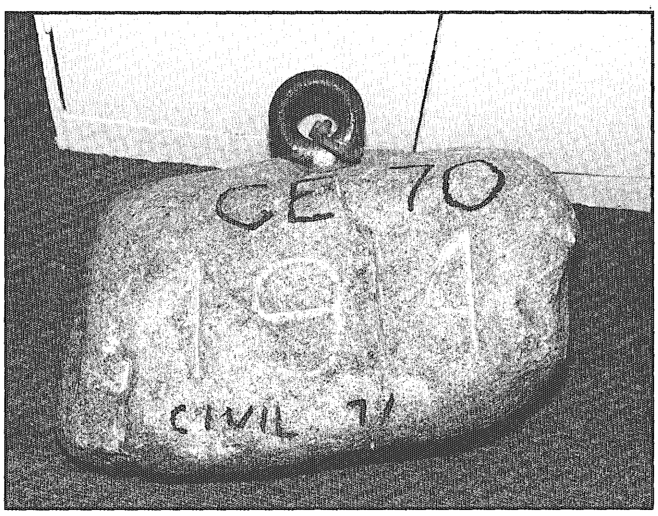


The competition had been taken too far in 1967, though, when Plumb Bob sabotaged Forester's Day. They broke into the St. Paul gymnasium and rigged up the PA system, making personal announcements during the forester's banquet. While there, they also climbed up the wall and hung an, "Engineers are Better" banner from the ceiling. During that same period of time, they spray painted "Erin Go Braugh" on the nearby water tower and, with a chainsaw, chopped down the pole used for climbing-type races. According to police reports, they used the chainsaw to make "threatening gestures" toward the foresters who caught them. Since then, the magnitude of destructive retaliation has lessened.

IT Week: Then and Now

IT Week, originally E Day, expanded into E Week, with E Day celebrated on the Friday of that week. When the College of Engineering changed its name to the Institute of Technology, it also added the School of Mines and the School of Chemistry. Later, in the 1960s, IT also added the scientific disciplines from the College of Science, Literature, and Arts (now the College of Liberal Arts). The new science disciplines complained that the name of the St. Patrick's Day celebration did not include them. Still, for many years the name was left unchanged because the majority of those celebrating were engineers. For a couple of years in the 1960s, the name was changed to IT Week, but it eventually went back to E Week in the 1970s. Finally, in 1982, the name was once again changed back to IT Week, which it has been ever since.

You may be wondering why IT Week isn't held over St. Patrick's Day when, after all, he was supposedly the first engineer. The answer is simple: the weather is just too cold in March. Originally, E Day was held on St. Patrick's Day, and when it was changed in 1923, it was rumored to have caused quite a ruckus.



E Week, as it was called at the time, began to have difficulties keeping up the popularity of this event. In 1981, the Technology Fair was added to revitalize interest in a dying E Week. Luckily, it was a success.

Photos by David Sager

IT Week, 1992

This year's IT Week is scheduled for May 4-9. A general list of events scheduled is as follows:

Monday, May 4
- Opening Ceremonies
- Stevie Ray's Comedy Troop

Tuesday, May 5
- Sand Volleyball tournaments

Wednesday, May 6
- Tech Fair, a two-day fair for students to make contacts with prospective employers
- Awards and Recognition Banquet, honoring IT students who held leadership positions in IT
- IT Class of 1942 Reunion

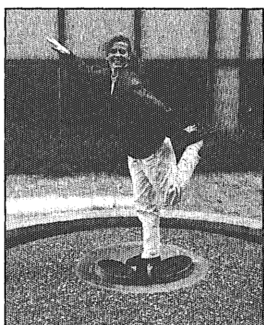
Thursday, May 7
- Tech Fair
- Student events, such as an egg drop or the trike race
- IT Press Conference, announcing the results of the IT Founder's study
- S&T Day (Enterprise Forum), a day-long focusing on the "entrepreneurship" theme
- Founders Recognition Dinner

Friday, May 8
- IT Olympics
- Student events
- Faculty/student volleyball
- Quality Conference, a day-long event consisting of conferences and workshops with internationally renown keynote speaker, Joseph Juran (1924 IT graduate)

Saturday, May 9
- Gold Plus Reunion, an IT alumni reunion of classes before 1942.

plumb bob: a usually conical piece of metal attached to the end of a plumb line. Also called "plummet."

plumb bob: a bob or weight hung at the end of a plumb line used to determine a vertical line.



TECHNOLOG
Writer Profile

This is Laura's last issue as Technolog editor. She's put in so many all-nighters working on the magazine over the past year that she's going to spend a semester recovering in Australia, where she plans to put in just as many all-nighters partying down-under with her Aussie friends. We hope she can overcome the language barrier.

Technolog Crossword Contest

by Eric Klis

Do you want something more satisfying for finishing a crossword than a warm fuzzy feeling? Well, here's your chance. What's more, you might win $10! Here's what you have to do. First, complete the crossword below, savoring the scientific entries while struggling through the liberal arts ones. You will notice the clues for the four long horizontal entries say *See Instructions*. Well, see here: a message is to be found by reading, in order, 20-across, 30-across, 49-across, and 64-across. Find what this message refers to, and write this **word** (not the message) on a piece of paper, along with your name, address, and phone number. Drop it off in Room 5, Lind Hall by Wednesday, May 13. We'll draw one entry at random from the correct entries received and give that person $10 in cash! Answers and results will be printed in the ***IT Connection*** available May 26. Good luck!

ACROSS

1 *Chiroptera* member
4 1/24, in gemology
9 Trim away (like a skin)
13 The Buggles' "___ Killed the Radio Star"
15 Where to find the Dioscuri
16 Notion
17 Great pain
18 Virtue embodiment
19 One with flaming pants?
20 *See Instructions*
22 Result
24 Wine glass part
25 Chronic inflamation of the sebaceous glands
26 Gumshoe
27 Gateway Arch architect Saarinen
29 Academic credit unit
30 *See Instructions*
37 One's likes and dislikes
38 Made verse
39 Alias abbreviation
41 Burden
42 Panty quests
43 Be subservient to
44 Fad candy of yesteryear
45 Most important commodity
47 "Alexander's Ragtime Band" composer
49 *See Instructions*
52 Rows
53 Against
54 Classify
57 Covert Chinese society in the United States
59 Be hard up for
63 Elected
64 *See Instructions*
66 William Jennings Bryan defeater
67 Transpire (as time)
69 Smelly lily family bulb
70 Buffalo's lake
71 Felt the presence of
72 Word after land or city
73 Letter opener
74 Tarries
75 Language suffix

DOWN

1 Redneck
2 Sun-dried brick
3 Dwellings
4 Kline of *Soapdish*
5 Stupefy
6 Baptism, for one
7 *Falcon Crest*'s ___-Alicia
8 Tedious
9 Steals
10 Farewell, to the waiter of 15-down
11 Produce a chemical change
12 You are here
13 Moving vehicles
14 Bluto's beloved
15 Waiter in 21-down
21 Son of King Priam
23 Assets quickly available as cash
28 67.5 degrees, to a compass
29 Garment borders
30 Subsides
31 David Leisure's commercial alter ego Joe
32 *Vitis vinifera*
33 Minnesota Twin Davis
34 Ireland's Douglas and Stevenson's Mr.
35 Postpone a bill indefinitely
36 Yarn coil
37 Remove the volatile parts from by distillation
40 *Atlas Shrugged* author Rand
42 Super Bowl XIV loser
43 Municipal regulation
45 Trap
46 Acidity
47 Lotto-like game
48 An hour ahead of CDT
50 Barnyard denizen
51 Died with a lump in one's throat?
54 Pretended
55 Stock unit
56 Bulgaria's capital
57 Slightly soused
58 Desert watering holes
60 Sewing machine inventor Howe
61 Abscond with a lover
62 0.00001 newtons=1 ___
64 Plato of *Diff'rent Strokes*
65 13, 24, etc.
68 Rent

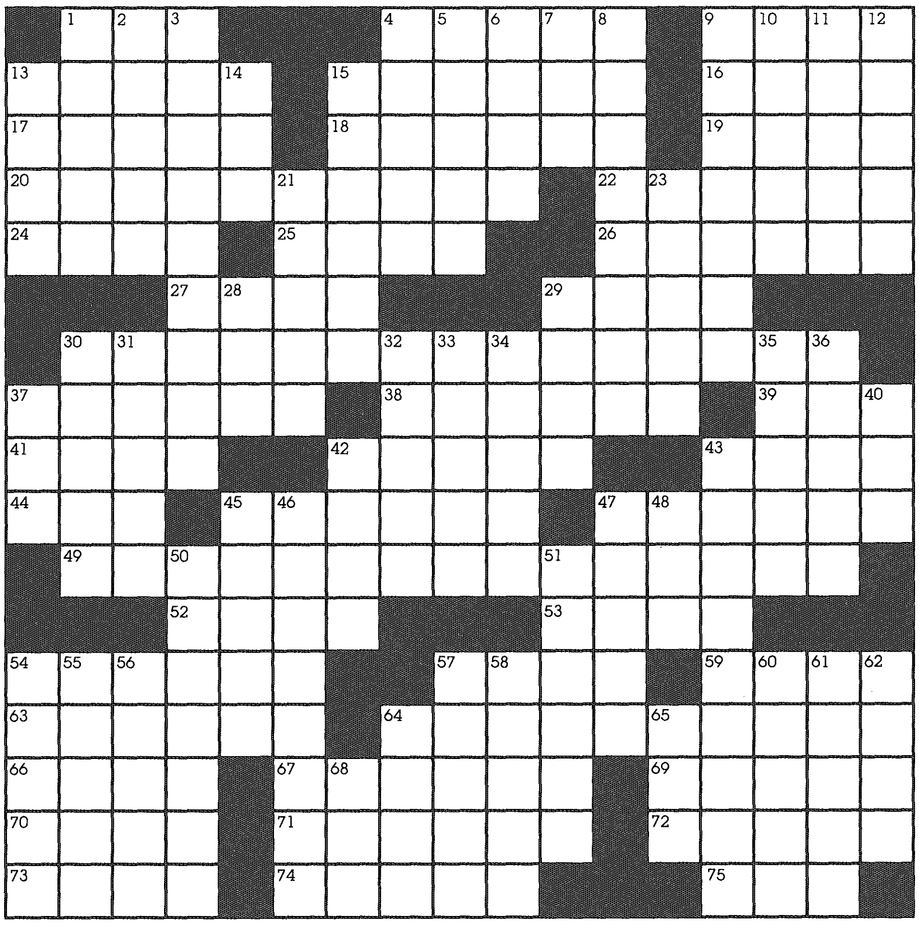
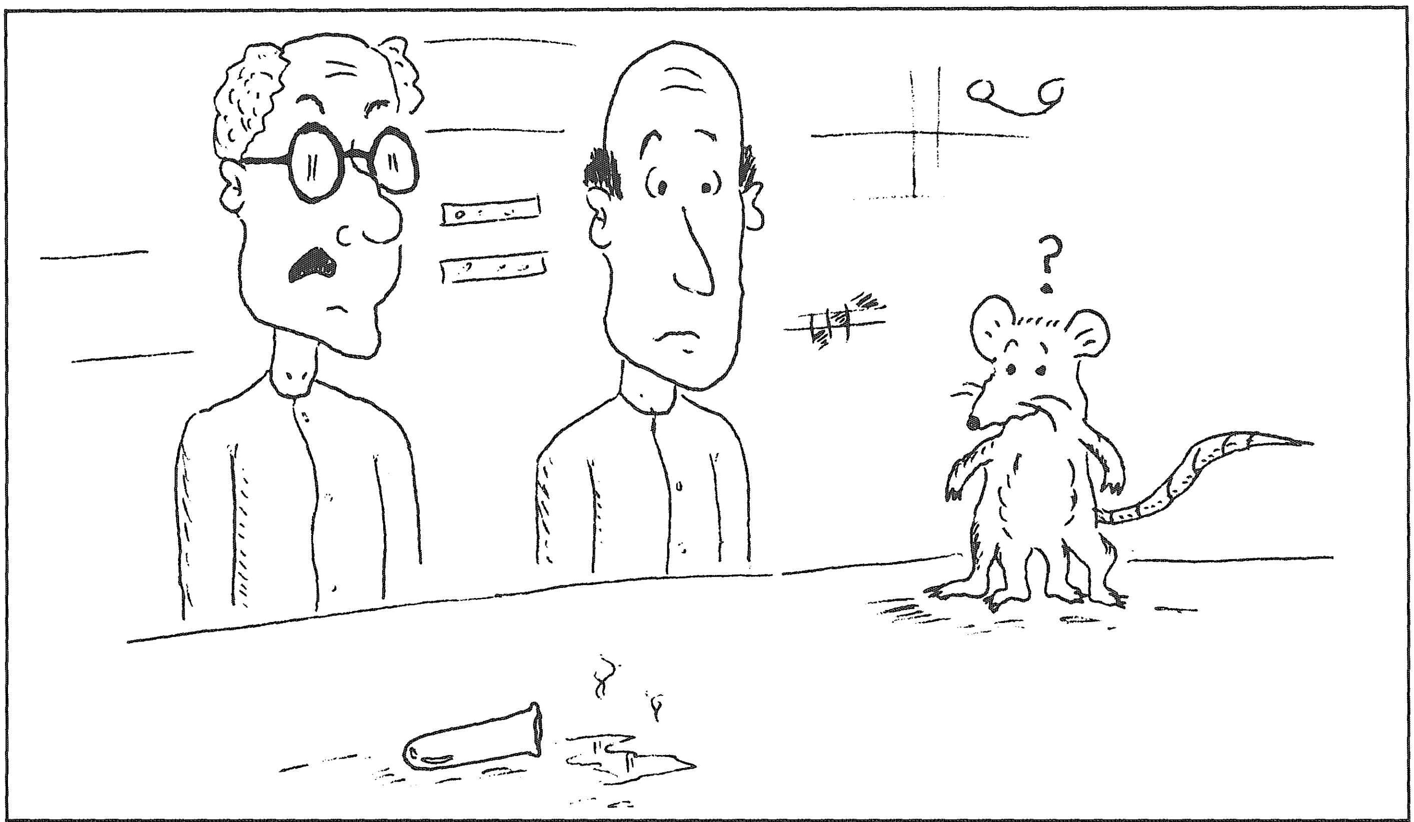
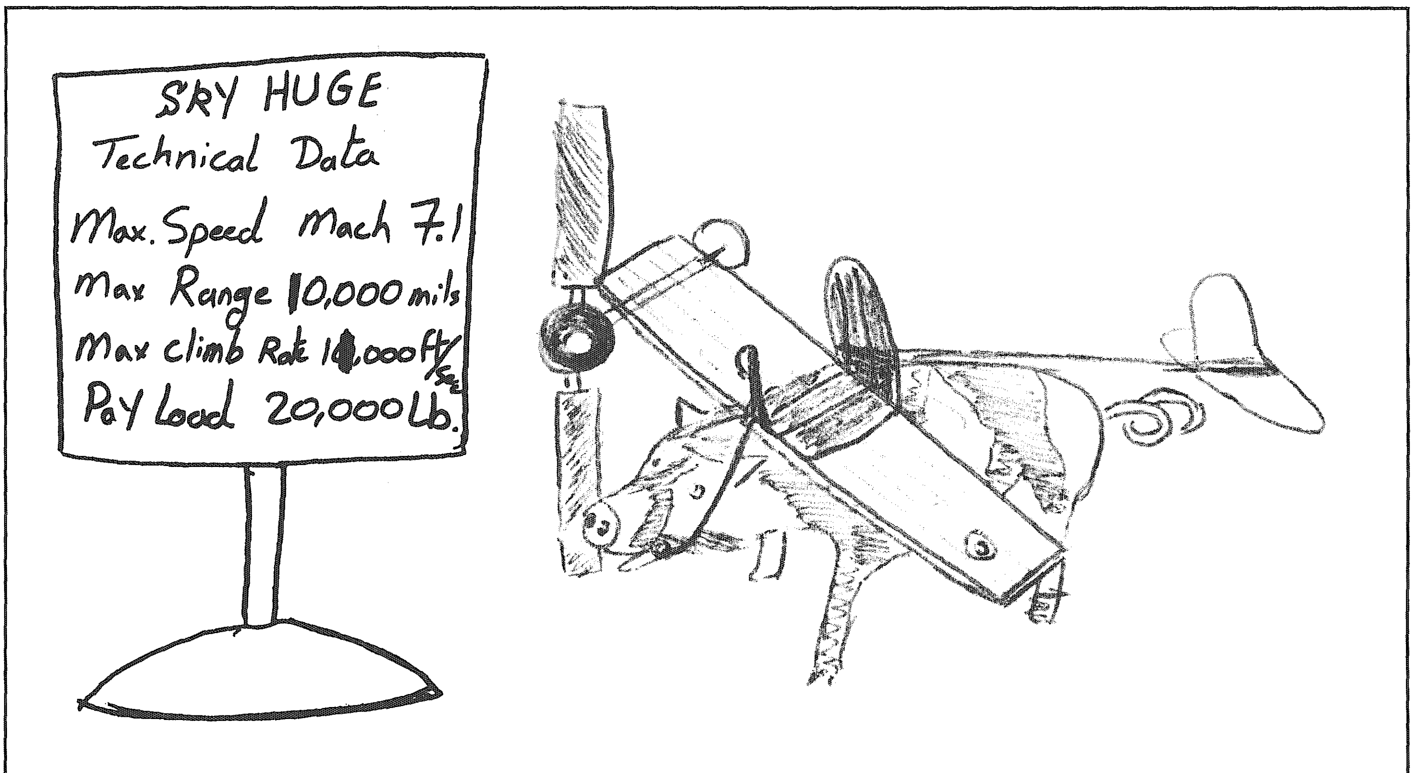


Illustration by Brian M. Kraft

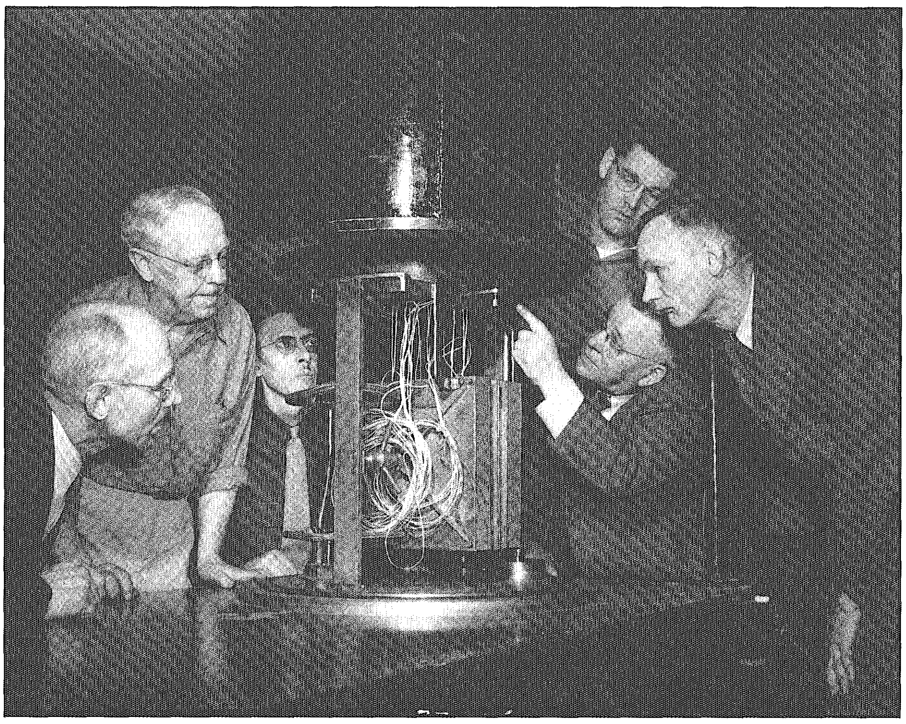


"Are you sure you added the right gene?"



"General, that may look like a ceiling fan nailed to a board on the back of a camouflaged pig, but look at the technical data we've specially prepared..."

Technolog Caption Contest



And the winner is...

"Here, put your tongue on this."—Ben Coifman

Honorable mentions go to...

- "Whose gum is that?"—Scott Anders
- "...and I believe that the fluctuations in the test results are being caused by that squirrels' nest."—Patrick Cramer
- "Hey, does anyone have any idea what this doohickey does?"—Ben Coifman
- "Nils' secret weapon against budget cuts."—E. Rosa
- "Watch what happens to my hair if I touch this."—Ben Coifman
- "Let's call it 'the transistor.'"—Wes Bue
- "See?...Here, in small print....Made in Taiwan."—Krystyna Shudy