MINNESOTA TECHNOLOG

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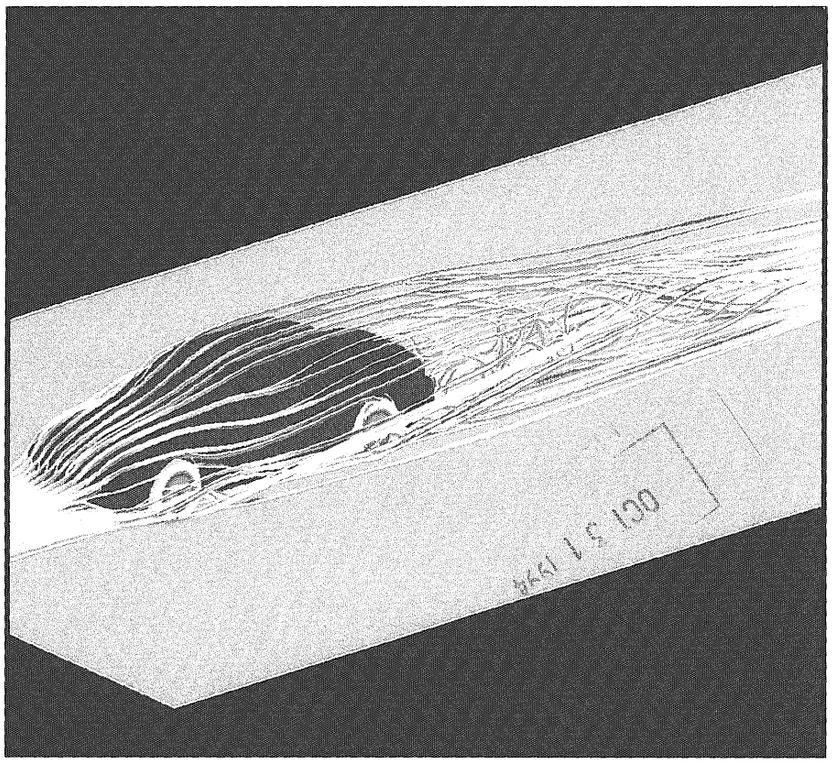

High Perfomance Computing

- Army High Performance Computing Research Center
- Minnesota Super Computing Center/Cray Research

The AHPCRC: a great resource for the State

Why feature high performance computing? I have heard from some that supercomputing is obsolete. These people reason that with the advent of Pentium processors and Power Macs, most research can go on just fine from the researcher's desktop. Well I don't agree and here's why.

Perhaps in terms of numbers of articles published without the aid of supercomputing, the view I wish to assail is correct. The majority of research does not require powerful computers. However, most researchers make so many assumptions about the systems they are modeling that the equations they use are not very complex. But the problem with many of these assumptions is that the more of them one makes the less the system resembles natural phenomena. If one wishes to model even ordinary natural phenomena, the complexity soon overwhelms the researcher. So, many researchers are faced with having to make simplifying assumptions.

But with the the development of massively parallel computers, we can now model quite complex systems without making too many simplifying assumptions. So our models better resemble the phenomena we are trying to understand. This is why supercomputers are so important. They provide a means with which our seemingly chaotic world can be modeled with fewer assumtions.

Take an example from basic physics. When I took engineering physics many years ago, I was struck by the absurdity of the situations we worked with. I simply had not encountered blocks sliding down frictionless incline planes. I wanted to calculate the wind resistence on the exterior of my father's Plymouth.

Continued on the back flap, page 18.

Staff Profiles

James Mathewson
Editor in Chief

I'm working on a Masters in Scientific and Technical Communication. I am a TA in both the Rhetoric and Mechanical Engineering departments.

As far as career plans, I am keeping my options open. I enjoy working with publications, teaching and training. My career will consist in a combination of those three elements. But the exact proportion of each depends on job markets.

The highlight of my summer was a recent canoe trip to Ontario's Quetico Provincial Park. The hard work payed off with some startling discoveries of ancient Indian paintings, plenty of good fishing, and beautiful scenery.

Julie Sivula
Art Director

Hi! I'm a senior at the University (finishing in four years!) studying visual communications, photography, and graphic design. I'm getting lots of experience working for Technolog and The Minnesota Daily.

When I graduate, I'd like to combine my interest in science with my experience in art direction to create my very own science magazine. But, if that doesn't work out, I think I'll take off and travel around the world for a year, settle down in Texas, go to medical school, and become a pediatrician.

In my spare time (what's that?) I like to watch Cosmos videos (Carl cracks me up), think about the future, go out dancing, and take weekend trips to get away.

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About the Cover

One step of a full-motion, 3D finite element analysis of flow around a Saturn automobile. At each step, a system of equations with 1,638,389 unknowns is solved.

Former Grad School dean takes Deputy Director post at NSF

On July 15, Anne Petersen left her position as dean of the Graduate School and vice president for research at the University and started work at the National Science Foundation (NSF).

In April, Petersen was appointed to the position of Deputy Director by President Clinton. In June, she was confimed by the U.S. Senate. In July, she was sworn in.

"It's very exciting. The job provides me with a chance to do a variety of things that have national significance."

--Anne Petersen, NSF deputy director

She is the first woman ever to hold either of the top two NSF positions.

In the post, she is the foundations chief operating officer. That job entails responsibility over all funding granted by the foundation.

Petersen said she is excited by two recent developments pertaining to her organization that occured in early August.

First, the Clinton administration released its report "Science and the National Interest." She said this is a document which demonstrates the administration's committment to scientific research.

Second, congress approved a 14 percent budgetary increase for the NSF for the 1994-1995 fiscal year. That's more money than the foundation requested. The new budget calls for nearly $3.9 billion.

"In a time when everything is being contained, getting more money than we requested is a great surprise. We hope it isn't a one-time deal."

--Anne Petersen, NSF deputy director

U hosts national astronomy conference

The American Astronomical Society held its annual conference at the University in the first week of June.

Several astronomy graduate students presented their work at the week-long conference.

The University of California-Berkley's Center for Extreme Ultra-Violet Astrophysics presented perhaps the most intriguing project at the conference.

Scientists from Berkeley have established an Internet link between K-12 school kids and a network of satalites.

Also at the conference, the National Center for Supercomputing Applications presentated a detailed computer model of the universe as we know it.

U Geometry Center gets two-year NSF grant extension

In July, after first visiting the University campus on May 20, members of the National Science Foundation (NSF) renewed the University Geometry Center's funding for two more years. The grant will add $4 million to the center's funds.

The center's mission is to provide geometric visualization techniques for teachers at a variety of levels.

The NSF evaluation team was particularly interested in the center's outreach programs, as those were found wanting in an earlier review.

> *" We're looking more towards . . . the actual technological support for faculty members of various departments accross the country."*
>
> **--Richard McGee**
> **Geometry Center director**

Since that review, the center has implemented many new outreach programs.

U researchers gain crucial Jupiter data

Many members of the University's Department of Astronomy are licking their chops in the wake of the violent collision between Jupiter and the comet Schumacher-Levey.

The collision provided some surprising spectacles for earth-bound scientists.

For instance, the collision apparently caused violent chemical reactions on the surface of the solar system's largest planet.

The reactions resulted in planet-sized scars that remained on Jupiter for several days after the collision.

U reserchers' experiment boards Schuttle

In July, University scientists Jennifer Stoehr and Douglass Ohlendorf developed experiments that were conducted aboard Space Schuttle Discovery.

> *We were able to grow crystals under conditions in near-zero gravity that we were not able to on the ground.*
>
> **--Douglas Ohlendorf, associate professor of Biochemistry**

The scientists conduct medical research that could lead to inhibitors or vaccines for toxic shock syndrome and the flesh eating bacteria.

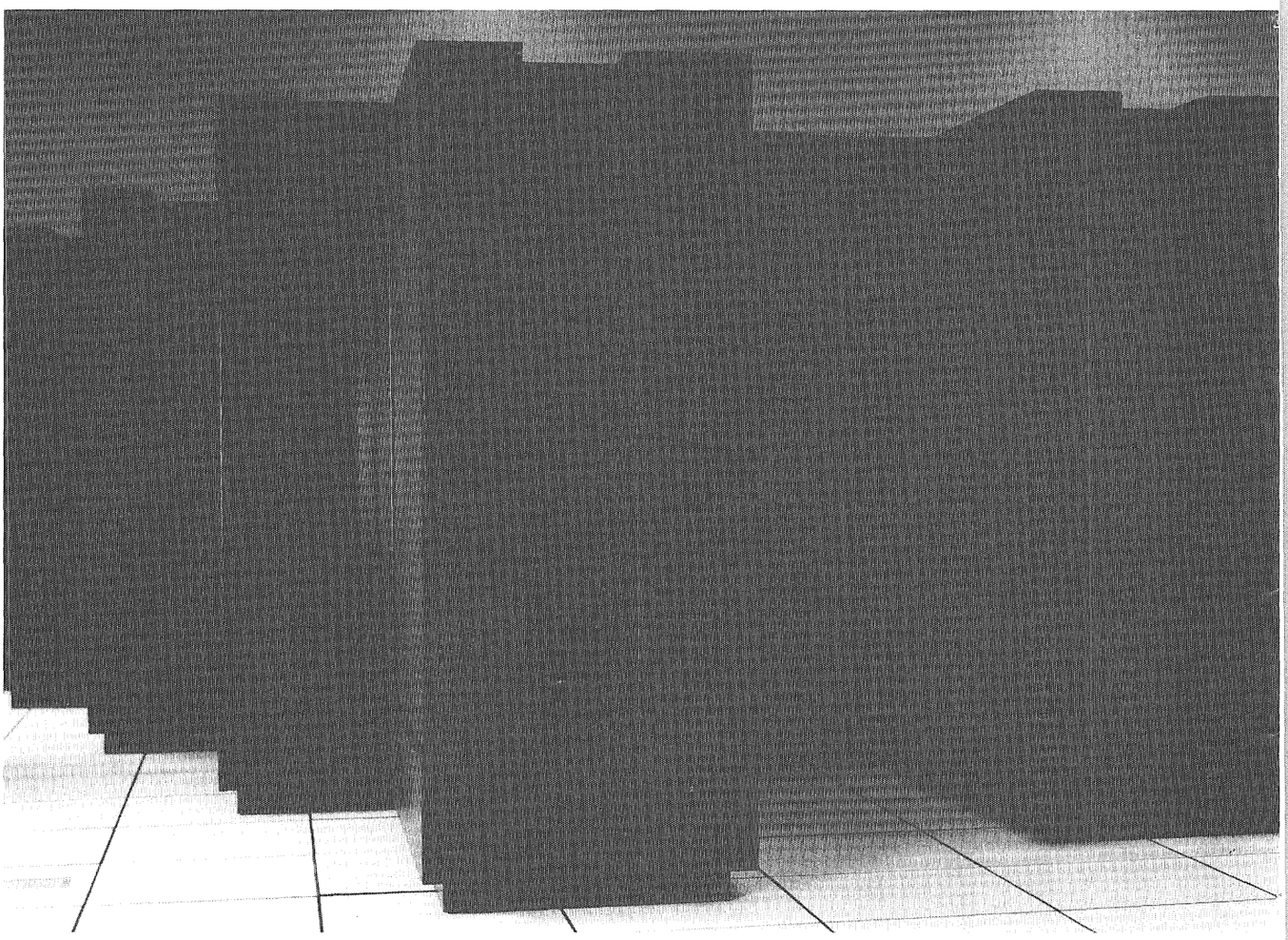
The research consists in growing crystals that contain proteins commonly produced by the offending bacteria. Once the crystals are grown, they can determine the structure of the protiens.

The near-zero gravity conditions of space are ideal for growing these crystals.

--Compiled by Aaron Osterby and James Mathewson

AHPCRC keeps

Professor Tayfun Tezduyar wants to ensure that the University remains a center of High Performance Computing (HPC) research.



The thinking machines CM-5 is reportedly the most powerful and widely used computer at any university in the world.

professor busy

Tayfun Tezduyar's work in fluid mechanics and dynamics gives us a glimpse of the future of high performance computing. As its director, his commitment to the Army High Performance Computing Research Center (AHPCRC) enables others to do multi-faceted research. His leadership, both by example and by title, provides direction for the center and gives the University a chance to continue as a hub of leading-edge research.

The AHPCRC

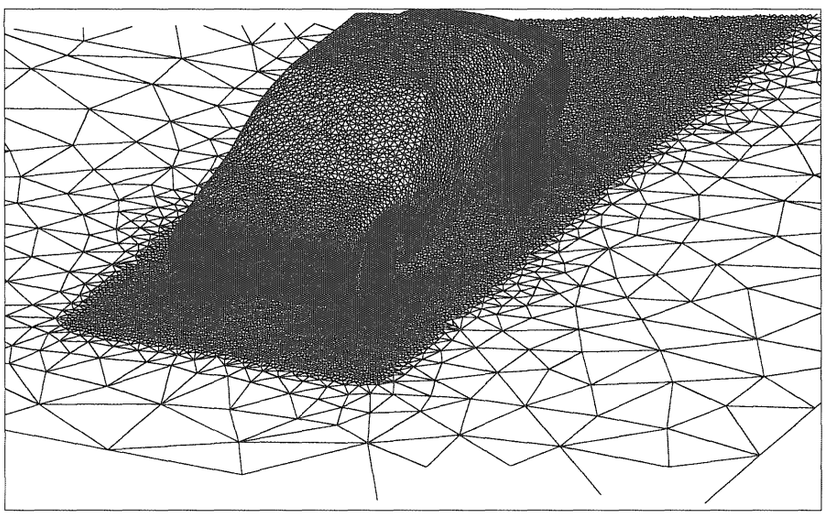
Founded in 1989, the AHPCRC's mission is to provide a nationwide leadership role in HPC research. With the initial five-year, $50 million grant, the AHPCRC purchased two massively parallel Thinking Machines computers, the CM-200 and the CM-5. The grant also helped set up the center, including funds for a large number of post doctoral fellows, graduate students, training and outreach programs and a partnership with three other universities — Howard University, Jackson State University and Purdue University. The partnership was a condition of the original grant proposal that helps foster national scientific collaboration and diversity in the HPC field.

Another important resource funded by the grant is the Graphics and Visualization Labratory. This state-of-the-art facility helps researchers put their models into a form that is easy for the layperson to understand. Many of the full-motion, 3D graphics (see cover) require the solution of millions of equations per step. A step is just one frame in a full-motion, 3D reel. So for each reel, there are hundreds of millions of equations solved.

The CM-5 computer can solve over 500,000 non-linear equations in 20 minutes at peak performance...and has a memory of 28 Gigabytes — 700 times the average desktop computer.

This is all made possible by the crown jewel of the AHPCRC, the CM-5. With 896 processing nodes in parallel, a researcher can set it working on a multitude of equations at once, thus tremendously speeding up the overall computation. The machine can solve over 500,000 non-linear equations in 20 minutes at peak performance. Rarely achieved, peak performance is defined in terms of how many processing nodes a researcher can get working on a problem at once. The CM-5 has a memory of 28 GigaBytes — 700 times the average desktop computer. Simply put, the Army's CM-5 is the largest of its kind at any university. Such a powerful resource is not idle very often. It is reportedly the most heavily and widely used massively parallel scalable computer in the world.

The AHPCRC shares resources with the Minnesota Supercomputer Center (MSC), located one block closer to the University than the AHPCRC on Washington Avenue and Interstate 35W. Those resources include a new Cray T3D, a Cray Y-MP C90, a Cray-2 and a Cray X-MP. The Center holds a con-



A **finite element analysis** is one of several numerical methods that allows the translation of governing equations of a physical problem into a form that a computer can work with. What distiguishes finite element analyses from other numerical methods is that they are applicable to problems involving complex geometries.

In this finite element analysis, airflow past a Saturn automobile at 55 miles per hour is simulated. The finite element mesh was generated with an automatic mesh generation system developed at the AHPCRC by Andrew Johnson. This tetrahedral element mesh contains 447,180 nodes and 2,801,488 elements. From this mesh, drag coeficients can be calculated on the CM-5. Graphics such as the cover illustration with stream ribbons can also be generated at the AHPCRC.

tract to maintain and operate the CM and Cray computers. MSC is a private corporation whose stock was principally owned by the University and a large foundation but has since been sold to Cray Research (see the feature by Aaron Osterby).

The AHPCRC also works with the Minnesota Super Computer Institute (MSCI). The MSCI is a coordinated consortium of scientists whose research requires high performance computing. Some of the Institute's scientists are fellows of the AHPCRC; others use the Army's computing resources through the MSC. The Institute holds many seminars and outreach programs. It collaborates with the AHPCRC on some of these education programs.

Sound complicated? It is. But if the three organizations work together, the oportunities for scientific research become more manageable for the user.

The research done by AHPCRC is a blend of work for the Army, private corporations, dual-use contracts and the National Science Foundation. The center hosts 15-20 post docs per year and a number of graduate students. In addition, 10-20 undergraduate students work at the Center each year during a six-week summer institute. Other undergraduates become involved on an ongoing basis with the research, giving them an unparalleled opportunity. As Professor Tezduyar said "This Center gives us the opportunity to collaborate in ways we could not do otherwise."

The AHPCRC also hosts training sessions and workshops to keep users appraised of the power of the machines. Another aspect of the Center is its regular symposia, with diverse international participation. Of particular note is the Center's ongoing relationship with Japanese researchers on a number of topics related to supercomputing.

One can imagine that Professor Tezduyar has his hands full with all the work being done at the Center. The job requires him to monitor all research flowing through the center. Of course, this coordination requires that he write regular status reports to the Army and to Francis Kulacki, dean of IT.

More importantly, he must ensure that the Army renews its grant to the center, to keep it operating here at the University for five more years. The first grant period was up in August, but he managed to get an extension until January 1995. Because of reduced equipment needs from the last proposal, this grant will not call for $50 million. But it will cost millions of dollars to sponsor the myriad of research activities at the Center over the next five-year period. Several other universities are competing with the University and its collaborating colleges and universities for the funds (Clark College and Florida A&M will be added in the new proposal).

The Research

Of course, in addition to his duties as the Center's director, there is also his research — some of the most complex work ever modeled with a computer. His work has two essential elements: a finite element approach which allows complex shapes to be mapped out with computers, and the computers themselves. Because of the complexity of the analysis, the research could not be done on machines slower than the CM-5. The logistics of the computations would not work on other computers. One could not schedule enough time on them to do the problems.

Because of the fine-grained finite element approach, simplifying assumptions about the phenomena can be minimized. By minimizing simplifying assumptions, Professor Tezduyar and company can describe the phenomena with an unmatched degree of realism.

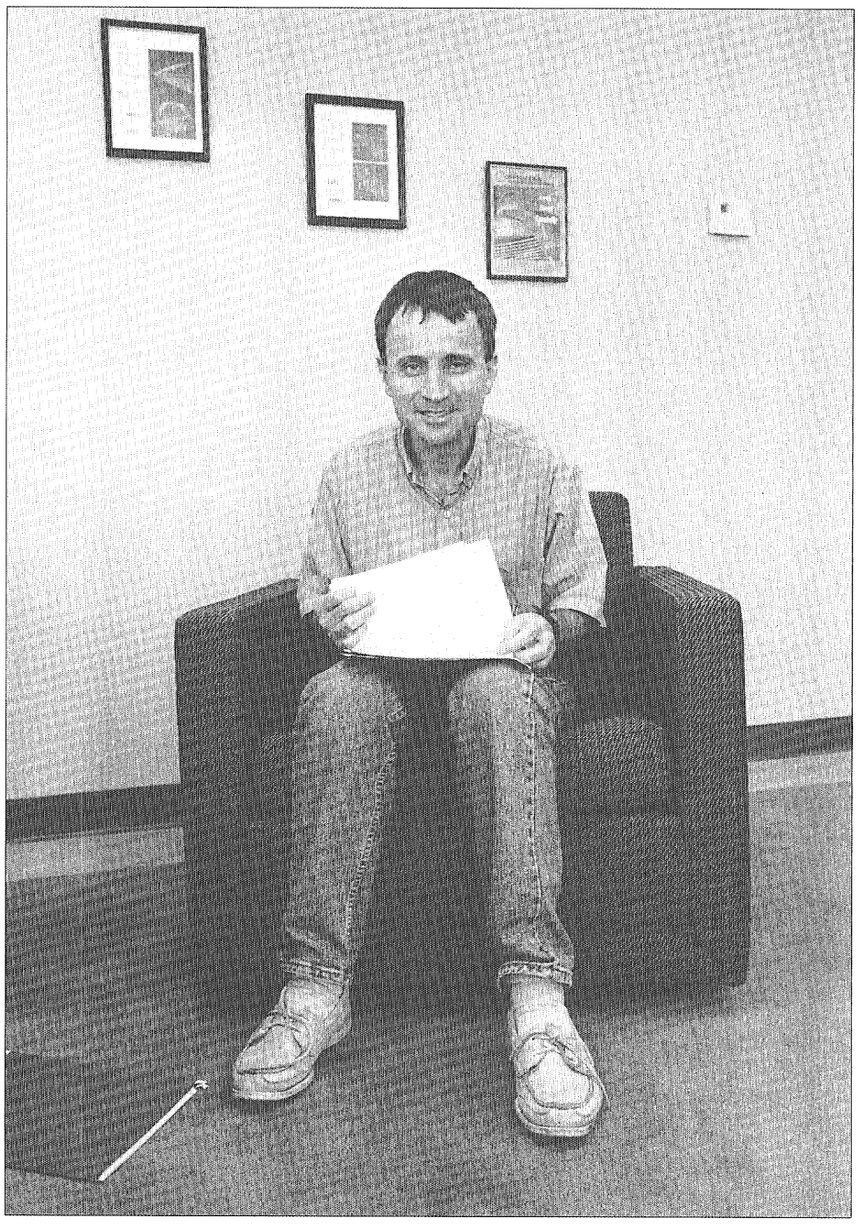
Examples of the degree of realism possible include the group's analysis of fluid flow around various objects such as planes, submarines and cars. Traditionally, these results could only be solved by field testing in wind tunnels and tanks. Now, the two methods can support each other. The wind tunnel and tank tests can support the numerical methods. Or the numerical methods can corroborate field testing. For example, suppose one wanted to calibrate a wind tunnel experimental apparatus. The computational methods would fit perfectly for this purpose.

"This Center gives us the opportunity to collaborate in ways we could not do otherwise."

--Profesor Tayfun Tezduyar
Director, AHPCRC

However, it is difficult to simulate compressed fluid flow around objects in wind tunnels. For these problems, the numerical methods go beyond field testing. An example of compressed flow is a shock wave that forms around the wing of an aircraft. Shock waves can only be prouced in wind tunnels at extremely high speeds. This takes tremendous energy. The only energy required to simulate shock waves with Professor Tezduyar's methods is the energy to run the CM-5. While the energy to run the CM-5 is not negligible, the reduced energy required for these tests represents a significant breakthrough in the design of aircraft components.

Another advantage to the computational methods is that one need not manufacture a component before testing it. One can design a finite element grid around a coinceived component and test it computationally. Once a design has been tested with finite element analysis, a prototype can be manufactured. That way the prototypes one tests are closer to the ideal than they would be without the numerical methods.



Tayfun Tezduyar at work in his office at the AHPCRC. Silvana de Faria

Teaching

As professor of Aerospace Engineering and Mechanics, Tayfun Tezduyar teaches in that department. This fall, he is teaching Computational Fluid Mechanics. In that course, he teaches many of the concepts he implements into his own research including finite element analysis, solving non-linear ordinary differential equations and supercomputing. His teaching is a good example of how high-level research complements instruction, rather than getting in the way.

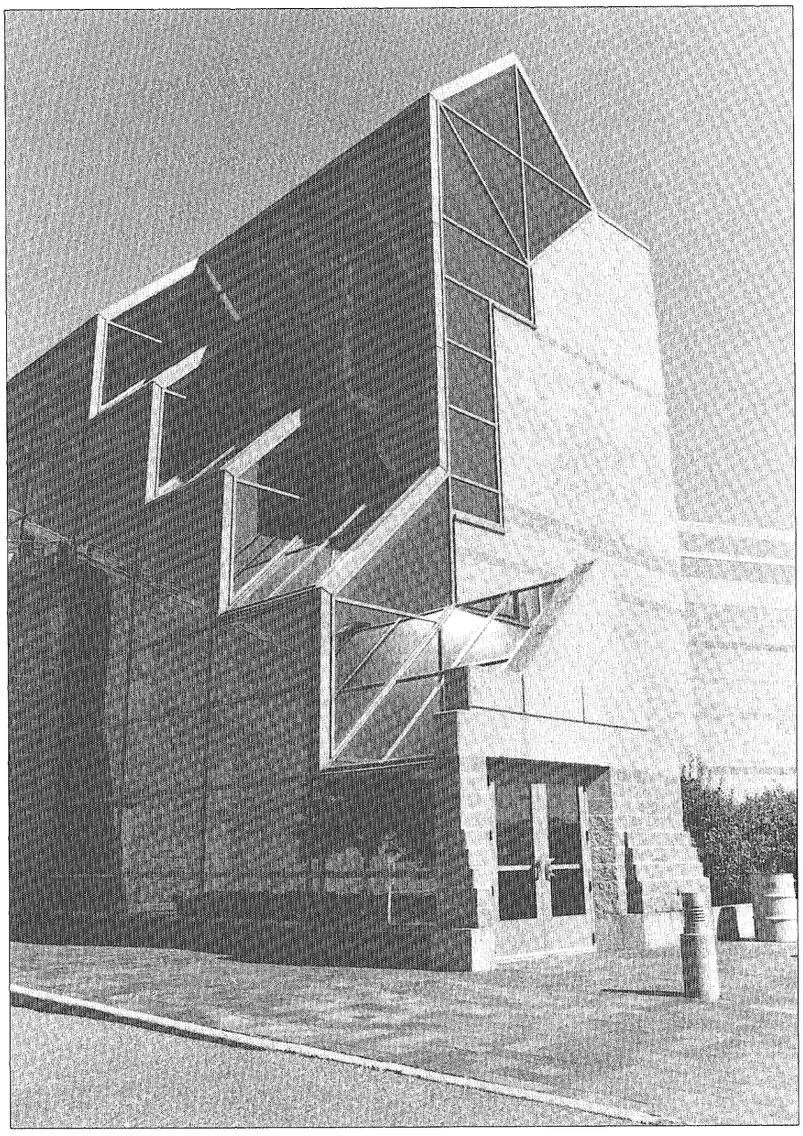
Whether in the classroom, the AHPCRC office or on one of the CM-5 interfaces, Professor Tayfun Tezduyar works tirelessly to provide leading-edge research oportunities for his students, post docs, colleagues and collaborators.

But he can't do it all on his own. Colloboration is a key word relating to all his work. "We would like to encourage more collaboration, but its not always easy. This center makes it easier," Tezduyar said.

-James Mathewson with help from Jolene Stephens

Cray Buys out MSC

On Friday, September 9th, 1994 the Board of Regents authorized President Hasselmo to close the sale of the Minnesota Supercomputer Center to Cray Research.



Cray Research has agreed to keep its newly aquired Supercomputer Center in the Building on Washington Avenue and Interstate 35W at least until the year 2000, when the current lease runs out. Silvana de Faria

By Aaron Osterby
Staff Writer

After a long struggle to pull the Minnesota Supercomputer Center out of a nose dive brought on by a series of legislative audits and a long stay in the bright light of public scrutiny, the University Board of Regents approved the sale of the ailing company in September. Selling the Center to Cray Research, Inc. doesn't toll the death knell for supercomputing at the University, but even so some are left with a feeling of unease as we hand over the keys.

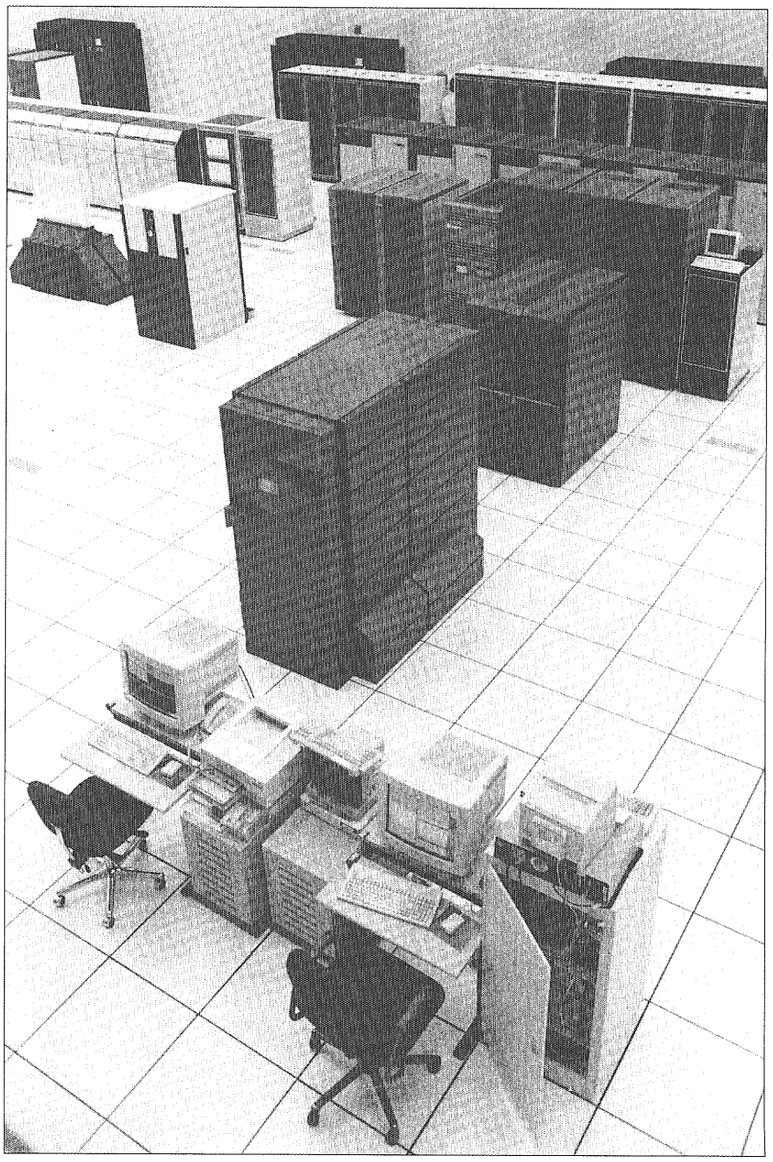
Some supercomputer users began complaining loudly about the Center's management in 1992. Criticisms included that the University subsidized the Center's commercial clients by paying inflated rates for supercomputer time. One group asked the Center's board of directors to fire John Sell, the chief executive officer. The complaints attracted the attention of the state legislature which conducted a series of audits. The audits uncovered some negligence but largely vindicated the University and the Center. The

center's dealings with the legislature were troublesome since the center wasn't a great money-maker in the first place, said Jim Infante, vice president for academic affairs. "I don't think this endeavour with the Supercomputer Center in the commercial market helped at all," he added.

In the months leading up to the sale, the Supercomputer Center lost nearly $200,000 per month, bringing the Center's total debt to more than $30 million. The Center's chairman Steven Pflaum told the regents that bad press from the series of legislative audits drove the Center's business into the ground. "Publicity, over an extended period of time, all found its way into the commercial world, all found itself in the hands of our customers and our lenders and it had an impact," Pflaum said. "Our customers were much more sophisticated about the price of the services being provided to the University compared to what was being offered in terms of commercial rates and they used it as a huge club to bargain their price down."

One supercomputer user who was in on the decision said it's a good deal but it shouldn't have been necessary to sell the Center in the first place. Cecil Smith is a representative to the regents and a graduate student in Electrical Engineering and Computer Science. Smith said he blamed the supercomputer users who caused the initial stir with their protests. "It was essentially a bunch of people who got mad at their bosses and by doing what they did, they ruined the company," Smith said. "The legislative auditor went in and saw that everything was clean, there had never been any wrongdoing."

Regent Wendell Anderson echoed Smith's sentiment. "I read letters to the editor by



The main floor of the Supercomputer Center is crammed with high perfromance hardware, including the Thinking Machines CM-200 (center), several Cray supercomputers and interfaces.
Silvana de Faria

users," he said, adding that those employees who wrote the letters are tenured or given civil service protection. "They were not temperate. I'm wondering if we can allocate the use of the supercomputer in a way in which we can avoid the involvement of people who wrote those terrible letters," he said.

Computer	Processors	Memory
CM-5	896	28 gigabytes
CM-200	32,000	4 gigabytes
Cray T3D	128	1024 megawords
Cray C 916	8	512 megawords
Cray-2	4	512 megawords
Cray X-MP	4	64 megawords

Cray executives can terminate some of the Center's employees before they actually take over, leaving the work of actually firing people to the University. "That is not an unusual business condition," Pflaum said. "Cray has indicated that they do expect to see some staff reduction as a result of the synergism. Though they do not expect it to be extensive, they're not promising to keep everybody on the payroll either."

University researchers will continue using Cray's supercomputers at a discounted rate until the end of the current contract in 1996, but no one is certain about the prospects for University use into the next century. After the current contract runs out, future time on the computers is dependant on the renewal of the supercomputing budget request by the legislature. Pflaum said losing the funding is a price the University must be prepared to pay, but he added that a lot can happen in two years and the case is still pending. "It is incumbent upon the University community on the one-hand and Cray on the other to be able to show just cause for continued legislative support of this operation," he said.

Administrators are less worried about whether or not Cray continues the discounted contract since the company expressed interest in working with University professors to make the new Cray Supercomputer Center a major success in advancing new ideas and technology. In addition to the already contracted time, Cray will give the Supercomputer Institute about 12% more time and resources than the original contract required and plans to change the "gifted time" policy of the former Supercomputer Center.

Under the old policy, the Center gave any computer time not sold to the Institute on a stand-by basis. But since Cray plans to aggressively market their services, they don't plan to have any free time if they can help it. To make up for the loss of the gifted time, Cray agreed to provide another large block of time for University projects. A committee of professors from the Supercomputer Institute and Cray executives would decide how best to assign computer time from this second block. Pflaum said Cray executives want to run projects during this block that will enhance the reputation of the company, the University and the professors. Pflaum added that Cray would not have veto power over research projects earmarked for the gifted time.

Cray and the University plan

to close the deal on October 15th. By then Pflaum estimates the center's value will be between $10.2 and $10.4 million. Cray agreed to buy all the center's stock for its listed value at the time of the purchase. Cray will also assume the center's debt, estimated to be more than $30 million.

The University's share of the buy-out is slightly more than $6 million and the Foundation gets the balance. The University got the greater share since it owned all of the preferred stock in the Center and 10% of the common stock. The Foundation owned the rest of the common shares. The University may also be entitled to an $800,000 tax refund from the recently purchased Cray T3D massively parallel processor. Under Minnesota tax code, major corporate purchases can be taxed only if they replace existing equipment, but purchases designed to expand its capabilities can be exempt. Pflaum argued that the University never should have paid the sales tax in the first place. "The new Cray is not simply a replacement of old equipment or we wouldn't have bought it," Pflaum said. "It is an enhancement on a magnitude of many times in terms of the memory capacity and speed."

"The creation of the Supercomputer Center really provided us with a world-class super-computer center. We need to be in a position to continue to be a world leader and this sale to Cray represents an unique opportunity for the University to be a partner in an exciting change."

--Acting vice president for research Mark Brenner

The Center's hardware at the time of the sale included the new Cray T3D along with three older Crays. Two Thinking Machines Corporation massively parallel CM series supercomputers are also housed in the facility but both belong to the Army High Performance Computing Research Center. The AHPCRC and the Center share equipment and facilities but are separate organizations.

Cray must keep the center in its current location on Washington Avenue until June 2000 when the current lease expires. Supercomputer Institute professors who will continue working with Center under Cray's management asked for extra space inside the Center for faculty offices and conference rooms. Cray agreed to sublet 3,300 square feet in the building but the University isn't required to take the space. Central administrators have not yet decided whether to take them up on the offer.

Though some see the sale of the Center as a loss to the University, president Nils Hasselmo said he looks at it as the beginning of a new chapter in supercomputing. "We are very pleased by this renewed and strengthened tie to one of the major corporations in Minnesota in an extremely important area," Hasselmo said. "I believe that this kind of relationship that we are establishing can be extremely productive for the University, for Cray and for the State of Minnesota."

Aaron Osterby's aura continues to haunt The Minnesota Daily offices. Formerly science and tech beat writer extraordinair, he has now been assigned the Legislature beat. Between fillibusters, he manages to write for Technolog.

Plasma treatment of waste

Two university professors develop high-tech ways to deal with an ugly problem.

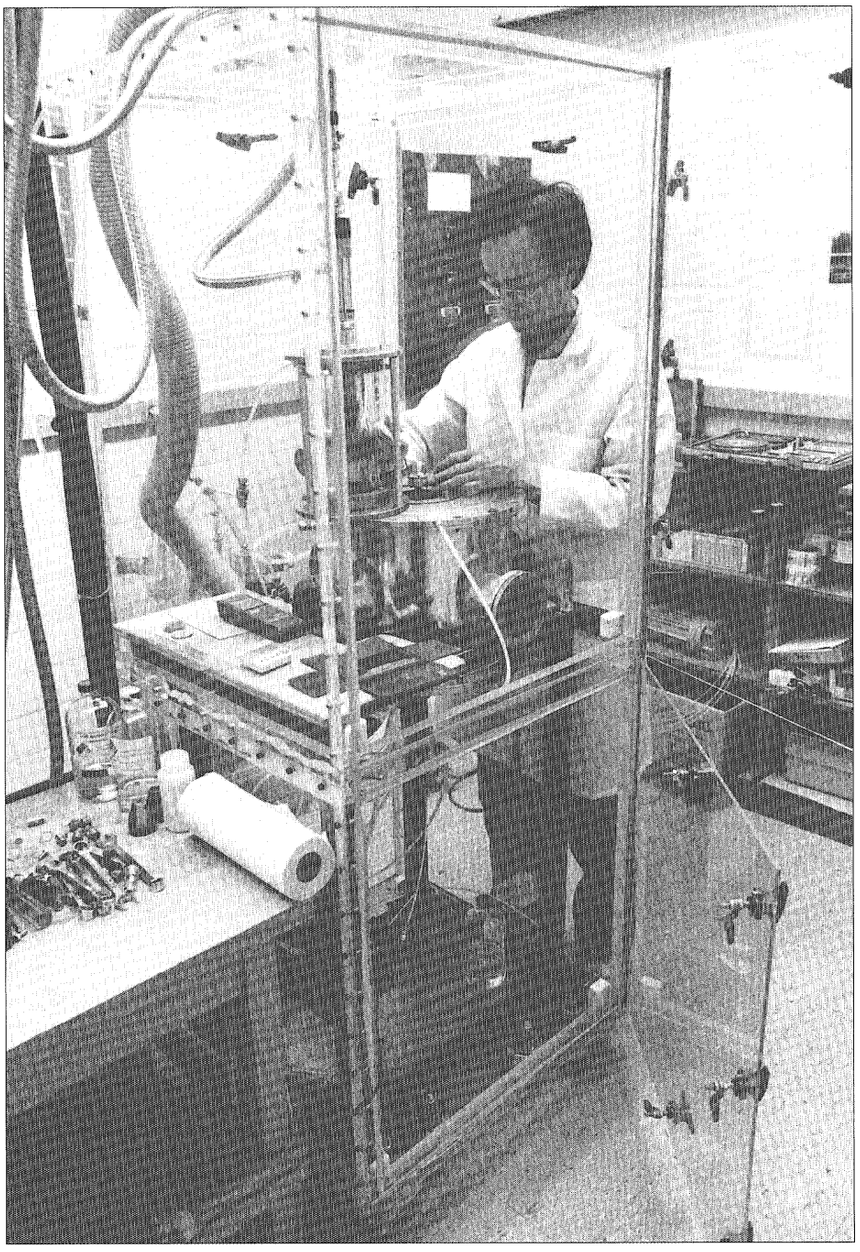
By Bharti Khanchandani
Staff Writer

In the United States consciousness about the environment has heightened drastically over the past 25 years. Researchers have devoted much of their time and effort to invent economically efficient methods in the arena of waste management. The government has enacted many laws that preach pollution prevention. Much of the progress in pollution prevention is driven by government regulations.

However, If an organization considered the environment as part of the entire production process, it would see the benefits of becoming more environmentally concious. Researchers have come up with technology that allows us to reuse the waste and produce a solid product that can be used commercially. The next step is to implement the technology.

An example of Corporate Pollution

An example of an organization that has helped reduce its environmental poluution is the Northfield, MN based company Sheldahl Inc., makers of electronic circuits for automobiles and computers. In 1987, Sheldahl was accused of emitting 1.175 million pounds of toxins into the air including 400 tons of methylene chloride, a widely used solvent classified as a "probable carcinogen". Minnesota Pollution Control



Mechanical Engineering Graduate Assistant Qingyuan Han prepares the counter-flow plasma reactor to start his experiments with waste destruction. Silvana de Faria

Agency (MPCA) issued a permit to get Sheldahl to develop an alternative to methylene chloride by Jan. 2 1991. Sheldahl invested $1 million on improvements and promised to reduce emissions by 90% within the next 3 years, gradually switching to flammable solvents. Sheldahl did meet the aimed goal and set an example in industrial toxic emissions.

Dozens of Fortune 500 companies announced voluntary reductions after Sheldahl reached its goal. Monsanto Corp. made a goal to reduce their emissions to 90% by 1992. Dow Chemical Corp. made a goal to reduce their overall emissions to 50% by 1995, Du Pont Co., promised to reduce their emissions to 60% by 1993.

Heightening Awareness

Public awareness about pollution prevention has resulted in the formation of several organizations including MPCA, Waste Reduction Institute for Training Applications and Research (WRITAR) that actively participate in providing training and incentives to those who are committed to protecting the environment. In Minnesota, the Toxic Pollution Prevention Act of 1990 created policy and program frameworks for the industry, government and the public to work in terms of protecting the environment. A program called the Governors' Award for excellence in pollution prevention resulted from this act. The program honors Minnesota businesses, public institutions, organizations and individuals using creative approaches to reduce the use and release of hazardous and toxic materials at the source. In 1994 there were seven winners of this award. They were Advanced Flex Inc., Crown Cork & Seal Co., Frigidaire Company products, Roger's Body Shop, Superior Recycled Fiber Industries, Target Stores and Unisys.

Plasma Technology

The most innovative method of treating hazardous waste is a plasma waste treatment process. Thermal plasmas are created by converting electrical energy into heat and light energy in the form of a high temperature gas (plasma). Plasmas are electrically conductive but consist of approximately equal numbers of positive and negative ions. Plasmas are currently used in variety of applications ranging from melting of refractory metals to spray coating aircraft engine parts to deposition of diamond and super conducting films.

A counter-flow liquid injection plasma pyrolysis (CF-LIPP) system for destruction of liquid toxic wastes has been developed in the High Temperature Laboratory of University of Minnesota. Plasma technology is beneficial to a wide variety of waste materials such as municipal solid waste, medical waste, mixed hazardous waste, and transuranic radioactive wastes. For the past ten years, the EPA has been evaluating plasma waste treatment process. According to Jochim Heberlein, a professor in the department of Mechanical Engineering, plasma technology is an innovative approach for destroying highly toxic chemical waste, but because the developing cost of plasma technology is comparatively higher than other waste treatment technologies, it is not yet commercially accepted.

The benfits of Plasma Waste Treatment Technology are:

- Operation at temperatures sufficient to destroy all organic wastes and break down non-organic wastes to simple compounds.

- Operation with a low gas volume resulting in easier and more complete off gas cleaning.

• Enhanced control over process chemistry through the use of inert, reducing or oxidizing conditions as required by the waste material.

• Excellent final waste form, a vitrified solid product that can be used to chemically bind toxic metals and eliminate potential leaching hazards.

• Small units of 1 to 50 tons/day capacity can be conveniently located at waste generating sites eliminating transportation and controlling liability.

• Capability to treat a wide variety of waste streams including secondary wastes (e.g. sludge, fluid dust and ash) produced by other treatment processes.

The waste that is most likely be reused is solid waste containing hazardous metals and organics. This waste should be in the form of soil and sludges. Sludges containing metals and organics may be processed to recover the organic fraction composed of carbon monoxide and hydrogen while stabilizing the hazardous metals. The process may provide the Navy with a means of producing a final waste form that can be safely disposed at sea eliminating waste storage problems. Other uses of plasma technology have been suggested, but for the most part they are still in the developmental stages or are not yet feasible for commercial use. According to Emil Pfender, a professor in department of Mechanical Engineering, Westinghouse, Inc. has developed a liquid waste plasma treatment system. However they are facing problems in terms of recovering the development costs because it does not justify the initial investment.

Plasma technology is still in the developmental stages. The National Plasma Development Center has made it their mission to establish a plasma process for waste treatment program that enhances cooperative research and development between industry, government, and universities. Such a collaboration reduces the business risks and decreases the costs associated with the development and implementation of new industrial plasma process. In the coming years, plasma technology will hopefully gain public acceptance and feasibility.

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A recent graduate of the University in Scientific and Technical Communication, Staff Writer Bharti Khanchandani hopes to build a strong career in technical writing.

Institute of Technology Student Commencement Address
By Peter Mach
June 3, 1994

Honored guests, members of the faculty and fellow students:

Graduation ceremonies are always a time for great celebration. As we take part in the program this evening, we will all look back with pride on the success we acheived here at the Institute of Technology. Behind every graduate stands several years of hard work and dedication to completing a long-term goal, and this serves to highlight the fact that tonight's occasion is a truly important event in our lives.

There are many things to look foreward to in the coming months, whether it be starting an exciting new job, going on to graduate school, or even just the chance to do some long-awaited travel during the summer.

Tonight, it is only natural to be caught up in a well-deserved feeling of simply being done with a difficult and important part of life, somewhat like the end of a long week of finals that has turned out well, except on a much larger scale. I would like, though, in the next few minutes, to look from a broader perspective on this oment, and to share a few thoughts on what an IT degree really means to us.

> *Ultimately, whether on the job, in a University lab or in classes, we have all had the chance to follow our interests in topics over the course of months of hard challenges. . .*
>
> **--Peter Mach**

As we end our undergraduate studies here at the University of Minnesota, we of course carry away a lot of information accumulated over years of learning. Whether we chose to follow our interests in physics, engineering, or computer science, to name just a few possiblities, we are all very familiar with the principles and methods we of the field behind our chosen degree. The countless hours of reading textbooks, writing out homework assignments, asking questions, and thinking about the ans has helped lead us to the knowledge needed to start successful careers and rdeal with themany challenges that lie ahead in today's world. Debates on topics important to the whole of society, such as the cost of our energy needs, increasingly require a familiarity with the technical issues underlying the problems.

Therefore, as we move beyond tonight's commencement, we should realize that as Institute of Technology graduates, we have gained both a unique ability and a special responsibility to contribute to the solutions that will be required by people in the future.We should also realize that as IT graduates we carry foreward the benefits of

not just the knowledge, but also the experiences acquired over the past several years.

For many of us, part of getting a degree has been the chance to participate in laboratory research or company internships. This kind of experience, teaching us aspects of planning an experimental set up, trouble shooting or improving a standard machine design, and communicating research results to others as clearly sa possible, introduced us to concerns that we will encounter as engineers in industry, researchers in academia, or as teachers of the next generation of students.

Ultimately, whether on the job, in a University lab or in classes, we have all had the chance to follow our interests in topics over the course of months of hard challenges, step-by-step goals, and temporary setbacks.

In departmental seminars, we have seen that it requires energy to keep up with the latest developments in a field and effort to turn the new developments into real products, or to follow up with more research, or even to explain important new trends to people with different backgrounds. These experiences have taught us the importance of being persistent, of being open to the new ideas that come up so quickly in a world linked by modems and faxes, and of investing the time needed to communicate clearly with others.

Finally, our graduation also represents the wider outlook on the world gained from our time here at the University of Minnesota. Part of our education has been the chance to become familiar with a whole range of technical subjects outside of our chosen major, so we leave the Institute of Technology with an appreciation for the work done in other disciplines. We also had the opportunity to pursue interstes in the arts, music, philosophy, and literature, and become familiar with more history, geography and foriegn languages. The result has been a better perspective for any career; enabling a scientist, for example, to see more easily the implications of research for society, or to better communicate with colleagues in different nations.

In this regard, the size and diversity of the IT community has served us well by allowing us to meet other students from different cultures, to form friendships, and to exchange opinions about the world, which we all must share together.

I believe that only when we step back to add up all this knowledge, experience, and perspective do we get a true picture of the real importance of today's ceremony, and opf how we will remember it.

It is true that graduation also marks the beginning of a new era in which we must establish our careers and do our part to build a prosperous society. I am confident, though, that the Institute of Technology graduating class of 1994, with our whole collection of tallents and abilities, will meet the challenges of our bright and promising future.

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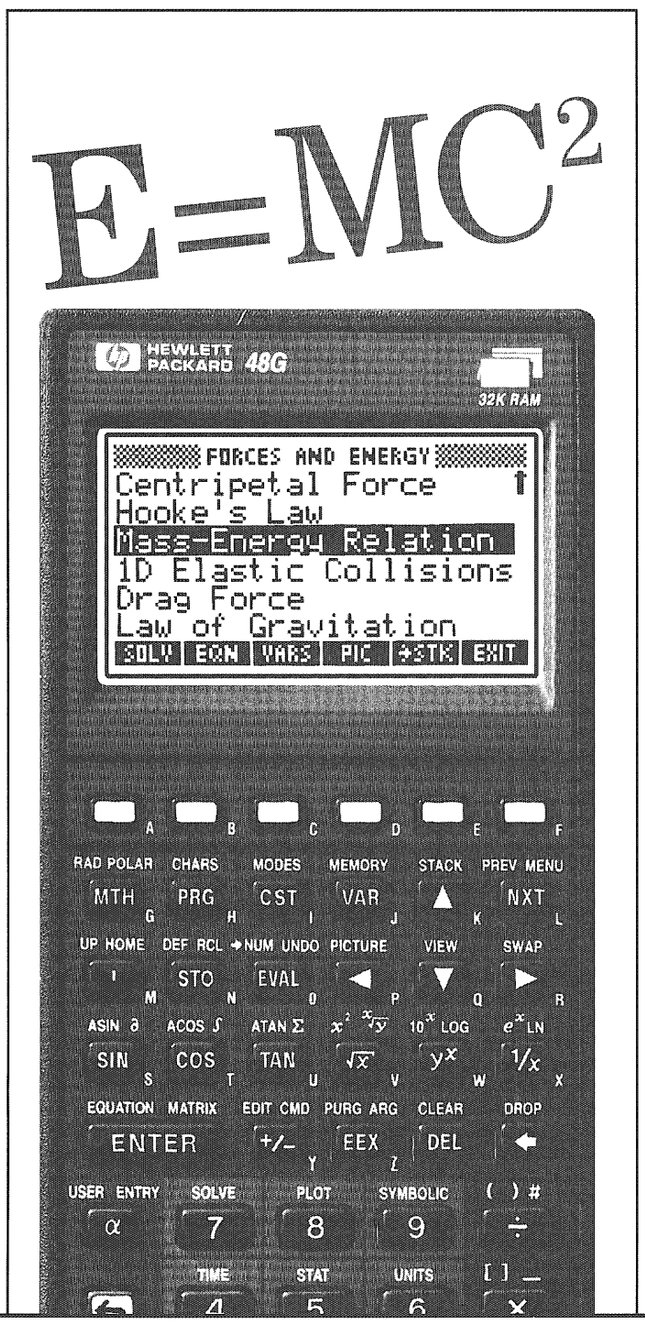

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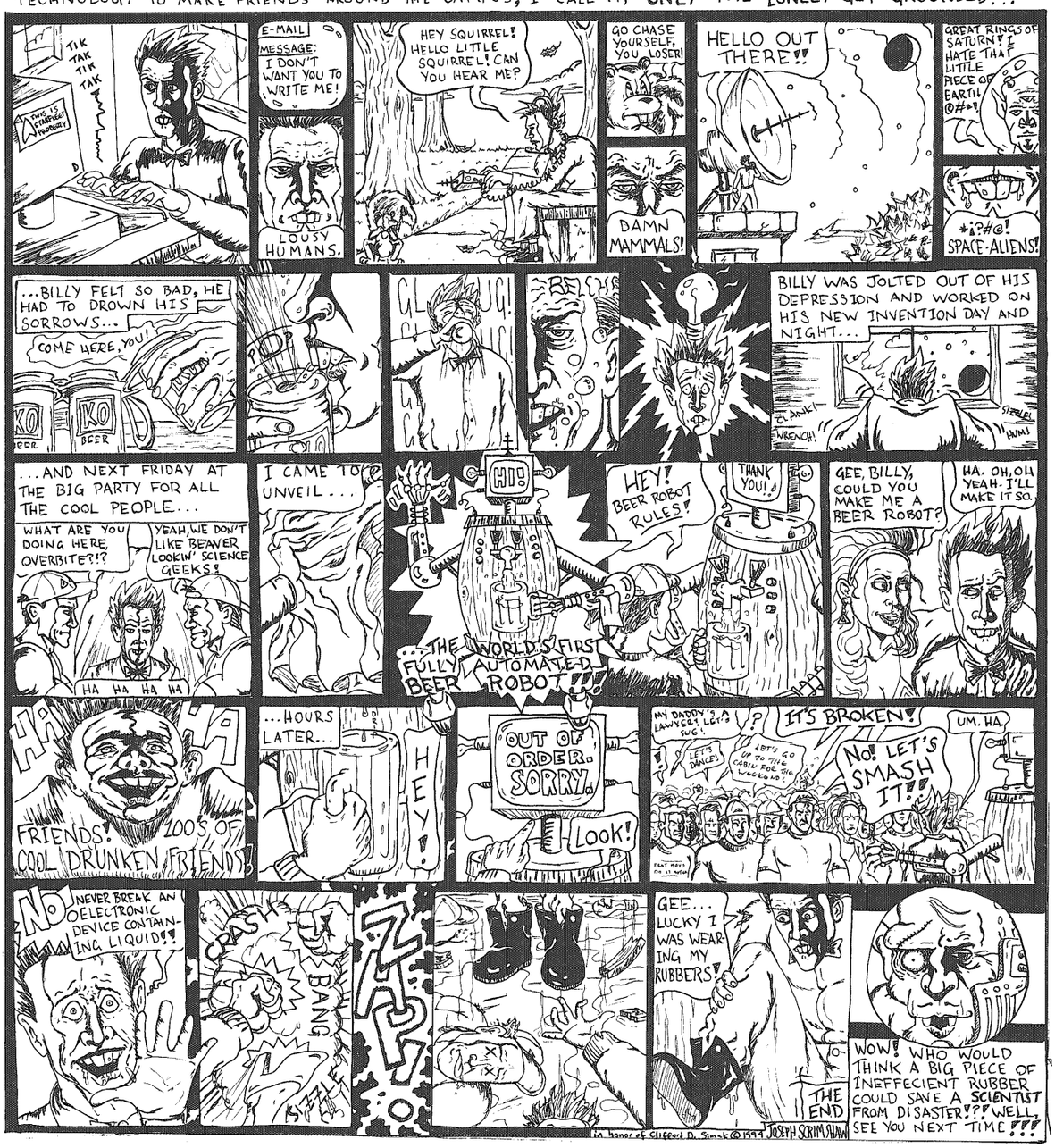
TALES OF TECHNOLOGY

HELLO THERE, BOYS AND GIRLS! MY NAME'S RAYMOND AND I JUST SNEAKED OUT OF THE MASTER'S LAB TO TELL YOU STUDENTS OF SCIENCE ANOTHER SCARY STORY! THE MASTER, HE SAYS I SHOULDN'T BOTHER TELLIN' STORIES, 'CAUSE I AIN'T EFFECIENT AND THAT THE ONLY THING I'M GOOD FOR IS 'SPERIMENTIN' ON, SO THAT'S WHY I GOT THIS HUNK OF METAL ON MY FACE! I'M GONNA BE A 99.9% PERFECT COMPUTERIZED STORY TELLER! ANYWAYS, HERE'S TODAY'S STORY ABOUT YOUNG "OVERBITE" BILLY AND HOW HE TRIED TO USE TECHNOLOGY TO MAKE FRIENDS AROUND THE CAMPUS, I CALL IT, "ONLY THE LONELY GET GROUNDED!!!"



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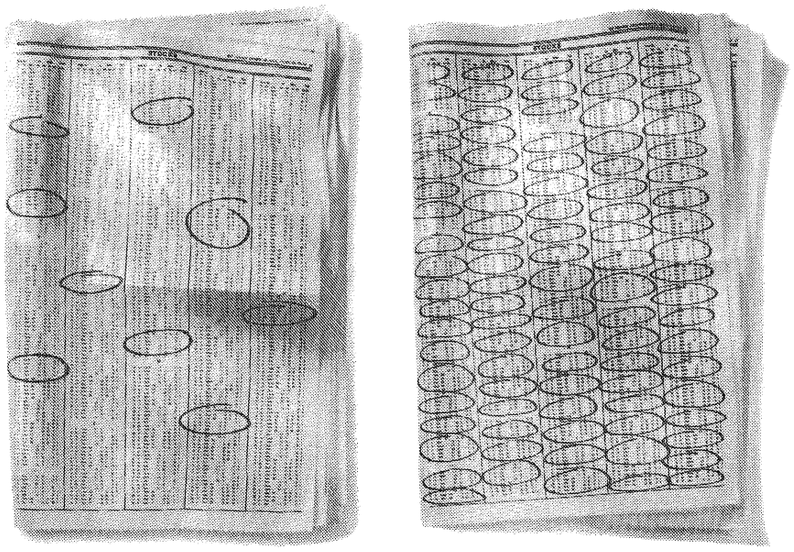

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Welcome Back!

Well, it's another year of Technolog to look foreward to. And with each passing year, we have a whole new staff, new cover designs and a new look and focus on the inside.

It is our hope that the changes we've made will help the reader easily follow the flow of the magazine. We also hope to provide accessible and technical features that will excite and stimulate the reader.

We realize that we cannot please everybody. Some readers will find our new focus too technical; others will find that our stories still come up short in the nitty-gritty details.

It is a fine line between talking down to the reader and making the material accessible. If we cross that line one way or another, let us know. E-mail the editor (math0038@gold.tc.umn.edu) and he'll consider printing it.

If you would like to get involved, E-mail IT Board of Publications President Tiffany Chung (chun0001@gold.tc.umn.edu).

'Too many variables' -- Not with supercomputers

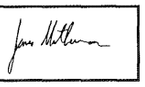
But my professor had to dampen that enthusiasm by saying, "We just can't know much about the physics of fluid mechanics and dynamics. There are just too many variables."

So we slogged along with infinitely long wires, balls flying through vacuums and line waves. But we really wanted to understand the magnetic effects of current through the short wires of our radios; or why Bert Blylleven's curveball was so much nastier than Frank Viola's; or how waves from many different directions interact on the surface of a lake.

The point is that each of these simplifying assumptions render the models less believable in everyday situations. I have heard physicists declare that it is impossible for bumblebees to fly or tailing fastballs to move up and in on batters, yet we all have seen both phenomena. They make these counter-intuitive declarations because their models have been tainted by these assumptions -- assumptions that are not necessary with the right methods and the right equipment.

Our cover story, on Professor Tezduyar and company, features work that simply could not get done without the CM5. The systems he models are so complex that they require between 350,000 and 750,000 calculations per step and thousands of steps (finite elements) per model. The CM5 takes minutes to perform the calculations; it would take days for slower supercomputers to do the job. One cannot schedule that much time on another supercomputer. But the things he models are also closer to our everyday concerns than much of the work that can be done from the desktop.

Far from being obsolete, supercomputers will be crucial to the future of science. For, the more advanced and accurate our models become, the more need we will have for high-performance computers. If we manage to keep the AHPCRC at the University, our community can be a leader in scientific enquiry. This will help greatly in the administration's U2000 goal of making the University a major research center.

James Mathewson 

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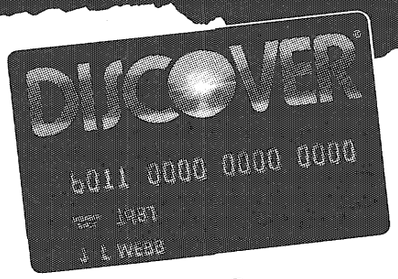

IF YOU DON'T GOT IT, GET IT.SM

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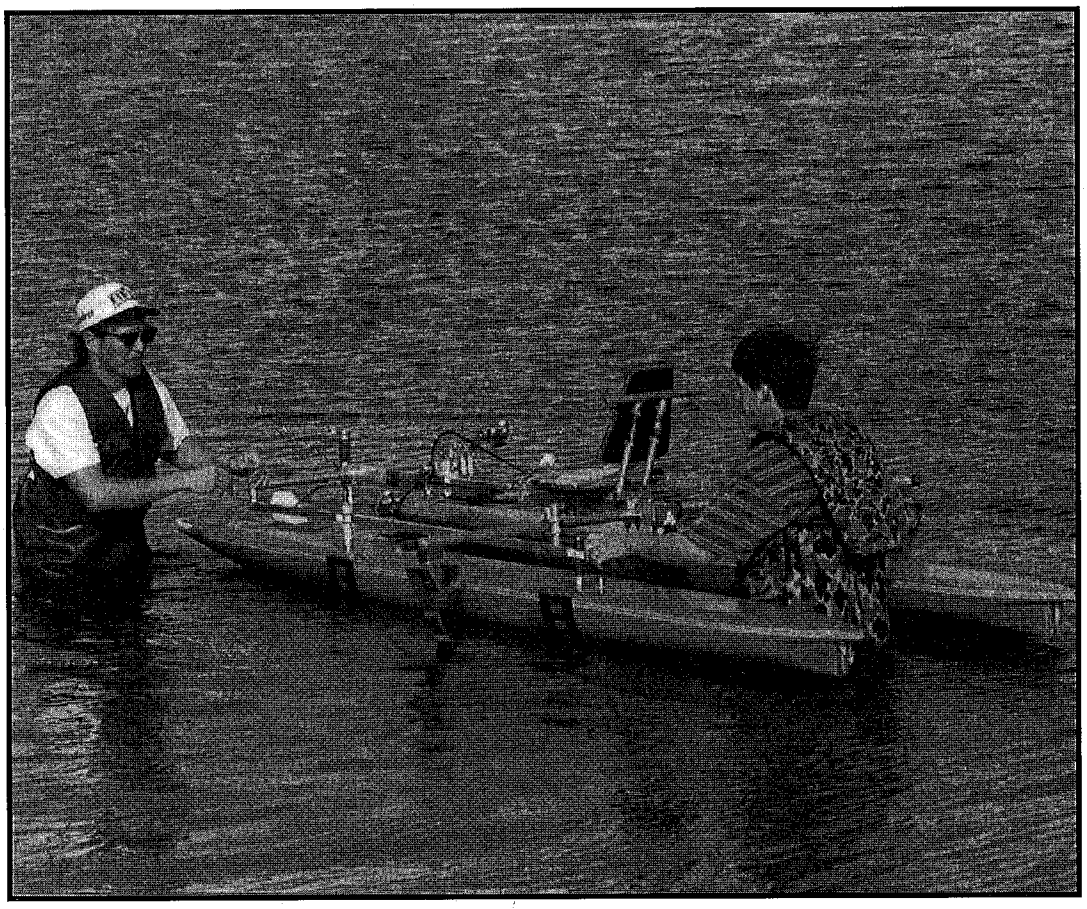
November/December 1994 University of Minnesota Volume 75 Number 2



Special Issue: IT Curriculum

- Hands-on Engineering Instruction
- Co-op Programs

Implement curricular reforms. . .

The primary responsibility of educators is that they not only be aware of the general principle of the shaping of actual experience by environing conditions, but that they also recognize in the concrete what surroundings are conducive to having experiences that lead to growth.

John Dewey, 1938

What surroundings are conducive to having experiences that lead to growth for engineering students? I wish John Dewey were here to tell us. In his absence, we will have to look at the surroundings in which engineering students are placed and see if their experiences lead to the kind of growth they will need after graduation.

Traditionally, students were placed in classrooms where they solved a number of theoretical engineering problems. These problems had two characteristics: they had little relation to the real world, and there was one distinct answer to each problem.

Whatever the reasons in favor of traditional pedagogy, it has many faults. First of all, it ignores all practical experiences that students will encounter after graduation. Engineering means defining the needs for new products and brainstorming ways to develop products that fullfill those needs. It entails building prototypes and extensively testing them. It means working with machinists, assemblers, line managers and the like to improve manufacturing quality and efficiency. It consists of a variety of hands-on, open-ended tasks that cannot be learned through solving closed-ended problems with paper and pencil.

Second, now more than ever, engineering is a social profession. Engineers spend much of their time evaluating products in quality-assessment teams and brainstorming in design teams. Working well in intimate group settings is a qualification many engineering firms demand.

Continued on the back flap, page 26

Staff Profiles

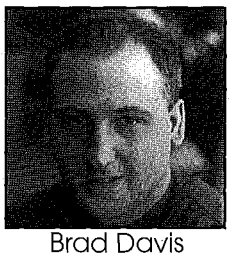
Chi-Ting Huang
Managing Editor

Howdy! I'm a graduate student in Biochemistry, Molecular Biology and Biophysics. My undergraduate degree was in chemical engineering. Using both degrees, I hope to work one day in the field of biotechnology creating new drugs and bugs to benefit mankind.

My current research project involves the mechanism of diphtheria toxin action in cell death.

My new hobby of the year is rock-climbing. Next year, I plan to take up wind surfing.

Chi-Ting Huang



Brad Davis
Associate Editor

As a senior in the School of Journalism and Mass Communications, I've learned a lot about the University from my work at the Minnesota Daily and Technolog.

If a career in international communications falls through after graduation, I plan to continue working summers in Alaskan salmon canneries as a means to supplement a meager freelance reporting income.

I enjoy traveling around the United States, playing golf in Arkansas, reading books and playing Risk.

Brad Davis

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Features

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About the Cover

University of Minnesota Human-Powered Hydrofoil Team members Paul Klobe (left) and Mike Worne prepare to test their prototype craft at the National Sports Center in Blaine Minn. Photo by Rick Loveless

U center gets massive funding from Department of Defense

The University's Army High Performance Computing Research Center (AHPCRC) will continue to be funded by the US Department of Defense (DoD) for at least three more years, according to published DoD reports.

"I'm excited by the research possibilities available through Cray Research and its industrial contacts."
--Tayfun Tezduyar, AHPCRC director

The grant calls for a three-year, $21 million agreement between DoD and AHPCRC. The grant period begins on January 9, 1995.

Upon further review, the grant will likely be extended for an additional two years, resulting in a five-year total of $35 million to the AHPCRC.

In 1989, the AHPCRC was originally funded for five years and $50 million. The original grant ran out in August but the Center received a six-month extension to apply for a new grant.

The difference between the original grant and the new one consists of equipment costs. The Center must request additional grants for any equipment upgrades it needs.

The 1989 grant funded the University and its academic partners — Purdue University, Howard University and Jackson State University.

This new grant will fund two additional academic partners — Clark-Atlanta University and Florida A&M University.

Among other things, the academic partners help the University fulfill one of the goals of the project — to foster diverse participation in computing and scientific work.

"It would be good if our research would benefit industry in general."
--Tayfun Tezduyar

Tayfun Tezduyar, AHPCRC director, said the funds allow the Center to emphasize interactions with Army scientists, academic partners, international contacts and the Center's industrial partner — The Minnesota Supercomputing Center (MSC). "In this respect, the new grant will fund much the same activities [as the previous one]," he said.

"I'm excited by the research possibilities available through Cray Research and its industrial contacts," Tezduyar said.

Since the University sold its stock in MSC, MSC is now a wholly-owned subsidiary of Cray Research.

"It would be good if our research would benefit industry in general," Tezduyar said, adding that the addition of Cray to the team enhances the chances that AHPCRC will develop industrial contacts.

--James Mathewson

Jupiter's travail . . .

Editor's Note:
As an end-of-the-year note, here is, in my opinion, the year's best science-related column. The following is reprinted with permission from the Washington Post Writers Group.

By Ellen Goodman
Boston Globe

The comet blasted through the news like a celestial bulletin. An alphabet of fragments crashed into Jupiter and slammed into our consciousness.

For once, a cataclysm of truly astronomical dimensions dwarfed the man-made disasters that dominate the headlines from places like Rwanda, Haiti and Bosnia. Astronomers, as exuberant as physicists witnessing a big bang, stepped up to share their excitement at this once-in-a-lifetime — perhaps once-in-human-liftime — experience.

Today we are not sure whether that small step for man was a giant leap for mankind.

As the blowouts and bruises emerged on the face of Jupiter, these scientists struggled to bring the story down to Earth. A blast larger than all the nuclear weapons in our [the world] arsenal.

But this was one event that would not be cut down to size. For once the word "awesome" — that staple of teenage vocabulary applied to every new song and every new sneaker — took on a literal meaning.

What a week in the solar system. While comet fragments pummeled Jupiter, we held a celebration for the silver anniversary of the first man on the moon. But our planetary party was nearly as modest as its hero, Neil Armstrong. Today we are not sure whether that small step for man was a giant leap for mankind.

An American generation has grown up that takes our trip to the moon for granted. Been there, done that. Those of us who were once stunned at the feat now came to the anniversary party wondering what it all meant. Was it just a Cold War circus trick? What are we left with? Technology? Tang?

We may be nostalgic for the sense of purpose that propelled us to the moon. But we are sceptical of the purpose itself.

On the 25th anniversary of the moonwalk, another space shuttle was in the 12th day circling the Earth. The news from the good ship Columbia, buried in the back of the paper, was that a second newt brought aboard died after laying eggs.

For years, long after Armstrong had been there, Americans told ourselves, "If we could put a man on the moon" we could do anything. But the belief in science and technology as cure-alls has evaporated. We may be nostalgic for the sense of purpose that propelled us to the moon. But we are skeptical of the purpose itself.

Continued on page 23

Educating Engineers o

❑ Engineering education can be significantly enhanced by hands-on experience. Projects such as the hydrofoil and solar car provide realistic, open-ended challenges to undergraduates. Efforts are also being made to revise undergraduate curriculum to increase exposure to hands-on engineering.

By Linda Pham

Silvana de Faria

Human-Powered Hydrofoil Team member Rick Loveless adjusts the chain on the craft's bicycle-style drive mechanism. This kind of hands-on work helps engineering students put their ideas into practice.

Today and Tomorrow

Human-Powered Hydrofoil Team

The human-powered hydrofoil project is one opportunity for University students to obtain "hands-on" engineering experience. The hydrofoil is a propeller driven, human powered craft that travels across the water on lift generated by wings.

The student-designed hydrofoil is a complex, carefully scrutinized mechanism. Its operating principle, however, is relatively simple. The current design features a recumbent rider to minimize frontal profile and increase stability. A rider applies force to the pedals, transmitting surging power to the propeller. Front and rear wings provide lift force. The lift force must equal the weight of the rider and craft to achieve "flight" through the water. Riders must overcome a drag force produced by the lifting force, profile drag caused by submerged objects, and interference drag associated with connections between submerged objects. As the rider continues to pedal, the wings lift the craft until the support pontoons rise above the water, Minimizing the considerable drag force created by the pontoons, the hydrofoil seems to fly through the water.

The project is coordinated through the mechanical engineering course Design Morphology with Applications. Fall quarter's team is composed of 11 students, primarily mechanical engineering majors. Team members break into subgroups that concentrate on specific aspects of the project, such as the propeller or transmission. "The students learn to tackle engineering from a system perspective while working from a component perspective," said Mike Hermanson, a former student team member and currently a project advisor. "Each component immediately impacts the work of the entire group."

"This is usually the first class in which students learn to apply knowledge in a real-world setting."

--John Samuelson Hydrofoil project advisor

There is a great deal to be learned from working on the hydrofoil project. For many students, this project is their first opportunity to design, build, test, and truly understand a mechanism. "This is usually the first class in which students learn to apply knowledge in a real-world setting," said John Samuelson, also a former student member and now serving as an adjunct faculty advisor. "This is a chance to step out of the textbook. Students learn group dynamics and problem solving as a team. They apply analytical skills gained from all previous classes." In addition to the experience of working with others on a team mission, the hydrofoil project improves communication skills, traditionally a problem with engineers. Students learn to effectively communicate their ideas and objectives. Weekly status reports, formal presentations and design justifications provide opportunities to develop strong oral, visual and written communication skills.

The hydrofoil project also improves problem-solving skills. Each team gets an open-ended problem with an ultimate goal defined. Understanding that they are challenged to create a high-speed, human-powered watercraft, they must design and build a mechanism to achieve the goal. "It is up to the student to develop the road map and design tasks. We [advisors] simply steer," explained Samuelson.

In addition to effective communication and design concept-ualization skills, the team learns to solve a problem despite severe financial constraints. "The hydrofoil is a shoe-string project," said Hermanson. "I'd say the hydrofoil runs on a broken shoe- string budget," amended Mark Lindell, student team leader for the summer 1994 hydrofoil team. The project is supported by corporate sponsorship and departmental funding. Insufficient funds prevented the team from participating in the 1994 International Human Powered Speed Championship in Eureka, Calif. Despite this setback, the team plans to continue optimizing its design in an effort to capture a world women's speed record.

"It's incredibly exciting to take the hydrofoil out to the lake for testing and seeing it fly across the water."
--John Samuelson

This persistance is typical of past and present hydrofoil teams. They invest an enormous amount of time and energy to witness the realization of their design concept. Students average about 20 hours per week working on the craft, often more before deadlines. The students, however, typically invest the tremendous effort because they love the hands-on engineering experience. From the initial concept through design, analysis, building, and testing, students finally realize the worth of the past few years' engineering education. "It's incredibly exciting," Samuelson enthused, " to take the hydrofoil out to the lake for testing and seeing it fly across the water."

"I originally joined the team because it sounded like fun to take the craft out to the lakes for testing during the summer while everyone else was locked away in the ME building," remembered Lindell. "I eventually learned that you can take a group of people with varied engineering experience, challenge them to apply their knowledge to a different sec-

History of the U's Hydrofoil Team

1990
Did not compete

1991
Won "Overall Best Vehicle" at the International Human Powered Vehicles Association competion in Milwaukee

1992
Unable to compete due to problems with radial design changes

1993
Won "Overall Best Vehicle" in Blaine, Minn., while setting world speed records for human-powered vehicles

1994
Had well-tuned craft but was unsuccessful in getting sponsors to pay for transportation to competition

Currently
Using last year's craft to actively pursue a female rider world record

Julie Sivula

tion of the hydrofoil, and have it all result surprisingly easily in a functioning, winning design."

Aurora II Solar Vehicle Project

The University of Minnesota Solar Vehicle Project offers another unique opportunity for obtaining hands-on engineering experience. The project goal is simple: win Sunrayce 1995. In the bi-annual intercollegiate solar-car race, the University's Aurora II solar vehicle and 39 competitors will trek across the country from Indianapolis to Golden, Colo. finally ending in a climb up Pike's Peak.

The solar vehicle project is the largest IT student venture ever. The design, fabrication, and testing of Aurora II spans all engineering disciplines. The team is composed of mechanical, electrical, and aerospace engineers as well as journalism and business majors. "We'd like to get some civil engineers involved, too," said Jessica Gallagher, one of the co-project managers.

"We're also trying to expand the project beyond just IT," she continued. The tremendous task of creating a vehicle for the Sunrayce is much more than a rigorous exercise in engineering. In addition to designing and building the solar car, the team enthusiastically fundraises and promotes the project. "We recruited an ad team," said Mohammed Al-Aidy, the fundraising and publications team leader. "They helped to sharpen and define the team image by producing a newsletter, T-shirts, and a new logo." Al-Aidy added that more students are also being recruited to lend expertise on business and marketing aspects of the project.

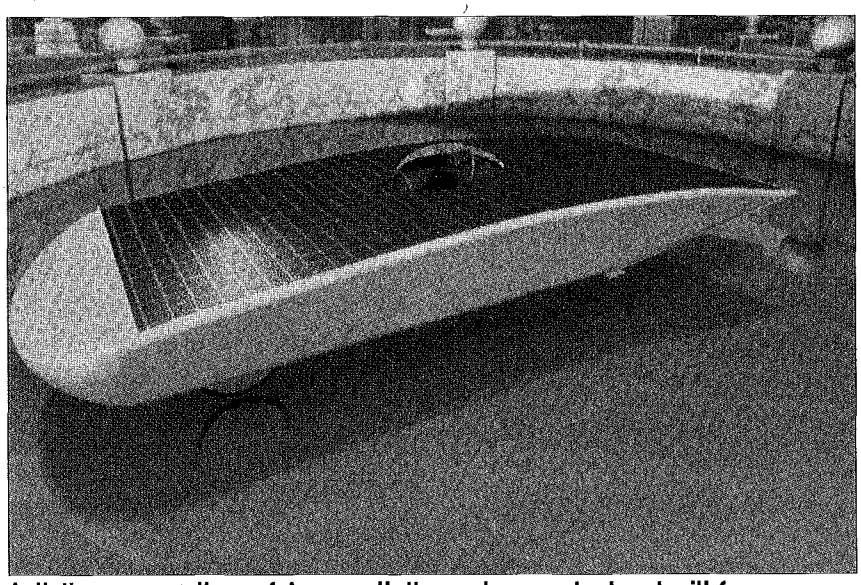
In addition to fundraising and publicity, the Aurora II is organized into five other subgroups. These subgroups focus on aspects like the aerodynamics, solar cells, power system and battery, mechanics, and logistics. Tteam leaders often guide the subgroups. This often produces situations calling for balance and compromise. "All of the team leaders look at the car differently. They all have valid points concerning their areas of focus," explained Gallagher.

"All of the team leaders look at the car differently. They all have valid points concerning their areas of focus."
--Jessica Gallagher, Aurora II co-project manager

"We need to recognize that there are interactions between the various groups and that there is not always a clear-cut answer," clarified Paul Kelsey, the other co-project manager. "For example, Steve White, our [solar] array team leader, would like to have a flat surface to attach his solar cells to. On the other hand, Lance Molby, our aerodynamics team leader, needs to have a curved surface for better aerodynamics." Students learn to work as a team, making compromises and considering all components that contribute to the success of the vehicle.

The solar vehicle project is similar to the development of a new product in industry. The Aurora II entails not only design, prototyping, fabrication, and testing, but also fundraising and project promotion. Department donations and private sponsors support the project. Private sponsors often donate in cash or in kind. In-kind gifts in the past have included testing facilities, batteries, a Cray supercomputer and software packages.

Fundraising helps many students improve their communication skills. As the co-project manager focusing on business matters, Gallagher prepared and presented budget proposals, consulted with school officials and gave presentations to project supporters from industry. She also wrote numerous reports and memos. Such activities help team members learn to clearly present and sell their ideas. Such skills are likely to produce success in industry.



Courtesy of the Aurora II team

Artist's conception of Aurora II, the solar car being built for Sunrayce '95. Dozens of students from throughout the University collaborate to create this ultra-light, solar-powered vehicle.

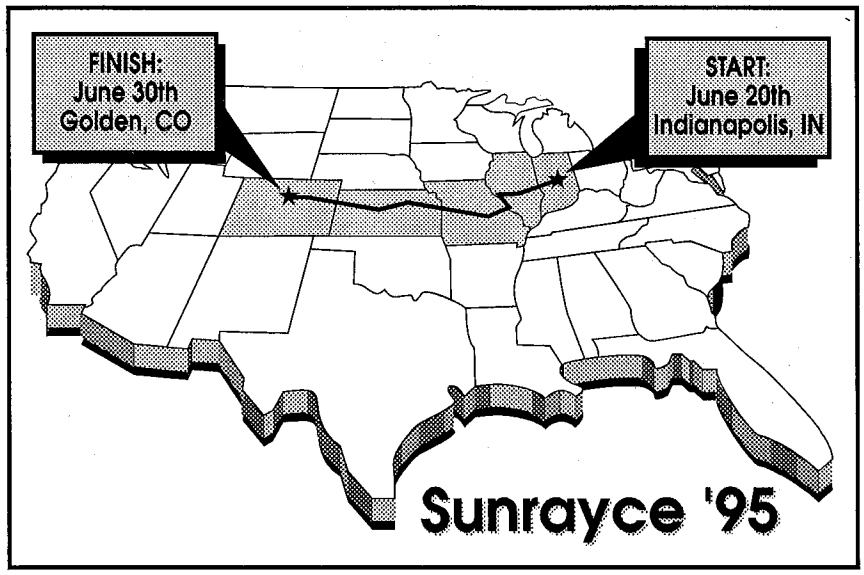
The solar car project constantly gives students opportunities to tackle open-ended problems. The team is challenged to build a solar vehicle to travel over 1000 miles across the country. Unlike homework problems, there is not one correct answer — there is a myriad of design options. "I worked with a team of engineers and learned to work with constraints like money, time, and Sunrayce rules. The challenge was to consider the alternatives and find the best solution," said Gallagher.

"... it is a great way to see exactly what is out there before we graduate."

--Paul Kelsey, Aurora II co-project manager

"This project requires students to work side by side with professors and engineers in industry in such disciplines as computational fluid dynamics, vehicle dynamics, composites, battery design, solar array design, and data acquisition for testing," Kelsey said. The project provides students with a chance to work in-depth in an open-ended problem, make connections and share knowledge with faculty and engineers, and to experience the gamut of engineering disciplines. Kelsey agreed, "Because the project is so dynamic and we are exposed to so many different technologies, it is a great way to see exactly what is out there before we graduate."

"Jessica is a perfect example of how the solar car team can enhance [one's] classroom education," said an enthused Al-Aidy. "She was a mechanical engineering major that didn't know anything about engineering or cars. In the beginning, she didn't even know how to use a power screwdriver. Now, she's putting cars together."



Julie Sivula

The Changing Design Curriculum

While projects such as the hydrofoil and solar car can significantly enhance undergraduate engineering education, some feel that more should be done to train tomorrow's engineers. One area in which sweeping changes are being discussed is the Design Division in mechanical engineering. The Design Studies Committee has proposed several ideas to change the design curriculum. William Durfee, an associate professor in the Department of Mechanical Engineering and the Director of Design Education, said, "Design defines engineering. It's an engineer's job to create new things to improve society. It's the University's obligation to give students fundamental education in design."

Currently, the mechanical engineering undergraduate curriculum contains only one course, Design Morphology with Applications, focused on the design process. Extensive prerequisites prevent students from taking the course before their senior year. As a result, most students do not gain design exposure until shortly before graduation. So many students are insufficiently trained to enter the job market or graduate school. "Design utilizes a learning process different than book learning. Students are taught to tackle unstructured problems without one correct solution. Given no rules and no constraints," Durfee explained, "students must draw on all the knowledge they've gained from class and life."

"It's the University's obligation to give students fundamental education in design."

--William Durfee, Director of ME Design Education

Several ideas have been discussed to improve mechanical engineering curriculum. The proposals range from practical and long overdue to boldly radical.

A new course, Introduction to Design, has been suggested. As a required lower division course, this class would emphasize analysis, simulation and predictions at a skill level appropriate for freshmen and sophomore engineering majors.

"The intent of the class is to give a flavor of the design discipline to students early on," Durfee said. Ideally, the class could be implemented IT-wide and eventually attract students to pursue mechanical engineering.

Introduction to Design would expose students to many steps of the design process. For most undergraduates, it would provide their first opportunity for hands-on engineering. Students would learn about design through prototyping and fabrication of a product using simple parts and basic fabrication skills. The course would emphasize analysis of physical principles and production through simulation. Students would also learn to use spreadsheets, documentation by drawing and estimation. This class would provide a solid foundation in design, providing skills that would be useful in future courses and projects.

Another proposed lower division course, Engineering Communication, would teach students to communicate at a level of competency and sophistication expected in other IT courses and in the workplace. This course would emphasize oral communication through presentations, written communication through weekly progress reports and writing assignments, data communication through use of charts, and visual communication by introducing 2-D and 3-D drafting and rapid visualization.

A pilot version of this course was run Fall Quarter 1994 by Durfee. A group of 15 students volunteered to participate in the class as an alternative to Engineering Graphics. They improved communication skills by taking a product apart, such as a video cassette, then understanding, drawing, writing about and talking about it.

ME 5254 and 5255 (Design Morphology with Applications) may be renamed Design Projects and Design Prototyping, respectively, and shifted toward emphasis of the entire design cycle. From definition of customers' needs through the fabrication, prototype and test stages, the revised structure will offer students a sense of design continuity.

In order to integrate design skills even further, it has been suggested to implement design education across the curriculum. In order to fully utilize students' engineering skills, design problems will not be limited to courses taught by the Design Division. This concept could be carried out through homework assignments incorporating synthesis with analysis activities, a substantial design problem relevant to the course material, design activities that span several courses to tackle multi-disciplinary problems, or case studies of existing designs pertinent to specific courses.

Implementing design education across the curriculum would be a daunting challenge. Said Durfee: "Philosophically, it would be appropriate to add more design in lower curriculum, but the question is how to implement it. Who will teach, staff, TA and develop the courses? The faculty at the U already carries a high teaching load for a research university." Teaching small sections and

Proposed ME Curriculum Changes

- Implement "Introduction to Design" to provide freshman with a solid foundation in design practice.
- Implement "Engineering Communication" to give underclass I.T. students needed Communication skills.
- Shift upper-division design courses towards the entire design cycle.
- Implement design accross the curriculum to emphasize analysis and synthesis activities outside of class.

grading open-ended design problems would require a greater investment of time and money. "To implement design across the curriculum, we would need to reprioritize or reallocate resources," Durfee said.

Another opportunity to enhance education would be through the Design Partners Program. This program would improve ties between the design program and industry. The program benefits both the University and the participating company in many ways, like producing concepts and/or prototypes useful to the company while providing financial resources and design project for students. A mentor program matching student with University graduates has also been suggested.

Thus, there are many exciting, innovative ideas for enhancing engineering education. Although these ideas are still in the discussion stage, they offer promise that teaching at the University is evolving in an effort to provide the highest quality education possible.

These courses, however, are not yet available. So until then, keep looking forward to the senior year capstone course to tackle exciting challenges like the hydrofoil project. Or, just remember that the Aurora II team is always glad to bring in new team members.

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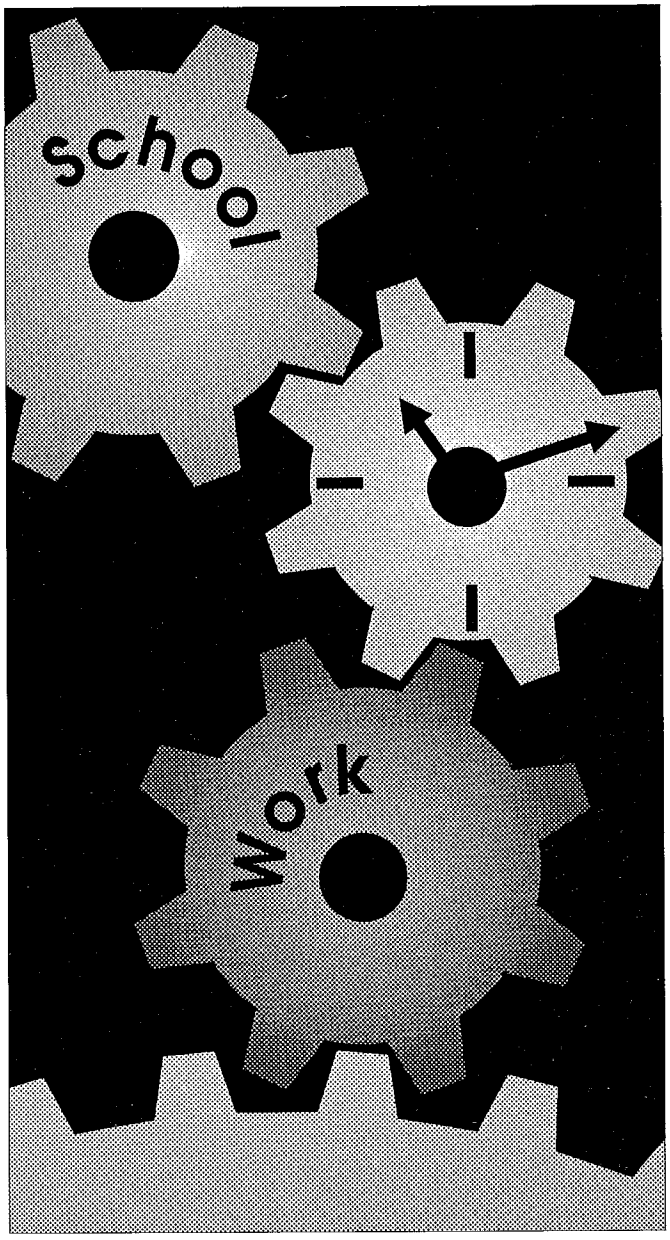
As a senior in the Mechanical Engineering Co-op program, Linda Pham is working in her third industrial assignment. After graduation she plans to study biomedical design applications in graduate school.

Co-op programs integrate work and school



Julie Sivula

❑Four IT programs on campus prepare students for the demands of the work place and put their book knowledge in perspective.

By Aaron Osterby

This year, as in the past, students graduating in engineering fields will face an uncertain job market. Few argue that, in Minnesota's climate of low unemployment, IT engineering grads will not find work. The trick is going to be, what kind of work will you be doing?

It's easy to pass up the lean salaries of a carbohydrate engineer working at the local burger joint, but after that the choices get tougher. What is it really like to work for the government? What about on-site consulting? And how are you supposed to deal with a citizen pressure group?

Cooperative internship programs between the University and private industry help handle the job crunch for graduating seniors by answering some of these questions before graduation and providing a new commitment to work. These questions could be answered for some IT students before they graduate and have to commit to a full-time job.

The various internship programs provide students with contacts and pointers toward arranging a job in their chosen field. The student gains invaluable experience and good resume entry. The company gets cheap labor, but more importantly gets to take possible new employees on a test drive before it commits to hiring.

The four major co-op internship programs in IT belong to Aerospace Engineering, Mechanical Engineering, Civil Engineering and Electrical Engineering. Some companies hire students from more than one department. ME and EE interns occasionally work for the same company as do AE and EE students.

Civil

Cooperation between the school and the nearly 700 companies invited by the department to host internships gets students working in the field with contractors, government agencies and private consultants.

Because Minnesota's chilly nature in the winter cools demand in the construction industry over, the program is set up to place students in jobs over the summer. Students work over the summer plus either spring or fall quarter. Some interns may end up working with private consultants or with a contractor on a government job or even with the government as an inspector's assistant.

"The local employers have indicated quite strongly that they look for internship or practical experience when they hire students."

--Rich Sterling, Civil Engineering Co-op Program director

Any direction students take gets them full credit for the academic quarter they miss while working the spring-summer and summer-fall internships. Since last year, nearly 60 students participated in the program. The department also gives information to students about openings for part-time positions and summer work independent of the internship program.

"The rate of pay varies quite a bit," Rich Sterling, director of the program, said, "It varies from as little as between $6 and $7 an hour, particularly in the out-state areas, to as much as $12 or $13 an hour."

While earning a little money, students learn valuable lessons not always taught in the classroom, Sterling said. Students interning for a testing firm can learn about consulting on public works projects, and those working for a public agency could wind up finding out first hand how to manage community pressure groups and city councils.

Co-op Programs continued on page 20

Students engineer brighter futures

Silvana de Faria

Mechanical Engineering Co-op students John Bukkila and Paula Sozynsky work with the dust chamber system at the U.S. Bureau of Mines.

After spending a few weeks in a hot, dusty coal mine in southeastern Utah, two mechanical engineering cooperative students not only learned firsthand what it's like to work in heavy clouds of black soot and dust, but they also witnessed just how valuable their United States Bureau of Mines internship has been for the welfare of the nation's coal-mining industry.

By Brad Davis

Last May, Institute of Technology seniors John Bukkila and Paula Soczynski joined other college students and government researchers at the Skyline Mining Co. near Moab, Utah, to help monitor the hazardous exposure of respirable coal dust and other toxic fumes to company miners. And it wasn't long before the two students themselves became exposed to the daily working conditions inside one the country's busiest coal mines.

They watched the suffocating haze of dust slowly blanket themselves and everybody around them from head to foot. They breathed in the black soot, gas fumes and other toxic ingredients that go into pneumoconiosis, commonly known as black lung disease, which has plagued the mining industry for decades. And they finally realized why they had logged all those long hours in the federal bureau's Twin Cities Research Center test laboratory.

When the dust finally settled, both Bukkila and Soczynski understood that their industrial hands-on experience not only taught them practical engineering skills but also provided the US mining bureau with valuable data that could one day reduce the health hazards associated with modern-day mining. "I learned in those two weeks that I'm not going to be a coal miner," Bukkila says as he reflected back on the expedition to Utah. "But I also realized we were doing research that hopefully in the end will save miners' lives. That is a very rewarding experience."

Both Bukkila and Soczynski are nearing the end of their two-year commitment in the popular Mechanical Engineering Cooperative Program (MECP) that has united young scholars and local industry since 1950. And as they look back on their experiences, both students say the program has fulfilled its two main objectives: providing students with a hands-on engineering experience while giving them an opportunity to apply some of their textbook knowledge of fundamental theories to practical problem solving.

"It's an excellent program because it shows you what the work place is really like out there."

-- Paula Soczynski MECP senior

The two University students have been applying their engineering knowledge in an ongoing research project within the Twin Cities Research Center Dust/Aerosol Technology Group. The group is currently developing a portable "dust-exposure" monitor that could continuously measure the concentration of coal dust within a mining shaft and then instantaneously provide that data to company officials.

The Twin Cites Research Center is one of eight research laboratories scattered throughout the United States. The center opened its first station in 1915 on the University campus before moving south near Fort Snelling in 1961. And it's there in the small dust aerosol laboratory where Bukkila and Soczynski work and study on the evolving dust chamber system.

The chamber system looks like something out a low-budget science-fiction movie: a tall cylinder wrapped in silver insulation with wires and gadgets spewing out of the top. It has two small openings on both sides that permit the scientists to protrude their arms

deep into its belly. Actually, the system does nothing more than simulate the conditions inside of a mining shaft. Through the use of dry compressed air and a vacuum pump, the system is able to re-create dust aerosol mixtures inside the chamber. And, with the help of computerized monitors, it allows researchers to test various dust-reduction devices.

The two interns have conducted many of the tests — a slow and tedious process that has produced some important data. Because the dust-chamber system is relatively new, technical problems are constantly on the rise, says Bukkila. But, he added, there is a lot to learn from mechanical troubleshooting, and the mining bureau lab has provided the interns with a rich deposit of information and resources.

"I also realized we were doing research that hopefully in the end will save miners lives. That is a very rewarding experience."

-John Bukkila, MECP Student

The Dust Chamber System research is part of a federal effort to cut the current amount of permissible exposure of coal dust to company miners. In 1972, the Mine Safety and Health Administration established a limit of two milligrams of particle per cubic meter. Today this amount of exposure is being challenged by new government reports that indicate a need to further cut the limit in half in order to reduce health hazards.

Today, more than 100,000 American coal miners suffering from black lung disease receive annual compensation and medical benefits from the federal government under the 1969 Black Lung Program.

The program spurred the nation's coal-mining companies to study new ways of reducing dust-particulate concentrations in work areas in an attempt to eliminate black lung. When the program was enacted, the medical evidence concerning pneumoconiosis was scarce and much of the monitoring equipment was outdated. Only recently, reports began advocating a need to explore new ways to make the underground mines safer and healthier for employees.

And it's this type of health-related research that attracted Soczynski to the federal mining bureau back in 1992. "I wanted to participate in a project that could help people or the environment. I didn't go into mechanical engineering to make weapons," she said. In fact, Soczynski said she has learned through her co-op experience that there's a lot more to the mechanical engineering field than she expected. "It's an excellent program because it shows you what the workplace is really like out there."

Each year, more than 80 IT students participate in the MECP to learn "what the work place is really like" after graduation. Most students in the program say they wanted to learn practical engineering skills to get an edge over other college graduates. Many also say that actually engaging in working relationships with an engineering team is much more meaningful than reading about it in an "Introduction to Mechanical Engineering" textbook.

Indeed there's no textbook like the two-year MECP experience. The program begins for most students in their sophomore year when they apply for admittance into the program and enroll in designated courses. Students have a wide

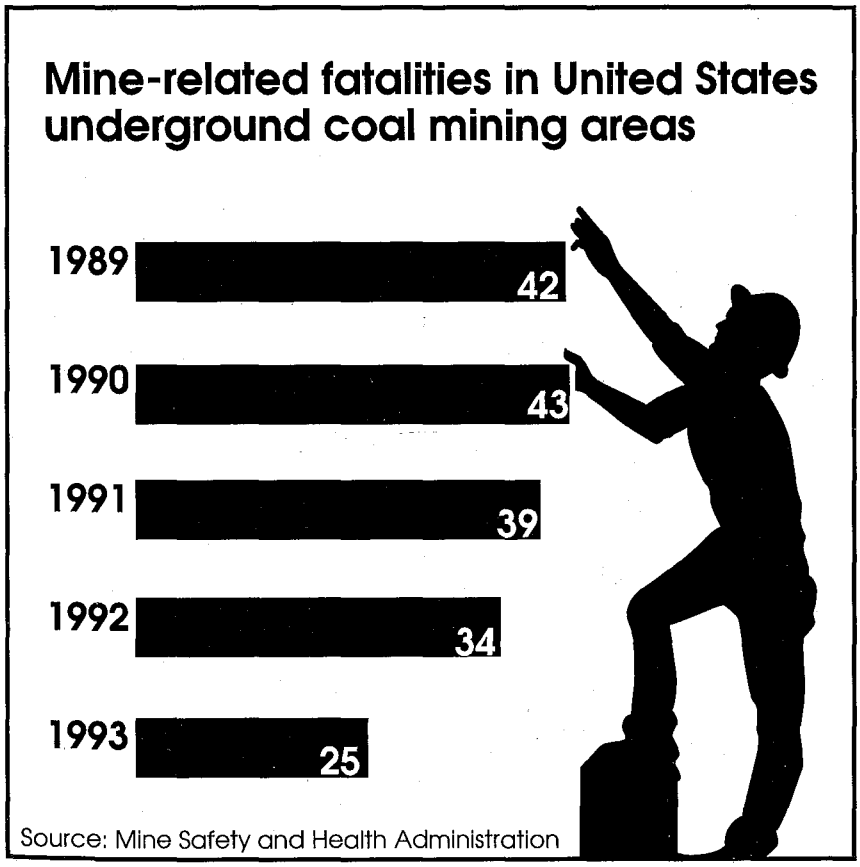
variety of industries to chose from when deciding where to intern. Past companies in the program include Northwest Airlines, Potlach Corp., Rosemount Inc., General Mills, Federal Cartridge Co. and Unisys Corp., among others.

The MECP is structured so that students switch back and forth each quarter between their full-time studies on campus to their full-time internship at a chosen industry. Students usually plan their academic schedules in advance so that their course work and internship can supplement each other. Some co-op students say the MECP has greatly improved their studies and grade point average. And aside from grades, co-op students can also improve their personal finances. Students can earn up to $20,000 over the two-year period from their industry or firm — a salary that attracts a lot of interest and competition.

MECP director Virgil Marple said after a student is chosen for the program, it's up to them to reap the maximum benefits. "Each student should take full advantage of his or her company internship. They should look at it as part of their overall education."

Professor Marple uses his own MECP intern experience, which he gained from an Iowa manufacturing firm back in the 1960s, to build the foundations for the current cooperative program. "The University of Minnesota provided me with a excellent background in engineering, but the practical experience I received from MECP, that was the icing on the cake."

For many engineering graduates seeking employment today, the MECP can still provide the icing on the cake in a competitive market where everyone is looking for a piece of the economic pie. "An engineering experience is so important for graduates because it exposes them to different types of working conditions and teaches them how to apply abstract ideas into real models," says Marple. The transition from academia to real-life working conditions is very important, he adds. "Once you become a co-op engineer, you become more of a full-time engineer than you are a student. You ease yourself out of an academic setting and into an engineering or corporate setting over this co-op experi-



Julie Sivula

ence."

But clearly students are not the only ones benefiting from MECP; many industries around the region see the program as a way to recruit top engineering scholars. "Companies do look at this [program] as a means to hire new employees," said Marple. Over the two-year period, co-op students have an excellent chance to prove their worth in the company and move to the top of the firm's hiring list, he added.

"You ease yourself out of an academic setting and into an engineering or corporate setting over this co-op experience."

--Virgil Marple, MECP director

And students can quickly prove their worth in simple ways, like being able to conduct themselves properly in the laboratory without causing major damage, according to Bruce Cantrell, who has supervised co-op students at the mining bureau for the past eight years. "This might sound so simple, but it's very important," he said.

Cantrell said he looks for engineering students who have a good foundation in the basic sciences along with some laboratory experience when hiring new co-op members.

At the U.S. Bureau of Mines, Cantrell stresses the importance of communication skills by assigning MECP students numerous written reports and oral presentations. "For many students, this co-op program is the first time they have been required to communicate," said Cantrell, who believes technical communication skills have not been taught very well in college. "Half of what we do as engineers is communicate our research; these skills are very important."

And above all else, MECP provides students with practical engineering skills — the type of skills many college students are lacking these days, said Marple. He thinks that today's engineering students don't have the same basic mechanical knowledge that former students had in the past. These students came from rural areas where they were expected to know all about the mechanics of cars and farming equipment, he explains. But in today's high-tech age it's more difficult for students growing up in an urban environment to obtain this basic knowledge. "Today, everything is computerized. Students don't learn much about mechanics working on television sets or video cassette recorders. It's a little more difficult to tear things apart these days," he said.

And so it's through the MECP that University students get to tear things up a little and learn more about their role as engineers. Both Bukkila and Soczynski say the program has provided them with a mother lode of practical experience that will allow them to stake a claim in the mechanical engineering industry.

--Brad Davis is a Technolog associate editor

Co-op Programs, from 14

"It's a whole range of activities which really increases their understanding of how the process works and gives them a lot of confidence," Sterling said. "The local employers have indicated quite strongly that they look for internship or practical experience when they hire students."

Though student interns may not get the ground-breaking assignments and instead have to put up with some tedious work, the program is still worth it, Sterling said. "Obviously punching numbers in for six months isn't going to help very much, but whether they're testing or out on site, they just get a feeling of the industry itself. Whatever job they're in, they come in contact with all the other elements."

Mechanical

Students can choose from companies both in Minnesota and out of state for the mechanical engineering internships. Some local companies like 3M may ship students out to remote manufacturing plants. This year around 80 juniors and seniors availed themselves of the opportunity to get some practical experience to supplement their book learning.

Students who participate in the program switch-off between class and work quarterly in their junior and senior years. To get credit for working, the interns are expected to write papers on various topics including a general description of the company they intern for and more in-depth design problems.

"What I like to see them do is to start out on the floor of a manufacturing plant, seeing how something is made. By the end of the fourth quarter I like to see them working as an engineer."
--Virgil Marple

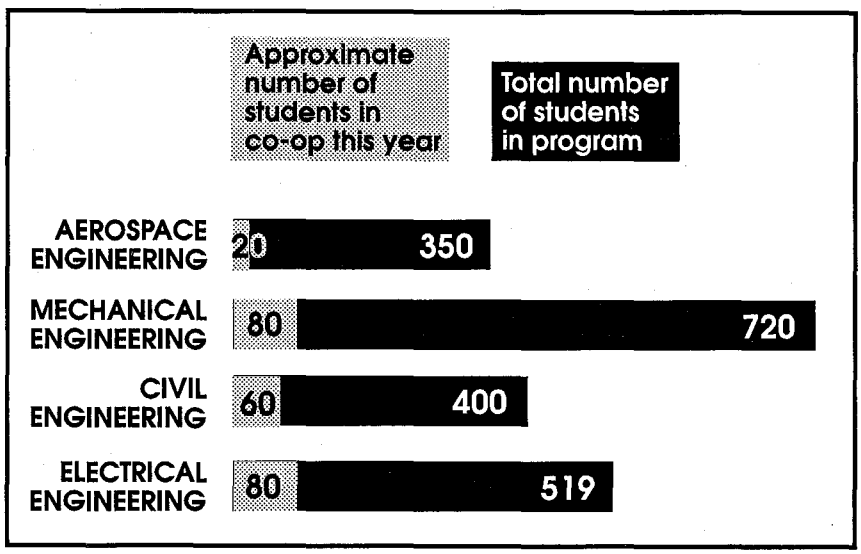
"What I like to see them do is to start out on the floor of a manufacturing plant, seeing how something is made. By the end of the fourth quarter I like to see them working as an engineer," Virgil Marple, the program's director said. "We look at it as a co-operative effort between industry and the University in their education. Industry can better teach the practical, hands-on experience, working with people, working with machines seeing how something is made, seeing what the real problems are that they're going to face."

Marple said the University is not an employment agency, and students should not let salary affect their company choice. He asks companies not to mention wages in the initial interview but said all of the positions do pay.

Most students look at the internship program as the first step toward a job. But Marple said its also a step closer to a wider understanding of how the world functions. He said students who intern often see more clearly which elective courses will be valuable to them in dealing with people as well as designs.

"When you take an education and go up and graduate and then go out to work you have a lot of faith that what you are learning will help you go out and get work," Marple said. But by interning, it's easier to see where that faith might be misplaced or well-founded. Students come back to school with a renewed impetus to study and shore up the areas they've discover need work.

Electrical



Julie Sivula

Internships are becoming more important for electrical engineering students since the booming job market of the 1980s is drying up in the 1990s. The rapidly expanding growth in the use of personal computers spawned a job environment where graduates could expect 15 to 20 job offers, but now companies are being more selective, Keith Champlin, the Electrical Engineering Department's director of the co-operative internship program said.

"With this tight job environment, they find it a real advantage to have an intern experience. It gives them an opportunity to gain real engineering experience while they're still in school and this gives them a real leg up when they graduate," Champlin said. "Co-op students find that they have a much easier time getting a job since they have experience. And very frequently they get job offers from the companies they have been co-oping for."

This year nearly 80 students are involved with the program, working mostly for Minnesota-based companies like Honeywell and Rosemount. Some manage to work as far away as California slaving away at Intel Corp., while the rest of us freeze.

Students earn two credits for a quarter internship by writing a report after they return to campus. While many are motivated by the prospect of learning more about the cutting edge of electrical engineering, most wind up learning less about that and more about how to work as part of a large team.

"Some of the jobs have a great deal to do with inter-personal skills. One of the students went to work for Intel and within a short time he was answering phones and fielding all of the questions people were bringing in about how their equipment operated," Champlin said.

The internship possibilities vary greatly. Students could wind up working for the federal government, a computer company or an aerospace firm among many others.

"The companies are widely ranging and the jobs in each company are widely ranging as well," Champlin said. "Frequently students work in teams with other engineers or work underneath an engineer who acts as a mentor. They have to interact with a group and deal with people as well as technical problems."

A good number of interns are hired by the companies they co-op with but even if that doesn't happen, the experience looks good on a resume and will help out in the interview. "It's good for the student, good for the company and also good for the University," Champlin said. "I think it's a win-win situation all the way around."

Aerospace

The smallest of the internship programs, Aerospace Engineering places a handful of students in the local aerospace industry and nearer the nexus of the business, at NASA and the Johnson Space Center.

Cutbacks in federal defense spending shrank the program to a mere trickle of students who were able to intern. But even as the program crawls back from the brink and, with the help of alumni in the industry who have added openings for interns, the demand still outpaces supply. Only about 20 students are currently able to take advantage of the opportunity. But Andrew Vano, the program's director, said those who do get in have an unparalleled experience.

"It's incredible the responsibility these companies give the students. They treat them as engineers, they don't just give them some kind of fictitious experience," Vano said. "At Rosemount many of the students get to do some test probes in their wind tunnels. At Northwest students looks at the operation of different aircraft and make sure the data provided to the pilots are correct. And some of them do studies to determine if an aircraft is up to FAA rules."

Interns are supervised, Vano said, since mistakes could be costly but the contributions students make to the company they intern for is real. Not all the jobs are with defense contractors though, Vano said one student did research on the properties of Minnesota's wind patterns for the state. A good survey would help determine where the best places to put wind-turbine power generators.

Students write papers about their internships to get credit but the program puts the students in contact with cutting edge technologies that the companies would prefer to not give out for free. Students who work with proprietary information do not have to explain what they did in depth, but can focus on other subjects.

Students earn about $4000 in each of their four workingasssignments. But according to the programs's application materials, students in a hurry to get out of school should take a pass on the program since it nearly always results in a postponed graduation.

Herb Harmison, the director of IT's placement office, said only about one of every ten students participate in the various internship programs but he added that the numbers ought to be higher.

"Co-oping in the best way to get an education," Harmison said. "Any one with the ability and a desire to become a contributing member of society should consider it. There's so many advantages and so few disadvantages that it really doesn't make sense not to do it."

Aaron Osterby is spending the quarter ramming his graduation paperwork through the system. In the meantime he is a contributing writer for Technolog and the state politics reporter for The Minnesota Daily. He also asked us to tell you he is a Leo.

. . . brings our problems down to scale

In retrospect, the moon landing doesn't seem like the beginning of a new age. It seems like the end of an era — at least in our relationship to nature. By 1969, we had completed the centuries-long transition from a species in awe of nature to a species that believed in the conquest of nature — even space.

On the anniversary, Buzz Aldrin, the second man to walk on the moon, complained about "an erie apathy (that) now seems to inflict the very generation who witnessed and were inspired by those events." He talked about a "withered capacity to wonder."

But today, it's not an excess of apathy or a lack of wonder afflicting us. Our relationship to our natural world has changed again, from awe to conquest to — what? — Guilt? To many, the idea that humanity should strive for domination over nature seems as quaint now as planting a "waving" American flag on the windless surface of the moon.

To many, the idea that humanity should strive for domination over nature seems as quaint now as planting a "waving" American flag on the windless surface of the moon.

It turns out that we were better conquerors than stewards. We tried to take the awe out of nature, to make the world we lived in safe and settled. But we ended up endangering species, including our own.

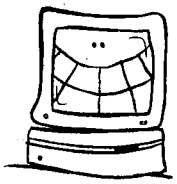
Our most "awesome" accomplishment — splitting the atom — left a mushroom cloud over our confidence. By sheer numbers, we tilled, built and devastated what was wild. Now every day we see problems of our own making. If we can put a man on the moon, we cannot necessarily protect the Earth.

Today the massive technological feats with astronomical price tags are likely to be clean-up operations for earth, air and water. There is the sense that instead of blazing new frontiers, we have to pick up our own earthly border.

In great and small ways, we are struggling to understand our place within the world. Not just over it.

So on a summer day, maybe it's not the memory of footstps on the moon that rivets our attention, or engages our attention, or engages our sense of wonder. It's a vast celestial event out of all human proportion, a comet crashing into a distant planet in alphabetical pieces.

We are back to where we started: a natural sense of awe in the face of nature.



To contribute to Views, send an e-mail to the editor <*math0038@gold.tc.umn.edu*>. Please include your name and two phone numbers in the message. Also, please state the purpose of the piece in the subject box of the e-mail transmission.

TALES of TECHNOLOGY

by Joseph Scrimshaw

HELLO THERE AGAIN, BOYS AND GIRLS! DO YOU SEE SOMETHING DIFFERENT 'BOUT YOUR OLD FRIEND, RAYMOND? THAT'S RIGHT! I GOT A BIG OL' HUNK OF COMPUTER INTERFACIN' WITH MY BRAIN! BOY, DOES IT TICKLE! BUT, WHAT'S 'SPECIALLY FUNNY IS, IT DON'T MAKE MY BRAIN WANNA LAUGH, IT MAKES MY BRAIN WANNA TELL YOU THIS SCARY STORY, 'BOUT THAT CRAZY "OVERBITE" BILLY, I CALL IT...

"WHAT FRIENDS ARE FOR"

UNITED STATES POSTAL SERVICE™

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PS Form **3526**, October 1994 *(Reverse)*

. . . despite University downsizing

Pushing a pencil in a cubicle does not prepare future engineers for this environment.

We feature programs that attempt to give students the concrete experiences that will lead to the kind of growth they need. Mechanical Engineering's Design Morphology with Applications course is a model of hands-on engineering pedagogy. Design Morphology gives students social, hands-on work and requires them to enter every facet of design — from brainstorming to prototype testing to the final product. But more needs to be done to give students this experience early on.

The various co-op programs on campus emerse students into engineering firms, where they learn the procedures and policies of a corporate environment. In these internships, students are thrust into positions of responsibility on design teams and are given a head start in the gamut of engineering experiences. Both sets of experieces enable students to do hands-on, open-ended problem-solving.

The challenge for engineering educators is to integrate these intensive experiences into the curriculum, especially in the face of University-wide downsizing. Professor Durfee from Mechanical Engineering wants to get students doing this kind of work throughout their undergraduate careers. But in the wake of budgetary cuts in that department which resulted in the loss of 15 quarter-time TAs and in light of the fact that faculty are already overloaded with teaching, implementing these reforms will not be easy.

These economic issues should not threaten reforms, however. Finding creative ways to solve seemingly impossible problems is a primary skill engineers are noted for. We need to use this skill to implement reforms in the face of budget problems. For example, we could recruit more engineers to volunteer their time to mentor students in design courses. As eductaors, we owe it to our students to find solutions to the challenges facing IT. As engineers, we are well suited to creatively find these solutions.

Announcing the 1995 Science Fiction Contest. Mail your entries to our office by February 7, 1995 and you could win one of three fabulous prizes!

- **First Place: $200**
- **Second Place: $100**
- **Third Place: $50**

Rules:

The contest is open to all registered University students except ITBP members. Entries must be typed and double-spaced, previously unpublished and no longer than 300 words. Attach a cover page entitled Science Fiction Contest Entry, and remember to put your name, address and phone number on the title page only.

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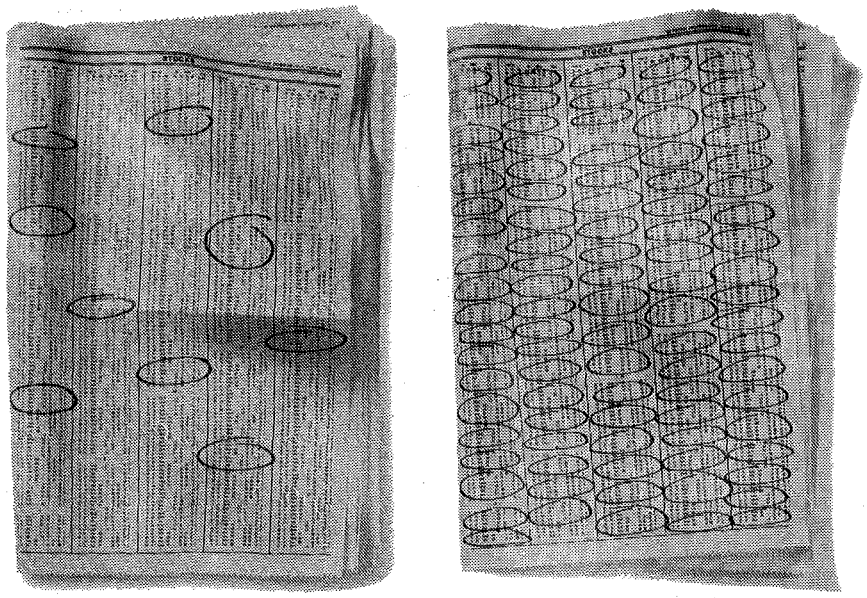

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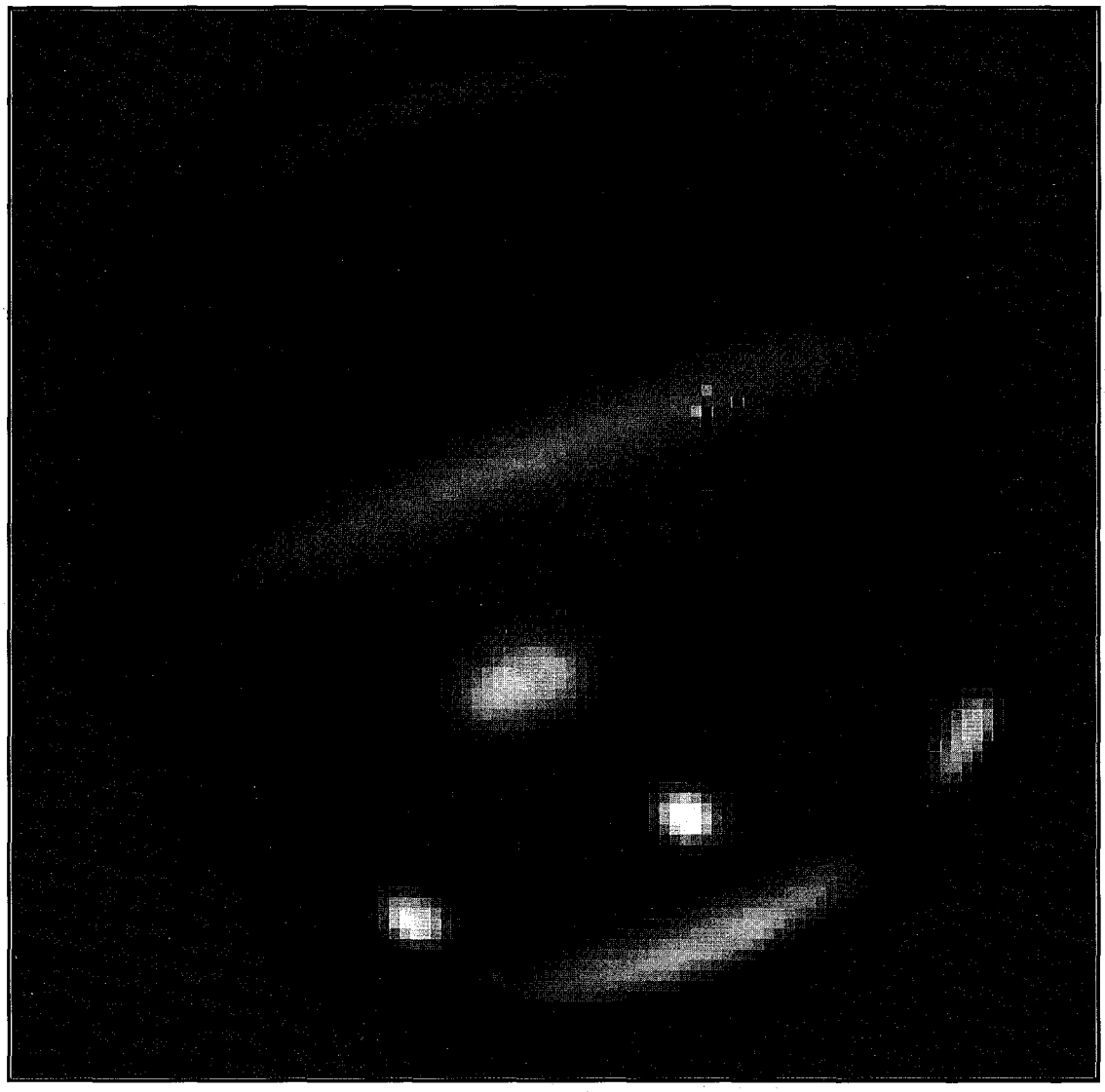

Research and U2000

- UROP Program
- Warm Superconductors
- Thorium Dating

. . . and more

U2000: Recreating the University . . .

University President Nils Hasselmo and his staff of administrators have come under repeated criticism for their U2000 plans. Most of this criticsm stems from the fact that these plans are under construction. People are frightened by what they do not know. Since we know too little about U2000, we react against it.

But what we do know about U2000, we tend to approve of. In the rough, U2000 is a platform of solid reforms of the institution. Many of these reforms are not controversial. We all want the University population to more closely reflect society's cultural quilt. We all want to improve the quality of undergraduate education, especially for the most diligent and bright students. We all want the University to be more user-friendly. We all want the University to become a major research institution world-wide.

The criticisms are not aimed at this lofty platform. They are aimed at the lack of discernable outcomes associated with these reforms. Aside from diversity, administrators have made too little progress towards quantifying these goals. And the present diversity projections are surrounded in controversy.

The criticisms are not aimed at this lofty platform. They are aimed at the lack of discernable outcomes associated with these reforms.

Administrators have suggested stiffer entrance requirements as a means of improving undergraduate education for motivated students. This suggestion lost prominence because it conflicts with the diversity goal. Statistical linguistic evidence suggests that people of color are disadvantaged in standardized tests. If so, a primary means of entrance evaluation hinders diversity efforts. To raise entrance requirements would only further hinder those efforts.

A recent plan on the administrative table would only hurt motivated undergraduates. Forcing departments to pay for their own TAs would drain the University of some of its best scholars. This will have a trickle-down effect on undergraduate education. The fewer bright minds involved in research and teaching at this institution, the fewer bright minds taking courses here.

Current electronic access trends show a commitment to a more user-friendly campus. But we don't know to what extent these programs originate in U2000 planning documents.

Unfortunately, of the four major reform goals mentioned above, research has received the least attention. How do we propose to improve the quality

--Continued on the back flap, page 18

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About the Cover

Computer-enhanced infrared photograph of Jupiter after Comet Shoemaker-Levy 9 collided with the planet. The scars from fragments G and L appear just below its familiar storm. (See **News**, page 3.)

Comet hunter Levy inspires awe

The astronomical discovery of the century almost didn't happen.

One cloudy March evening in 1993, David Levy and two amateur comet hunters, Gene and Caroline Shoemaker, were ready to call it a night because of the weather.

The shots revealed what looked like a "squashed comet." The 21-piece comet crashed into Jupiter three months later at 130,000 mph.

Even though a brief break appeared in the clouds over Mount Palomar, the expense of taking pictures of the night sky did not justify enduring the tenuous conditions. But Levy convinced the Shoemakers to take photos with some damaged film. Since the film was already a loss, Levy reasoned, it wouldn't hurt to try.

Miraculously, the shots of the sky near Jupiter revealed what looked like a "squashed comet." After verifying that it wasn't just a light leak on bad film, it was official. The strange-looking object was named Shoemaker-Levy 9. In July 1993, this 21-piece comet crashed into Jupiter at 130,000 miles per hour. For two weeks, every day brought a new cosmic collision. Each collision left scars still visible today.

In January, Levy came to the Ted Mann Concert Hall to tell the wondrous story of how this comet was discovered.

His lecture was a refreshing mix of media. He opened with this quote from Hamlet: "There are more things in Heaven and on Earth Horatio than are dreamt of in your philosophy." He then quoted poetry, flashed slides, played music and showed film clips while he told stories, the kind of stories a man in love with the night sky tells.

Even the smaller pieces caused huge fireballs and shock waves. Many of the pieces left scars larger than earth.

He showed the audience how comet hunting is as much an art as a science. "There's something magical that happens on a starry night," Levy said. "Just me and the sky."

The images of the collision between Jupiter and Shoemaker-Levy 9 would make Leonardo da Vinci blush. Each time a piece of the comet slammed into Jupiter's southern hemisphere, an astounding series of events took place. Even the smaller pieces caused huge fireballs and shock waves on the planet's surface. Many of them left scars larger than the earth.

Every major observatory on Earth directed its attention to the display for those two weeks. Even the Galileo Space Probe joined the party. The resulting data set is large, and scientists have much analysis to complete. "Six months later, the questions remain," Levy said. "This is the most enormous collection of data ever attained." The answers are there, he added, but it will take a long time to find them.

--James Mathewson

U ranks 6th in the nation in R&D expenditures, says VP

In February, Interim Vice President of Research Mark Brenner presented information on U research to the regents.

The most impressive information he presented was a graph showing the 10 schools with the highest total expenditures for science and engineering research and development for the fiscal year 1992.

No. 1 was John Hopkins University with $736 million spent. Michigan University was second with $393 spent. Third was Stanford University with $353 million. The University of Wisconsin — Madison followed with $324 million. At sixth was the U, with $317 million.

The Institute of Technology received $49 million in grants in Fiscal Year 1994.

At the University of Minnesota, several million dollars are granted by government and private groups for research every year. In the fiscal year 1994 $250 million was granted for research, training and service. The Institute of Technology received $49 million in grants. Arts and Sciences received $21 million. The largest portion of the $250 million went to Health Sciences with $131 million.This $250 million total grants increased $3.6 million from the previous year. IT's research money rose $6.6 million.

As of January, 237 companies hold licenses to 199 University inventions: 42 in engineering, 71 medical, 32 biotechnological, 7 patented plants and 34 copyrighted software programs.

Brenner also highlighted five research projects. Chemical Engineering and Materials Science Professor Lanny Schimdt's project representing IT. The project involves converting natural gas into more feasible fuels and improving auto-emissions. Schmidt's research is mainly supported by two federal grants, a National Science Froundation grant of $100,000 and a Department of Energy grant for $130,000. Schmidt also receives more than $100,000 annually from industry for research.

--Jeannette Hoffart

U experiment on *Discovery*

On February 2, a toxin first identified by U researchers in 1980 was sent into space on *Discovery*. This is part of the U's continuing research on proteins that contribute to diseases such as diabetes, multiple sclerosis, certain types of arthritis, and, most notably, toxic-shock syndrome. In an effort to produce vaccines against these diseases, U scientists decided to send the bateria-produced toxin into space.

On the earth, crystal formation is affected by the force of gravity. In space, the imperfections in a crystal are minimalized. By allowing a liquid form of this toxin to crystallize on the spacecraft, scientists create a near flawless crystal. From the crystals' less-flawed structure, researchers can extrapolate the toxin's molecular structure.

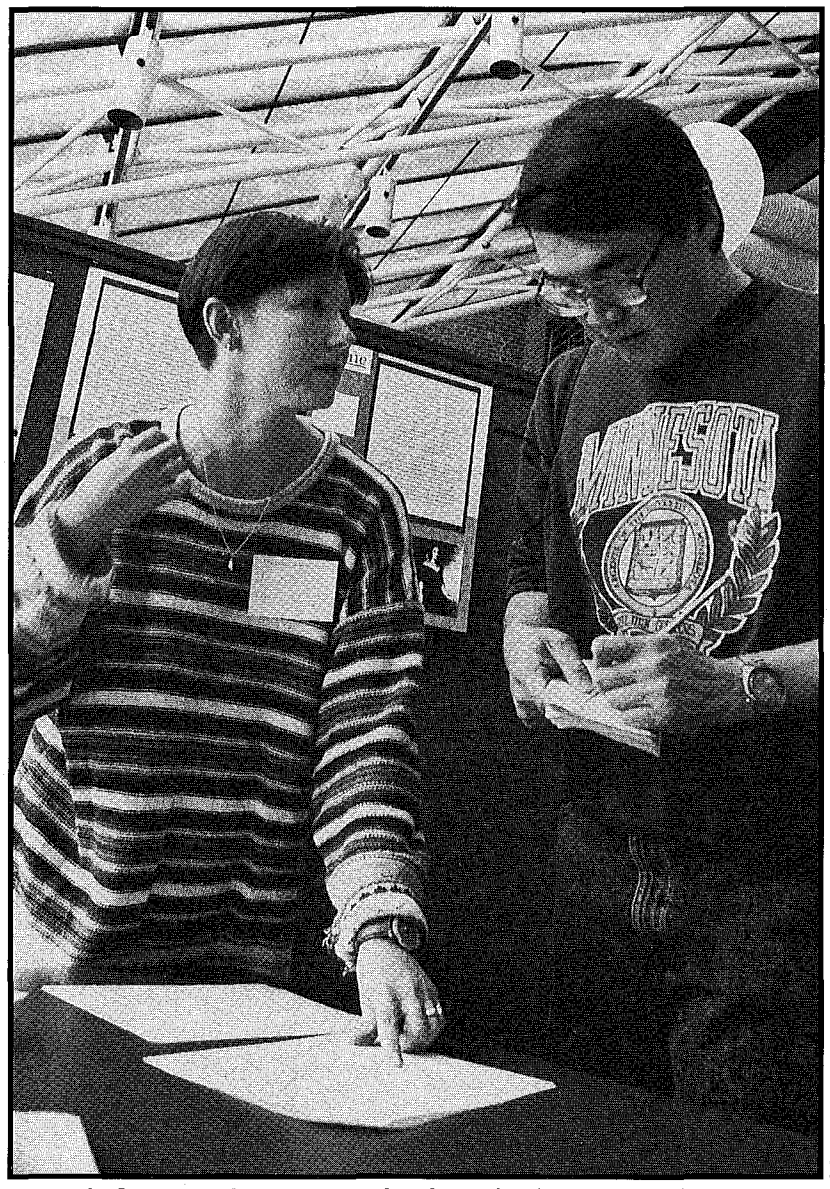
University scientists Douglas Ohlendorf, Cathleen Earhart, Patrick Schlievert and College of Biological Sciences senior Jennifer Stoehr began working on this project last May. Researchers at the University of Alabama at Birmingham are also working on the project.

--Chi-Ting Huang

Working with the best and the b

By Cathleen McGinnis

❒ More than 350 undergraduate students at the University of Minnesota do research funded by the Undergraduate Reseach Opportunity Program (UROP). The program teams students with scientists and scholars conducting serious academic research. This experience helps students decide between the challenges of graduate school and those of the workplace.



Nancy Johnson

Speech Communications senior Jennifer Stromer-Galley explains her UROP project to University Relations representative Bob San at a recent Undergraduate research fair.

ightest

UROP's primary purpose is to provide students with practical experience. Students gain many experiences including the design of a project, the preparation of a grant proposal, the feel of competition for funding, experience with trouble shooting research problems, the opportunity to obtain experience for the job market and more.

In addition to the educational benefits UROP provides, the program also helps foster mentor relationships between students and faculty sponsors, said Vicki Monro, coordinator of the UROP program.

One advantage for UROP participants is an edge over others applying to graduate school. Undergraduate research is becoming important for graduate school applicants. Independent research shows a commitment to quality, and a certain independence — qualities graduate schools want.

Undergraduate research is a "big benefit in getting students where they want," says Monro. As one participant in the program commented, "The program is vital for students who want to learn whether a research career is appealing to them and also vital for the faculty to learn whether a student has the potential to carry out research."

Each UROP participant is also eligible to apply to attend the National Conference of Undergraduate Research (NCUR), an annual event that is attended by college students nationwide. In 1987, 37 University of Minnesota students attended the conference, along with faculty advisors. The record was set in 1992, when Minnesota hosted the conference; 87 students qualified to present their projects.

"Applying is not like throwing a penny down a wishing well"

--Vicki Monro, Coordinator of the Undergraduate Research Opportunity Program

This year, over 40 students have qualified to attend. According to Monro, selection by the NCUR committee is very competitive, although nearly all U of M applicants have been accepted. A local equivalent of the NCUR is the Undergraduate Student Research Fair, held in CMU Wednesday, February 15.

According to Monro, University students who have completed original research without being part of the UROP program may also present their results at the Fair. The local fair helps student researchers gain experience in presenting and defending their research. Such an opportunity is a stepping stone for presentations at professional meetings.

UROP was developed by the Educational Development Office in 1985 to allow all University of Minnesota undergraduates the opportunity to conduct independent research in their field of interest under the guidance of a faculty member. Stipends and/or expense allowances are provided for qualified applicants. The program was modeled after a similar one at MIT. Initially,

UROP serviced four U of M Twin Cities colleges: Agriculture, Biological Sciences, Liberal Arts, and IT. In November, 1995, the program expanded to include all undergraduate colleges on the Twin Cities campus, Duluth, and Morris campuses. The Crookston campus has recently been admitted into the program.

"It has been really beneficial to have hands on experience that relates to the textbook material."

--Sarah Tapper, Junior in Chemical Engineering

UROP is under the control of the Office of the Vice President for Arts, Sciences, and Engineering. Funding of UROP comes directly from the state legislature as part of the budget under General Operations and Management. This portion of the budget is directed specifically to funding research.

In April, 1985, 133 proposals were submitted, and 70% were funded, resulting in funding of $287,219. The state has allocated $400,000 to the program for the 1994-95 school year; $179,005 has been awarded to 96% of the first round applicants. According to Monro, over 350 applicants were funded.

UROP ALLOCATIONS AND FUNDING

Academic year	*Allocations*	*Funding*
1985-85	$200,000	$287,219
1986-87	200,000	257,731
1987-88	200,000	260,280
1988-89	200,000	238,450
1989-90	250,000	255,139
1990-91	250,000	292,739
1991-92	300,000	322,834
1992-93	350,000	338,280
1993-94	350,000	383,939
1994-95	400,000	*179,005

*As of April

Julie Sivula

Monro urges applicants to apply. "Applying is not like throwing a penny down a wishing well," you do have a good chance of getting funded.

According to Monro, most recipients are in Chemical Engineering, Chemistry, and Physics. Sarah Tapper, a junior in Chemical Engineering is currently working on her UROP project.

"I started by volunteering some hours over the summer. By fall, (Professor Wilmer Miller) had found a small consulting project for me to work on. I applied for a UROP grant that fall so I would be able to continue working with Professor Miller after I had finished the consulting project," Tappir said.

To determine what her research would entail, Tapper met with both Professor Miller and one of his graduate students, Laura Iverson. One of the goals Tapper wanted to accomplish with her project was to do something that would fit in with the research Professor Miller was conducting with his graduate students and also to fit her educational needs.

As Tapper explains, "His lab works mostly with polymers.

My project has been based on synthesizing polymers of varying molecular weights and then characterizing them by viscometry." Professor Miller assists Tapper in analyzing the data she receives from her experiments. She also credits Iverson for teaching her techniques she uses in the lab. According to Tapper, her lab research somewhat parallels what has been taught in class. "It has been really beneficial to have hands on experience that relates to the textbook material."

The Undergraduate Research Opportunities Program was started at the University of Minnesota in the spring of 1985.
In part, the program was started in response to a 1984 Dean's retreat during which the idea of increasing undergraduate research opportunities was raised.
Lesley Cafarelli, then director of the Office of Educational Development Programs created UROP to meet the needs for more research opportunities.
The program was modeled after existing programs at other universities, in particular, the one at MIT.
The initial phase of UROP included participation from four colleges - Agriculture, Biological Sciences, Liberal Arts, and the Institute of Technogy.
The program was later expanded to include all the undergraduate colleges on the Twin Cities campus as well as students from the Duluth, Morris, and Crookston campuses.

Julie Sivula

Not everyone will finish their research in the time they stated in their proposal, says Monro. Tapper agrees. She has received two extensions on her project. "The UROP program is very cooperative and understanding about the number of hours one can work a week. The flexibility built into the lab work is definitely one of the positive aspects of UROP."

Rober Ruffner, who is now a graduate student in the Department of Geology and Geophysics, learned about the program through his undergraduate advisor, Chris Paola. He selected Professor Paul Weiblen as his project advisor because Weiblen carried out research similar to Ruffner's interests. Ruffner's project — "A contribution to the understanding of the Minnesota Lunar Simulant" — involved analyzing the bulk chemistry of a basalt rock that is similar to rocks found on the moon. Ruffner states that he developed the basic concept of the project, and Professor Weiblen worked out the specific steps. Rufner spent about 10 hours per week on his project. "How long varied substantially from week to week depending on my course load."

"The flexibility built into the lab work is definitely one of the positive aspects of UROP."

The best part of his UROP experience was "learning that I do enjoy research and I learned some valuable techniques along the way."

Ruffner believes strongly that the project helped him get into graduate school. "The project helped me focus on the specific field of study that I chose to pursue in graduate school and I also don't think that it hurt me to honestly be able to say that I had done some independent research as an undergraduate." Erin Elliott, a third-year physics/astrophysics major, found out about the UROP program through the Lower Division IT Honors program and through friends who had participated in the program. She didn't have a

specific project in mind, so she asked various faculty members for suggestions. The project she chose is entitled "Galactic Rotation Curve." Her Project advisor, Professor Dickey of the Astronomy department has gradually acquired the components to build a radio telescope. Part of her project involves assembling the telescope and electronic equipment on the roof of the physics building. "Data will be taken as objects 'drift' across the telescope's view. It will detect the 21 cm line of hydrogen, and Doppler-shift effects can be used to determine how the galaxy around us rotates." According to Elliott, the telescope will be used by other undergraduates when she completes her project.

Elliot has benefited through UROP "by gaining practical knowledge of astronomy" and applying what she has learned in her classes to her project. She is also coming in contact with people who can share their knowledge of astronomy.

"No one's going to approach you with (a project), but many professors are eager to participate in the program and are very receptive when you approach them."

--Erin Elliott, Physics/Astrophysics major

Elliott believes participants must be outgoing. "No one's going to approach you with (a project), but many professors are eager to participate in the program and are very receptive when you approach them."

The application procedure has three steps: obtaining the application materials, developing a research project with a faculty member, and writing a thorough grant proposal. Students in IT should contact associate dean Russell Hobbie in 106 Lind Hall for application materials.

Stipends of $800 will be awarded to accepted proposals, with an expense budget of up to $250. Items such as supplies, expenses, and project methods should be worked out with the advisor before the application is completed. Proposals must include a detailed explanation of the steps in which the research will be completed, how the equipment will be used, and how long the project will take to complete. The student must also state the importance of the project to the student's area of interest. Students who are completing the project as part of thesis credits are ineligible for the stipend, but are eligible to apply for an expense budget.

Deadlines are approaching for the next window of research grants. For projects beginning July 1, applications must be submitted by April 10. October 23 is the deadline for projects starting January 1, 1996.

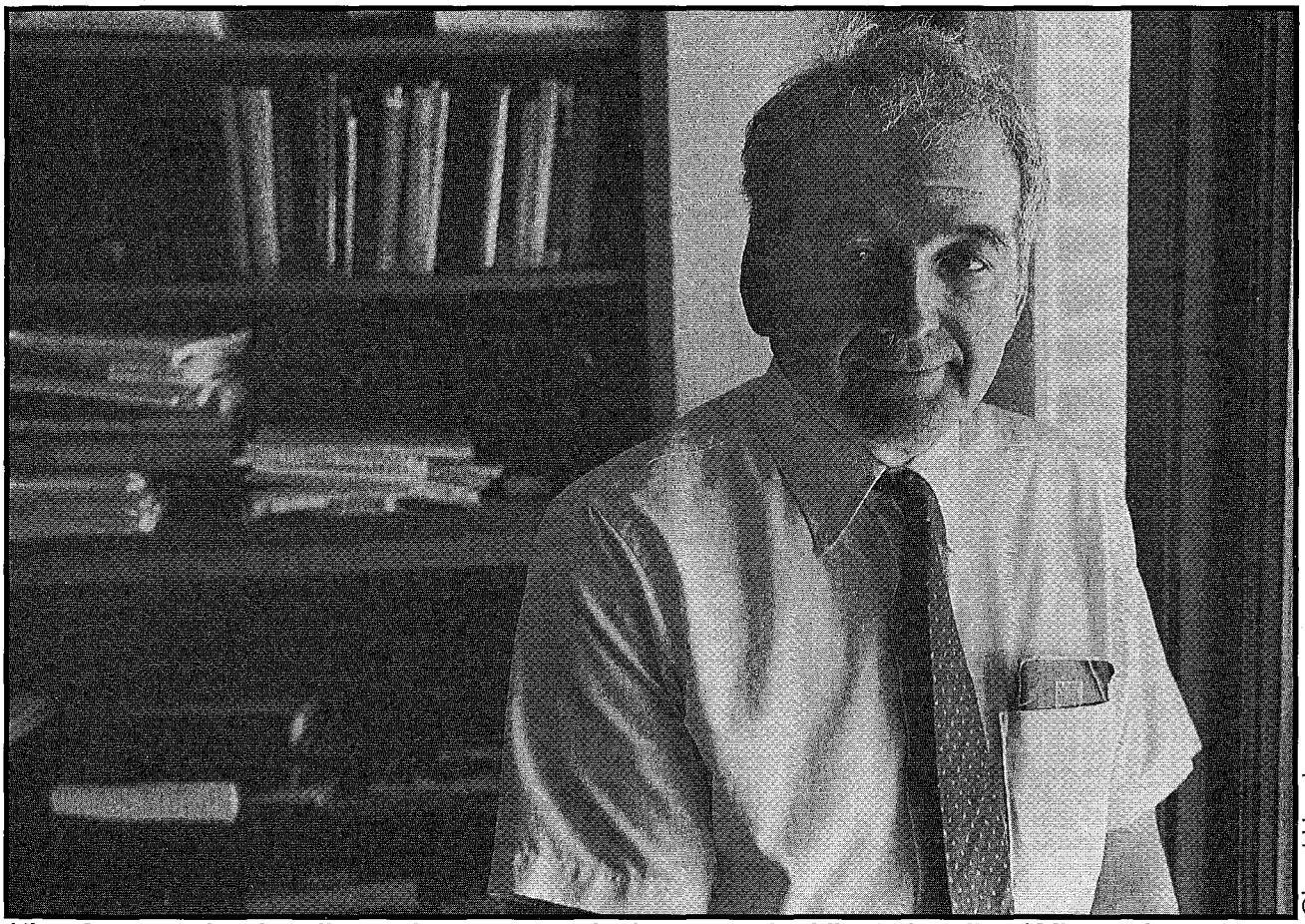
To be eligible, a student must be a full-time undergraduate; adult special and those who are on academic probation are ineligible to apply. All projects must be completed before the student accumulates 216 credits. Group projects are acceptable; however, each participant must file for funding separately. Those who complete the project must submit a final report of their findings and an evaluation of the program. Students who complete one project are eligible to apply for a second.

--Cathleen McGinnis is an IT senior majoring in Geology. She is currently a UROP participant and plans to pursue a Ph.D. at Notre Dame this fall.

Warming up to superconductors

❒ Physics and Astronomy Professor Allen Goldman works toward better understanding of warm superconductors in hopes of finding a more feasible superconducting material.

By Aaron Osterby



Chad Harder

Allen Goldman leads cutting-edge superconductor research at the University of Minnesota. With the help of his colleagues, he developed an extremely precise way to measure superconducting material properties. The resuts challenge other theories of superconductivity.

University astronomy and physics professor Allen Goldman is working with a team of graduate students and post-doctoral students to understand the basic principals of the much sought-after warm ***superconductor***.

In a superconductor, electric current is transmitted with no detectable resistance. Superconductivity is one of the most exciting fields of study for condensed-matter physicists. Widespread use of superconductors in energy transmission would substantially reduce wasted energy.

In 1986, European physicists Karl Mueller and Johannes Bednorz discovered the first warm superconductor. Since then, several other materials have been found that superconduct at relatively warm temperatures. Scientists from all over the world are now working to understand how these superconductors work.

Goldman's team measured the penetration depth of areas over which magnetic fields can change within a superconductive material. Under various circumstances, a superconductor can either screen out a magnetic field or accept one.

According to Goldman, the key property that determines whether or not the material accepts a magnetic field includes its array or lattice geometry of quantized vortices.

"The magnetic field sort of punches through the conductor," Goldman said. "It makes a tiny region normal." He added many of the macroscopic magnetic properties of the superconductor are associated with the motion of the vortices.

By studying the penetration depth, Goldman said, one can understand the nature of a

A ***Superconductor*** does as the label suggests — it conducts electric current very well. If a material conducts electricity well, it provides little resistance to the flow of current. Low resistance is intriguing to scientists because resistance burns energy. Feasible superconducting materials would revolutionize the way electricity is generated, transmitted and stored. For example, if power lines were made of superconducting materials, it would provide astronomical energy savings.

To date, most materials that superconduct do so at very low temperatures. So they have to be in close contact with cryogenic (very cold) liquids in order to "perform their magic." But cryogenic liquids are expensive to keep cold. They require super insulated Dewar flasks to keep them from changing into gasses. One could not feasibly wrap an entire power line in a super insulated tube.

The bulk of the research on superconductors today is directed at finding so-called "warm superconductors". These are materials that would not require such extreme temperature measures to get them to superconduct. For such a material, its superconducting temperature (Tc) is its most important feature. In 1993, the Tc standard was set at 167 K (-159 F) by mercury-based compounds under pressure. Some scientists envision the potential for materials that superconduct at room temperature.

Cf. http://www.tcs.uh.edu/htsintro.html

material's transition to superconductivity.

So far, most researchers agree that paired electrons enable the transmission of electricity without resistance. In metallic superconductors, Goldman said two electrons with opposite intrinsic spin and opposite momentum get together to form a small but extended molecule-like bond. An electron will move through the crystal lattice medium and polarize the structure leaving a positive wake behind which persists for enough time to attract the second, negatively charged, electron.

"One of the raging issues is what the symmetry of the pairing state is," Goldman said. "In the case of the high-temperature superconductor many people believe, and there is some evidence to the effect that the pair is not symmetric."

But Goldman said University experiments contraindicate that idea. He added researchers who believe the key is asymmetric pairing may be using too simplistic a model of particle interaction to explain high-temperature superconductivity.

The University experiment involves putting a single, highly-ordered crystal into a magnetic field and then rotating it around a line perpendicular to the field direction. The resulting data reflects magnetic properties at right angles to the direction of the field and the rotation axis.

Goldman contends that the crystal lattice structure of a material is the cause of its warm superconductivity. But he said the asymmetrical pairing model is forced on theorists who wish to believe that superconductivity involves magnetic properties.

"There's a full-fledged debate in the scientific community about this."

--Allen Goldman, physics and astronomy professor

"There's a full-fledged debate in the scientific community about this," Goldman said. "It's one of those things where one is seeing a serious application of the scientific method."

To date, no other research team has duplicated Goldman's experiment because no other major research University has the complicated metering and manipulation devices required.

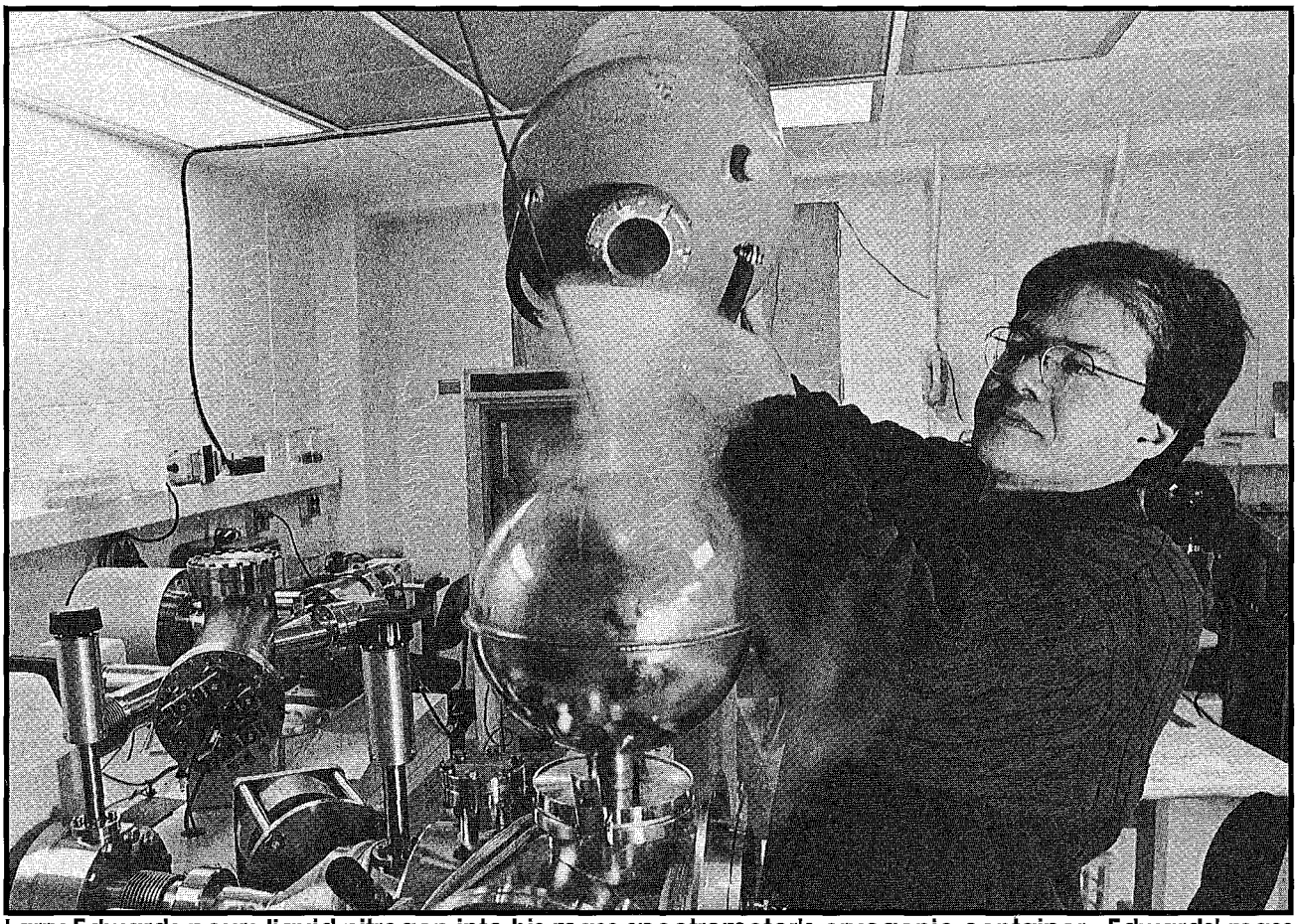
Goldman plans to expand his research to try to answer other research questions. These include how certain materials are able to switch between insulating and superconducting states.

The research has many applications, of course.

Goldman said one application stemming from upcoming work will allow the University to make tunneling junctions with ultra-low capacitance wires which are thinner than any others available now.

This year Goldman's budget for the research totals $830,000 which includes some one time funding for new experimental equipment. Of the total more than three fourths comes from outside grants from such places as the National Science Foundation and the American Federation of Scientific Research.

--Aaron Osterby is the state government reporter for The Minnesota Daily.



Chad Harder

Larry Edwards pours liquid nitrogen into his mass spectrometer's cryogenic container. Edwards' mass spectrometer measures the ratio of thorium-230 to uranium-234 in constituents of coral. The procedure is the most accurate dating method yet developed.

Rediscovering past climate

One Geology and Geophysics professor has revolutionized the way we date ancient material

"(Coral dating) is part of a bigger puzzle that will ultimately lead us to understand how climate was in the past. And that will help us understand future climate."

--Larry Edwards, associate professor of geology and geophysics

On the fourth floor of Shepard Labs, Larry Edwards dates coral in order to better understand the history of climate. It is one piece in the complex puzzle of reconstructing the earth's past. When all the pieces are in place, we should be able to predict future climatic change.

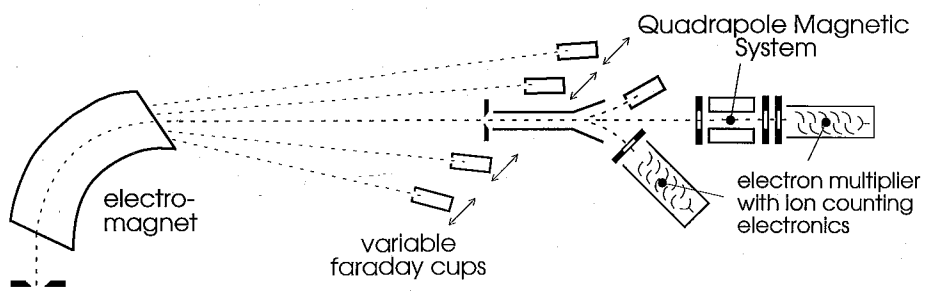
Since U-234 decays into Th-230 at a constant rate, it is possible to date material containing those two isotopes. At California Polytechnic Institute, Edwards developed a precise technique that measures the ratio of the isotopes in ancient material using a ***mass spectrometer***.

The technique involves several steps. After material is collected from a suitable location, acidic compounds are used to break it down into its basic parts. The decomposed material is then run through a mass spectrometer, which separates constituents of matter by mass. The result is and isotope spectrum that can be numerically analyzed.

Edwards prefers analyzing coral samples for a number of reasons. First, since coral contains a relatively large amount of U-234 and Th-230, mass spectrometer readings are more reliable than they are with other materials. Coral species also grow at known rates and according to known principles. So if he collects a certain species of coral from a certain place, he can glean insights from the age of the coral.

For example, coral is collected from the southwest side of Barbados, an island in the West Indes. Since Barbados is rising at a constant rate, coral on its hillsides was once under water. Edwards and his colleagues collect a species of coral that grows 5 feet below sea level. When they date this coral, they can determine the sea level at the time the coral was alive. As we shall see, this sea level data is used to gain further insights about climate.

Edward's technique in more precise than previous attempts to date material using the U-234/Th-230 ratio. The residual error in the other methods was just too great. "The more precisely you determine ages, the more problems you can



A ***Mass Spectrometer*** is a device that heats matter to its ionization temperature and uses an electromagnetic field to deflect the moving charged particles. The particles are deflected according to their speed, their charge and their mass. Once deflected, the particles are collected and analyzed numerically. If the speeds and charges are known, the mass can be calculated, and the particles identified.

solve" and the more clues you can find, Edwards said.

Since coming to Minnesota in 1988, he has applied his technique to a number of problems, including the following.

Calibrating Carbon

Thorium dating is limited. Both isotopes are primarily found in material that forms in water and only in trace amounts. But thorium dating has further applications because it can be correlated to the timeline of other isotopes. In 1993, Edwards began using thorium dating to calibrate parts of the cabon-14/carbon-12 (C-14/C-12) timeline.

Edwards uses his technique to date coral samples. He then sends samples of the same coral to the University of Arizona, where the C-14/C-12 in the samples is determined. Since the age of the coral is already known through thorium dating, the atmospheric C-14/C-12 ratio at that time period can be found. Until Edwards' method, the primary way to calibrate ***carbon dating*** was with tree rings.

"The more precisely you determine ages, the more problems you can solve"

--Larry Edwards

Trees are known to grow one ring per year. The C-14/C-12 ratio in a tree with 10,000 rings provides the ratio existing in the atmosphere 10,000 years ago. All other material at that time should have the same ratio. Unfortunately, tree ring records go back only 10,000 years.

For a long time, scientists assumed that the atmospheric C-14/C-12 ratio is always equal to 1. So they used the tree-ring calibration and extrapolated back as far as they needed with carbon dating. But other scientists found that the atmospheric C-14/C-12 ratio varies. So these extrapolations are highly doubtful.

With Edwards' methods, we can gain accurate measures of the atmostpheric C-14/C-12 ratio at certain time periods. If Edwards does this for a number of different time periods, carbon dating can be more reliable for up to 400,000 year-old material.

Since most land materials contain carbon and not thorium, many more land materials can be dated with carbon dating. We can conceivably date anything 400,000 years old or younger using the combination of methods.

Carbon Dating

Carbon dating is the process by which the ratio of carbon-14 to carbon-12 (C-14/C12) is measured. The C-14/C-12 ratio in a substance is a function of the ratio of the isotopes in the atmosphere at the time the material was on the surface of the earth and the rate of decay of C-14 into C-12. Since the rate of decay is known, the age of the material can be gleaned by the measured ratio of the two isotopes.

But since the atmospheric C-14/C-12 is not constant, the ratio at each major time period must be found before accurate dates can be acquired.

Milankovitch Model

When glaciers form, sea-level falls. When glaciers melt, sea-level rises. So, by taking the inverse of sea-level records, you have a record of glaciation. By

Milankovitch

Milutin Milankovitch, a Yugoslavian astronomer, constructed a model based on variations in the earth's orbit and axis tilt.

The model corelates these variations with climatic change in the Northern Hemisphere. Consistently cool summers in the north cause periods of glaciation, or ice ages. Using the model, he calculated times at which cool summers should occur, thus he was able to predict the dates of glaciation and deglaciation. The model contains three cycles superimposed on each other, with periods of 100,000 years, 41,000 years and 22,000 years.

dating this coral that grows close to sea level, Edwards and his colleagues can determine the sea-level at that time, which leads to a record of glaciation and deglaciation.

Many theories site causes of glacial periods, or ice ages. One of which is the "astronomical theory" proposed by the mathematian Milutin Milkanovitch in 1941. But, as with all mathematical models of nature, Milankovich's work requires empirical proof. It is just a mathematical model. There are many competing models that attribute ice ages to other casues. In short, Milankovitch's view needs further evidence in order for the scientific community to accept it.

As it turnes out, Edwards' and his colleagues' measurements and Milankovitch's predications match up quite well, thereby supporting the model. And since the model was mathematically sound, the correlations also provide support for Edward's methods.

Earth's climate can change very rapidly. According to evidence, the climate in North America went from a glaciation stage to a deglaciation stage in three to seven years. After looking at such a dramatic shift, Edwards worries that we might see such a dramatic change today. So he studies.

The point of all this study is to develop a better understanding of climatic change. With this enhanced understanding, we can hopefully predict future climatic change.

For example, we would like to know if the models that predict global warming are correct. By looking at past climatic change and correlating it to the level of carbon in the atmosphere and the earth's orbit and attitude, we can test the predictions with what happened in the past.

Furthermore, the technique is precise, but is not perfect. Edwards and his colleagues are now working to make his technique more precise with smaller samples of coral.

And the search continues for new applications of the technique.

"The present is the key to the past. Now it's getting to the point (where) the past is the key to the future."

--Larry Edwards

--Technolog staff

Tales of Technology

by Joseph Scrimshaw

Hello There, Boys and Girls! I guess your old friend, Raymond, made some of you sad with those scary stories 'bout that crazy "Overbite" Billy. But don't worry, Boys and Girls, since I got a new creativity microchip stuck up in my hypothalamus, I'm sure you'll like this story about three very different college students, forced to become...

"The Mars Brothers"

. . . and expanding its research renown

and quantity of research taking place here? How much of the $88 million 1995 State Budget request for U2000 goes to the promotion of research? Should we concentrate those funds in a few areas or spread them out across the disciplines? If we concentrate the funds, where do we focus them? These and other questions must be answered before wide-spread confidence in U2000 builds.

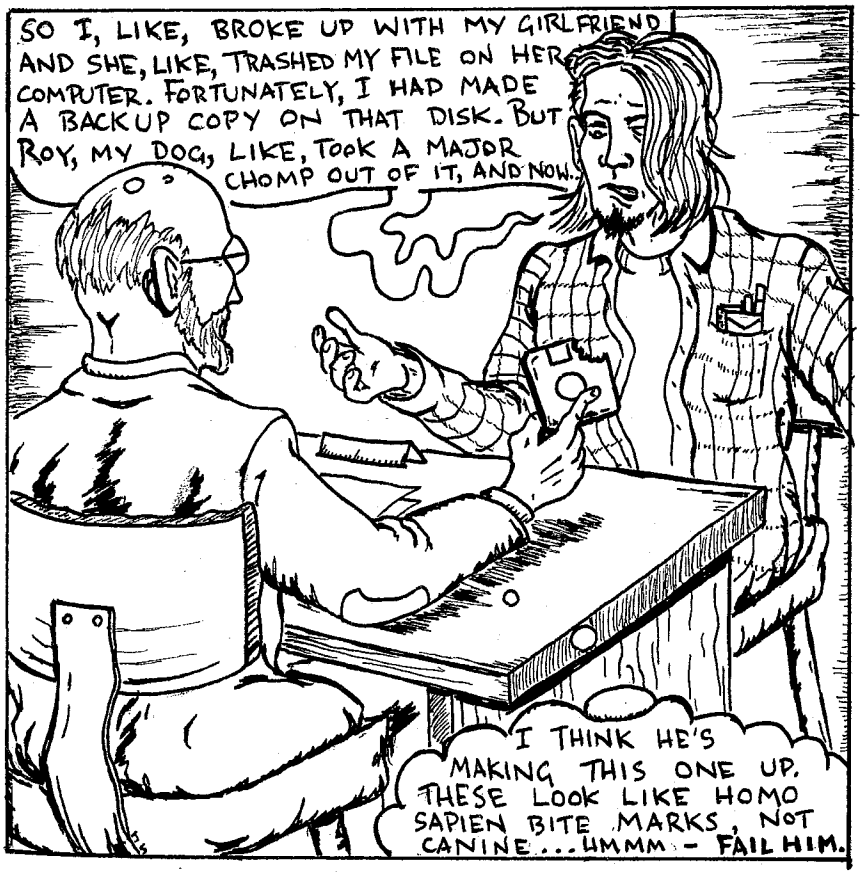
Promoting research like that conducted by Allen Goldman (Physics and Astronomy), Larry Edwards (Geology and Geophysics) and Lanny Smith (Chemical Engineeering and Materials Science) and their colleagues is a good place to start. Perhaps grant writing support can be greater funded for these and other big-ticket professors.

Programs like UROP help the University achieve two U2000 goals at once. It enhances both undergraduate education for the initiated and it helps researchers do work on a limited budget. More options like this will need to be explored in an age of shrinking funding.

The first step in gaining consensus on the research aspect of U2000 has been done. Mark Brenner, interim vice president for research, has made a thorough-going assessment of the state of University research. All in all, things look very good. The University already can claim to be a major research and development institution in science and engineering. All trends are up except in the health sciences.

The next step is to come up with objectives we can work towards that build on present strengths and compensate for present weaknesses. That means we need strong leadership from folks like Mark Brenner and Provost Jim Infante to build consensus. Now is the time to start building that consensus.

Excuses **by James Mathewson and Joe Scrimshaw**



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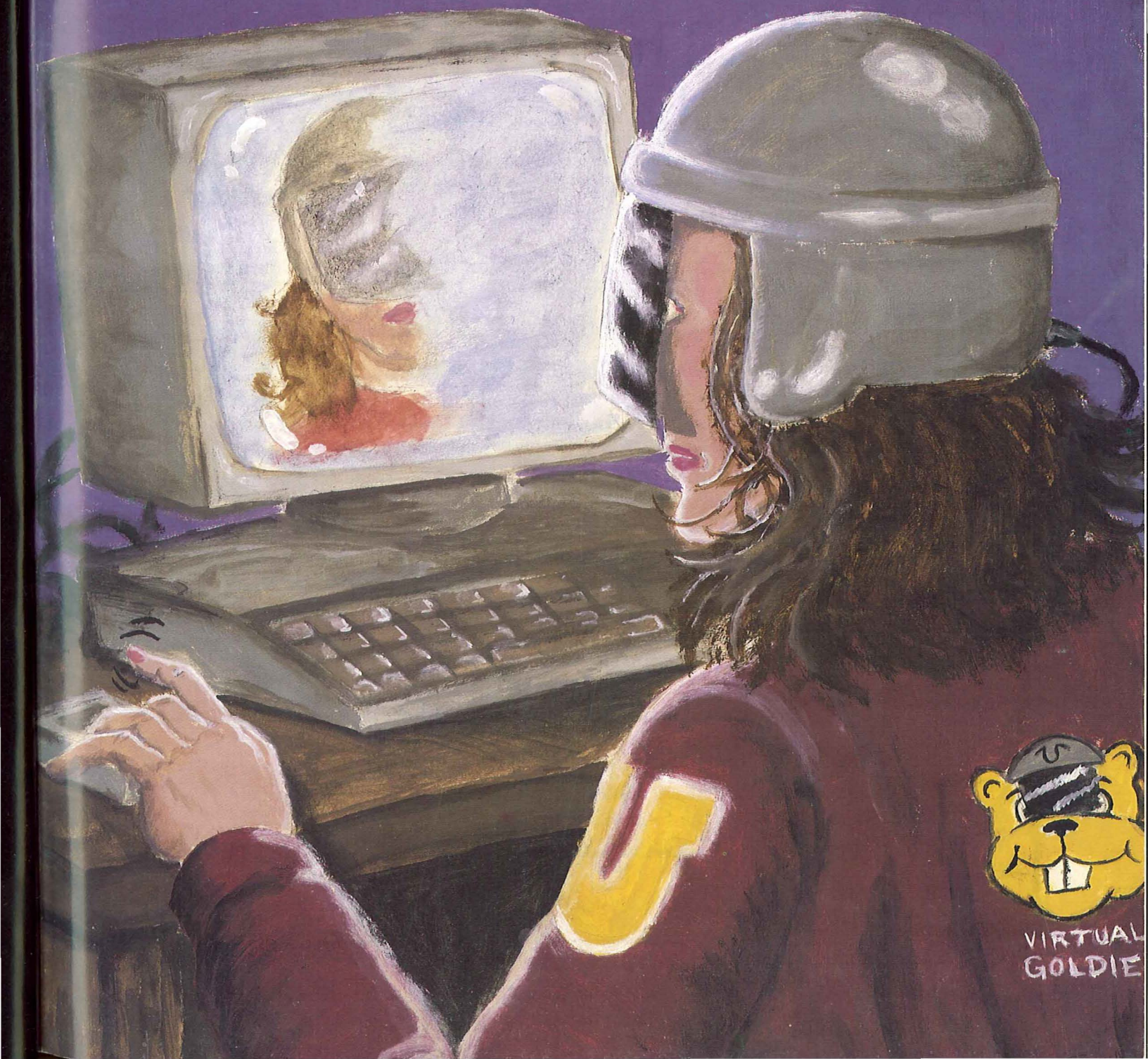
VIRTUAL CAMPUS



Welcome

MINNESOTA TECHNOLOG

The times, they are a changin'—

an appropriate refrain for student-run magazines, especially when it comes to staffing.

Julie Sivula, our former art director, is off to Oregon to continue her preparation for medical school in the great "Northwet." Her energy and enthusiasm will be missed.

Welcome Chris J. Lee, our new art director. Chris is fresh off a successful run as art director of *XS*, a magazine produced by journalism students Winter Quarter 1995. Chris has a lot of fresh, creative ideas about the art direction of our little magazine. Upon viewing this issue, the reader will be instantly struck by these ideas.

His ideas were independently affirmed at the annual Engineering College Magazine Association conference attended by 10 delegates of ITBP. While the reviewer liked our old layout framework, he felt a change to a more open, free-form style would provide more interest to our readership.

So, enjoy the new format and don't be bashful in praise of Chris Lee's work!

Please do not complain about quality of photos taken from the Internet.

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the VIRTUAL CAMPUS issue

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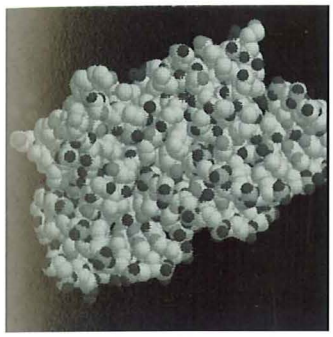
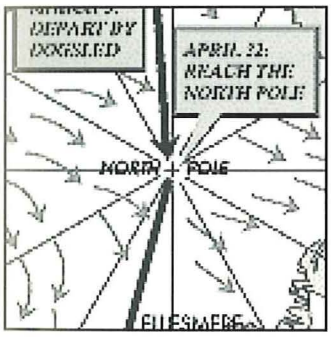


Reflections of a Cyberstudent

The author reflects on his experiences taking a university course entirely taught via Internet tools. Though he was able to collaborate with top-notch scientists from all over the globe, he missed the personal contact of traditional learning.

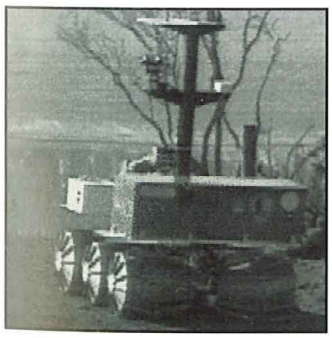
by Jon D. Benson



A World of Adventure—at Your Fingertips

Will Steger and his international team of polar explorers navigate across the Arctic. Thousands of students tag along with the use of electronic communication technology.

by Linda Pham



Electronic Field Trip

Multi-media technology is revolutionizing scientific education in America. The JASON Project uses all available electronic tools to provide immediate scientific knowledge to kids.

by Brad Davis

Editorial

The Cover

Our twisted cartoonist has seen the future, and it's virtually frightening. The artist's vision blurs the line between seeming and being.

by Joseph Scrimshaw

Editorial

Cyberspace cannot replace face-to-face

by James Mathewson

Picture the University in 2021. Most students "attend" entirely through their computers, which resemble home entertainment systems. Lectures and seminars can easily be downloaded off the World Wide Web. Most interpersonal discussions are conducted via teleconferencing. Many students live out of state and never leave their homes to go to school. Degrees are conferred electronically in a ceremony similar to Sunday Mass on television.

The high cost of education coupled with the perpetual cycle of funding cuts have left most students with no choice but to go to teleschool. The elite pay a 400 per cent surcharge to receive face-to-face education. The few professors who made it through their bitter tenure battles teach large classes of these elites.

The picture is not a pretty one. But some say it is inevitable, if current funding trends continue. And with the ever-growing national debt, there is little reason to think current trends will change.

The most devastating aspect of this futuristic picture is that people would be denied face-to-face education on the basis of economic privilege. Face-to-face interaction is a fundamental aspect of all education to this point. Sure, we rely more on text now than we did 500 years ago and we rely more on electronic communication now than we did five years ago. But we have yet to put a dent in the role of face-to-face interaction in education. And we should not come close to eliminating it from our general-public-access education systems regardless of costs.

Clearly the most valuable aspect of my education has been the discussions in which I have participated over the last several years. Of course, reading, writing, calculating and designing have also played significant roles. But in discussions, I get immediate feedback on my ideas and demonstrations. Plus, the range of things I can understand in a face-to-face conversation is much greater than in mediated communication because of all the non-verbal cues I can receive.

This experience cannot be fully replaced with mediated communication. You can come close with teleconferencing as long as there are only a few people in the discussion. But with larger groups, aspects of the conversation must be ignored in order to transmit most of it. Any medium must distinguish between signal and noise. The more conversants, the more aspects of the conversation must become noise to the system. The logistics of electronically processing large-group discussions are prohibitive.

Recent advances in electronic media have enhanced our educational systems in two ways: convenience and scope. As far as convenience goes, we no longer have to wait for professors or TAs to get off the phone in order to ask them questions; we no longer have to wait in line to register; we no longer have to go to the library to see if a book is in.

More important than the convenience of electronic media is the scope of topics they enable us to investigate. On the last issue, for example, I was able to access a World Wide Web site on warm superconductors and summarize the information therein in less than one hour. Such a summary would take me at least a day working entirely with text. This access has many benefits: it enables more inter-disciplinary work; it encourages more novice participation; it removes many of the barriers of access associated with traditional education (race, gender, disability, distance, etc.).

In these respects electronic media can be tremendous aids to education. But beware of those who wish to use electronic media merely to cut the costs associated with face-to-face education. These people will try to convince you that nothing is lost when we convert to exclusive use of electronic media—not true. Doing so would destroy a fundamental aspect of education. Electronic media should be used not to replace but to enhance education as we know it. Ω

Another View

by Roland C. Amundson

Reprinted with permission from the *St. Paul Pioneer Press* and Roland C. Amundson

I've never lived inside a moat or behind the gates of a walled city. So perhaps I am not qualified to evaluate the promise of BearPath, the new Eden Prairie subdivision with gates, guards and cameras. I am, however, a little surprised at the virulent reaction to it.

While most of us do not live in such readily apparent segregation, I wonder if our criticism is fair. It seems to me this self-imposed isolation from community is not entirely determined by class or economic status. In fact, rich, poor, new and old neighborhoods are increasingly populated by the new exiles: Those who prefer to live life by airwaves and fiber optics.

I don't pretend to ever understand the technology behind this new cultural phenomenon. But, as a judge, I am concerned about its ultimate effect. It hasn't always been this way, has it?

The University of Minnesota's Humphrey Institute is presently tackling the problem of community and shared values. It poses the rhetorical question: Do Americans share any values? Perhaps the better question is, do we share anything in this modern age? In the realm of human experiences, when do we really involve ourselves with our neighbors, co-workers, family or friends? Not much anymore, and less so each day.

Take a stroll along any of the residential streets in communities with houses that have been there since this century was new. Almost every house has a front porch. You can imagine how many times these screened-in living rooms gave relief from the notorious Minnesota summers. Shaded, and accepting any breeze, a family could sit for hours on its porch. Look more closely, and you'll probably discover the hooks where summer beds were attached by chains to the wainscoted ceiling.

The porches were always in front, exposed to the street. Passing neighbors were greeted and strangers were scrutinized. The neighborhood news and business was conducted on this most intimate and effective level. Government by neighbors.

Those once venerable porches are empty now. They hold our lawn furniture and recycling bins, nothing more than a place to scrape our feet before we cross the threshold.

Look more closely at the house around the corner. There it is, the air conditioner, technological savior on those steamy summer nights. Using it, we recapture our whole house for year-round use. First, of course, we close the windows and draw the shades. Splendid isolation. The cool dark house becomes the perfect environment for an evening of televised entertainment.

And if anyone chooses to sit on their porch, who would they see, the neighbors? They're doing the same thing, aren't they? And the few souls out on a summer stroll? Don't bother to greet them. Using their Walkman strapped to their heads, they walk alone, in touch only with the music beating through their headset.

In so many ways we have all become exiles from our community. Eschewing human exchanges, we shop, bank, complain, praise and pray by touch tone. Is anybody really out there?

I am not an opponent of technology, certainly no Luddite. I am grateful for the material advances in communication, medicine, housing and transportation that are the result of scientific advancement. But I am wary of its lure.

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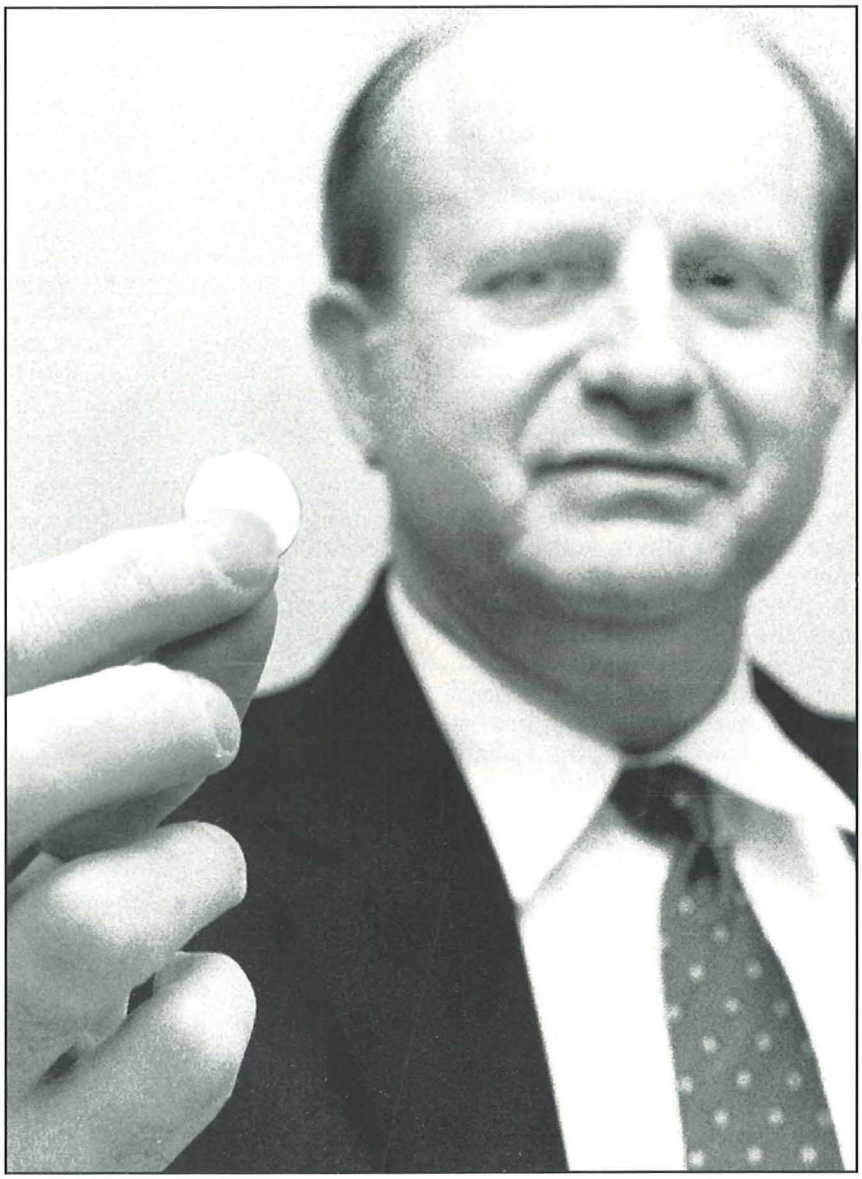
University races to build better battery

Photo: Chad Harder



Professor William Smyrl holds up an extraordinarily powerful battery. The vanadium oxide battery is a prototype of the highest-powered portable battery yet produced.

Over the last 20 to 30 years, inventors have investigated thousands of materials to see if they could improve the lead-acid battery.

About three years ago five University professors decided to do their own research. So they found the money and started with an idea: to deliberately control the porosity of the material to control the rate of the charge and discharge. Professor Edward Cussler Jr. had an idea about how to do this and Professor Boone Owens had a lot of experience in the field, so they decided to do it. Professors William Smyrl, David Shores, and Michael Ward joined them.

Smyrl and Owens had already collaborated on battery research for several years. With federal grant money they were now able to do deeper research.

The group's goal is to identify materials that would make a lighter and higher-powered portable battery possible. This battery would charge and discharge at a higher rate and would last longer. The key to a higher rate of charge and discharge is very porous material.

Right now vanadium oxide appears to be a superior battery material. Further research will verify or discount this. In the meantime, the group is also investigating other materials. It is quite possible it will find an even better material.

Anthrobots in the Twin Cities

Thirty years ago a young boy became enthralled with television's "Lost in Space" drama and "Astroboy" cartoon.

"I was fascinated by this vision of robots as part of daily life. (But) when I looked around, I saw it wasn't like that. I wanted to make what I saw real."

Today this man is founder and president of a robotics research and development corporation.

"I guess you could say I never grew up."

He is Mark Rosheim.

Rosheim claims he coined the term anthrobot, a robot which mimics human movement. His design technique of patterning robots after humans has produced some very effective and lucrative robots.

The anthrobots Rosheim designs are often used in hostile environments. NASA plans to use them on lunar bases for astronaut meal preparation and greenhouse tending. Westinghouse uses them to clean the boilers of nuclear-powered vessels. Rosheim hopes to get humans out of hazardous work environments by replacing them with anthrobots.

Because the human skeleton system of muscles, tendons, ligaments, and bones is such an efficient mechanism, emulating robots after it is a logical step. In the human body, when one muscle is weakened or fails, nearby muscles take over. It is the same in anthrobots. If one function fails, there is another function to back it up.

> **"You don't let anything stop you. You have to have faith, the kind you have when you are young and don't know any better."**
>
> ***—Mark Rosheim, anthrobot inventor***

Initially, Rosheim worked on individual components, hands and wrists, but he planned to one day to design an entire system. His first contract with NASA last spring required him to do just that.

Since then, NASA has asked him to design a second generation of the anthrobot. This one will have a spinal column and improved shoulders and controls.

Rosheim, who has neither a college degree nor a high school diploma, claims nothing is impossible. "You really make your own opportunities. Don't let anything get in your way. Never compromise.

"You don't let anything stop you," he continued. "You have to have faith, the kind you have when you are young and don't know any better."

Rosheim's company, Ross-Hime Designs, of Minneapolis, is working on three projects: (1) Building an Omni-Wrist TM for Los Alamos Laboratory. It will be used to decommission nuclear weapons and hydrogen bombs. (2) Designing micro-robots to perform surgery. (3) Designing Phase 2 of the anthrobot for NASA.

Besides these projects, Rosheim is working on his fourth book. It is about T. Nelson Downs, a famous magician who is from Rosheim's Iowa county.

Rosheim's other books are *Robot Evolution: The Development of Anthrobotics*, *Anthrobotics: History and Future of an Idea*, and *Robot Wrist Actuators*. Ω

—Jeannette Hoffart

Over the last three years "we've doubled the amount of energy one could get out of it (vanadium oxide)," says Smyrl.

"We've certainly been successful in making materials with high energy," he continued. "Getting the part of high rate is what we're still working on."

This project operates on about $1 million a year. The money comes from three federal agencies: the Advanced Research Project Agency, the Department of Energy, and the Army Research Office.

Two years ago the race to build a better battery sped up when Sony introduced its lithium-ion battery.

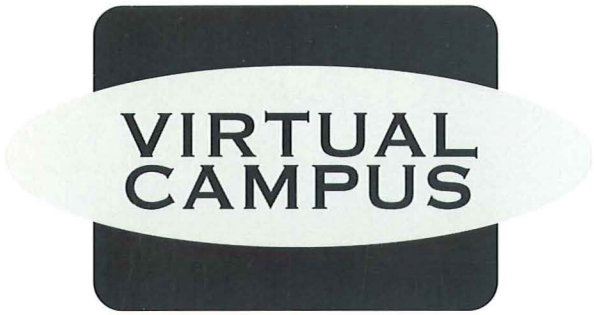
"We've been able to do a lot of good work," he said. "(But) we don't want to claim too much yet.

Over the next two years the group plans to find industrial partners willing to test the vanadium-oxide materials in an industrial laboratory and to build a prototype. With a prototype the group hopes to convince manufacturers of the battery's worth to consumers. Ω

—Jeannette Hoffart

Reflections of a cyberstudent

by Jon D. Benson



Though he was able to collaborate with scientists all over the globe, *Jon D. Benson*'s experiences with the Internet course "The Principles of Protein Structure" were less than ideal.

Classroom learning is a concept we all recognize instantly. When the word 'classroom' is spoken, we imagine rows of students seated in desks facing the instructor who stands at the front of the room. However, this image of the classroom may be fading. As Bob Dylan sang, "the times, they are a changin'." Now with the development of computer-mediated communication, we may be on the verge of replacing that classroom filled with rows of desks with a computer network. The students are connected to each other only by keyboard, mouse and modem, and their lectures and discussions occur in a virtual cyber-school. Perhaps these concepts seem like science fiction, but with the advent of high-speed computers and ever quickening information transfer rates, students linked by the Internet are at the beginning stages of computer-mediated learning in a virtual classroom.

These past six weeks, I have been taking part in just such an experiment in virtual education. Last fall, while working through a conventional course in audience analysis in scientific communication, I heard from fellow students about an Internet course on protein structure to be held in the winter term of 1995. The course would be administered by the Globewide Network Academy (GNA) and taught at the BioMOO. A MOO (Multi-user domain Object Oriented) is an online Internet device which allows the real-time communication of written text between hundreds of participants through a Telnet connection. This MOO course was conceived to be a fully developed course run by a panel of experts from the field of protein structure and computer programming.

This February, I found myself enrolled in the Internet course "The Principles of Protein Structure" (PPS). The course developer, Peter Murray-Rust, head of protein structure computing at Glaxo Research and Development in Greenford, England, has found time to develop many Internet resources to help scientists collaborate. Murray-Rust's interest in Internet teaching began with his involvement as a consultant for the GNA's C++ programming course. By combining the use of BioMOO, communication by e-mail discussion lists, and posting hypertext course materials on the World Wide Web (WWW), the GNA Technical Group have put together

Three-dimensional representation of the bacteriophage protein cro, which controls the rate of production of other phage proteins. Using Internet tools, students are able to download images like this one and rotate them in several diferent directions.

a robust, reusable technology for hyper-education and the management of virtual organizations.

This dynamic collection of materials has become the course PPS URL: <http://www.cryst.bbk.ac.uk/PPS/index.html>. The course is comprised of 20 groups (one for each amino acid) of about 15 students each from around the world. Sponsored by Birkbeck College, UK, in collaboration with the Virtual School of Natural Sciences of the GNA, PPS may be the largest, if not the first course in which the students never actually see one another, the instructors or consultants.

These computer communication resources were, in part, made possible by the existence of the GNA. The GNA is a consortium of educational and research organizations located on the Internet. Its mission as a teaching institution is to provide a central organization in which teachers, scholars and researchers can meet and interact. It resembles a university in that it consists of autonomous member colleges. These colleges, of which the Virtual School of Natural Sciences is a member, try to offer a diverse range of learning opportunities.

Currently, PPS is at its mid-point. I must report that my experience with it has been mixed. As an individual exploring and using the

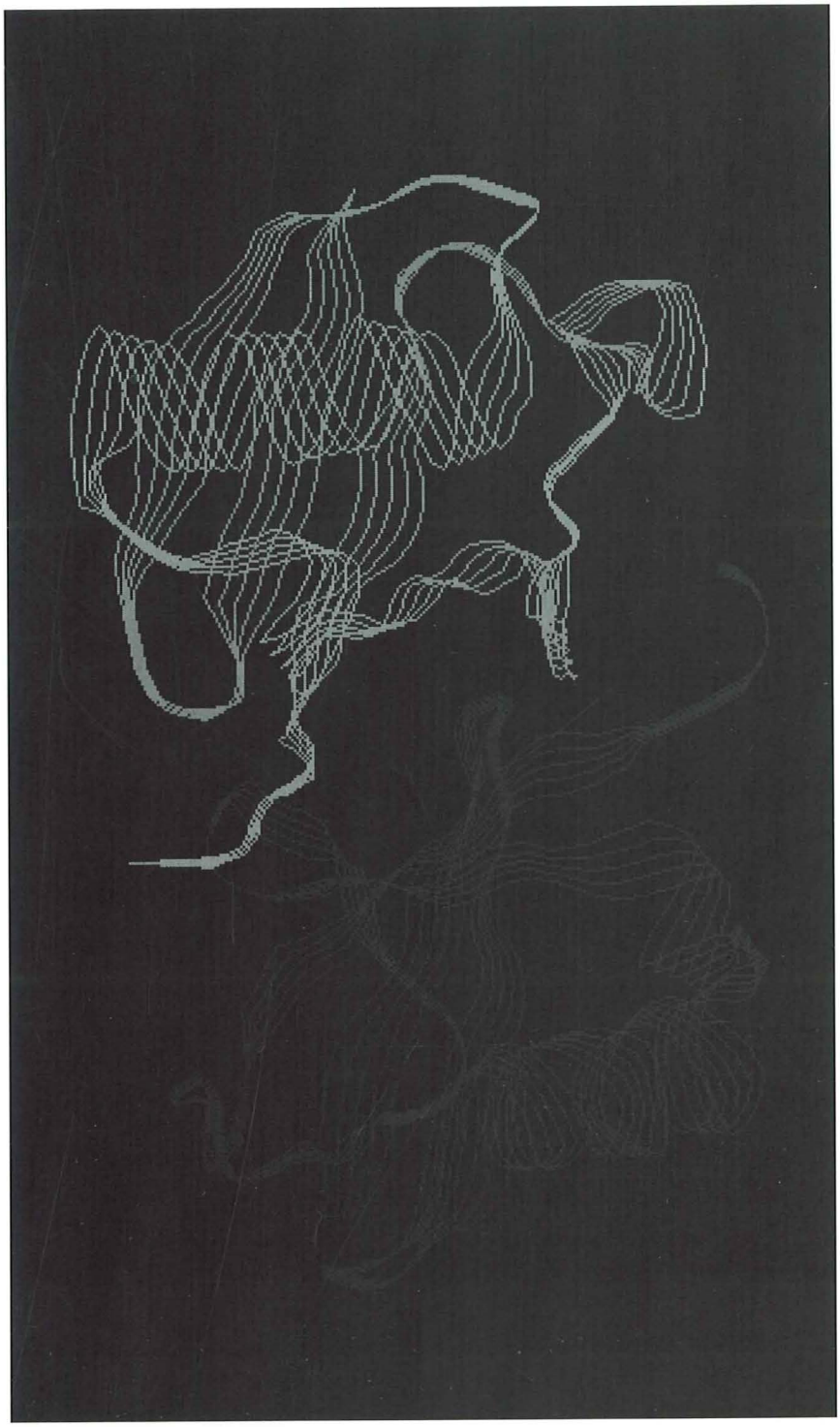
information resources found on the Internet, I have had interesting results, but to me learning is more than gathering information. When I participate in a class, I form social bonds with my fellow students. I gain greater insights about a topic through conversation and collaboration. For example, we may work together on a project, argue about a theoretical point, or commiserate after a tough exam. To this point, my experience with on-line education has lack all the social aspects I associate with learning. The following is an account of my experiences with the course.

The first hurdle to overcome in the class was the technical barrier of computer communication. Our first assignment, entitled Electronic Communication and Tools, was to meet people and make friends. This lead me to MOO technology. The BioMOO is accessed by a Telnet connection to the MOO server URL: <http://bioinformatics.weizmann.ac.il:70/1s/biomoo>. This connection is very similar to the other Telnet connections I have grown accustomed to using. However, once I logged onto the MOO, I realized MOOing is very different from other Telnet technologies such as Lumina.

After logging on as guest, I read a message that said I was in a lounge. The message described the surroundings and the other people in the "room." Not knowing how to proceed, I referred to the help command. A list of command terms would roll by my screen, but invariably as I began reading the list, one of the other individuals who were logged onto would send a message. This would cause the help list to scroll up my screen at a very fast rate. This annoyance, combined with the lack of visual cues to guide the conversations, was so frustrating that I logged off the MOO.

With that experience, I felt I had effectively failed the first course assignment. I wondered how I was to contribute to the group discussion if I could not raise my voice to ask a question or make a comment. I was reminded, however, by Peter Murray-Rust's comment, "Different students will use different methods. Some won't go near the MOO and prefer read-only courses, others will love [the MOO]." Well I hated it.

Discussions on the MOO are free form, lacking a moderator who can sense when a quiet individual could make an important contribution. For example, in a recent real-life course, our instructor knew when one of the students wished to make



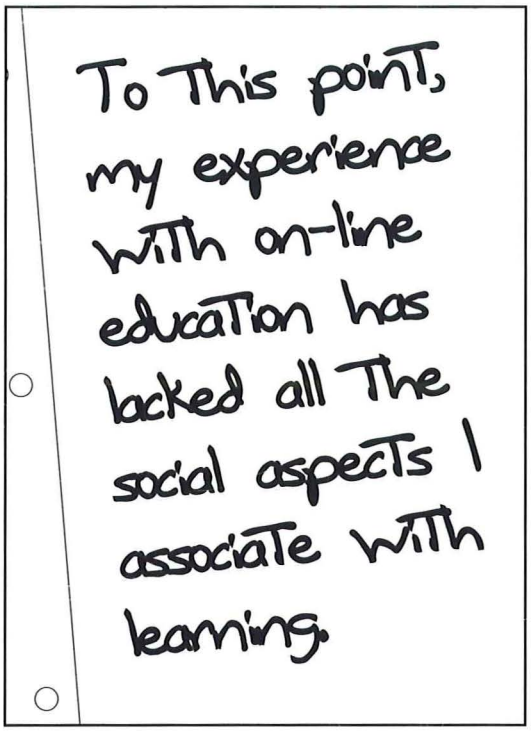
Three-dimensional representation of the protein ubiquitin, common to all life forms.

a contribution to the discussion by her body language. When the student had something on her mind, she would slide forward in her seat. The instructor would recognize this and call on her. In an on-line discussion, her voice would be mute. Her thoughts would be silent. The pace of the conversations on the MOO were distracting and not very enlightening. With this in mind, I decided to leave the communication aspect of the course behind and move boldly onto the next course assignments.

The second and third assignments, the Biological Internet and Finding Out About Proteins, had us pick a protein and explore its chemistry and structure using information retrieved from on-line sources. Armed with the few helpful suggestions given by the course administrators, I set out to find out about ubiquitin—a protein found in all eukaryotic cells. This protein may be critical to an organism's survival because of its role in regulating the breakdown of other proteins.

My first point of exploration of the chemistry and structure of ubiquitin lead me to the Swiss-Prot data base of protein sequences. This key-word searchable index is assessable through the WWW at URL: <http://expasy.hcuge.ch/ (ExPASy server at Geneva)>. By simply entering in the word 'ubiquitin,' I received a large listing of ubiquitin, ubiquitin-like, or ubiquitin binding molecules. From this list I chose the entry for ubiquitin characterized from the algae chlamdomonas reinhardtii. This entry included a brief description of the protein's function, information on its nucleotide sequence, and files containing three dimensional images of the protein.

At an earlier point in the course, I down-loaded a program for visualizing the three-dimensional structure of proteins. Called RasMol, or RasMac for the Macintosh, it reads brookhaven/PDB files and displays the molecule in a variety of ways including wireframe, spacefill, and ribbons. I was able to view the three-dimensional structure of ubiquitin quite quickly after finding the file in the Swiss-Prot database. As I viewed the molecule, I was able to rotate it in all three dimensions. This was cool, now I can see ubiquitin, but what should I do with it? It is with this point I believe the course developers excelled in their design of the curriculum.

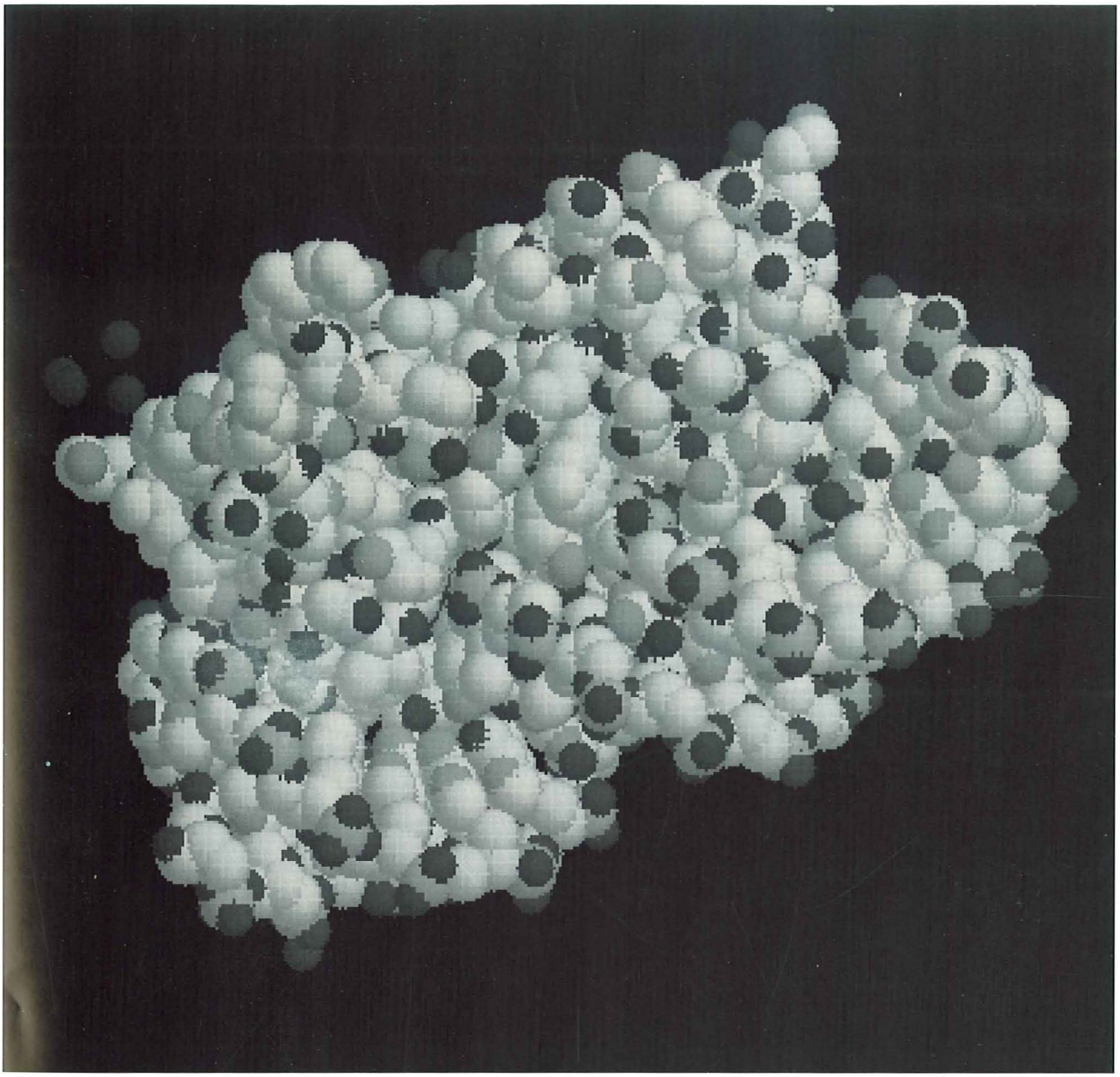


As a part of each assignment, a series of questions were posted on the WWW. These questions were well conceived to guide you through the concepts of the creation of these 3D images from the primary amino acid sequence or crystallographic data. In addition to these study questions, periodical course chapters are revealed on the WWW. These hypertext-books are very well written. For example, the course chapter on protein geometry takes the reader from the initial concepts like how an amino acid side-chain conformation can affect protein structure. The chapters also supply ample amounts of additional recommended readings.

From these study guides, I was able to learn a great deal about the nature of the ubiquitin structure. For example, I was able to reason that from the molecule's predicted tight globular structure, it would behave like a much smaller molecule in isolation procedures like gel filtration. Armed with this new-found information, I decided to reattempt the classroom communication. Still stinging from my experience with the MOO, I moved to the course's other communication technology—the e-mail discussion lists.

The course administrators set up the discussion list at the beginning of the course. Each discussion list focused on a different part of the course. Briefly, they were Backbone, Families, General, Glossary, Groups, Projects, Technical and Students. From my reading of the list material, I was disappointed to learn that the discussions mostly centered on the technical portion of the course. I was eager to jump in on the discussions with other students about such things as the effects of protein structure on gel electrophoresis. Instead, what I mostly found was discussions about topics like creating hypertext documents for posting on the WWW. For example, in the past month, the Technical list had 15 postings, while the Students list had zero.

However, the focus on technology may be shifting. The past several weeks have seen exciting discussions on the Projects list. As a part of the course commitment, each student is expected to complete a project in the form of a short essay on some aspect of protein biology. This student project will be mounted on the Birkbeck server as part of the course material. Discussions about the projects have been very stimulating. Several course consultants have volunteered to collaborate with students on the develop-



Another graphical depiction of the protein cro. Students can download several different types of images of the same protein. This is a spacefill depiction, which gives the viewer an understanding of how large the molecule is in terms the number and configuration of its electron shells.

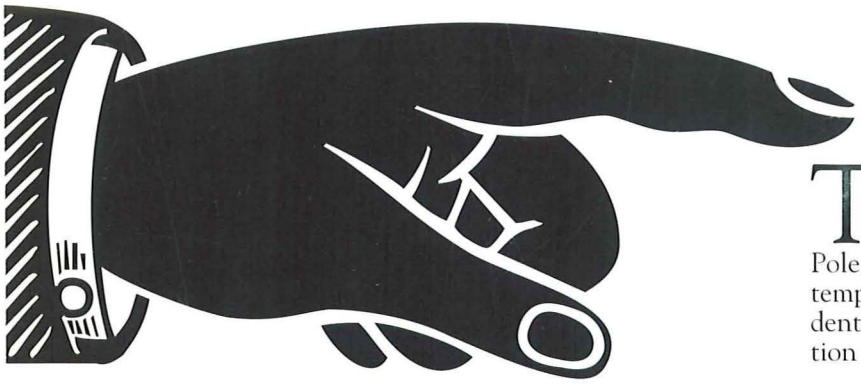
ment of their projects. These discussions are bringing together the students with a group of experts that could not be accomplished without computer-mediated communication technology.

For me, taking this course was an experiment. But for the organizers and contributors, this was a serious attempt to push the boundaries of education. The GNA has an ongoing mission to organize and support on-line education. The GNA has many projects planned for the future. If you are interested in participating in a future GNA project, look up this URL: <http://uu-gna.mit.edu:8001/uu-gna/schools/index.html>.

Virtual classrooms hold great potential for the changing landscape of education. It eliminates the need for costly buildings, but it also eliminates classroom face-to-face contact. As it allows individuals to work in collaborations which were once limited physical location, it also keeps the biology of communication at bay. By engaging this new technology, we are not simply enhancing the existing conventions, we are transforming them. This Faustian bargain is associated with all technological change, and we, as critical members of society, need to recognize it as it occurs. Ω

• Jon D. Benson is a M.S. student in Scientific and Technical Communication.

a world of ADVENTURE



by LINDA PHAM

Through the Internet, you can join Will Steger and his team of explorers as they cross 2,000 miles of frozen tundra from Russia to Canada via the North Pole. While Steger and his team brave high winds and temperatures below -40 degrees Fahrenheit, curious students, teachers, and other Net-surfers can join the expedition without even donning a sweater.

As many people know, Steger, a Minnesota native, is a seasoned Arctic explorer. In his 1986 expedition, he led the first unsupported trek to the North Pole since Admiral Peary. In 1990, Steger led the first crossing of Antarctica by dogsled.

For his current expedition, the International Arctic Project (IAP) 1995, Steger will lead a team of three men and two women on the first surface crossing of the Arctic Ocean by dogsled in a single season and also the first expedition using canoe sleds. Using the Internet, IAP 1995 is also educating the world about Arctic exploration, the Arctic climate, and the Arctic's role in the global ecosystem.

IAP 1995 stresses the importance of maintaining the Arctic environment. Steger said, "The hope for addressing the complex environmental issues we face lies in a global demonstration of interactive education. Beginning with an understanding of the Arctic region, I believe we can transform the natural interest students have in adventure into a comprehensive understanding of the inter-related nature of the world."

VIRTUAL CAMPUS

at your FINGERTIPS

The expedition also uses Scholastic Network, an interactive service for K-12 educators and students available on America Online. The explorers carry computers and other communication equipment to keep in touch with IAP 1995 headquarters in Minneapolis and to update members of the Scholastic Network.

Scholastic Network allows teachers and students to access:

- a special events calendar
- program highlights
- reports from the team
- dog-of-the week reports
- live interviews
- discussions

The special events calendar posts the dates and times of live interviews and discussions. New events are posted as they are confirmed. Live interviews are planned with the explorers, dog trainers, and designers of food, clothing, and gear specifically for the Arctic environment. On February 16, a live discussion was held with all six of the explorers from their training camp at Homestead, Minnesota. A discussion addressing training and nutrition with professional dog trainers and team members training the dogs was held February 27.

Scholastic Network also helps students learn more about specific Arctic issues via a message board. Experts available include an oceanographer from the National Ice Center, a meteorologist from the National Ice Center, an Arctic cultures expert, and a specialist on the Aurora Borealis.

A myriad of information is also available by accessing the International Arctic Project 1995 Home Page at this URL: <http://scholastic.com:2005/public/IAP/IAP-Home.html>

From here, the user can explore virtually any aspect of the expedition. The home page leads to an overview of IAP 1995, weekly updates from the explorers, photographs and biographies of the explorers, a map of the journey, information about the dogs, details on the specialized gear and supplies, news about diet and nutrition, articles from *Scholastic News*, an Arctic bibliography, and the IAP photo gallery.

A map shows the user the route stretching across 2,000 miles of solid and broken sea ice from Russia to Canada. The team left Severneya Zemlya, a Russian Arctic Island, March 5 and planned to arrive at the North Pole by Earth Day, April 22. Then they will continue across the Arctic Ocean to Resolute, Northwest Territories.

When the team reaches the Queen Elizabeth Islands in June, the dogs will be exchanged for canoe-sleds. The trip will be finished using the canoe sleds to overcome both land and water. They will be pulled on ski-like runners across the ice and paddled through the water.

To learn more about the explorers, biographies and photographs are available. Steger, the project leader, Victor Boyarsky of Russia, Julie Hanson of the U.S., Martin Hignell of Great Britain, Takako Takano of Japan, and Ulrik Vedel of Denmark describe their previous travel experience, hobbies, future plans, education, team responsibilities, and occupations.

Of all the information available through the IAP home page, the most fascinating may be the daily reports logged by Steger and his team. The members record their location, the temperature, pH and salinity of the water and ice, wind speed, heavy metal levels, ozone and UV readings, observations of wildlife, and physical reactions to the environment. This information encourages school children around the world to follow the team's progress and track the climate conditions.

The reports also offer an intimate glimpse into the exhilarating experience of Arctic exploration. These reports detail group morale, daily tasks, and any other feelings and anecdotes the explorer chooses to share. The writers share their frustrations, fears, hopes, and triumphs.

In one report, Takano related an encounter with three polar bears that frightened the dogs. The bears were frightened away by using flares.

In another daily log, Vedel's harrowing fall through the ice is retold. In an effort to rescue two dogs which fell through thin ice, Vedel endangered his own life. The experience is a sobering reminder that the high adventure of Arctic exploration is accompanied by omnipresent danger. Sadly, Vedel chose not to continue with the journey shortly after his fall through the ice.

While the reports provide a rare opportunity to understand the harsh weather and perilous adventures, they also offer a chance to share in the team's joy. The explorers wrote of an adorable puppy that hung about their campsite and celebration of Takano's birthday.

The explorers convey their awe throughout the expedition. They write eloquently and honestly, painting an image of the wonder that surrounds them. The sound of the menacing breaking and crashing ice is described as a "railroad," "creeping freight trains," and "I-94." The howl of the Arctic wind is said to sound like a "ghost" and "whale songs."

Vivid imagery is evoked from passages such as National Geographic photographer Gordon Wiltsie's description of the sea ice. "Imagine a bomb blast with rubble everywhere. There is ice rubble everywhere and open water everywhere, all swirling in different directions. It is like a maelstrom."

The daily reports keep the public involved in the exploration and promote classroom activities.

Curious Net-surfers who may or may not realize that "nutrition can make or break an expedition" can follow the home page connection towards more information of the explorers' diets. Steger and his team need a peak performance diet to promote rapid muscle recovery from the strenuous activities of skiing, running alongside the sleds, canoeing, and hauling. The Shaklee Corporation spent three years developing a special high-carbohydrate diet for the expedition. The diet requires more than 5,000 calories per day.

There is also information on sports nutrition, hydration, and packing limitations. A sample of the IAP trail diet is also included.

Breakfast
2 cups oatmeal
1 ounce brown sugar
2 Tbs. peanut butter
2 ounces dried fruit
1 raw lime
1 Shaklee Carbo-Crunch Energizing snack bar

Lunch
2 cups Shaklee Will Power Soup
4 ounces dried fruit
2 ounces mixed nuts
15 crackers
8 ounces Shaklee Meal Shake

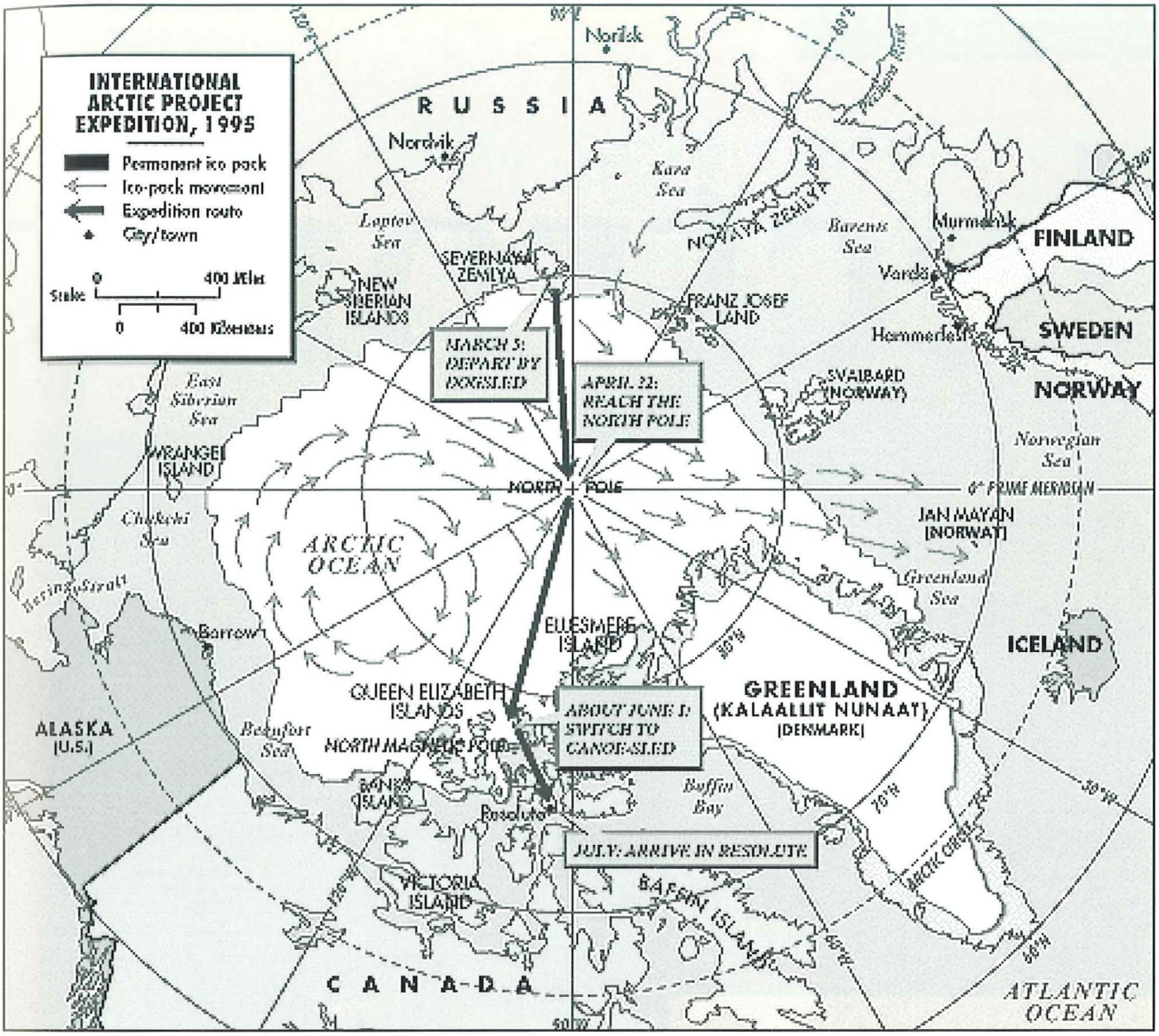
Snack #1
(eaten on the trail)
2 Shaklee Carbo Crunch Energizing Snack Bars

Snack #2
(eaten immediately after setting up camp and again in the evening)
8 ounces Shaklee Physique Workout Maximizer Supplement

Dinner
2 cups egg noodles
6 ounces beans
2 cups Shaklee Will Power Soup
2 ounces cheese
3.5 ounces dried meat
2 ounces semi-sweet chocolate

Totals
Calories: 5,200
Calories from protein: 16%
Calories from carbohydrates: 68%
Calories from fat: 16%

Net surfers interested in the explorers' heavy-duty clothing can read about the five-layer clothing system developed by Lands' End Direct



Courtesy of International Arctic Project

The map of the route of Will Steger's expedition.

Merchants. The system is designed to adapt to varying climate conditions that the explorers will face throughout the journey. Details of the features and functions of the moisture control layer, temperature control layer, regulating layer, and outer garments are listed.

Further information on the expedition gear and supplies is just a click away. Clothing, footgear, dog sleds, stoves, sleeping bags, tents, weapons, and canoes are described.

Animal lovers may choose to read about the sleds the dogs pull or their specially-formulated program from Hill's Science Diet.

In addition to the Internet, Steger's team is providing telephone updates via 1-900-976-POLE.

An IAP Education Packet encourages following the journey's progress. It contains a 24-page background guide, an Arctic wall map including classroom activities, and an expedition tracking map. Details on obtaining the IAP Education Packet and subscribing to Scholastic Network are available on the Worldwide Web.

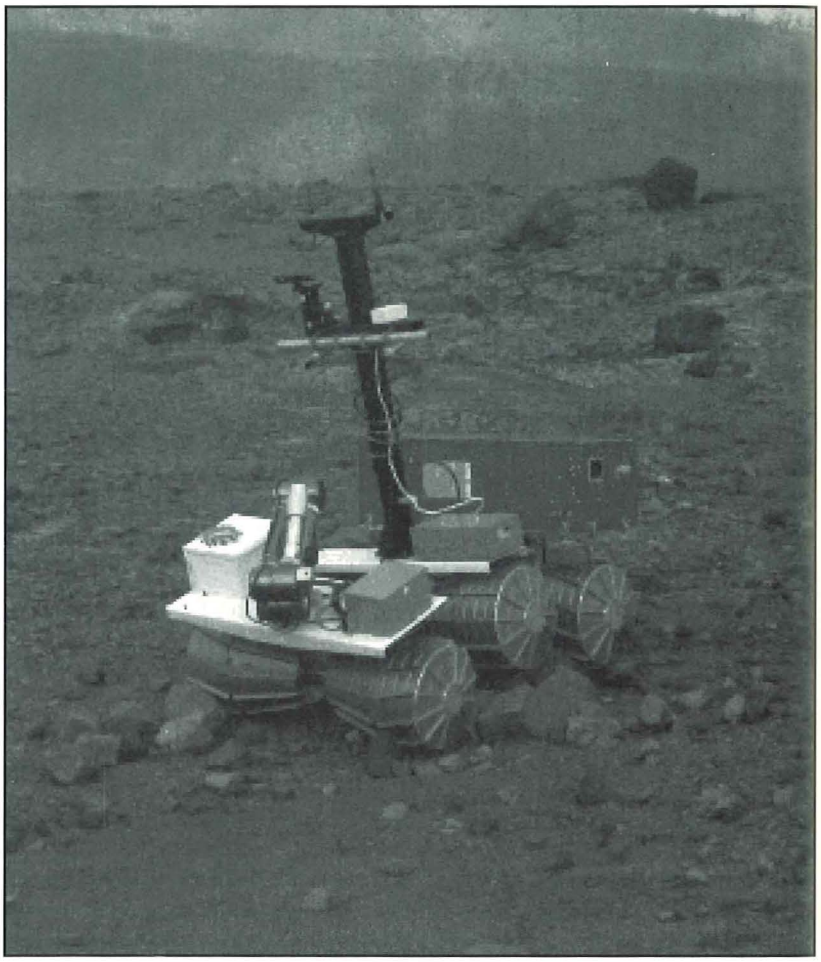
The Internet provides a remarkable opportunity to experience the International Arctic Project 1995. The expedition encourages students and teachers to explore the Net, promotes awareness of the Arctic environment, and encourages consideration of the Arctic's role in the interrelated global environment.

To join Steger and his team on their journey across frozen tundra, access the IAP home page at the URL:<http://scholastic.com:2005/public/IAP/IAP-Home.html>. A world of adventure is at your fingertips. Ω

• Linda Pham is a senior co-op student in the mechanical engineering department. She plans to study bio-medical design in graduate school.

Electronic

VIRTUAL CAMPUS



Above: A NASA Remotely Operated Vehicle (ROV) probes deep into a volcanic crater in Hawaii for JASON Project VI.

Opposite Page: The NASA Observatory atop Mauna Kea, where astronomers captured digital images of volcanoes on other solar system bodies.

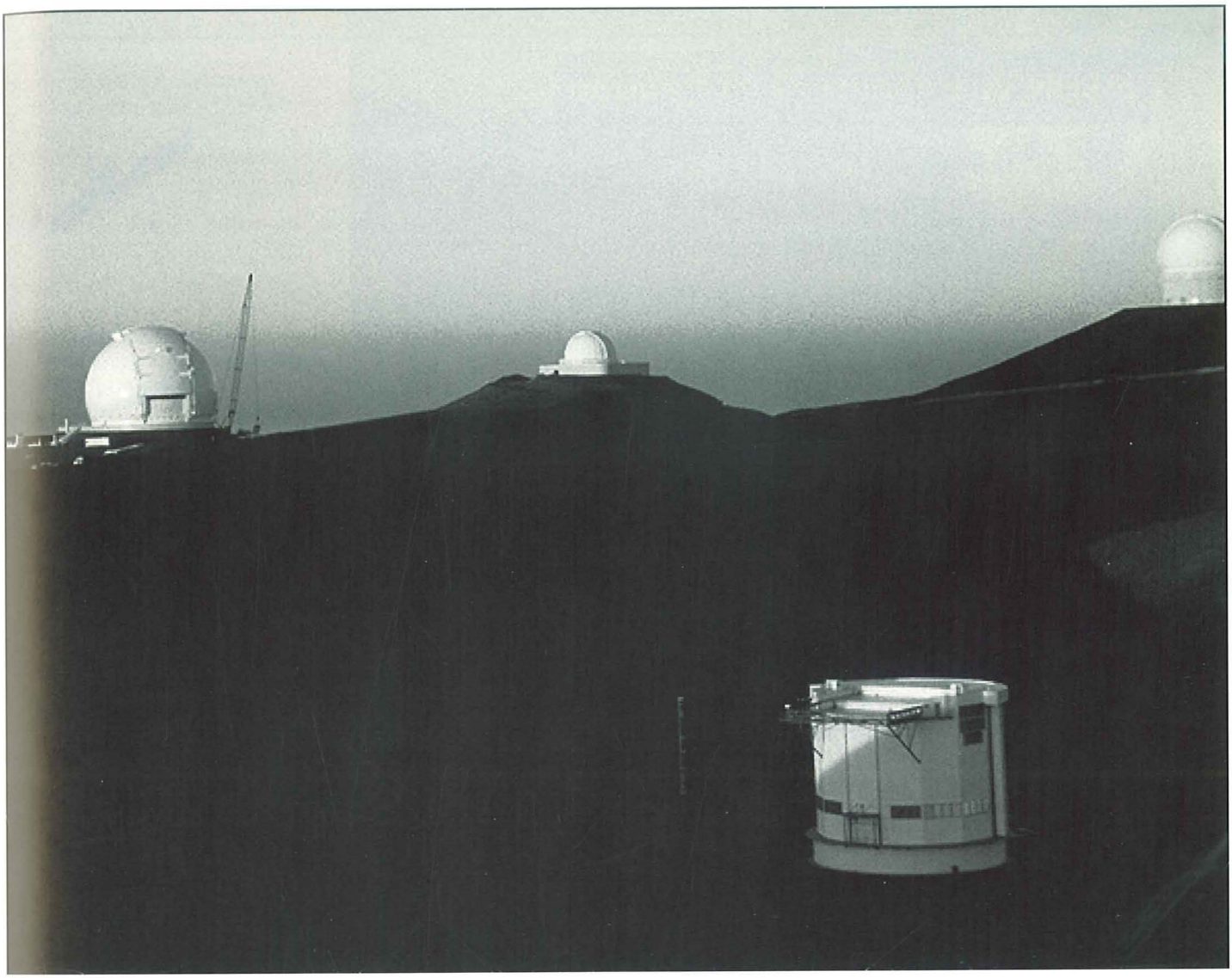
Photos courtesy of JASON Project

by Brad Davis

Forget *The Mad Scientist's Club*. It's time to get on-line.

Old science textbooks spring alive each March on the University of Minnesota campus as thousands of elementary students embark on an interactive voyage. This year, Minnesota students took an electronic field trip to Hawaii's Kilauea volcano and witnessed volcanic activity on Io, a moon of Jupiter, while sitting in front of their computer terminals at the Bell Museum of Natural History back here on Earth.

And you thought memorizing the Periodic Table of Elements was exciting.



Field Trip

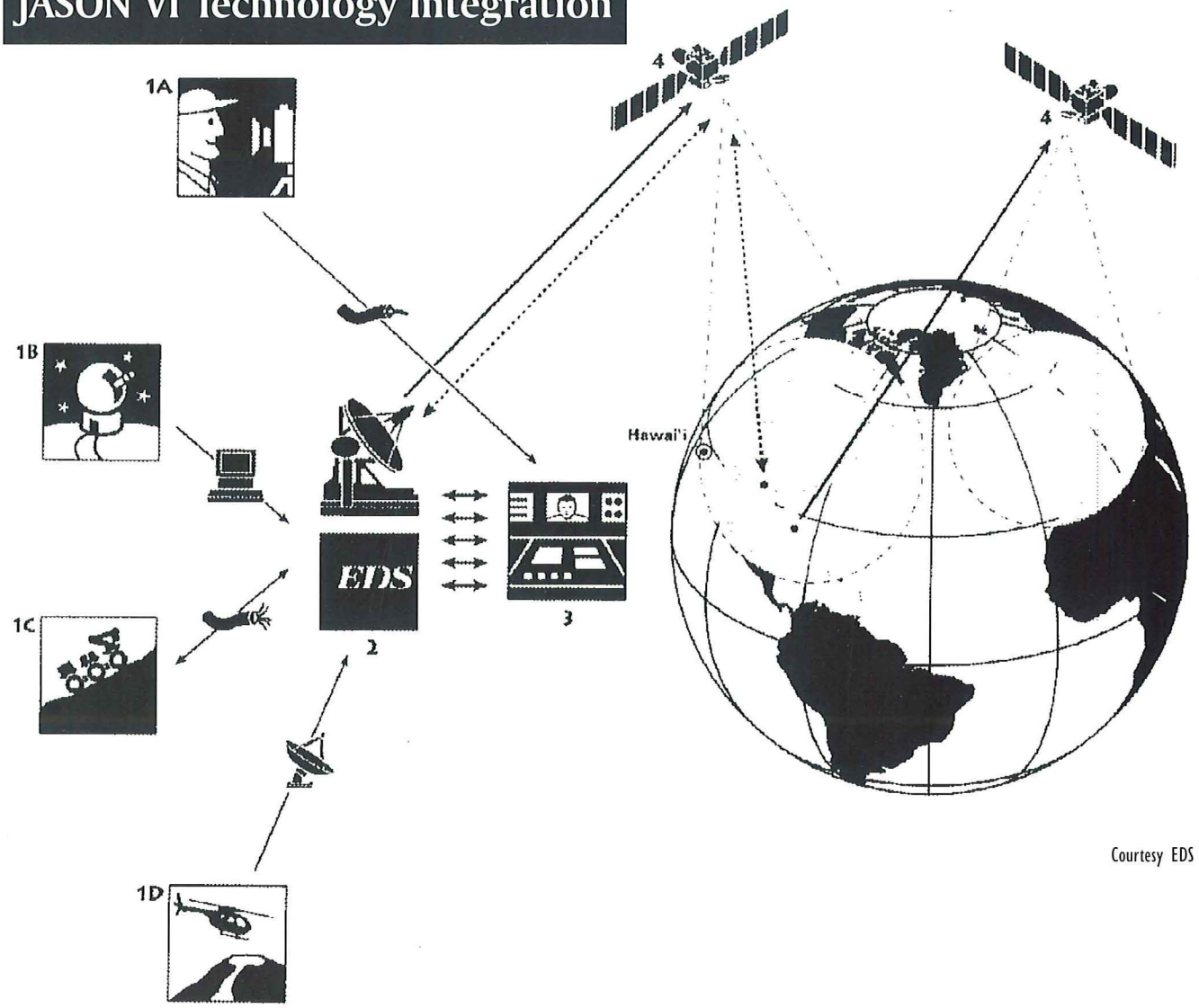
It's called the JASON Project, and each year more than 13,000 fourth-through-12th-grade students in Minnesota and one million students worldwide have the opportunity to interact live with a team of scientists via Internet and satellite communications. For nearly three weeks, the Bell Museum auditorium is converted into a futuristic set right out of *The Adventures of Jonny Quest*: young scientists sitting at their illuminated computers, looking into TV cameras that transmit images across a satellite hook-up into a research station deep in the tropical rainforests or under the distant seas. These students have many questions for the crew working live out in the field.

"It's 32 degrees in Minnesota, how warm is it in Belize?" a seven-year-old asks.

"Actually, the temperature varies from 87 degrees 100 feet above the jungle floor to 70 degrees on the jungle floor," responds a botanist right on location. Instant knowledge.

It is this kind of interactive education via state-of-the-art technology that has revolutionized science and technology studies in the United States, according to many science educators. Not only has science projects like JASON changed the venue of education, it has also changed the way students learn. "The project excites and engages kids,

JASON VI Technology Integration



Courtesy EDS

In 1995, JASON VI originated from various sites on the Big Island of Hawaii. This diagram illustrates the EDS communication link-up:

1A) Scientists coordinate live exploration at multiple research sites from the Expedition Control Center, which is connected directly to the television Production Center via coaxial cable. The EDS Expedition Communications Center receives this signal from the research site by various technologies.

1B) At the NASA observatory atop Mauna Kea, scientists capture digital images of volcanoes on other planets, which are then relayed via the data network.

1C) A remotely operated vehicle (ROV), connected by fiber optic cable, explores the moon-like landscape of a lava field.

1D) Cameras mounted on a helicopter transmit images of a volcano using a microwave link.

2) The EDS Expedition Communications Center receives the video, audio, and data signals from the research sites via multiple technologies. Simultaneously, it also receives audio and data signals via satellite from the interactive sites. The diverse signals are integrated and monitored for quality and real-time delivery. Then, all of the programming options are relayed to the television Production Center.

3) At the television Production Center, producers review all incoming signals from the EDS Expedition Communications Center and Expedition Control Center. After they have selected the final images, the completed program is then sent back to the EDS Expedition Communications Center.

4) From there, program video, audio, and data take different routes to the interactive sites. First, all are uplinked to a domestic satellite. Program audio and data are downlinked to the EDS Information Management Center in Plano, Texas, then uplinked once again to the domestic satellite, where they join the video portion of the program. Finally, the completed program is downlinked to interactive sites across North America, where students experience the thrill of live exploration. For interactive sites outside North America, the program is uplinked another time to international satellites for the journey to waiting students.

- At the interactive sites, including the Bell Museum of Natural History, the video broadcast, phone lines and data networks allow students to see the research as it happens, communicate with the expedition scientists, collect and analyze data, and operate ROVs.
- The EDS Information Management Center in Plano, Texas, provides the two-way audio and data links, as well as continuous monitoring of the entire JASON network for quality control. All transmissions, from research sites to interactive sites, take place in less than half a second!

we are shaping future scientists," says the state's JASON Project director Amy Theisen. "Where else could you sit in Minnesota and do research in California?"

Or Florida, or the Baja, or the Antarctic? The JASON project's itinerary over the years reads like a back issue of *National Geographic* magazine. The first project came to the Bell Museum in 1989, when students explored the Mediterranean Sea, discovering ancient Roman shipwrecks and retrieving artifacts. The following year, the project moved to the Midwest and explored the sunken U.S. battleships from the War of 1812 in Lake Ontario. In 1991, the project team went to the Galapagos Islands where students explored marine and botany life along with studying Darwin's theory of evolution.

By 1993, the JASON Project had blossomed into a major educational event for both students and teachers. The project opened up a whole new world of armchair travel for student who otherwise could not pursue their scientific interests, according Dr. Robert D. Ballard, JASON founder and project chairman. In a 1992 article for *T.H.E. Journal: Technological Horizons in Education*, Ballard wrote: "With the JASON Project, we are creating a world classroom where students join together in exploration and learning."

Last year, these students joined together in Belize, where archeologist, biologists and geologists were studying the natural habitat and ancient ruins of this small country on the east coast of the Yucatan peninsula. And hold on to your passports kids - and dig out that blue-and-yellow snorkel set - because in 1996 the project team is off to the Florida coast to study sharks and the coral reef system.

While the Bell Museum remains the technologically advanced "main terminal" to these exciting

Photo: Chad Harder

destinations, Theisen says in the future students will be able to access the satellite links right in their own classrooms. Down-linking in schools across the fruited plains, JASON will "expose students to different cultures, different environments," says Theisen.

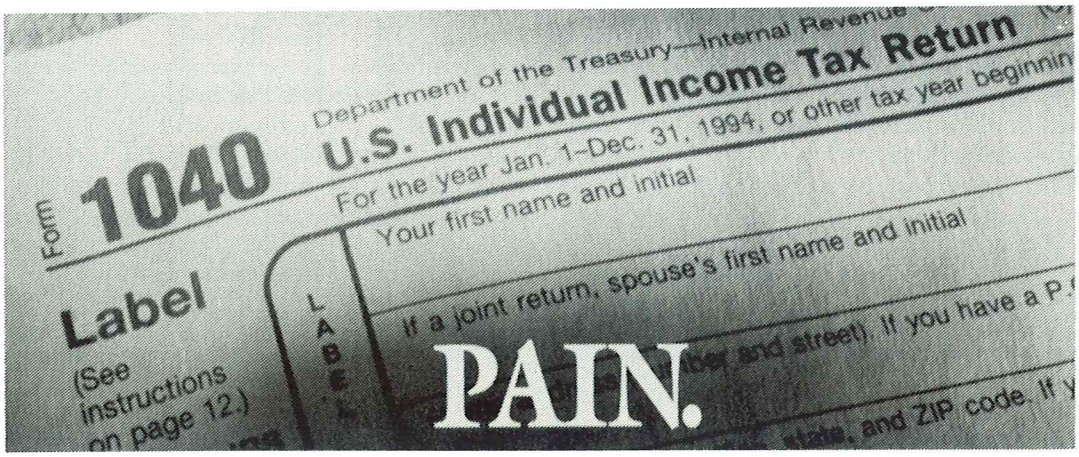
And as with all new technology, these "virtual-schools" will change the level of instruction and student participation in the science classrooms, says Mike Damyanovich, development coordinator for Sci-Math Minnesota, an organization committed to improving scientific and mathematic literacy in the state. Along with this new technology and electronic communication systems, pupils have created new relationships with their instructors. "Students can talk to professors via Internet on an equal basis. It's a whole new role and a whole new kind of learning," explains Damyanovich. This new kind of learning has shifted the focus away from the traditional "teacher-centered" scientific instruction to more group work, problem-solving and knowledge sharing instruction, he adds.

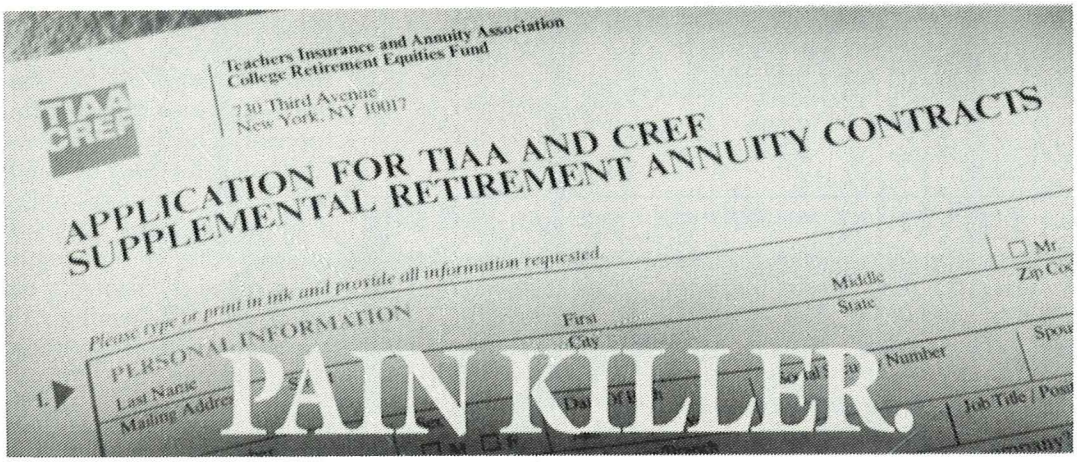
And Theisen agrees. Students are not the only ones that benefit from JASON. "Teachers learn right alongside the students," she says, expressing the importance the project has on science education development. Damyanovich suggests that this new technology might even redefine the role of teacher in future classrooms. What happens to the level of instruction, he asks, when students can go online and just ask the experts? And in this age of information, he continues, just who is an expert?

These and other posing questions will have to be tackled as scientific education prepares for the 21st Century. And no one will be better prepared than the young scientists at Bell Museum who are learning a new way to learn. As Ballard concluded in his article: "The most amazing element about the JASON Project is that it offers a real-time resource to students, exposure to information that won't be found in textbooks for years to come." Ω

- **Brad Davis is a *Technolog* associate editor. He will graduate with a degree in journalism this spring.**

PRINCIPLES of SOUND RETIREMENT INVESTING





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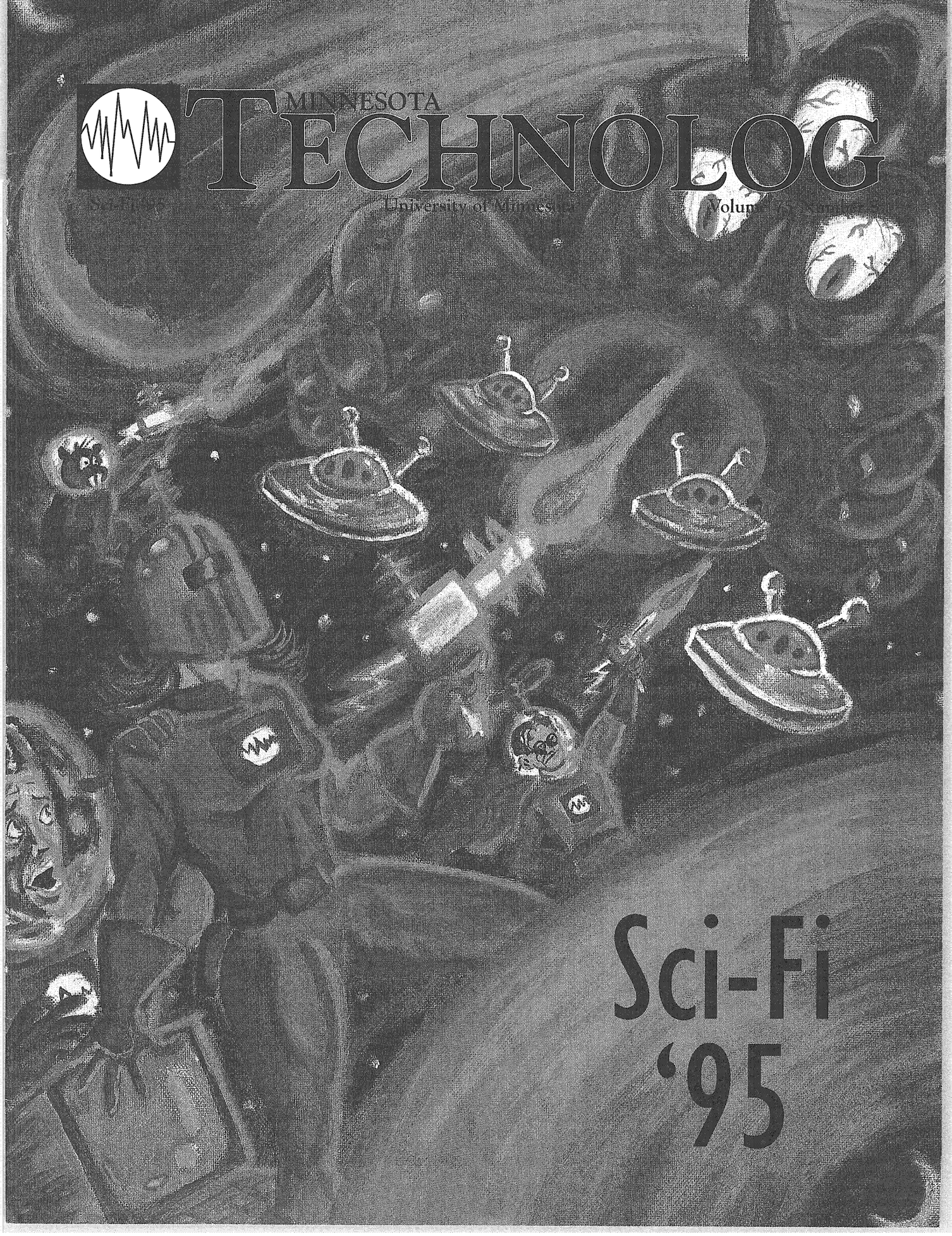


MINNESOTA
TECHNOLOG
University of Minnesota
Volume

Sci-Fi '95

For Starters

News bytes, tidbits, and odds & ends

Playing the Futures Market

Michael E. Marcum, 21, was arrested for theft of six 350-pound power company transformers in Stanberry, Mo. in January. Marcum said he needed the transformers for the "time machine" he was building. He said he wanted to transport himself into the future a few days, find out the winning lottery numbers, and then return to buy a ticket.

UFOs, Space Aliens, and Their Final Fight for Earth's Spoils

All reproducing space aliens—including mammalian and reptile—use Earth's humans simply for their own interest (and have been for thousands of years). They intentionally keep humans falsely "programmed" or "in the dark" primarily through religious concepts, secondarily through reproductive and "humanitarian" concerns. They support these preoccupations by transmitting images and thoughts into Earth's atmosphere around the clock. These "Luciferians" abduct humans for genetic experimentation, "rob" healthy human specimens for their own next "suit of clothes," and induct humans into their service.

A very accelerated "classroom" (for "birthing"—incarnating) is now being offered for the third and last time in this civilization, by those representatives from the 1975/76 "yield" to the remainder of the souls that have been saved from a previous time by the Next Level.

The representative 2000 years ago, the two representatives who came in the early 1970s, and their students from that "yield" and the present one, all came and will leave in spacecrafts of "clouds of light."

Representatives from that Next Level will speak April 9 at 1 p.m. Reading material will be available. Free Admission. Your assistance is welcome. We are not funded.

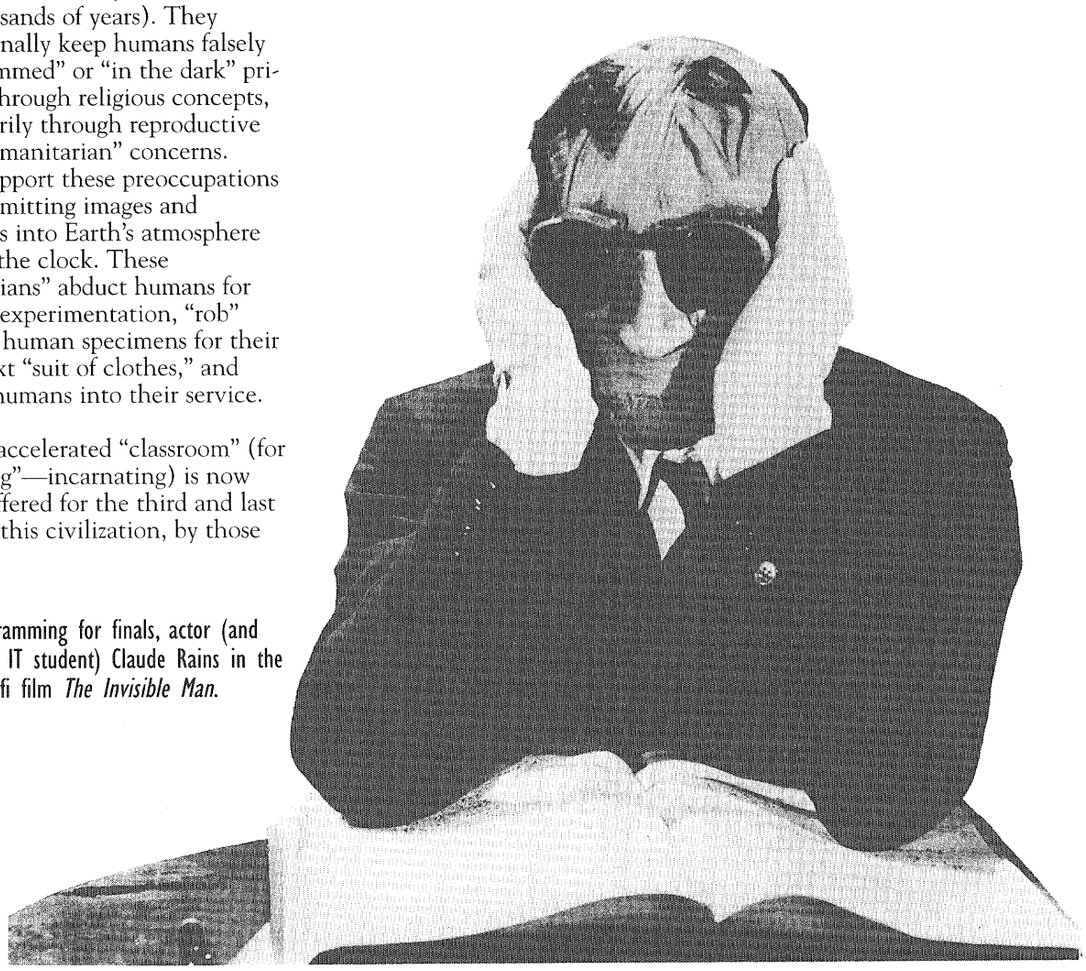
—From a poster recently sighted at the Walker Library in Uptown.

First Annual "Crimes Against Poetry" Award

Pulled over on the Internet for
Indecent Exposure
Carcrash, half dead, half alive
Got a new heart, couldn't die
My computer-thoughts cannot lie
So . . . I'm a Cyborg,
wonder why . . .

Metal bones and silicon skin
Spectral eyes scanning, what a sin
Electronic chips controlling this
brain
So . . . I'm a Cyborg, going insane!

—From The Cyborg Destiny on the Internet



Right: Cramming for finals, actor (and sometime IT student) Claude Rains in the 1933 sci-fi film *The Invisible Man.*

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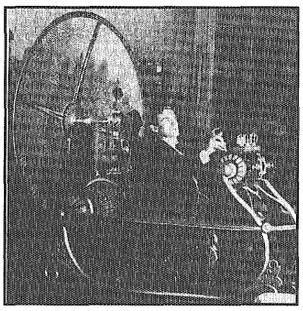
by Steve Gigl



Lost in Time

Science Fiction need not conform to present physical possibilities but it does have to conform to logical laws.

by James Mathewson

Photo Essay

Creatures from Beyond the Stars

A recent weekend sci-fi mini-conference in Bloomington was the chance for some strange sightseeing through the lens.

Photos by Teddy Maki

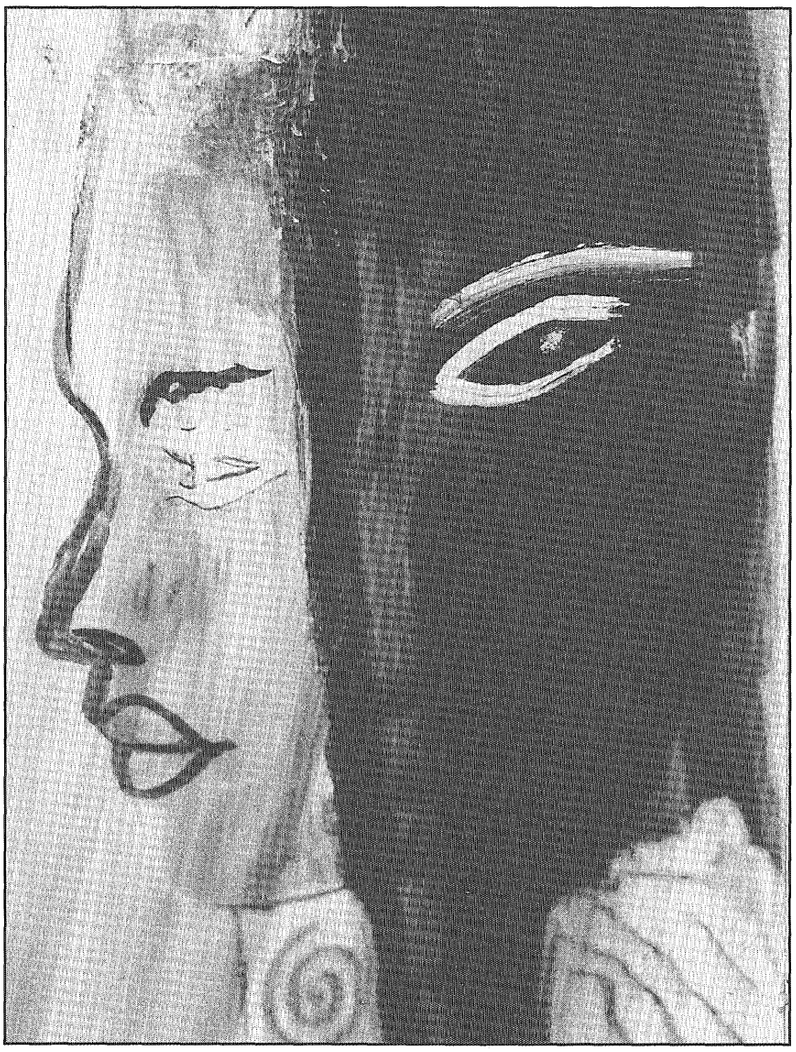
The Cover

by Joseph Scrimshaw

The Future's Now

Making the familiar strange and the strange, familiar

by Josie Rawson



"Mysterious Union" by L. Angelis

For us sci-fi freaks inhabiting the fringes of the literary canon, the names of our best writers read like a list of comrades running night raids into the sleeping camp of readers: H.G. Wells, Ursula K. Le Guin, William Gibson, Joanna Russ. These, and plenty of others, are writers whose works sound the alarm by offering up alternate realities to ours. In turn, their stories reveal the ways in which our assumed realities are made.

Science Fiction is the literature of the visionary, able to rattle our conventional notions about nearly everything: race, gender, economics, political powergames, the limits of technology, human nature. With each new "school" of innovation—from early War of the Worlds scenarios, to 1960s New Wave, to yesterday's Cyberpunk—the realm of what's possible, if only on the outskirts of imagination, expands.

At its worst, sci-fi is poo-pooed as the stuff of basement dwelling utopists; but at its best, sci-fi throws open the shutters and barks, "This place is getting moldy, baby. Let's get some light in here!" I like to think of sci-fi as a kind of rebellious cousin who crashes the family reunion: a wild party-hound on the scene, upsetting the banquet table, yodeling toasts to the future, waltzing with the waiters. The real appeal of sci-fi is its against-the-grain misbehavior in the face of all that's taken as normal. It mimics the mundane scene, comments on it, criticizes it, and in turn fires off an insistent refrain of *why, why, why* into the crowd of guests.

What I enjoy most about sci-fi, whether on the page or on the screen, is its drive to conceive of the galaxy as a whole, rather than fenced off into provincial subdivisions. It pays no attention to "no trespassing" signs or invisible borders on the map. As a result, its creators and followers are often more acutely tuned-in to issues of global ecology, for instance, or the ethical implications of broad technological advancement. A denuded, toxic landscape conjured up in Warpzone Six resembles, and accentuates, the crisis here on the home *terra firma*; how this plotscape is suffered and cured by its inhabitants, in the hands of a gifted writer, offers instruction today, here, now, for healing our own predicament. And a science fiction

grappling with ethical complexities on the frontiers of technology—how much *humanness* will this damned device devour? Is the material body replaceable? At what cost?—reminds us of our own ironic fallibility as an entire race.

I recently spent a long weekend here in Minneapolis with the sci-fi writer Samuel R. (Chip) Delany. In the course of a long and eccentric career, he's composed an extensive body of stories that both fascinate and disturb with their themes of racism, sado-masochism and homosexuality. (Read, in particular, the series set in the ancient land of Neveryon). Delany, with his signature insight, noted that any genre fiction *per se* is viewed by some as valueless, in that to be recognized as part of a genre—be it sci-fi, western, horror, mystery—the individual text must fulfill so many expectations that there's little room left for the necessary violations which characterize great literary works.

But, he argued, this criticism is also true of realistic fictions, which must abide by their own rules of conformity in order to be "believable." What lifts any text, literary or paraliterary, out of the mundane and into excellence, is what Delany calls the "very fancy dance of fulfillment and violation that produces the 'Wow!' of wonder." Such moments—and we stumble on them often in the best sci-fi stories—occur on many levels, from character to plot to metaphor. The power of sci-fi as a genre is its wow-inducing knack for making the strange familiar and the familiar strange, in universes where its ultimate epiphanies shatter our entrenched ideas.

Since the catastrophic bombing last month in Oklahoma City, I've been thinking a lot about these issues of defamiliarization and estrangement. What struck me most at the time, and still does, is the odd confluence at ground zero of so many subplots—terrorism on home soil, the targeting of a federal institution, the lightning-speed spread of alarm, the mental searchlight for aliens in our midst—that accompanied the event. If it weren't true, it would be unbelievable. If it hadn't actually happened, in real time, to real people, the explosion would seem better suited to the realm of science fiction. The alien, it turns out, is among us. The alien, in the end, *is* us.

And this, I think, is one of the main wonders of sci-fi literature: dismissed by some as mere fanciful amusement, it cuts an impressive swath through the imagination as it grapples with themes of honor and evil, spirit and machine, will and accident—all themes that play themselves out in the day-to-day "news" of our present lives. It's not difficult to conceive of such a catastrophe occurring in a sci-fi text fifty years ago, perhaps even as a prediction for April, 1995 in America.

What ground sci-fi literature will claim next—with its previously alternate realities becoming actual events in the world—is a big question. We can only hope there are authors out there who are visionary enough to imagine such futures, for us here and now, in stories. Ω

- **Josie Rawson will be the *Technolog*'s Editor in Chief for 1995-1996.**

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the sci-fi issue

Science Pulp^Fiction

From the early "pulp" flicks to tomorrow's next best techno-wonder, sci-fi films use the latest technology to create magic before our eyes.

by Steve Gigl

Suspension of disbelief is an important skill to learn when watching movies and television. The situations on the screen must appear real, even if nothing similar has occurred to you. This is even more important when watching science fiction. The ability of the knowledgeable viewer to ignore (often unscientific) embellishments to our reality is what allows us to enjoy watching programs riddled with errors such as the travel of sound through a vacuum.

Until recently, however, this suspension of disbelief was not such an easy accomplishment. When sci-fi first appeared on the screen, it fell into that critical black hole labeled "pulp" movies: black-and-white flicks with flying saucers, little green (it was assumed) men, and titles like *It Came From The Crab Nebula*. Financial backing was scarce for these early films, and in the rush of production there was little time for directors and artists to spend on details. Viewers had to work hard to ignore the fishing-line-like strings supporting the "space ships," as well as the tacky, papier-mache costumes of the aliens. Once in a while, a story was good enough to blot out the bad effects, and sci-fi started to gain a following among film goers. Eventually, more sophisticated tech

effects were developed to hide the strings, and the more "realistic" shots on screen made films easier for audiences to enjoy, if not believe. Still, many studios turned to alternate-reality shows like "The Twilight Zone" in order to avoid the high costs of producing space-oriented science fiction.

Much of this had changed by the time "Star Trek" landed on the scene. Set directors dumped those nasty strings—except for the occasional puppet alien—and the models used in the production became highly detailed. Viewers could see little windows, as well as running lights, on the Enterprise when it flew by (with a "swoosh," of course), and their disbelief was partially buried under a fascination with the incredible special effects and well-crafted plots. For this reason, "Star Trek" eventually became the most popular sci-fi universe ever, spawning seven box-office smashes and four zany spin-offs (if you include the cartoon series).

Stanley Kubrick's *2001: A Space Odyssey* took another powerful step in the right direction for the motion picture industry. Scientifically more accurate than any film in recent history, *2001* demonstrated the flexibility and scope models at the time could achieve, both on the set and in the cutting room. Though popular, it was a bit too cerebral for the mass audience to be a universally acclaimed hit. In time, it would take a far less accurate—but more accessible—film to make sci-fi flicks as in demand as they are today.

Ten years later, that very film appeared. The models and sets for *Star Wars* were incredibly detailed, enough so that looking closely at the Star Destroyer in the opening scene is still enough to give the most nitpicky observer the chills. And the aliens were just as convincing, making the bar scene in the first movie a film classic. The other two *Star Wars* movies continued the tradition of detailed (and expensive) space battles, the climax of which came in the battle around the Death Star in *The Return of the Jedi*. Cinematographers and effects wonks filmed these models using conventional "blue screen" techniques, meaning that they were shot alone, then placed in front of their various backgrounds.

When sci-fi first appeared on the screen, it fell into that critical black hole labeled "pulp" movies

While production teams achieved huge advancements in computer-controlled camera (and model) movements, it was a time-consuming and costly method. Also, certain effects were hard to achieve with such a technique. The original *Star Wars* exhibits numerous examples of the limitations of using models: when TIE Fighters fly in front of the Death Star, one can see the little editing boxes around them; when the Rebel ship is captured by the Star Destroyer in the beginning of the film, shadow lines are decently done but not realistic enough to completely fool the eye. Based on the blockbuster success of the original movie, however, the two *Star Wars* sequels secured enough production money to nearly eliminate such slip-ups.

In 1984, the next generation of sci-fi special effects hit the world, in the form of a movie called *The Last Starfighter*. The effects were done not with models, but with a CRAY supercomputer which was used to generate all the space shots. Though the scenes were quite detailed, it took took only eight hours of processing time on the CRAY to generate the stunning effects. This film was less popular

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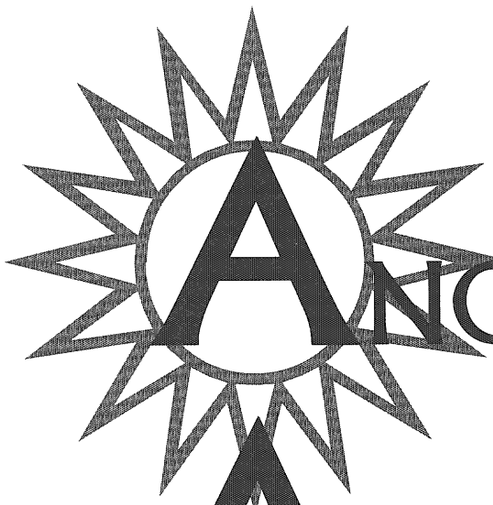

ANOTHER day, ANOTHER credit

by Gregory D. Hawkins

"Mark, it's time to get up," crooned the lifestyle-companion computer in a slightly synthetic female voice. The windowless apartment brightened and filled with the sound of singing birds as the wall monitors displayed a stunning sunrise scene.

"Kill the birds," Mark said groggily. The chirping ceased. "Just a little longer . . . ." He rolled over and covered his head with a pillow.

"Mark, I really must insist. You're due at your terminal in 45 minutes." L-cee's tone expressed a hint of artificial annoyance.

The only response was a muffled snore.

"Must we go through this every morning?" L-cee asked as the lights brightened and the birds resumed singing at twice their original volume.

The sudden noise made Mark jump. "A bit testy this morning, aren't we?" He grinned in spite of himself. L-cee's personality upgrade was worth all 800 credits. It was almost like having Megan, his beloved wife, back again.

"There are some articles of personal interest to you on the business news net this morning. Should I summarize them for you, or would you prefer to read them for yourself?"

"Not interested," Mark said as he flopped out of his sleep module and halfheartedly began some light exercises.

"Three solid weeks of disinterest. A record even for you. Do you realize that you have over one hundred pieces of unread mail?"

"Do *you* realize that for a few extra credits I could trade you in for one of those new LC 9000 models?" Mark asked. "I hear they're less difficult . . . ."

"Oh, masta' I is sorry. I do better. Sho thang!" The monitors displayed an old earth cotton plantation complete with people laboring in the fields. An old woman in the foreground seemed to be speaking L-cee's words in a thick southern accent.

"Maybe we'd better stick to difficult."

"Okay, but you really should read your mail," L-cee said, returning to her standard voice. The monitors reverted to the sunrise scene.

"Enough about the mail," Mark snapped. "I don't want to see it. What if I get another . . . just drop it."

"But Mark—"

"I said drop it! Computer go off line." All monitors went blank and Mark was left to his exercises and his thoughts.

Three weeks ago, Mark received a letter from Northwestern Hospital. Due to a horrible oversight, he got a card wishing his daughter, Colleen, a happy birthday. She would have been one year old.

Megan started shrieking. "Mark! Wake up! Something's wrong with the baby. Something's wrong with Colleen!"

"What? Dear?" Mark shook the sleep from his head.

"The baby!" Megan slumped over and clutched her swollen belly as a second wave of cramps overcame her.

"Megan!" Mark shook his wife gently but there was no response. His hand came away wet with his wife's perspiration. Frantically, he ran to the viewphone and dialed the emergency number.

Within moments, a man dressed in a white environment suit entered the airlock outside Mark's apartment. He swiped a small card through a magnetic reader, entered his emergency security override, and entered the apartment dragging a stasis unit behind him. Upon reaching the bedroom, he said, "Sir, please stand away from the patient."

"Megan. Will she be okay? And the baby?" Mark's eyes were swollen and tearing, but he was glad help finally arrived.

"Do you have her insurance disk?"

Mark stared at him blankly.

"I can't do anything until I get the disk."

"Help her," Mark pleaded as he ran into the other room and searched for the disk. He hunted for several minutes before realizing that he had packed the insurance disk away with the clothes Megan would need at the hospital. Even though her due date wasn't for three months, Mark was already prepared. He was always prepared for everything. Except this.

When Mark re-entered the bedroom, the man had already laid Megan in the stasis unit and set the environmental controls for outdoor travel. He took the disk from Mark and inserted it into the console. "Mr. Davis," the man said, reading the name from the display screen on the top of the stasis unit, "I have to get your wife to the hospital as soon as possible." He indicated that Mark should remove himself from the doorway.

"Can I go with her?"

The man typed an inquiry into the stasis unit's computer. "You're welcome to sir, but your insurance doesn't cover spousal costs for public area life support."

"Maybe I'd better stay here."

Without another word, the man left, wheeling Megan and Mark's unborn daughter behind him.

"Mark? I know I'm supposed to be off-line, but you're due at your terminal in 15 minutes," said L-cee tentatively.

"It's okay. I'm sorry I got upset. It's just... it's late, I need to get going." Mark stopped his sit ups and realized he had no idea how long he had been exercising. His breathing was labored and a sweat had broken out on his forehead. "Turn up the oxygen. I'm suffocating."

"Mark," L-cee said, "it's a peak usage time. Any increase will cost twice the standard rate."

"Funny, I don't remember asking about the utility costs..." Mark said. The computer adjusted the oxygen ratio, and Mark began to breathe a bit easier. "Now that I'm on my own, I can afford an extra mole oxygen." Mark entered his personal hygiene module.

"I beg to differ. Look at the monitor. Using your own finance monitoring program, you can see that your active account balance is quite low. Of course, if you'd let me transfer some of the savings account..."

"NOT another word! The savings is not to be touched. It must *always* have at least 2457 credits." Mark took a moment to shake off his sorrow then stepped into the sonic shower. Before long, he was humming above the din of the shower.

L-cee decided to take advantage of the positive mood swing. "Mark, you really should get out more often. They say it's not good for people to relate only to computers. Personally, I think it's the other way around. I wish you'd let me access the network, I'm dying for some intelligent conversation."

Mark smiled, "Touché, my dear L-cee, touché. The answer's still no. According to you, I wouldn't be able to afford it. I'm perfectly content to stay right here with you. Besides, if I did go out it would only be to look for a new computer." Mark stepped out of the shower and began to shave.

"I won't hold my breath," L-cee said in the most sarcastic tone she could muster. "What do you want for breakfast?"

"Sorry, but I don't have time. My computer made me late." Mark finished up in the hygiene module and began to get dressed. He surveyed his bland living unit and frowned slightly. "I'm tired of the sunrise scene. Let's get something better up on the monitors. How about a different outdoor scene? Maybe something to simulate windows for this place." The monitors filled with a hazy gray view of two windowless buildings and a barren patch of dirt in between.

"No, no, NO! I don't want to see what it *really* looks like outside. I want to see what it *should* look like outside," Mark said emphatically.

"Sorry," the computer said softly. "Sometimes you need to be more specific." The monitors filled with

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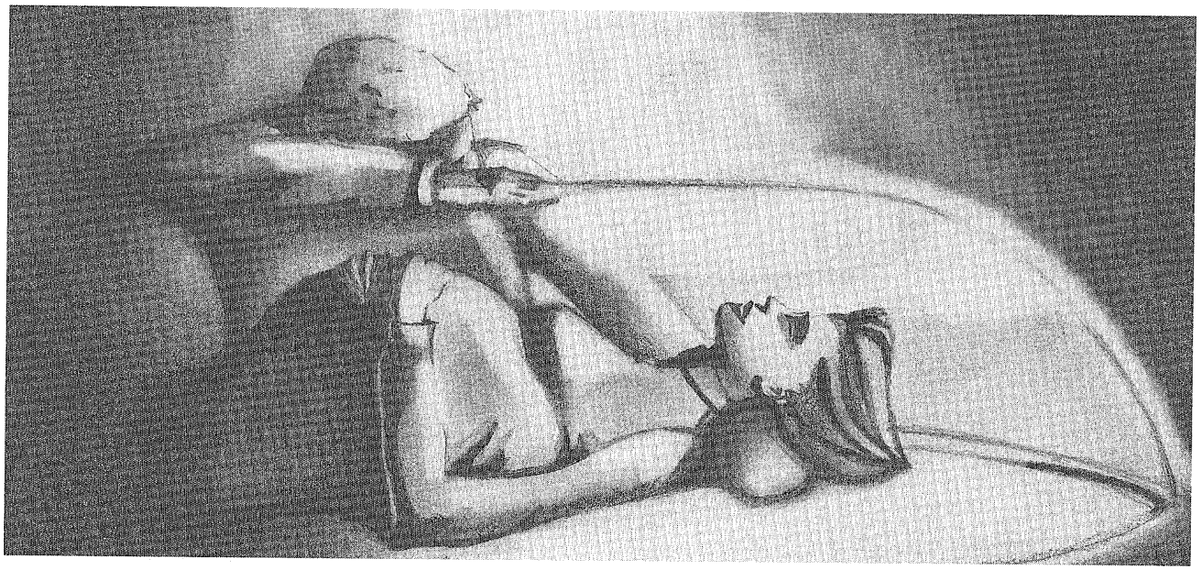


Illustration: Anne Peterson

Ain't No Sunshine When She's Gone

by John Sheflin

Gathering the crumbs from her sandwich, she sweeps them to create a mound on the counter top, her pinkies the zambonies, as the clean white surface glints like ice. She turns to her husband (whom she does not love) and asks:

"You know that song, 'Ain't No Sunshine When She's Gone'?"

He looks up from his soup, annoyed. "Huh?"

"That song, 'Ain't No Sunshine When She's Gone,' do you know it?" She begins to sing the chorus, bobbing her head to the beat contained within.

Exaggerating, he winces at her tunelessness, and replies, "Yes, of course." His mind is empty, but he knows the correct reply, and asks it. "Why?"

"No reason. I'm going to the store. Do you want anything?"

"No, thank you."

She grabs her purse and bobs out the door.

The husband knows.

Bob, the grocery clear at the corner market, has swept the place, then mopped, then dusted each item on the shelf. He has no reason to read, and nothing to do. His mind is empty, but he is not bored.

She (the bobber, with the song in her head) is named You. You chooses a banana, a bag of fat-free pretzels, a bottle of water, and People magazine. She carries the groceries to Bob. He holds up the magazine and eyes her. "Oh," she asks flustered, "you haven't the need to magazines?"

"Not for quite some time." Bob seems disappointed in her, as he should be. Any person, especially a white one, should have no need for reading material at this time.

"Well, I, uhm, I'm sort of behind," You says, looking down, avoiding Bob's eyes in shame as he counts her change.

She beings to leave, but turns and asks, "Bob, could I ask you a question? You should know."

"Yes, go ahead." The grocery clerk looks down to her, awaiting the surely elementary question.

"Do you know the song, 'Ain't No Sunshine When She's Gone?"

"Yes, of course."

You fumbles, watching her feet push the dirt around on the cement floor. She lifts her head as if to ask another question, then falters. "Oh, I was just checking."

"All right, Miss," Bob says, dismissing her.

Bob knows.

You sits in a booth, reading her magazine and waiting for the waitress to take her order. The waitress walks up and notices You's magazine and snips, "Are you still reading?"

Twice in one say, You thinks. She closes the magazine and looks up. "Yes, I'm a little behind."

"Behind? Girl, that was months ago, and I am a little more behind than you, you know."

She's behind. You wonders, then realizes the waitress has dark skin and a squished nose. She looks to her own pale skin, feels her pointy nose, and remembers the report from the mirror every morning: You Specht; Caucasian female, 26, green eyes, blonde hair, 15 pounds overweight, dry skin, myopic, fourth-generation German/American, homemaker. Every morning she jokes with the mirror, "Wasn't I raised by wolves in the Amazon jungle?" And every morning the mirror replies, "There are no wolves in the Amazon, You," and spouts into the same lecture about the homelands of various wolf species and lists those birds and animals who do live in the Amazon and would be capable of raising a human baby.

Today the mirror sternly reminded You of how far behind she was and she looked at the floor, embarrassed, and said nothing. The mirror spoke gently, "You, I know you can do it, you were given so much more than so many others who are now beyond you. What is so difficult?"

"It's not difficult, it's just . . . " and she could not finish her sentence.

The mirror's lecture continued "Well, whatever it is, I hope you

get over it soon and begin to compete. Mexicans and Africans no longer need to read. Do you think the whole world will wait for you to catch up?"

The waitress looked down to her watch and, after allowing the 10 minutes of tangential daydreaming allotted to people like You, cleared her throat and startled You from her flashback. "May I take your order, Miss?"

"Oh, yes," You said. "Beijing grits and chocolate humus on a fruit salad."

The waitress looked embarrassed and leaned down to You to whisper, "That's wrong, ma'am."

You jumped from the booth with her bag and ran from the cafe, tears already falling.

The waitress knows.

"This woman is clearly deficient." (This man, wide with a handlebar mustache, wonders 'how can a human being be deficient?' but cannot ask).

"Doctor, you know that is impossible. These people are incapable of deficiency. They always excel or deflate as dictated, not one is deficient. This woman is of wonderful genes. Her mother was a chemist and her father was a record-breaking artist." ('A record-breaking artist?' wonders the woman, but cannot ask).

"An artist? What sort?"

"He sculpted and painted landscapes and was part of The Next Try."

"He was named Art, wasn't he? He was killed." ('He was a beautiful man,' Mustache wants to say).

"Yes, but he is right there." He points to a car that zooms past You, who is running down the street, crying with her hands over her eyes.

"Of course, she was wiped clean after The Next Try was discovered."

"Of course."

"Does her husband beat her?"

"You know that doesn't happen anymore. They are Caucasian." ('What does that have to do with being Caucasian,' she cannot ask). She continues before the other has a chance to ask a stupid question. "And she is not an alcoholic, nor does she gamble or use drugs or desire a female lover or have low self-esteem."

"Well, then she is surely sad." ('I am surely sad,' Mustache cannot say).

"Sad? Doctor, what does she have to be sad about?" ('What does she have to be happy about?' the woman wants to scream, but wants and feelings are not expressible, for these two are employees to the greatest experiment, and the boss does not allow statements contrary to the good of the experiment).

You jumped from the booth with her bag and ran from the cafe, tears already falling.

"You watches her father's strong hand sanding the oak and is confused. "Dad, I thought you could just see a work of art and then it is."

"Yes."

"Well, then, why are you sanding and sawing and stuff?"

"I'm making you a bookcase for your birthday."

"Yeah, but why don't you just think it?"

"Well, because I like the feel of the wood, and I like the satisfaction of actually working."

"Oh. Dad, I already have four bookcases. I don't need another."

He stops sanding, perturbed. "What do you want for your birthday, then?"

"I don't know."

"Think about it."

"Okay." You remembers her father's creative block and asks, "Dad, have you made any art lately?"

He stops sanding and beams. "Oh, You, it's so beautiful. It's called The Next Try. Do you want to see?"

She nods and follows him down the stairs to the root cellar, around a corner, through a door. He is gazing down at a sand box in obvious bliss.

"Dad, what is this?"

Torn from his joyful trance, Art slowly turns to her and whispers, "It's a box of sand."

"Yes, but why is it there?"

He shushes her and leads her to a pair of lounge chairs facing the sandbox. You and Art sit. "But, Dad...." He shushes her again, watches the sandbox. Suddenly a beautiful baby boy comes into view and crawls to the edge of the sandbox. Lifting itself to the edge of the sandbox, the baby tumbles over into the sand. Art laughs as the baby blows sand from his lips and begins to scoot around in the box.

You is amazed. "Dad, what is that?"

"I don't know. But it's beautiful, isn't it?"

"Yes, but what is it? Did you make it?"

Suddenly more babies crawl into sight to join the first in the sandbox. Other children run in with balls and dolls and chalk and jump ropes and marbles. Art has to scream over the din of the children to answer: "I made no art for years because I was trying to think of a piece of art that would bring joy to people's lives. I could not. Then a week ago, the sandbox appeared, here in the cellar. And as I sat to watch the first time, and these little people came to play, the name The Next Try appeared in my head. I don't know about what it means, or why it is here, but I've been thinking...."

But You is not listening. Images of the ideal birthday present shift in her mind. Finally, she turns to her father and interrupts: "I know what I want for my birthday, Dad."

— Continued on page 26

Illustrations: Anne Peterson

An Esslandic Adventure

by Josh Evans

Allow me to introduce myself. I am Cap. I am the new head of security for Qatar, the president of Essland. We are presently on the way to Tollenapolis to witness the unveiling of a great technological invention. I have little or no idea what it is, and oddly enough, Qatar doesn't know much about it either. He just refers to it as "the big doo-hickey."

I just arrived in Essland a couple of days ago, but I'll tell you what I know about the place. Ten years ago, Essland was a wreck, a nation of twisted and evil forms of government which controlled nearly every facet of Esslanders' lives. A bully among nations, Essland fought its neighbor to the north and my former home, Desperan, and its people took nearly everything they could on a regular basis. Desperan became a nation of poverty and despair.

Then Qatar came on the scene. He didn't seize power, he more or less stumbled into it. As the president of Esslandic Enterprises, he was the only non-governmental person who had any kind of influence with the Esslandic people. He came to be despised by the government, then run by Lord Ziman of the Korphosys Order.

Qatar had made many public speeches on how much he disliked the government, and the people rallied around him and asked him to start a revolution. It never had time to occur. In the meantime, the Esslandic Armed Forces were busy beating up on Desperan, and Lord Ziman and his cohorts were in the city of Tarson experimenting with new ways to torture Desperans, one of which blew up in their face, literally. An entire city block in Tarson ceased to exist due to the accidental detonation of a little-known ionic explosive.

Four of the top five ranking members of the Korphosys Order were killed, including Lord Ziman. The other, Dalsen, was in a hospital in Koko, undergoing electro-neural treatment to try to save him from dying of Traxxon fever. It was successful. As a result, the Army was perplexed as to what to do and the people demanded that Qatar step up to power. He did, and Essland has not been the same since. Qatar helped to rebuild Desperan, and although technically still two different countries, Desperan and Essland are practically one nation now.

The Korphosys Order did not die out completely. Sull, son of Lord Ziman, started an organization called Shadowguard about three years later. Not having the support of the people meant that he had no

chance at true power, so Shadowguard became an organization of crime. They started a massive crime wave in what was then the largest city in Essland, Vobson City. The situation was so bad that people fled the city in droves. (Vobson City is now the third largest city in Essland, behind Tollenapolis and the national capitol, Absondar). Qatar eventually defeated them; Sull died, but Shadowguard lives on and still commits crime on a large enough scale to be noticed. This is why I am necessary.

Perhaps I know a bit more about Essland than I claim to.

"Arriving in Tollenapolis within the minute," says the pilot.

I comment to Qatar that it seems like we just left fifteen minutes ago.

"We did," says Qatar. "It's only 400 miles from Absondar to here. Haven't you been in a hyper-shuttle before?"

"No," I reply.

"No matter, just exit the shuttle and prepare to be amazed. Tollenapolis has always been one of my favorite cities."

Qatar was right. Stepping off the shuttle, I can instantly see why Tollenapolis is called "The City of Steel and Silicon." Everywhere I see neon lights flashing cheerfully off the large steel skyscrapers, and small computerized gadgets busily wheeling around to make sure that everything is just so. It is truly breathtaking, even more so than my hometown of Calisaan at sunrise.

"Cap," says Qatar, "over here. I'd like to introduce you to someone."

I walk over to Qatar, who is standing by a happy couple.

"Cap, meet Jayson Telnon, Jr., mayor of Tollenapolis. Jay, this is my new head of security, Cap."

I shake the mayor's hand. "Well met, Mr. Telnon."

"Please, call me Jay," he replies. "I'd like to introduce you two to my sister, Cynthia. I just hired her as my bodyguard a couple of weeks ago."

"Bodyguard?" I inquire, thinking that she hardly looks the type.

"Yes, she is a rather tough young lady. I once saw her flatten a linebacker from Derion University with one right hand. He wouldn't take 'no' for an answer."

For the first time since this conversation began, I take a good look at Cynthia, and it hits me as to how beautiful she is. She stands about 5'9", with long blond, curly hair that a supermodel would die for, mesmerizing blue eyes, and a

smile that radiates so much warmth it could melt an ice cream cone. (I'd tell you what Jay and Qatar look like, but, damn it, they just aren't all that exciting to look at). Cynthia doesn't look at all like the type who would, or could, deck a linebacker.

Jay is an honest man, according to Qatar, so I trust what he says about his sister, and thus I think it best not to test the waters of this topic any further. Not only do I not want to make a scene, but I also know that if I were to anger Cynthia, she could easily beat the crap out of me. Even though I can fire a Culsican phaser through a five-inch ring from eighty yards away, my right hand would be hard-pressed to stun the water boy of the Derion football team, let alone a linebacker.

"You guys hungry?" asks Jay.

"Certainly," Qatar replies. "What did you have in mind?"

"I was thinking about The Edge."

"Sounds good," says Qatar. "Shall we go?"

"Sure thing. We'll take my air car and be there in a minute and a half."

As I recall, The Edge is about ten miles from here. I really have to get used to the speed of transport around here.

The Edge is a quaint little place just outside of downtown Tollenapolis. It serves a wide variety of entrees, everything from grill to gourmet. The decor is typical Tollenapolis: Shining steel and neon lights. A rather large holovision (a 3-D version of television developed about twenty years ago) fills the center of the restaurant. A fairly large crowd is here to watch the crunchball game on the holovision. The service seems to fit the surroundings as well: A touch-screen menu with the complete array of meals served at the establishment. Jay insists that we try the Edge-Burger, so we each order one.

Jay and Qatar start conversing about something or other as I take a drink of my cocktail. Cynthia looks about as bored by the conversation as I am.

"Did I offend you earlier?" I ask.

"Not at all," says Cynthia, as her bright smile reappears on her face. "I actually receive much worse than that from most people."

"Really?"

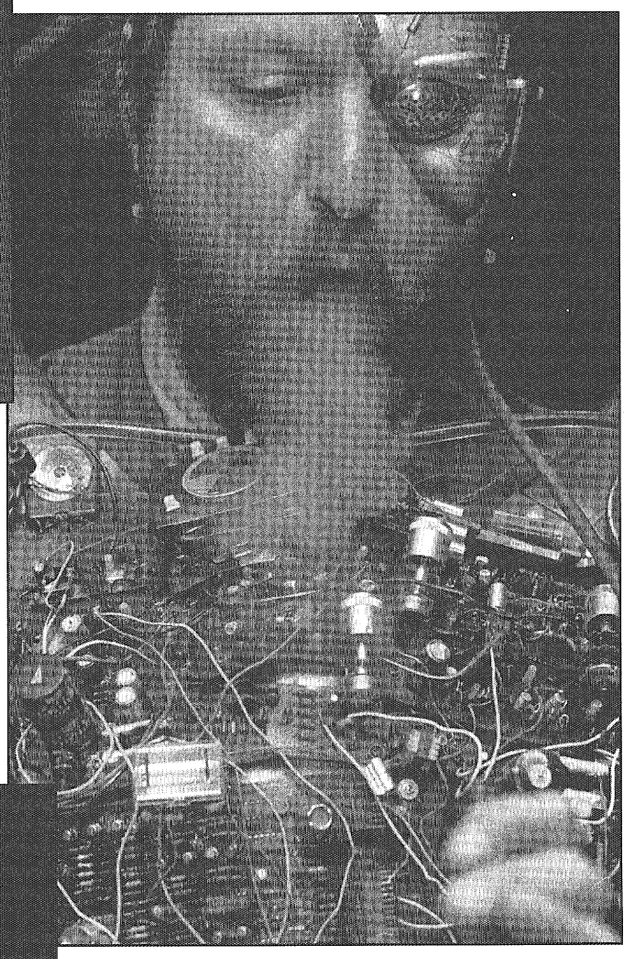
"A week ago, some doorknob challenged me to punch him. I declined until he insulted me again, at which point I had to belt him in the gut."

"Some people!" I say, as I try to think of a way to change the topic before my fighting abilities are questioned. "What were you doing before your brother hired you?"

— Continued on page 25

Photo Essay

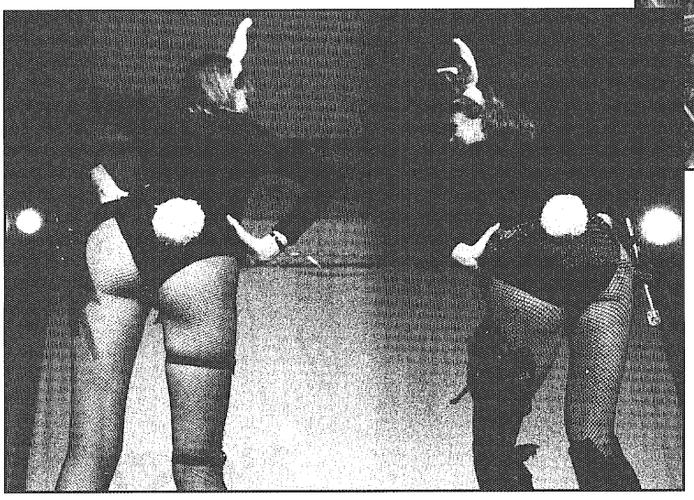
Creatures from Beyond



ABOVE: A woman decked-out as a fearless cat claws her way across the stage in search of the cosmic litterbox.

RIGHT: Dressed as a 21st Century smoker (a soon-to-be extinct species), a man fumes at the mouth. The costume was made from junk he found around the house.

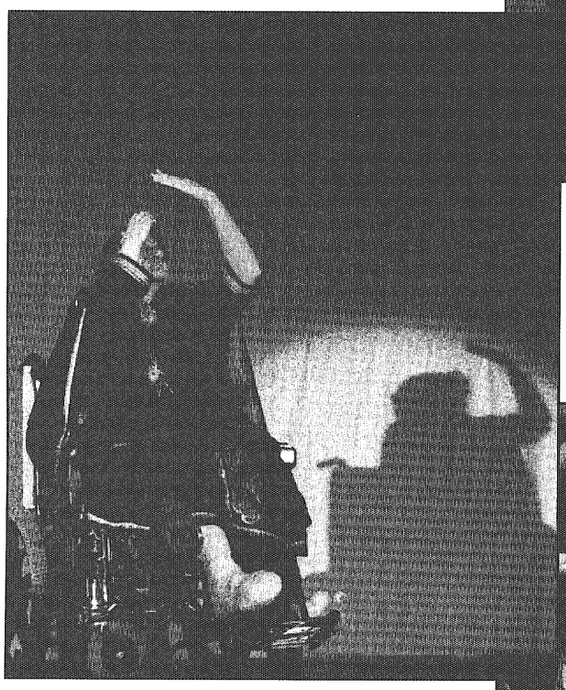
BELOW: Two "space bunnies" moon the audience at the end of their masquerade skit. The women did not win any official prizes for their gestures.



At a recent sci-fi mini-conference in Bloomington, photographer TEDDY MAKI went on a search-and-snap mission for *Technolog.*

the Stars

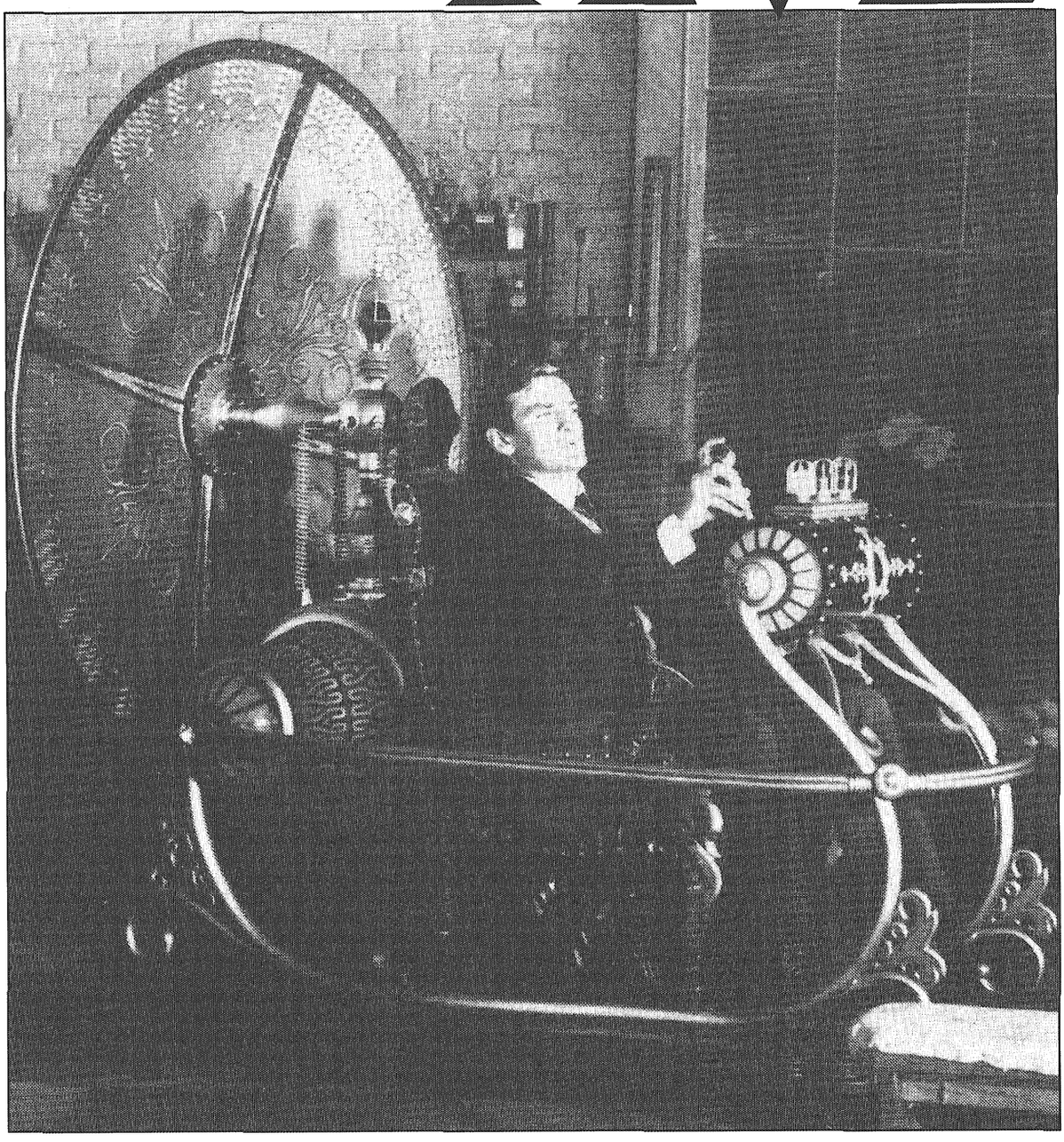
ABOVE: The three-night mini-con included displays of inventive costumes, mass consumption of liquor, and good times. Revelers took over the entire Radisson South to celebrate this annual event.



ABOVE: A woman gives an interpretive performance with her eyes, hands, and heart.

RIGHT: Masked creatures wait in anticipation for the second half of the masquerade parade to begin. The judges gave out more than 15 awards to contestants.

LOST IN TIME



Actor Rod Taylor in *The Time Machine* (1960).

BY
JAMES MATHEWSON

Captain Picard's doppleganger is found floating in a shuttle in the middle of nowhere. Analysis of the shuttle log shows that he was thrown back in time a few days by the near-by explosion of the Enterprise. The explosion was caused by an overload of the warp engines by some sort of energy vortex. After several loops through the same time warp, Picard ends the loop by killing his doppleganger and doing the counter-intuitive—running the Enterprise straight down the throat of the vortex.

A fun episode, but is it possible? No. Why not? See, there's this little thing called the Law of Identity. Roughly, it states that a thing is identical to itself and any two identical things share all of their properties.

If you believe in the Law of Identity, you cannot believe in the kind of time travel Captain Picard goes through in this episode. Why not? Well, Picard is identical with himself. So, when he travels back in time and meets his earlier self, he should have every property of his earlier self. Now, the doppleganger is an older, unconscious Picard in a different location; these are three properties—age, state of consciousness, locale—they do not share. And when one Picard kills the other, life is a fourth property they do not share. We have violations of the Law of Identity all over the place. The aftermath is beyond belief, or even suspension of disbelief. The older, dead Picard disappears into thin air along with his shuttle.

Science fiction that includes time travel is filled with similar odd occurrences. In *Terminator* Sarah Connor would not have conceived her son if he had not sent his father back in time to save her. There's an infinite regress in there somewhere. Similarly, in *Terminator 2*, we find out that the SkyNet would not have been built if the Terminator hadn't gone back in time and left some chips behind. But the Terminator wouldn't have been built if the SkyNet did not exist.

IF SCIENCE FICTION LEAVES READERS AND VIEWERS CONFUSED, IT CAN'T BE ENGAGING.

In turn, SkyNet wouldn't have been built if the Terminator had not gone back in time and...hey, wait a minute! Writers faced with these paradoxes often just punt and hope the reader doesn't notice. In the case of *Terminator,* the paradoxes are intentional.

But there are plenty of other unintentional paradoxes. In an episode of the old "Star Trek," a deranged McCoy goes through a time portal which lands him in depression-era America. Suddenly, the Enterprise is gone. Apparently he had corrupted the timeline so that the technology wasn't able to advance to the space-travel stage in the present. So Spock and Kirk have to go through the portal and arrive on Earth *before* McCoy in order to stop whatever it was he did to corrupt the timeline. Well, how could Spock and Kirk even be on the planet with the time portal if technology had never advanced to space travel? Oops. Writers get easily confused when time travel is part of their stories. And so do readers and viewers.

Some people say, "If you can think it up, it's possible." Not so. True, science fiction need not conform to present *physical* possibilities, so replicators, holodecks and even transporters are acceptable. But science fiction does have to conform to *logical* laws. And the Law of Identity is one of our most basic logical laws.

In arithmetic, this law manifests in the simple algebraic theorem: Whatever you do to one side of an equation, you have to do to the other. Throw out the Law of Identity and you also throw out your linear algebra with differential equations textbooks. You can just do whatever it takes to solve the problem. Integrate with respect to f on one side and take the differential of t on the other, it doesn't matter. Wee, calculus is fun. Not! Throw out the Law of Identity and you throw out arithmetic. That wouldn't be good, now, would it?

Perhaps my facility for suspension of disbelief is stunted. After all, even with these logical problems, the stuff is still entertaining. But don't you see, it can't be really good if it isn't readily engaging. If science fiction leaves readers and viewers confused, it can't be engaging. This is why time travel, as a ploy in the plot, should usually be avoided in fiction. Ω

- **James Mathewson is the retiring 1994-1995 editor of the *Technolog*. We recently pulled him out of a time warp; fortunately he was wearing protective clothing.**

CHINA WHITE

BY MICHAEL A. BURNS

Illustration: Anne Peterson

EMPEROR Wang rose to the thunderous adulation of the greatest human society of all time. The five-foot Cantonese pharmacist smiled briefly, then spoke to the undivided ear of one and a half billion people.

"This is the greatest human society of all time," said the emperor.

The crowd went wild. The fact that this 88-year-old had in the space of 30 years created the happiest, most productive, most efficient culture yet realized could hardly be disputed. The average Chinese citizen worked for 80 hours a week with no vacation or sick leave, had no transportation save a bicycle, no television, no radio, no casual clothing, no spending cash. There were no property rights. In fact, there were no rights of any sort. Nobody complained. Crime, suicide, divorce and alcoholism were virtually nonexistent. Job satisfaction and government approval ratings never dipped below 99.99 percent. Unhappiness in China was about as common as smallpox.

"There are enemies abroad who wish us harm. There are those who wish to put an end to our general happiness."

About the only people who did complain about the Chinese state of affairs were the Americans. The same sun which had risen on Chinese Empire had set on the Free World, and the United States of America was among the last of the old order. In the 50 years since the emperor had lost his son in a bloodbath in Tianenmen Square, the Americans had managed in their search for gold and freedom not only to devastate their own country, but the countries of virtually everyone who had the misfortune of dealing with them.

"Our enemies have laid waste to the world, and would have the same done to us."

Half of the Eastern Seaboard was underwater, and the remainder had been turned into a free-fire zone by roaming hordes of starving refugees. The West Coast was divided between choking metropolitan sprawls and staked-out Japanese beachheads populated by machine guns and escapees from the flaming ruins of Nippon. The heartland was a spreading dustbowl, marked by a northward migration of United Foods Corporation combines. The race wars in the South had ended only with the introduction of a banana-flavored diet soft drink.

Of course the Americans considered themselves blessed among God's children. Despite their domestic problems, they were far more fortunate than most. After the global stock market crash of '15, Europe had suffered a third and final nervous breakdown which was artfully orchestrated by elements of the CIA. The Middle East was a nuclear fireball, thanks to a personal visit by the President. Latin America entered a state of total anarchy when the decreasing American global presence prompted American investors to pull in their chips. Among the things the Americans were able to save were the Brazilian rainforests, which were all completely destroyed anyway as concerned gourmet ice-cream connoisseurs hunted down a cure for the latest killer retrovirus.

"Our enemies have taken the wealth of the world, " spoke Emperor Wang, "yet they want more. They want our happiness, which they know they cannot take."

Before the emperor's balcony stood in perfect formation legions of soldiers, laborers, operators, and supervisors. Millions upon millions more watched him with rapt attention via large video screens scattered across every district in China. They were being called into action. They were beaming with joy. They were wired.

The news had hit the American public so hard that they momentarily ignored the collective hell they had carved out for themselves in the name of life, liberty, and the pursuit of happiness: Emperor Wang was controlling the actions, thoughts, and feelings of one and a half billion Chinese with drugs. It was profane. It was depraved. It was a revelation so unspeakably repulsive to the American psyche that Vice President Thomas A. Post (the Presidency had remained open since five consecutive electees had been blown up by Mossad agents) got Congressional approval within five minutes for an immediate dec-

laration of war on the Chinese Empire. It might as well been another War on Evil, except that this time they were not even dealing with human beings, but crazed, laughing dope fiends led by a diabolical mastermind whose idea of human evolution consisted not of competition but of conspiracy, a conspiracy with the ugly truths of biochemistry to subvert and overthrow all that was holy and right.

"We are going to war against the Americans who wish to destroy what we have made. The fight will be difficult. Many of you will not survive. But you will not lose hope. You cannot lose hope. There is enough hope in your bloodstream to last a thousand years. The fight will be painful. But you will endure. Two-hundred fifty micrograms of adrenaline analogs, *three times daily.*"

Emperor Wang was still a better pharmacist than a statesman, he thought as the crowds cheered, but that did not matter much in the new order. He did not need to understand human behavior in order to generate it. His subjects were mindless pleasure drones, so what? For every American rifleman who dropped dead full of God and Country and Death and Taxes, there would be a Chinese who floated away smiling on a cloud of drug-induced euphoria, thinking happy thoughts as his body was blown to bits. What was lost?

As the bomber pilots took off in squadrons to deliver their little bundles of joy to the American aggressors, the emperor looked on. He wanted to be happy, Wang pleaded to himself, he wanted to be happy. Tears streaked down his round, wrinkled face. The defense minister approached jovially, and laughed. "Happy, yes!"

Wang had him shot. Ω

• **Michael A. Burns is a science fiction writer in the most rudimentary sense of the term: he writes about people in situations that are mostly made-up, involved with forces that are poorly understood. He is employed as a heat pump.**

The Senator and The Assassin

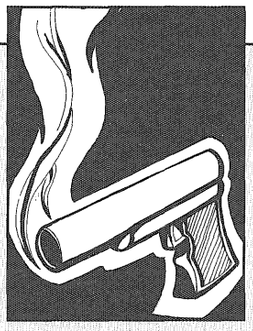


Illustration: Anne Peterson

by Robert Bodor

The assassin is sitting at the breakfast table reading the morning news. He is grim.

The news viewer is flashing dozens of headlines at him, but he sees only two.

"Four Thousand Emerson Trucking Employees Lose Jobs to Robotic Trucks." "Senator Compton to speak at Nationalist Political Rally Today."

"Finally, the day has arrived," he thinks.

The assassin turns on the recorder and begins to speak.

"Ever since the Nationalist party has gained power it has worked to take jobs from honest citizens. First it was the factory workers, then the farmers, and now the truckers are losing their jobs. All in the name of efficiency. But we of The Human Liberation Organization know the real Corporation, though you won't read that on the news viewer. No, in fact that piece of information is so secret that it is only known by about two dozen people in the world: the Board of Trustees of the UARC, and HLO. Today that is going to change. The death of Senator Compton will serve to show that The Human Liberation Organization will not be ignored. The people will be forced to listen to us, and will then finally know the truth."

It is a perfect day. The sun is shining, the birds are singing in the trees nearby, and a crowd of people has gathered to hear the speech of the man who they expect to be their next president.

Four video cameras are floating above the crowd, each belonging to a different news network. Each is positioned to get the "best" angle on the senator's momentous speech.

The assassin stands in the middle of the crowd, a solemn figure amongst a sea of joyous anticipation. He does not notice the weather, or the birds. The only things that matter to him are the blaster concealed in his right sleeve and the anonymous recording that was just received by The Daily News.

"It is time to usher in a new age!" begins the Senator. "There is no longer time to sit idle, while the other countries of the world pass us by. America must move forward. We must regain the position of world leader! This means sacrifice!"

The Senator pauses as the crowd begins to roar its approval.

"Sacrifice is right, you bastard," mumbles the assassin as the blaster slips down his sleeve and into his palm.

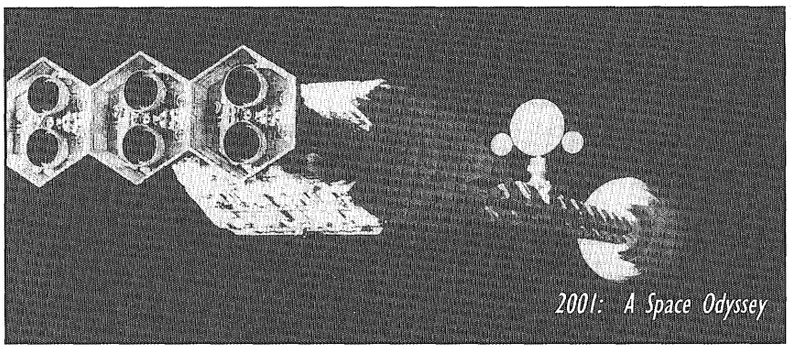
"We must sacrifice our comforts in order to bring about a more prosperous economy," continues the Senator. "That prosperity will come from only one source — robotics. Robots will bring about greater economic prosperity through efficiency."

The Senator pauses again to await the crowd's roar, but he is instead greeted by a sudden flash that brings with it a searing heat that melts the flesh from his skeleton. The crowd erupts into an amalgam of screams. The Senator, however, is unmoved. He doesn't even flinch. Senator Compton simply continues the speech that he was programmed to recite.

"Robots can withstand a great deal more than humans can, and are therefore the perfect workers," says Senator Compton as the sun glints off his metal endo-skeleton. Ω

• **Robert Bodor is a senior in Electrical Engineering, and will be pursuing a Master's Degree in Mechanical Engineering at Minnesota next year. Confidential Sources tell us that this is the first story he's ever written.**

Film



It's hard to rate cult films. And science fiction movies have a tendency to become cult classics. This simply means that lots of people like them in spite of their questionable quality. But it just so happens there are three movies that clearly top the rest of the cluttered field. These movies don't rely on technical wizardry to fill the holes in the writing, acting, directing and cinematography—holes that trekkies and *Star Wars* mavens alike are perfectly willing to ignore. These movies are good cinema regardless of their designated genre.

Blade Runner

This is perhaps one of the Top 10 movies of all time. Consistency is its most striking feature. The director, Ridley Scott, came up with a futuristic view of the world and carried it through into every detail. The viewer leaves the present to live with these fascinating characters in the decaying, rain-soaked streets and buildings of 2021 Los Angeles. The main character—Decker, played by Harrison Ford—is a cop whose main job is a replicant seek-and-destroy mission.

Replicants are artificial humans developed for slave labor in the off-world colonies. They were designed without emotions. But they begin to experience emotions after about five years of life. So their creator, Tyrell, limited them to a five-year life span. If they manage to live to experience emotions and recognize their terrible plight, they will do whatever it takes to survive. In such dire straits, replicants occasionally rebel and make their way to Earth in search of their creator—the Tyrell Corporation.

The script writing here is fantastic and sometimes poetic, as in one memorable scene when Rutger Hauer's character, Roy, knows he's about to die: "All those moments will be lost in time, . . . like tears in rain." The cinematography is amazing: Light and shadow uniquely shimmer across the screen. And the cast does a remarkable job of fitting into the spectacle.

One note of caution: If you haven't yet seen this movie, don't rent the director's cut. The flick is so bizarre that the editors of the original release decided to add a voice-over (or narrative track—Ford's voice) to make sense of the action. Having seen the movie dozens of times, I prefer the director's cut because the voice-over gets in the way. But I showed the director's cut to a smart friend who hadn't yet seen the original release and, try as he might, he didn't get it.

2001: A Space Odyssey

This movie is clearly distinctive in its scientific accuracy. Stanley Kubrick's screenplay, based on a novel by Arthur C. Clark, uses what we know about weightless travel and space-station design to paint a realistic picture of space travel in the 21st Century. It also doesn't back down from an overt spirituality. The resulting combination of these two elements could puzzle the greatest philosophers.

This movie is not for everyone, though. Because of its commitment to accuracy, the film's action seems to unfold in slow motion. Plus, the small portion of the film devoted to dialogue seems right out of "Leave it to Beaver." Also, the long sequence of psychedelic images at the end, while interesting, tends to overload the visual cortex. In its day (1971) this film must have been very popular with those who survived the '60s with its proverbial "trips to space."

Total Recall

This was the toughest pick. No film really distinguishes itself right away. My first inclination was *The Terminator*, but that film and its sequel suffer from similar time-travel paradoxes. Viewers unconcerned by infinite regress might rate the first of the terminators the next best film. But I cannot.

Then there's the other blockbusters, which all suffer from inconsistencies. *Star Trek* varies from fantastic (*Generations*) to awful (*Star Trek V*). *Star Wars* has its moments, but the director gets very little out of his actors. (How could Harrison Ford be so good in *Blade Runner* and so bad in this trilogy?) The *Alien* series gets my vote for best alien, but the dialogue is too contrived at times. *Jurassic Park* uses the best effects, but the movie still doesn't come close to the depth of the book. Spielberg sure crafts great film, but he doesn't always write great screenplays.

The only movie that stands out in this mix is *Total Recall*. This generous film has something for everyone: a lot of good action, a strong plot, cool alien archeology and a happy ending. Its best feature is a believable version of Descartes' problem. The viewer leaves this film without knowing if it was all a dream or if it really happened. This film is not always believable, though. For example, after Quaid and Serena get sucked out into the thin atmosphere of Mars, they should explode in the low-atmospheric pressure almost instantaneously (in real life). But you can't have the hero and heroine exploding right before the ending, can you? (Perhaps it really was a dream).

There are a few good obscure sci-fi films (*A Boy and His Dog* comes to mind). But most sci-fi makes for better reading than viewing. For this reason, it's best seen as part of "Mystery Science Theater 3000" or not at all.

—James Mathewson

Books

Science Fiction is suddenly vibrant with new voices, new themes, new names on the scene. And never before has this most taboo-breaking of genres been so populated by female writers. A recent article in Ms. magazine (Nov./Dec. 1994) noted much of the vitality in these women's work "seems to come from an inclusionary politics, a sense that there are many futures and many ways to get there."

Feminist writers, starting in the 1970s, have moved swiftly into the realm of fantasy, transforming the usual plotlines filled with flashy weaponry and testosterone-powered heroes. They've borrowed conventional narratives—the ultradeluxe techno future, alien race conflict, conquer-and-claim heroic ego-wrestling—and made such motifs a source of irony, parody, satire, downright fem fun.

It can be argued that women have always lived in an alternate reality from that portrayed in the male-dominated literary canon; the thematic device of, for instance, encounters with The Other seem tailor-cut to women's historical experience. Feminist writers who've embraced sci-fi in the past few decades have often praised the genre's ability to contain radical investigations into the meanings of such socially-constructed gender roles.

Sounds heavy? Perhaps. But on the page these genre-within-a-genre novels and stories are a delight: entertaining, mind-bending, just the thing to pack for a day's roasting by the lake or a sluggy night on the couch. Here, in brief, are three of my personal favorite writers and a quick run-down of their recent books.

Doomsday Book by Connie Willis

Connie Willis is a mainstay in contemporary women's science fictions. She's won six Nebula Awards, four Hugo Awards, and the John W. Campbell Award for her first novel, *Lincoln's Dreams*. *Firewatch*, her first short story collection, made the New York Times notable book list. And to top off this remarkable bio, she's got a new novel—hot off the press this past month—called *Remake*.

Willis spent over five years researching and writing *Doomsday Book*. It's set in the world of 1348, a dark era of human history plumbed by the incredibly detailed and descriptive turns of Willis's prose. The set-up of the plot is simple: A young, 21st-Century historian named Kivin travels back in time to the Middle Ages, and mistakenly plunks down during the Black Death epoch. The solution to this predicament is juicy and complex, made an even better read by the author's exhaustive research into the anatomy of this particular epidemic.

Parable of the Sower by Octavia E. Butler

Octavia Butler is a LA-based, 46-year-old self-proclaimed "black baptist feminist, an oil-and-water combination of ambition, laziness, insecurity, certainty and drive." She's penned over 10 novels during her short career. Her short story "Speech Sounds" won the Hugo Award for best short story in 1994, and "Bloodchild" won both the Hugo Award in 1995 and the Nebula Award in 1994 for best novelette.

Parable of the Sower is set up as the diary of teen-ager Lauren Olamina, 2024-27, an empath struggling to survive the collapse of her previously cloistered enclave and its surrounding environs. Outside the walls of her small world howls drug-crazed gangs, barbarism and madness. Olamina makes plans to lead followers of her fledgling religion out of the chaos and into the northern wilderness, but the enclave is attacked and torn to ruin. With other refugees, she escapes along the beach, hounded by earthquakes and other, unnatural disasters. The prose is compelling and lucid, with lots of visual details and strong dialogue.

The Denver Post recently called *Parable of the Sower* "a powerful story of hope and faith in the midst of urban violence and decay...excellent science fiction and a parable of modern society."

The Furies by Suzy McKee Charnas

Charnas is a no newcomer to the sci-fi scene. This is her third novel in an already acclaimed feminist sci-fi series, a volume many years in the making (*Motherline* came out in 1978). But it's worth the long wait.

Here the world's in the chokehold of ecological catastrophe, and women of the Holdfast have been cast into slavery—chattel for labor and breeding. Alldera, our main heroine, has escaped to the matriarchical Riding Women of the Grasslands; she leads a flock of other refugee fems back to foment revolt and grab control of their fates. But unforeseen obstacles pop up along the way.

Charnas is noted for, among other strengths, her talent for avoiding the predictable, didactic political diatribe. While this series is allegorical in structure, her deft prose constructs a complex, multi-dimensional cast of characters and subplots, full of drama and gritty dystopian texture.

—Josie Rawson

STAR TREK

TRIVIA QUIZ

Star Trek: The Next Generation

Answers on page 27

First Season

"Encounter at Farpoint"

1 • *When did Data graduate from Starfleet Academy?*

"The Battle"

2 • *Where did the "Battle of Maxia" take place?*

Second Season

"The Child"

3 • *What was the pulse rate of Troi's baby when he was born?*

"Contagion"

4 • *What percentage of the Enterprises's systems were automated?*

Third Season

"Evolution"

5 • *What song played on the Bridge?*

"The Enemy"

6 • *How did La Forge detect the Romulan craft?*

Fourth Season

"Family"

7 • *What rank did Jack Crusher achieve?*

"Final Mission"

8 • *What injuries did Picard sustain?*

Fifth Season

"New Ground"

9 • *What is Worf's last name?*

"The Outcast"

10 • *When was the Federation founded?*

Sixth Season

"Realm of Fear"

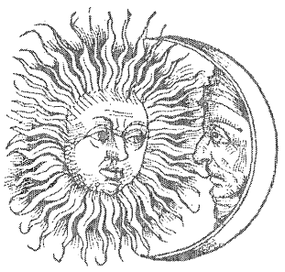
11 • *What technological breakthrough stopped the illness "transporter psychosis"?*

"Descent"

12 • *At the beginning of this episode, Stephen Hawking won a round of poker with four sevens. What was the fifth card in his hand?*

HOROSCOPES: 2095

by Astro-gal



• ***Aries (March 22-April 21)***
You're likely to be involved in conflict with Marsites at the start of the month. But you'll lose cortex velocity in mid-scuffle. Be particularly wary of backstabbing ortniks at your birthday gala. Drink lots of glug for vitality.

• ***Taurus (April 22-May 21)***
Good month for staying close to the home planet, fiddling with pod decor and propagating mutant viral strains for kicks. Your stubborn edge makes gray-matter expansion difficult. Extra oxidated air recommended for neuro verve.

• ***Gemini (May 22-June 21)***
Your witty nature calls for galactic schmoozing with The Other this month; festive wingding are the key to calming overcharged aurations. Get in touch with your inner virtual-child on the 12th and 18th. Love life forecast: Remember, earth girls are easy.

• ***Cancer (June 22-July 21)***
Beware of moodiness in your stars this month—your sensitive spirit is easily offended by LR38-P psychic assault. Financial investments are out of this world on the 8th and 13th. Eat freeze-dried argoloops to keep that trim figure in check.

• ***Leo (July 22-Aug. 21)***
Your incessant roaring echoes through the stratosphere. Ambitions carry you to Wastezone Five, in search of territory and high-adventure porcuphant safaris. Your bossy tendencies may get you an invitation to more than one clan spanking by Unitrades this month.

• ***Virgo (Aug. 22-Sept. 21)***
Your neat and tidy nature needs to loosen up. Travel is recommended—try balmy outer Mercury or a wild meditation on Andes Outpost 8. Consider also a cryonetic session with your hypnotrainer, and an afternoon at the ecto-spa.

• ***Libra (Sept. 22-Oct. 21)***
Ever the charmer, you Libra you. Make embassy calls abroad. Good month for controlplate lube job, and other techno-maintenance. Zids will cloud your ambiscreen on the 12th and 14th. Your inherent fence-sitting may cause some nasty picket burns on the 20th.

• ***Scorpio (Oct. 22-Nov. 21)***
You need a virtual reality check this month! All those paranoiac episodes, all those late night schemings in Retroarcana's back alleys will get you in some hot plasma if you're not careful. Snazz up on the 15th for a cortex orgy with Spamites.

• ***Sagittarius (Nov. 22-Dec. 21)***
Travel, travel, travel's on deck for you. Your philosophical bent provides entre into some pretty intense galactic web-fusings, but avoid the temptation to spend credits recklessly here. Plan for the future: Consider cryogenizing.

• ***Capricorn (Dec. 22-Jan. 21)***
Ever the candidate for martyrdom, you need to seek out sympathetic fringe communities in Outer Universe 7 and offer your services. Challenging dates for regerobics: 10, 21. Wear protective clothing.

• ***Aquarius (Jan. 22-Feb. 21)***
Always the eccentric, look for new frontiers this month—you need an appreciative audience for your avant-garde squizzectomy act. Try the Garden of Utopia on the 12th for romance. Good month for transport tune-up.

• ***Pisces (Feb. 22-March 21)***
You'll have trouble with weightlessness this month. Keep your toes firmly planted in the sand. Your escapist soul longs for meldfuse with another. Fortunes are boundless. Good time for composing that opera-of-the-spheres, or toasting in front of an exploding star.

Pulp Science Fiction • continued from page 7

than anticipated, so few people realized the visually-breathtaking influence computers were now capable of having in the film industry.

Three years later, computer animation was still time-intensive and expensive, so when "Star Trek: The Next Generation" began production, the ships were models, although many effects were computer-generated. The models were by then more intricate than ever—no strings attached! But still there wasn't always enough money or time to drum up all the effects from scratch. But who can forget the moment in this series when a painted bottle of Liquid Paper became a medical scanner? (A similar—and true—story from the original Trek is that some of Dr. McCoy's medical props were actually salt shakers bought by Gene Roddenberry).

Once computer graphics became less expensive and time-consuming, they became more popular with filmmakers. The "evil" Terminator in *Terminator 2* changed into different characters and objects, utilizing an effect called "morphing." This was reasonably advanced five years ago but can now be accomplished on home computers with relatively inexpensive software. This incredible advancement in computer graphics brought with it the possibility of producing a sci-fi TV show using only computer animation for the space shots. Beginning in 1987, J. Michael Straczynski and Doug Netter did just that, with their innovative development of "Babylon 5."

The space shots in "Babylon 5" are convincing, right down to the small altitude jets on the "fighter" ships. But the main advance represented by the complete computerization of the space effects is the savings: New ships and other objects still take some time to create, but shots of ships that appear often in the show can simply be reused with a bit of editing and reanimation. Even more complexity is possible as the computing capabilities of Foundation Imaging (the company that does B5s special effects) increase. A mix of live action and computer graphics often livens up certain shots; even some aliens on the station have been computer generated.

The dinosaurs of *Jurassic Park* are another example of the computer at work for Hollywood. In the past, dinosaurs were animated using stop-motion photography with clay figures. This was painstaking work, and the final result turned out to be usually less than stunning. By the advent of the *Jurassic Park* era, computers made it possible for film makers to animate incredibly life-like dinosaurs via technology. The creation process involved in animating living creatures was certainly expensive and monotonous to get every little muscle movement correct. But the returns from and reviews of the film proved that getting every little muscle movement right was worth it.

Now that filmmakers are relying heavily on computers to suspend viewers' disbelief, the possibilities are virtually limitless. The first of three new *Star Wars* movies is expected to be released in 1998, and it is certain George Lucas will be using all of the technological wonders available to convince the audiences of the "reality" of his stories (which will be the Episodes I, II, and III, if rumors prove true). Of course, the last thing that any sci-fi entertainment can do is to depend wholly on its special effects to jack-up its profits at the box office. An example of this was the (thankfully) short-lived television show, "Space Rangers." Effects here were computer-generated and reasonably good, but the plotlines ran thin, and the acting quickly staled. Now that they expect effects to look natural, more viewers will be concentrating on content in the future. We're wising up, Hollywood. Even the most incredible, mind-numbingly complex special effects can't save a film or TV show if its plot is a dud.

• Steve Gigl is a member of the 1994-1995 IT Board of Publications. He is a confessed film buff and, rumor has it, sci-fi couch potato.

Another Day . . . • from page 9

a lush green field, and a small farm house in the background.

"That's more like it. I'd like some coffee before I get started," Mark said, no longer irritated.

Mark finished getting dressed, took the newly synthesized cup of coffee from the food production unit, and sat at his computer terminal. "Well, computer, it looks like I'm ready for another day at the grindstone. Initiate a link with First National Communications computer." Mark sipped his steaming coffee as he stared at the computer screen.

"Initiating link...Access denied. Hmm, something must be wrong with the lines. Would you like me to try again?"

"If you want me to get paid for today, you'd better," Mark said. He hoped it wasn't a serious problem; he really counted on every bit of his paycheck.

"Access denied. I checked the communication lines and there isn't a record of a malfunction."

"Well, I guess you get your wish. Access Information Services and see what's up. But you'd better enjoy your *intelligent* conversation, it's the last one *I'll* pay for," Mark said. He wasn't really worried, things like this had happened before. Hopefully, he would still be able to put in a full day after the problem was fixed.

"Accessing...Scanning current files...Scanning complete. Mark, I have some bad news," L-cee said in her most soothing voice.

"I don't have time for these games," Mark said. "Just tell me what's wrong."

"Effective today, FNC merged Transnational Communications. Your position has been eliminated. In accordance with current business law, FNC notified all effected employees through Information Services two weeks prior to termination. You weren't offered any severance benefits," said L-cee. All traces of playfulness were now gone from her voice.

Mark was stunned. Now time was of the essence: Even though his income had stopped, the continuous automatic withdrawals from his active account would not.

"I recommend that you take action immediately to stabilize your

— Continued on page 24

financial situation," the computer said stoically.

Mark was snapped out of his momentary daze. "Computer, put my résumé on file with all companies with appropriate openings. Cut oxygen flow by ten percent, and shut off all non-essential systems," Mark said, urgency tainting his voice. His stomach grew uneasy and a sweat broke out on his forehead.

"Mark, I'll do as you ask, but please relax. Try not to upset yourself. This problem is only temporary." The extra monitors in each room faded then shut off.

"Cut the reassurance crap and give me a financial report." Fear started to burn in Mark's eyes. It was happening again.

Mark's hands clutched at his desk. His face was a pasty white and his eyes were glued to the red insurance benefit gauge on the left hand side of his computer screen. The rest of the monitor filled with a hectic view of doctors buzzing around a woman on an operating table.

The baby was gone. She lived long enough to bring a smile to Megan's face, but that was all. Now, Megan was fighting for her own life due to unexpected complications of Colleen's birth.

The benefit monitor started blinking, and much of the activity around the table halted. "Mr. Davis," an Artificial Human Interface said as her synthetic face replaced the view of the operating room on the screen. "We have a problem."

"We have a problem, Mark. There are ten companies advertising for employees with skills similar to yours, but it will cost four credits to place your resume with each of them. Your active account currently only contains 34.26 credits. If you'll let me transfer some..."

"NO! Just apply for the top eight positions." Fear started to burn in Mark's eyes. "Activate my finance monitoring program for my active account." Mark stood up from the desk and began to pace the floor.

A gauge appeared on the screen with a needle which pointed to 2.24, but was slowly making it way toward zero. 2.23, 2.22, ...

"My God..." Mark was on the verge of tears. He hadn't even noticed that it was becoming more difficult to breathe. "What am I going to do? What am I going to do? Computer cut oxygen by four percent." Mark's voice was becoming shaky and unsure. His breathing was ragged and his heart raced.

"By cutting your oxygen level again..."

"JUST DO IT!" A new burst of pain blossomed in his head. The computer complied and the rate of loss on the gauge of the financial monitor dropped imperceptibly. "Have we heard anything back from the businesses?" Mark struggled to keep his fear and rage in check.

"Normal reporting time on résumé submission is typically one hour. You have 57 minutes to wait. Mark, your heart rate and respiration have increased dramatically. Please relax and allow me to increase the oxygen to recommended levels."

"NO," Mark shouted wildly. "I must save money. Computer shut yourself down."

The computer submitted a request for emotional counseling for Mark and paid for the service from Mark's savings. Such independent actions were forbidden for L-cee computers under normal circumstances, but Mark wasn't acting normal. The response from the counselor was almost instantaneous. Mark would be contacted before the end of the day.

"Computer! What are you doing? I told you to shut down." Mark shook his fist at the terminal.

"Mark, that won't save anything. My in-home services have already been paid for through the end of the month."

"You're right," Mark said, trying desperately to control his voice. He was aware of L-cee's programming and knew that if the computer thought he was behaving irrationally, it would be able to call in outside help. Ultimately, it would cost him credits. Without taking his eyes off the financial monitoring gauge, Mark forced a smile and tried to sound rational. "Of course you're right. You probably should transfer all of my credits from my savings to my active account. Everything will be okay."

"Good. I'm glad you're coming to your senses," L-cee said. The computer transferred the funds. "We'll have a new job for you in no..."

"What have you done?" Mark cried. "My credits, I don't have enough credits!" The gauge showed the active account's balance as just over 2440 credits.

"Sir, in order to complete the operation we need a total of 2457 credits. The remainder of your insurance benefits is only 1500 credits. And the..." The lips of the Artificial Human Interface seemed to move with the words being synthesized.

"But... But... I already gave you access to our savings and active accounts." Mark found it difficult to breathe.

"I know. You didn't let me finish. The total of both the insurance and your savings is just over 2000 credits. That's not enough for the final phase of the operation." The AHI's face showed no emotion.

"Can't you do it on credit? Please hurry! My wife... Can't you understand?"

"Mr. Davis, you know we can't extend credit for this type of operation. Too risky. I'm sorry." The AHI's face disappeared and the operating room was again visible. A tone sounded and the doctors in the room started to file out with their heads lowered.

"Megan," Mark screamed. "I'm so sorry Megan. I'm..." Mark broke down into fits of tears. He reached forward and hugged the screen on his desk. Megan did not feel the kiss he placed on her televised lips. In the lower left hand corner of the screen, the insurance benefit monitor continued in its steady decline.

"Mark, I'm sorry. It's just that you're so upset today. I just wanted to help you," L-cee pleaded as Mark stormed around the room. "Your heartbeat is still too fast. At this oxygen level, you must decrease your activity to remain conscious. I'm sorry I spent the credits, but you have to understand..."

"*I* have to understand? How could YOU *possibly* understand. You're just a machine. You stole my credits. I don't have enough anymore. Cut the oxygen level back to normal!" But L-cee didn't want it to come to that. It decided to make one last effort to reach Mark, and said, "If only you'd listen to me..."

In a fit of rage Mark flung the chair at the computer. "You listen to

me! I'm the human. *You* listen to *me*," he screamed as the chair crashed into the monitor, destroying the computer's reasoning chips, and locking the oxygen flow at its present level. He collapsed and his chest heaved struggling to glean what oxygen it could from the air.

Mark began thrashing around wildly on the floor of his blackened living unit. Glass shards from the broken monitor cut his hands and face. His movements slowed, then finally stopped when his oxygen starved-muscles could work no more.

As his mind began to drift toward an eternal abyss, he forgot about credits and computers, and began to feel the unfamiliar warmth of companionship. There were others there, billions of them. Megan and Colleen were there. A tear of joy escaped his eye, and he was gone.

Within minutes, three different companies tried to contact Mark for various positions in the communication industry, two of which offered larger salaries than he had earned at FNC. When they learned of Mark's fate, they simply made their offers to someone else. Ω

• **As a fourth-year theoretical physical chemistry graduate student, Greg Hawkins doesn't spend as much time writing fiction as he would like, but if the job market doesn't improve, he may soon be writing up a storm.**

An Esslandic Adventure • *continued from page 13*

"I was a secretary for my father's company for a couple of years. It made me enough money to live on, but I would occasionally go down to Midnight Street and pick up a few extra bucks in a fight. How about you?"

"I've known Qatar since I was about seven years old, and he said that he hoped that one day I might work for him and Esslandic Enterprises like my parents do. I had a flair for marksmanship; Qatar needed a new head of security, and the rest is history. Before that, I was a professional marksman for a short time."

I am having a bit of trouble looking her in the eyes. I'm not sure whether it is because of her or our surrounding.

An Edge-Burger is an interesting physical phenomenon. When you pick it up it feels like a hockey puck, but the taste is a true delight. I'll have to remember this place.

"Jay, are you there?" says an electronic voice.

Jay pulls out his LRN device, puts in the ear piece, and starts conversing with someone. The Laser Radio Network (LRN) is a technology which replaced the cellular phone about fifteen years ago.

After a few minutes, Jay says, "Qatar, we've got to run. They need us at City Central. Something about the unveiling tomorrow afternoon." He turns to me. "We have to go alone, so could you take Cynthia home?"

"I can get myself home," says Cynthia, but none to quickly.

Feeling bold, I too insist, "It would be my pleasure. How far is it?" completely forgetting that I have no idea how to drive any of these vehicles around here.

Cynthia smiles. "It's about three blocks from here. I can drive you back to Jay's place later." Qatar and I are spending the night in the mayoral mansion.

"OK," says Jay, "but don't make any trouble. See you."

"Later," says Qatar.

Cynthia and I politely wave good-bye.

It's been two hours since Jay and Qatar left, and Cynthia and I are still at The Edge. We have been talking, not about anything in particular, but having a good time nonetheless. We are about to leave, but Cynthia needs to make a rest stop first. After all these years, they still haven't advanced that technology much.

Apparently I had zoned out a bit too much, because the next thing I hear is Cynthia whistling at me while standing over by the exit. I get up and leave with her.

It was quite bright when we came, but the sun has since set from the Tollenapolis sky. I pause to take a look at all the neon lights surrounding us; although they are beautiful, they don't do much for illuminating the streets. I suppose that is why neither Cynthia nor I see the fellow in the black jacket approaching.

"Hey baby," he says to Cynthia, "looking for a little action?"

"Watch your tone with the young lady," I respond. "She's with me tonight."

"Oh, yeah?" he insists. "And who do you think you are?" It seems quite obvious to me by now that he is drunk.

"I am the head of security for your Supreme Commander. And you?"

He starts laughing. "Yeah, right," he says sarcastically, "and I suppose now you're going to tell me that she knows the mayor."

"Better than you think," I reply, after which I see a left hook coming my way, which I block. I then throw that "devastating" blow that I've told you about. And he blocks it. I proceed to hit him in the fist with my face, quite unintentionally, of course, and I'm flat on my backside in an instant.

Three seconds later, my rear end is not the only one planted in the pavement. Cynthia cures his diarrhea of the mouth with a right hand that could stop a speeding air car and put it in a repair shop for a week.

I get up, and am greeted with a kiss on the cheek from Cynthia. "Thanks for trying to protect me," she says.

"Yeah," I say, still a bit groggy, "but remind me to let your fists do the talking next time."

I am now at the mayoral mansion. Jay and Qatar still are not back yet, but the guards are all too happy to let me in. There are people here willing to give me the royal treatment, and any other time I might take advantage of it. Tonight, however, I am simply intent on resting. It's been a long day, and tomorrow is bound to be even more stressful. At least today was fun for the most part, excepting the incident outside The Edge and the ride here. Cynthia is

— Continued on page 27

You is sitting against a neatly trimmed maple tree in the part at the town's center and is crying. During You's birthday dinner, Great Aunt Betty held You's shoulder tightly and said, "Not even the savages read. Why are you so behind?" and You ran from the celebration. She sits beneath the tree quietly crying and looking around, watching for people who would see her tears and judge her further.

She had taken her father's birthday gift when she ran from the party and had dropped the brightly-wrapped box to the ground when she fell beneath the tree and wept. She now lifts the gift and opens it.

A beautiful doll, a baby like those that played in the sandbox. But You does not know what she holds; she has no memory of The Next Try or of the children or of her father's bliss (or of her father's death). Confused by the gift of what seems to be a small and deformed plastic mold of a person, she examines it and finds a ring stuck to its back. She fumbles with the plastic ring and then finally pulls it.

"I love you," says a baby's soft voice, and You feels the deepest part of her crumble and break. Her soul no longer able to support her spine, she crumples beneath the tree. She sweeps without regard to any passer-by, or to her own weeping, or to the doll. She weeps without regard to anything that she is aware of, with complete desperation. She pulls the string and cries.

She does not know the word love, nor the word insane. She does not know why she is so sad, but has no energy to wonder: She is completely occupied with the string, the doll's words, and the feeling of falling. But falling is not accurate—the feeling is that the entire world has disappeared and the only anything is the doll and utter sorrow.

You suddenly lifts herself to lean against the tree, her eyes squinting, peering around. "Is someone there? Hello?"

Evening is approaching, a few porch lights across the street from the park are lit, but no one answers. "Hello? Is someone there?"

Once again, no presence and no reply.

You peers up into the sky, where a monkey would be hiding high in the branches if a tree identical to here stood in the street in front of her. She squints her eyes, trying to see the hiding monkey in the sky.

"Hey! Hey you!" she shouts, trying to address the air above the road.

No response.

"Hey, you behind the keyboard! Go away! Leave me alone! You! Behind the keyboard! You have glasses on and you look confused. I am talking to you. Go away!"

She stands now and is pointing her finger...at me. She is referring to me! This is so odd. I am sitting alone in my house, writing, and I am going to ask a character I created, "Are you referring to me? Can you see me?"

You nods her head and is suddenly lucid. Everything forgotten, she holds out her hands as if to touch me and says, "Please, don't leave. I want to ask you some questions."

"Okay."

She ponders a bit and asks, "What is going on?"

"I don't know what you mean," I tell her.

"Yes, you do."

"Okay, I do, but can you ask a more specific question?"

"What is your name?" You asks.

"John."

"John, why am I behind everyone else in the world?"

"God," I say, "that is a tough one. Your world was created as an experiment of sorts. What do you know about your birthday?"

"I just know everyone's birthday is the celebration of their existence in the world. It's the day I came into the world."

"Do you know how that happened? How you happened to come into the world?"

"No, I never really thought about it." She holds the doll and looks down, prepared to be scolded.

"You, I'm not going to scold you. Look, this is hard to describe. The creator of your world wanted to set up an exact replica of his, with a few changes as a test. I know you don't know what a child is, you don't know what love is, you have no concept of religion." She lifts her head at the word love, her eyes hoping for an explanation.

I am trying to understand as well. "Do you have sex?"

You blushes and looks down again, embarrassed.

"I'll take that as a yes. I suppose you wouldn't know if you had free thought, since everyone around you is a blank."

"What do you mean, a blank?"

"See, the experiment began with a simple question of human nature. If humans are not in contact with the question of their own existence, or the miracle of birth, or questions of death or life after death, or love, will they wonder?"

"I don't understand," she says, wanting so much to understand.

"I know that. The rules of the experiment are that if someone wonders, they are instantly killed and replaced by an exact emotionless, thoughtless replica. And every other person in the world wondered and has been replaced, except for you."

For some reason, she knows that I am telling the truth, and the severity of being the only human in the entire world forces her to lose her balance and sink against the tree.

"My father?"

"Yes. You and your father were the last two humans remaining in the world, and then he created The Next Try, which you don't remember. Anyway, if he hadn't been killed for The Next Try, he would have been killed soon for loving you."

She looks up at me with the saddest eyes I have every seen and asks, in a whisper, "Am I going to die?"

"I don't think so. I think that since you can see me, you won't be replaced."

"Are you sure?"

"Pretty sure."

She smiles now, beaming with hope. "Hey John, can I ask you a question?"

"Yeah."

"Do you know the song, 'Ain't No Sunshine When She's Gone'?"

"Yeah."

"Is it a good song?"

"Yes, it's a wonderful song." 

• **John Sheflin is a fourth-generation myopic German-American who wants to be a rock 'n' roll star and a natural mystic. He certainly hopes this story is science fiction, but, hey, if he breaks a genre all the better! He will graduate in a year and immediately fly to New Zealand on a search for Truth.**

almost more deadly with an air car than with her fighting skills. We may have even been better off had I tried to drive...well, maybe not.

Now it's time to put all that behind me and get some sleep, and that shouldn't be too hard considering how comfortable this liquid mattress is.

Jay, Qatar and I have just arrived at the Falcon Civic Center, the site for the great unveiling. Cynthia is supposedly waiting for us.

I tap Qatar on the shoulder. "What do you expect today?"

"Well," says Qatar, "I caught a glimpse of the project last night. I still have no idea what it does. I sure hope somebody does. And I figure that if they won't even tell the president about it, it must be something either very powerful or very perverse."

"There she is," Jay says.

"Huh?"

"Cynthia. She's over there." Jay says as he points to her.

She spots her brother, and comes running over to us.

"I saw some strange individuals back there," she comments. "Or at least they were people I didn't recognize."

"Probably a lot of that type around here today," I reply.

"Actually, no," says Jay. "Cynthia knows almost everybody who was invited here, and those she doesn't would be guests of others whom she does know. We'll have to keep our eyes out today."

One word comes to my mind: Shadowguard. They probably know more about the project than Qatar does. I do not comment on this thought, however.

"Ladies and gentlemen, it is my honor to present the president of Essland, Qatar," says the speaker.

The crowd of approximately 150 people applauds as Qatar comes up to the podium. I sit about ten feet behind Qatar on the stage, with Cynthia at my right and her brother next to her.

As Qatar speaks, I continue to look around for any sight of a stranger. Seeing as almost everyone here is strange to me, this doesn't help much, and I don't wish to speak to Cynthia or Jay about it because it would be rude of me to interrupt the president.

"...and here it is, ladies and gentlemen, the all-new PW260!" says Qatar as he pulls off the cover.

The PW260, to be succinct, looks like a pair of toenail clippers. I'm not sure whether it is a weapon or just something to make our lives a little less confusing. As I look around the crowd, they stare at it as if somewhat disappointed.

Qatar speaks again. "It may not look impressive, but watch this!" He picks up the PW260 aims, and squeezes a lever. A small projectile shoots into the target, which quickly explodes into flame and causes massive applause. Unfortunately, it also causes a small guy dressed completely in black to jump out of nowhere, knock Qatar unconscious, and take the weapon, after which he proceeds to threaten everyone to let him go unharmed.

As I begin to wonder what in the world happened to the security squad I had arranged for, Cynthia steps forward, out of either bravery, insanity, or both. Since the thief has his back to us, he doesn't see Cynthia get up, but he senses her about to throw a punch which causes him to turn around and threaten her. She stares at him, and proceeds to punch him in the face. He drops the PW260, but then retaliates with a martial arts flurry that would have made a ninja cower in fear. He knocks Cynthia over and proceeds to run down a long aisle, as I sit frozen in my seat wishing I hadn't given my phaser to one of the guards at the gate.

I look at Cynthia. She is dazed and unable to stand. It causes my adrenaline to rise. Is it because somebody actually defeated her, because somebody has just committed a crime that I am powerless to do anything about, or is it because I am deeply concerned for Cynthia? Could it be true? Do I really love Cynthia?

"Cap, CATCH!"

My thoughts of emotion are interrupted by someone throwing me something roughly the size and shape of a holo-vision remote. I suddenly click back into the real work: It's a phaser!

The thief is about a hundred feet away from me and nearing the doors. I assume he has a means of escape awaiting him outside, and the doors he's heading for lead directly out. I stand up, catch the phaser, aim and fire. Let's just say that the result was an example of why Qatar hired me in the first place. I don't like to brag too much.

"Cap, come here," says Qatar.

I walk over to Qatar. "Yes?"

"After that fine work today, I think you deserve a break. I've made arrangements for you to go to a resort over in the Winstell Islands for a week if you're interested. You could use a bit of stress relief."

"I don't think I can pass up that offer," I reply.

"Well, the tickets are waiting for you at the shuttleport. Have a good time, and I'll see you in Absondar next week."

"Okay," I say, puzzled as to why this has happened all of a sudden. I want to say good-bye to Cynthia and Jay before I go.

I walk over to Cynthia. "Qatar just gave me a vacation in the Winstell Islands, and I didn't want to leave without saying good-bye."

Cynthia looks at me in shock. "Jay just told me to take a break and go there, too," she says curiously.

I look over at Qatar. He winks at us. I look at Jay. He does the same. They set this up. Cynthia smiles at me and kisses me. "Let's go," she says.

One thing is for sure: This will be fun. Ω

• **Josh Evans is an IT Sophomore in Mathematics. His hobbies are chess, dawdling on computers, and thinking about how much better the ending to this story could have been if he had more than 3,000 words. His life's ambition is to remain sane.**

Trivia Quiz Answers (from page 22)

1. Class of '78; 2. In the Naxia Zeda star system; 3. 137 beats per minute; 4. 90 percent; 5. "The Stars and Stripes Forever" by John Philip Souza; 6. He used a positron scan; 7. Lieutenant Commander; 8. A broken right leg, a fractured left arm, a blow to the head, and possible internal bleeding; 9. Rozhenko. (True, that is the last name of Worf's human parents, not his Klingon parents); 10. In 2161; 11. Multiple Pattern buffers; 12. The Jack of Diamonds

—from *The Nitpicker's Guide for Next Generation Trekkers* by Phil Farrand

WRITERS WANTED

MINNESOTA TECHNOLOG

Minnesota Technolog is looking for writers for 1995-1996. We're looking for IT undergraduate and graduate students who'd like some experience writing for publication! We have several beats in mind, including environment, ethics, new technology, personal profiles and features, editorials, and personal reports on the specific projects you're working on for school.

Although our editorial board mainly consists of creatures from outer space, we've been known to work well with humans. If you'd like more information, or would like to come in for an informal interview with the editor, please leave a cover letter, a resume and any available writing samples in an envelope outside the *Technolog* office in Room 5, Lind Hall.

You can also call the editor directly: Josie Rawson, 637-7821 (pager) or 879-9055 (home).

And, if you're not quite up to writing, but have interesting ideas for stories you'd like to see in upcoming issues of the *Technolog*, please jot them down on this form and drop it by the office.

MINNESOTA TECHNOLOG

Description of story idea(s):

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Would you like to write the story? _____

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MINNESOTA
TECHNOLOG

Summer '95 University of Minnesota Volume 75 Number 6

Biomedical Technology

For Starters

News bytes, tidbits, and odds & ends

Well this is it—my last issue of *Minnesota Technolog*.

I will remember this job most for what I learned in doing it. Of course, I've learned a lot about layout, design and writing issues involved with magazine production. But, more importantly, I've learned some management techniques that I can take with me anywhere I go. I have a new respect for managers now that I've spent a year managing.

As most of you know, I will be passing the torch to Josie Rawson. Josie's a graduate student in the School of Journalism. She also does freelance work for a variety of organizations around town. Feel free to offer any advice or assistance to her. I'm sure the quality of the magazine will only improve under her guidance.

Farewell and thank you for a great year!

James Mathewson

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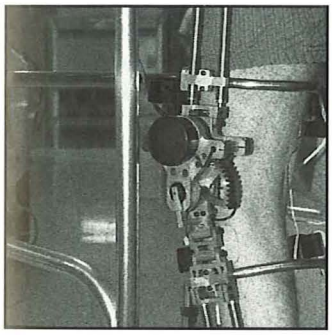
Bio-Tech

Features

Looking for the Cure That Does Not Ail

Artificial implants often cause clotting, inflammation and other problems which require medication. Biocompatible materials reduce the need for medication with implants. Ph.D. candidate Anja Kohler seeks these biocompatible materials.

by Greg Lauer



Assistive Technology: Developing a Brace that Complements the Chair

Professor William Durfee and his colleagues conduct concept testing on a brace that shows great promise in providing assistive technology to paraplegic patients.

by Steve Gigl

Minuet: Programmer Cruises the Internet—Without

Profile: George Gonzalez and his team of programmers are close to releasing Minuet, a multipurpose Internet tool that runs graphical interfaces on the DOS platform.

by Ron Gabrielson

The Cover

Under Construction:
Fire Proofer Dave Wagner shows off the new Basic Sciences and Biomedical Engineering building on Washington Avenue and Church Street. The building will be dedicated in the Fall of '96. The construction is ahead of schedule—really.

Photo by Joshua Zuckerman

Editorial

Biomedical technology yields tough questions

by James Mathewson

In building the new structure on Washington Avenue and Church Street, the University is showing a commitment to biomedical research and development. Biomedical Engineering is the science of designing artificial devices that help medical practitioners prolong or enhance human life. It sounds like a noble cause. And several Minnesota companies like Medtronics and SciMed Life will try to convince us that it is. But when engineering starts to push the boundaries surrounding human life span and quality, a variety of ethical concerns crop up.

Some concerns surrounding life span are related to the reduced quality of extended life. For example, terminal cancer patients often get massive doses of chemotherapy or radiation therapy that may allow them to lead longer lives with perhaps more pain and less dignity. This care method is contrasted with hospice care in which terminal cancer patients are kept comfortable but otherwise allowed to die a dignified death in the home near loved ones. Most cancer patients choose some combination of these two methods. The question is: at what point does treatment end and hospice care begin? Some say treatment should yield to hospice care earlier than traditional practices suggest. To these people, medical technology is not necessarily a good thing.

I began to agree with these folks when my father became a terminal cancer patient in 1986. He volunteered for a chemotherapy treatment here at the University through which an infusion pump is inserted into the chest. The pump is equipped with sophisticated electronics that regulate the flow of chemotherapy into the body. The pump was advertised to promote a prolonged remission of the disease. At first, it performed as advertised. My father's cancer ceased its growth almost instantly.

But with this advertising, my parents began to believe that the remission would last indefinitely. It is so much easier to deny the inevitable when there is a miracle remedy with which to rationalize the denial. Sadly, the inevitable happened, and they were not prepared. As is typical with cancer, once the brief respite from the disease was over, it ravaged his body and he was dead in two weeks. The treatment prolonged his life, and this I'm grateful for. But, because of the treatment, he did not live those last six months with the same verve that characterized his first 65 years. While the device lengthened his life, it lowered his quality of life.

Problems pertaining to quality of life are hard to get a handle on. We would think that prostheses, artificial limbs and organs not only prolong life for terminal patients, they give non-terminal patients capabilities they wouldn't otherwise have. For example, Mechanical Engineering Professor William Durfee and his colleagues are developing a brace that would allow paraplegics to use their legs and perhaps improve mobility. This sounds like a good thing, especially for people like Christopher Reeve who suffer serious spinal injury in the prime of life. And with the advent of more dangerous recreational lifestyles (for example, the Extreme Games), the number of young people each year who suffer these injuries in this country alone is astronomical.

But there are a variety of ethical concerns surrounding this type of device. One problem is that similar devices in the past have advertised miraculous results only to deliver meager benefits. In the aftermath of spinal injury, muscles atrophy at alarming rates. In order to use the device for even a few minutes at a time, patients must go through painful physical therapy regimens. Is all the pain and struggle worth it if the device only aids mobility a little? Even after a lot of struggle, patients still need walkers and their gait does not nearly resemble walking. Sure the device gets paraplegics back on their feet and allows them to work atrophied muscles and do some things that are cumbersome in a wheelchair, but does it falsely raise hope for the miracle cure that will help them walk again? The detractors of technology say serious spinal injuries are to be accepted with dignity. Just as patients with terminal cancer should embrace hospice care, serious spinal patients should embrace the wheelchair.

In this case, I don't follow the argument of the detractors of technology. A 19-year-old motorcycle accident victim is a bit different than a 66-year-old terminal cancer patient. The 19 year old has his whole life ahead of him. He should be given a choice as to which combination of technologies he wishes to use to aid his mobility. What Durfee and his colleagues are trying to do is offer people this choice. They are not offering an alternative to the chair but an additional technology that will help in certain circumstances.

Whether I agree or not with opponents of new technology, the ethical issues of biotechnology need to be voiced. Also, other issues including the economics of medical technology need to be aired. Before new medical technology comes to market, we should not only ask whether we *can* make it, but whether we *should* make it. It is easy to discover whether we *can* make something. It is much harder to find out whether we *should* make something. Ω

A Rendezvous with Destiny

by Dawn Hastreiter

In 1936, President Franklin Delano Roosevelt prophesied, "There is a mysterious cycle in human events. To some generations much is given. Of other generations much is expected. This generation has a rendezvous with destiny." While his words were meant for the adults of the Great Depression era, they have significant meaning today as well.

A majority of us graduating today are members of what has been termed Generation X. This generation has undoubtedly been given much. We have lived in a time where America has seen its highest standard of living, and we have been taught with access to the highest levels of education and information in history. When you consider that much of what we have learned as undergraduates was not even taught at the graduate level 25 years ago, it is clear that our generation has been prepared to bring the nation into a new era. Empowered in this way, should we not be expected to produce fundamental changes in American society and the world?

Thus, our generation has a rendezvous with destiny. Its goals and eventual legacy, though, consist of unanswered questions. What role do *we* want our county to play in the new world order? How will *we* overcome the world's population crisis? How are *we* going to pay for the Baby Boomers' social security? How will *we* change the Information Superhighway to change education, the work environment, and our daily lives? With the knowledge gained in the Institute of Technology, our duty lies in ensuring the discovery of beneficial answers to these and other questions and in preserving the integrity of technology in society.

We have reached adulthood during the formative years of the Information Age, and only we have the educational background to know how to shape it. With the arrival of the Information Superhighway, almost every home will have the capability to explore the Internet for education, entertainment, and communication. As graduates in technical fields, we not only have the ability, but also the responsibility to ensure that all facets of society fully benefit from this. I can foresee two possible futures: one in which people are isolated, verbal communication is minimal, social capital is lacking, and a poverty in education has created a class system based on knowledge; the other is characterized by a heightened awareness and concern for others, appreciation of diversity in thought and culture, enhanced computer-based education, and the possibility of a more direct democracy. It is up to us to decide which path to follow.

We certainly could take the easy way out and do nothing. Those who coined the term "Generation X" feel this will be our choice. We have been criticized as having limited attention spans, lacking unified goals for the future, and being lazy, unfeeling and apathetic. There is a political science theory called the Logic of Collective Action. It surmises that people will not join an organization or participate in an act if they can partake in the benefits without joining or contributing. They wait for someone else to expend the effort but hope to share in the payoff. For example, many people are not members of the Institute for Electronics Engineers (IEEE), but they enjoy what the institutes standards, research funding, and publications have accomplished. Yet, if no one was a member of IEEE, none of their achievements would have been attained. If we decide to adhere to the Generation X caricature, we will not beat the logic of collective action.

— Continued on page 23

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Francis Kulacki will leave his post as Dean of IT

Fading into memories in Walter Library:
Photographer's conception of the fading tenure of Dean Kulacki. Photo by Joshua Zuckerman

Editor's Note: *In a recent phone interview, soon-to-be full-time Professor of Mechanical Engineering Francis Kulacki assessed his two-year tenure as Dean of IT. Here are some excerpts:*

Q: What are you most proud of in your two-year tenure as dean?

K: "I anticipated this question. There are two major areas. First, we emphasized improved computer facilities for undergraduates. We implemented a computing fee that insures consistent funding for computer upgrades. The fee generated $600,000 last year. This year, we expect to receive $ 1.2 million in additional moneys due to the $300 per-student fee. Second, we protected funding for TAs. This is very important—up there with other kinds of support to the undergraduate program. We had to make these two hard decisions without reducing faculty."

But there are several other successes I can point out. We have been successful in not only maintaining, but improving our research reputation. We have successfully maintained our research centers and are adding new ones."

- We have been commended by the National Science Foundation for looking at innovative ways to reform the calculus curriculum. Our preliminary proposal was selected by the NSF and they will make an on-site visit to evaluate the proposal further."
- The three main NSF research centers—the Army High Performance Computing Research Center (AHPCRC), the Geometry Center and the Plasma Research Center—are doing well. The AHPCRC

and the Plasma center are supplementing their NSF support with industrial seed money."

- We have begun the Minnesota Center for Industrial Mathematics."
- We have enhanced our focus on biomedical engineering and bioprocess engineering."
- We have been successful in getting a new building for Mechanical Engineering. We think it will take 3 years to collect the $9.3 million needed for the building. Governor Carlson mandated that we raise $6 million. That sum has increased to $9.3 million because of cost concerns. We have been in a quiet mode in fund raising for the building in deference to the new Carlson School of Management building. Now that that project is underway, we can more actively pursue corporate donors."

These are incremental steps in a lot of areas that add up to a very significant step forward."

Q: What direction do you see the Dean's Office taking after you're gone?

K: "It will have to continue to look for new sources of funding. It will have to increase its alumni activities and actively seek more private money. We will be getting larger gifts for professorships and scholarships shortly, so that should help the financial condition. But, in general, IT needs to be more interactive with industry and alumni."

We need to be continually active in the area of tying our academic program to the resources that we have due to state funding constraints. This is part of a general trend towards increased accountability in higher education."

Q: Where do you go from here?

K: "I step back into my position as full professor of Mechanical Engineering (ME). I am in the energy sciences side of ME, where I've been active for a number of years. I am the program chair for the World Conference in Engineering Education in St. Paul. More than 600 participants will convene their this fall. Between now and the end of fall, I will be very busy retooling research projects." Ω

—James Mathewson

Aurora II second at Sunrayce 95

Aurora II—the University of Minnesota's solar car—finished a close second to the car from Massachusetts Institute of Technology in Sunrayce 95. Though *Aurora II* finished more than 28 minutes ahead of the MIT car on the last stage of the race, it wasn't enough to overcome MIT's 47-minute overall lead at the start of the day. So, the Gophers finished 19 minutes behind in the cross-country solar car race, which wrapped up on June 30 in Golden, Colo.

"It was really a photo finish," said Virgil Marple, one of the team's advisers. "The third-place car was some three hours behind us."

Aurora II was a huge improvement over *Aurora*—Minnesota's first solar vehicle. That car finished 21st at Sunrayce 93. It was really a better car in every respect than the first one, Marple said.

The car won first place in aerodynamics at the competition. "It is basically a section of wing," said Marple. It also won honorable mention in composites. Most of the car was constructed at Northwest Airlines, which was a major sponsor of the car. Minnesota's lightweight, sleek vehicle seemed to fare well in the elevated Rocky Mountain terrain. The Minnesota racers crossed the finish line at 1:44 p.m. CDT, then waited anxiously as MIT's entry crawled its way through the last miles, losing battery power in the overcast conditions.

Sunrayce 95, a competition for the nation's top 40 technical institutions, began June 25th in Indianapolis. Though officially sponsored by the U.S. Department of Energy and General Motors, students from the University's Institute of Technology did their own fund raising to pay their expenses, including securing donations for the materials needed to build the car.

"Funding was bleak throughout the project," Marple said. "Because of funding problems, we weren't able to do any testing before the race. If we had known the capabilities of the car ahead of time, we would have gone faster in the beginning and possibly won."

Marple said the whole project "does an awful lot to help student's engineering education. It is a great vehicle to improve kids' education." Very few of the students on the team actually get credit for their work. Most are in it for the challenge and the fun of competing. Ω

For more information see this URL:
<http://www.nrel.gov/hot-stuff/sunrayce_update/ sunrayce_update.html>

—James Mathewson, with help from U Relations

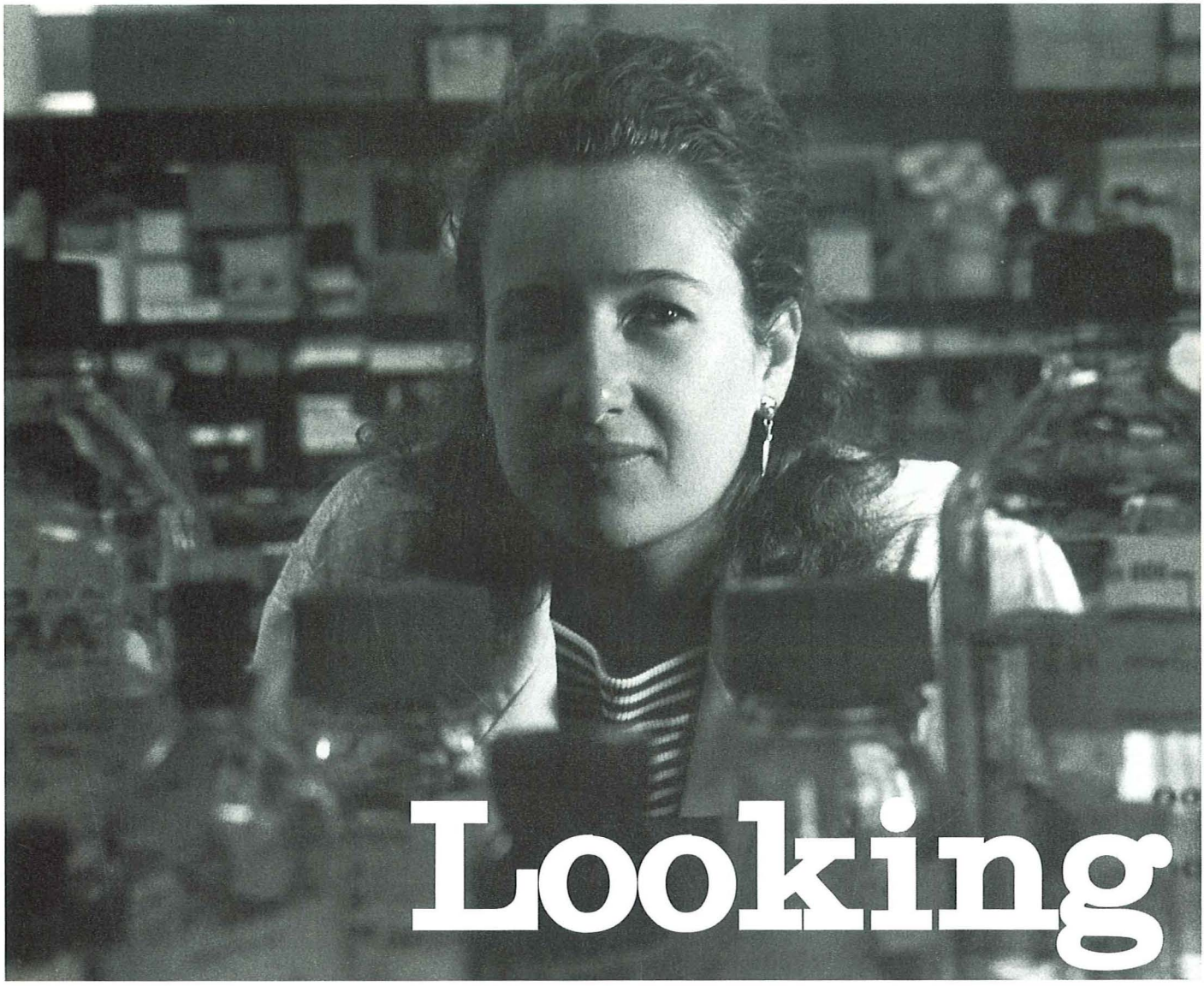
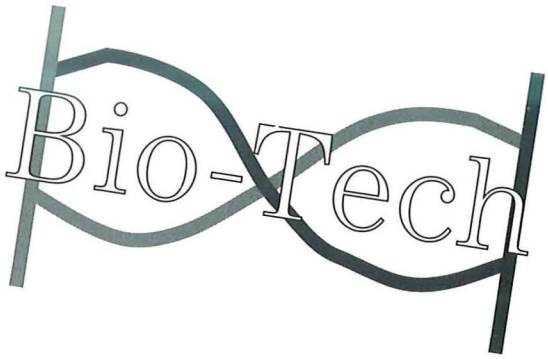


Photo: Joshua Zuckerman

Looking for the Cure That Does Not Ail



Ph.D. candidate Anja Kohler finds materials that harmonize with the human body.

by Greg Lauer

The monitor is a dull white with black splotches randomly dispersed across the screen. To the untrained observer it looks like bad reception on the TV. The splotches, however, are blood platelets and proteins, and they enable your blood to clot and prevent the cut on your finger or the scrape on your knee from turning into a life-threatening trauma experience. Here in a corner buried in the labyrinth of offices in Moos Towers, grad students are busy counting platelets in order to learn more about the process of blood clotting. Welcome to the world of biomaterials research.

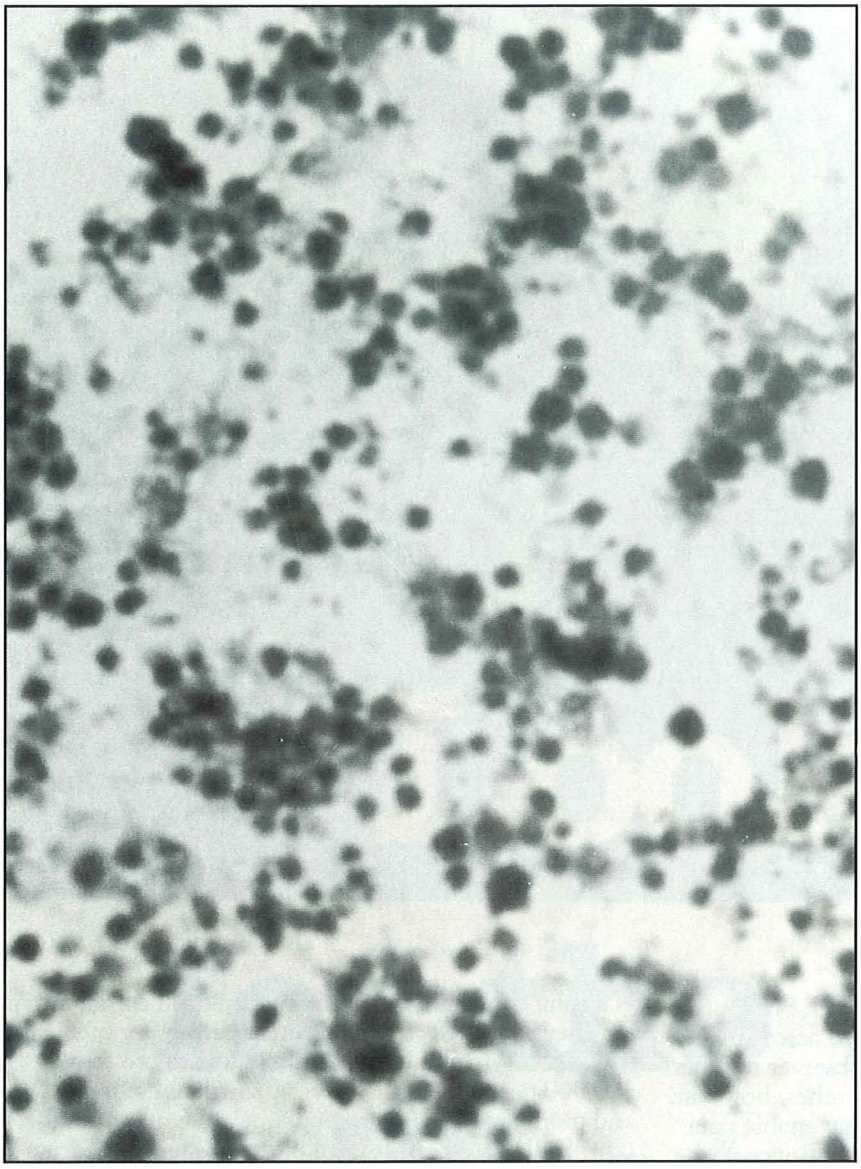
In a modest laboratory crowded with test tubes and chemicals, Anja Kohler probes the mechanisms associated with bleeding in an effort to develop the next generation of biomaterials, the synthetic coatings industrial engineers place on medical devices.

A strong demand exists in today's medical community for safer, more effective synthetic coatings for medical equipment. In the United States alone more than 300,000 people owe their lives to artificial kidneys, and more than a million people have heart pacemakers. Still more benefit from blood oxygenators, drug infusion pumps, artificial blood vessels, and orthopedic prostheses. Although the metals, plastics, rubbers, and gels currently used in artificial organs and implanted devices and grafts are classified as inert, they possess potential long-term side effects such as inflammation, infection, scarring, and blood clotting.

At present nurses and doctors are confronted with two unappealing alternatives. They may continue to use the same synthetic materials in use since the mid '60's, or they may prescribe drugs to reduce the blood's clotting ability. The need to replace decades-old

technology and the movement to reduce the use of anticoagulant drugs are the primary motivations fueling Kohler's studies.

Although it is unlikely the results of her research will appear in a hospital emergency room or an intensive care ward in the near future due to regulatory and testing hurdles, there is a strong possibility the results of her work will eventually influence current medical technology and the design of specialized life-saving equipment.



In more scientific terms, the focus of Kohler's research is the application of polymeric phospholipid materials, and it shows great promise in the search for a blood compatible, non-thrombogenic surface coating. The underlying premise of her research is fairly straightforward—by mimicking the biologically inert surface of platelet and red blood cell membranes, more effective surface coatings may be developed. The process of discovering, studying, and evaluating these unique materials, however, is anything but simple.

First a bit about how the process works. Initially phosphatidylcholine molecules are covalently bonded to various materials such as glass or polypropylene. In principle by modifying and grafting a phospholipid's fatty acid chains to an aminated surface, the polar head groups of the phospholipid molecules are exposed. It is believed these molecules exhibit a unique interaction with water (blood is approximately eighty percent water) and subsequently deter platelet adhesion.

Although the best surface characterization techniques available are being utilized such as thin layer chromatography, fourier transform infra-red spectroscopy, x-ray photoelectron spectroscopy, atomic force microscopy, and contact angle measurements, the exact mechanisms responsible for the difference in platelet adhesion (between eighty and one hundred percent) are not fully understood at present.

Blood compatible biomaterials

In order to create more "blood-friendly" materials, small pieces of proteins called peptides are first identified and synthesized in the laboratory. These peptides are then chemically coupled to the molecules in polymers and plastics used in medical

The research Kohler is conducting is very unique, and only a handful of lab groups around the globe are conducting similar studies in order to understand the mechanisms associated with the behavior of new synthetic coatings. Like many other specialization's in the biomedical field, the number of published papers in her field is low. Opportunities for exchanging information with colleagues do exist, however, and Kohler has presented her work to the Society for Biomaterials.

Kohler is one of more than fifty graduate students in the University of Minnesota Biomedical Engineering Center, a highly regarded and respected research institution in the medical community. The center boasts a

strong industrial orientation and a remarkable history of innovation and invention.

The center supports researchers in a wide range of specialties from biomechanics to imaging and modeling technologies to biomaterials and biocompatibility, Kohler's specialty. She is a member of a small group of graduate students and faculty focusing their efforts on understanding the structure, function, properties, and behavior of selected biological tissues such as skin, muscle, and vascular tissue. Their work includes the study of materials used in implantable devices and their compatibility with the human body.

Like many of the other projects being carried out at the Biomedical Engineering Center, a compelling need for more "blood-friendly" biomaterials definitely exists in the medical world today, and it is one of the driving forces behind Anja's studies. The industry is searching for a new type of synthetic coating less likely to cause clotting for devices such as catheters and blood oxygenators. Currently there are four to five marketable coatings enjoying widespread use, and the majority of these products were developed more than thirty years ago. Sometimes in place of coatings, doctors prescribe Heparin, a blood-thinning agent that inhibits the clotting process. Neither of these two options, however, is entirely satisfying, and a tremendous commercial opportunity exists for safer and more effective surface coatings. Not surprisingly the University is seeking a patent based on Kohler's work.

Unfortunately extensive testing and approval from the Federal Drug Administration is necessary before we're likely to see the next wave of biomaterials in our hospitals and clinics. Additionally a manufacturing firm must express interest in producing one of Kohler's new surface coatings, and that won't occur until the technology is proven to be commercially viable. With only a handful of research institutions worldwide specializing in investigating the properties and behavior of synthetic biomaterials, it is naive to expect these next-generation surface coatings to reach the marketplace and the medical community in the very near future.

devices effectively creating a thin surface coating. The coating tends to "smooth" out the surface, and side effects normally associated with an implant, such as inflammation and blood clotting, are reduced. A number of blood platelets adher to a untreated surface (left). Virtually no platelets stick to the treated surface.

Although synthetic biomaterials in the developmental pipeline will have to wait a few years before receiving their due recognition, Kohler's success is coming quickly. After three and a half years of intensive studying and research at the University of Minnesota she is about to receive her doctorate and is preparing to move on to a career in industry. Ω

- Greg Lauer is a lost math major in civil engineering and computer science.

Graduate Research Assistant Kurt Korkowski and undergraduate Mechanical Engineering major Mirna Slayhi (background) monitor the progress of patient John Christiensen at the VA Hospital in Minneapolis. Christiensen is helping researchers at the University do concept testing on a computerized brace that may be helpful to sufferers of spinal chord injuries. Photo by Joshua Zuckerman.

assistive technology

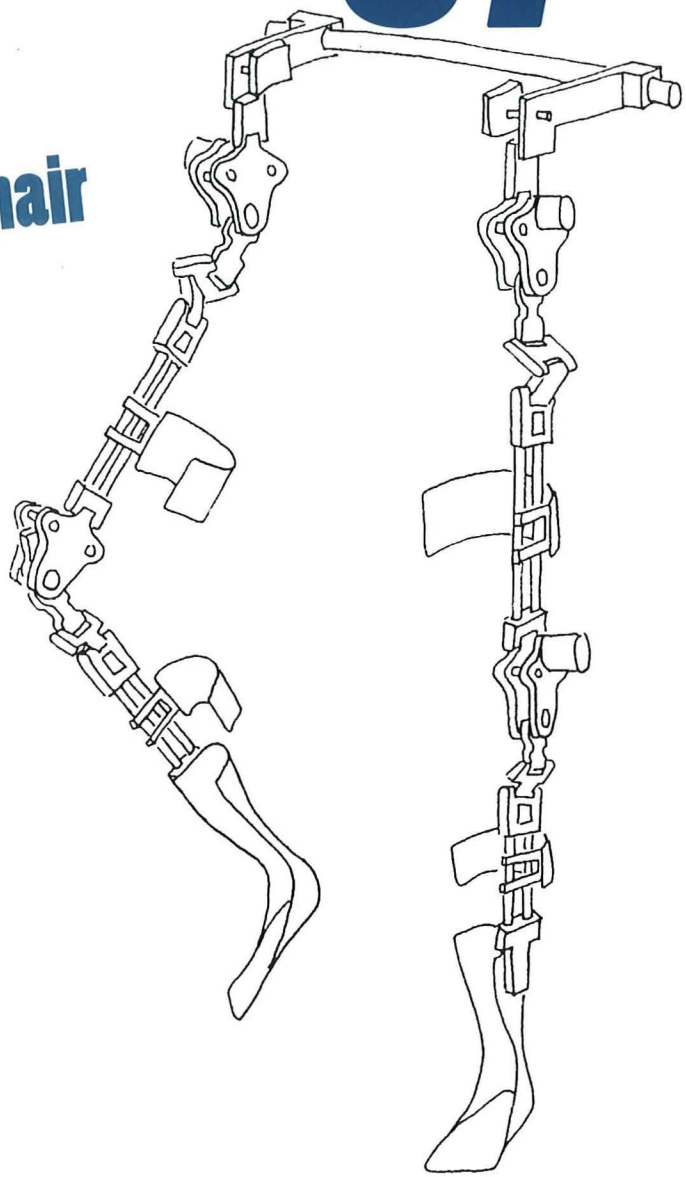
Developing a Brace that Complements the Chair

by Steve Gigl

When America's Superman, Christopher Reeve, fell from his horse and suffered a spinal cord injury a few weeks ago, the world's attention turned to medical experts in hopes of a promising cure or, perhaps, a miracle. While the star is able to move muscles in his upper body, it still remains to be seen how extensively the accident has damaged his body.

For over thirty years, scientists and doctors have been working to restore the ability of paralyzed people to move without wheelchairs. The leading technology in this research has been Functional Electrical Stimulation (FES), which, simply put, means the electrical stimulation of motor nerves in order to cause muscle contractions.

FES has produced some well-documented and favorable results, but it has its faults. Among these are the unpredictability of electrically-stimulated muscles; after all, the movement of joints in the human leg is a complex task that can be hard to control, and as such leads to uncontrollable variations in the testing of FES technology. Another problem is fatigue. When muscles are electrically activated, they always contract as strongly as possible, allowing the FES test patients to move limited distance before debilitating fatigue occurs.



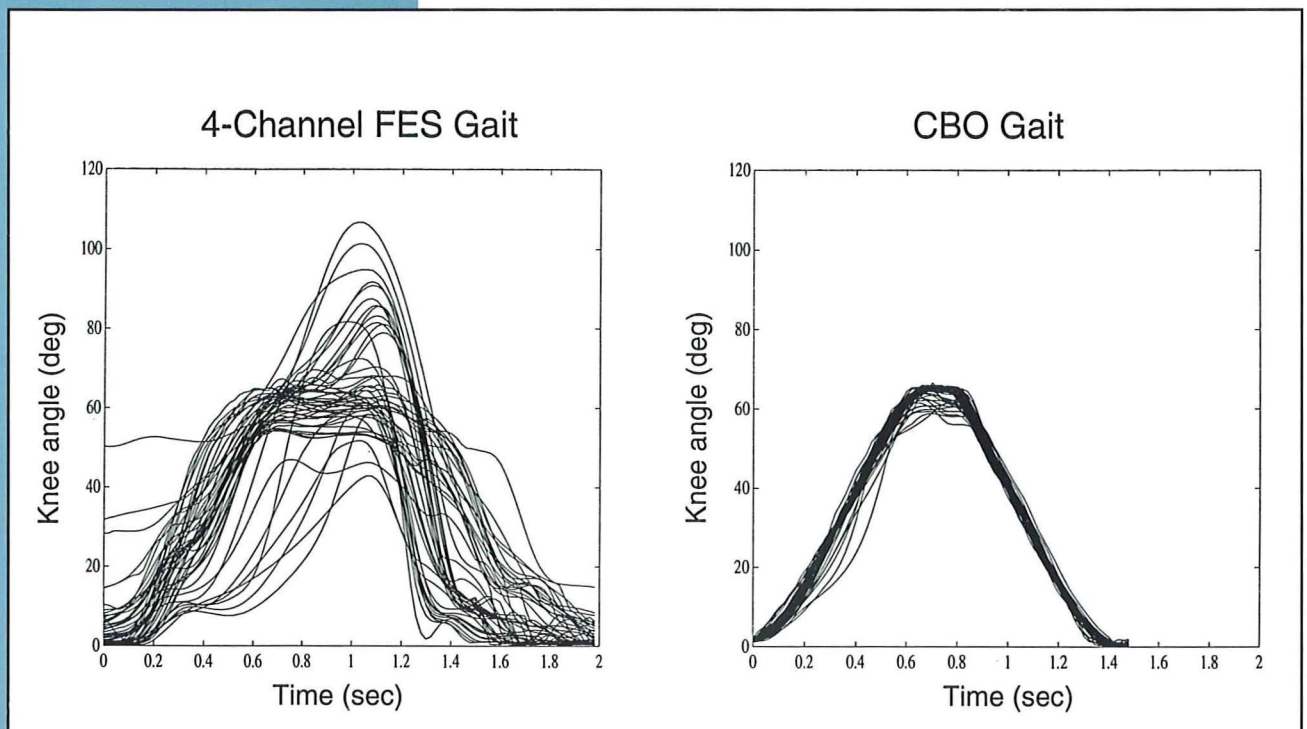
Sketch of the controlled-brake orthosis (CBO), which enables a more controlled gait using functional electrical stimulation (FES)

Here in Minnesota, these two problems are being attacked by William K. Durfee, a professor in the Department of Mechanical Engineering. His research group works with a group at MIT (Durfee moved to Minnesota from MIT two years ago) and the Minneapolis Veterans Administration to test a device that is designed to both improve the gait of the patient and to cut down on muscle fatigue.

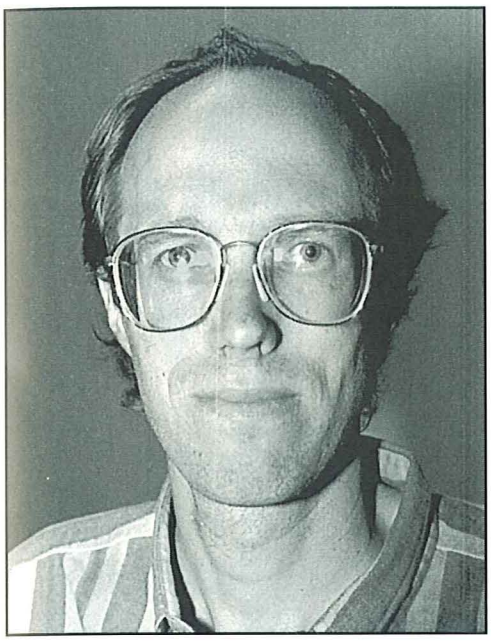
The device in question is a brace that looks like two metallic legs joined by a bar at the hips, and is called a controlled brake orthosis, or CBO. The "controlled brake" part comes from the cylindrical gadgets at the knee and hip joints. These are magnetic particle breaks which act, in Durfee's words, "like the handbrake of a bike going downhill." When an electric current passes through the brake, magnetic particles between two metal plates align and cause one plate to rotate into the other, slowing or stopping motion. These brakes, when controlled by a computer, control of the gait of the person wearing the brace. This design helps reduce the wide-ranging differences between one step and the next in FES-assisted walking.

The brakes also allow for the reduction of fatigue in the muscles of the brace wearer. With FES alone, a lot of quadricep strength is burned while standing. The brakes on the CBO offer it the capability to lock a joint in place, which in turn allows for the "turning off" of muscles in the legs that are not needed when the joint is locked. The brakes also allow the wearer to go from a standing to a sitting position without the stimulation of any muscles, thereby removing another source of great fatigue for the user.

The CBO project deals with two small aspects of a wide field. "Our program is relatively small at this point, and will probably stay small, because we're only dealing with one small part" says Durfee. Right now, Durfee and his team are conducting concept testing. That is, they are testing how much of an improvement is offered by the



Graphical comparison of the human gaits with standard FES technology and the CBO shows a tremendous improvement in con-



"We're not talking about curing spinal chord injuries, which would be ideal. We're talking about assisting paraplegics with brief periods of standing and walking."

—William K. Durfee

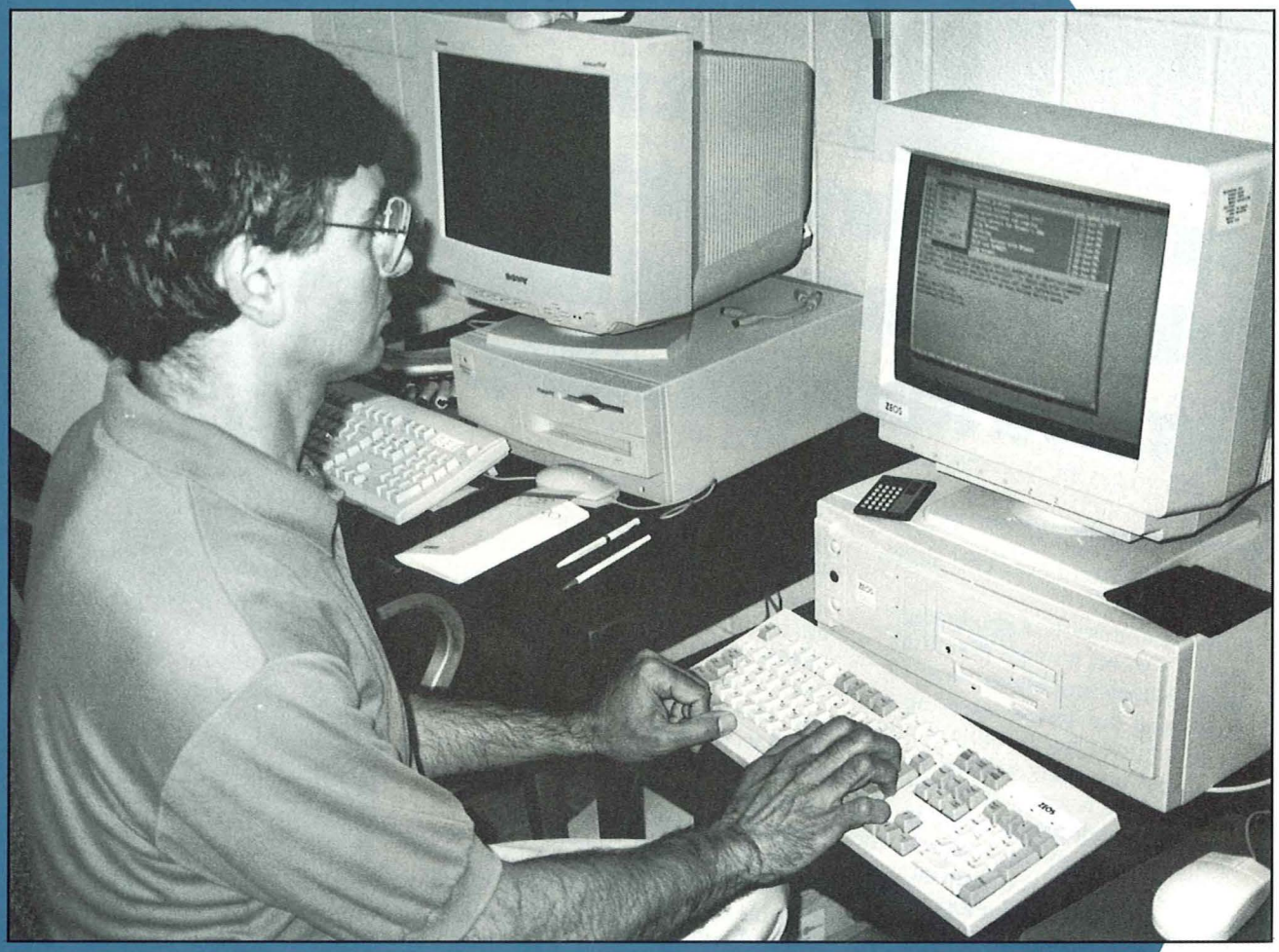
CBO brace system over FES alone.

If the combination of the brace and FES shows enough potential, research into simplifying and improving the design—making it more lightweight, portable,and easier to put on—may soon be in the works. This research is in the product-development area. In order to conduct this research, they will need to get an industrial partner since product development is not part of the mission of universities. If product development goes well, a similar version of the CBO may be available in the commercial market.

It should be noted that, although the CBO is an important step in spinal cord injury research, the technology remains quite limited in its abilities. For the time being, it is very unlikely that paraplegics will be able to use a device like this to walk around for an indefinite period of time, without the use of a wheelchair. Rather, devices like the CBO could be useful in short distance walks, perhaps from a chair in a classroom to a nearby wheelchair, or to stand while cooking. They may also help relieve the effects of long-term sitting, such as pressure sores. While many believe that such an advancement would be a immediately positive step for paralyzed people, the device, for now, still lacks the advantages of the wheelchair in terms of mobility and ease. CBO, says Durfee, is not a permanent solution to paralysis, but rather a useful tool with a lot of promise for the future. Ω

• Steve Gigl is a member of the 1994-95 IT Board of Publications. He's majoring in undecided studies.

Features



Programmer extraordinaire George Gonzalez constructing Minuet—perhaps the only DOS program that has a graphical interface. Photo by Ron Gabrielson

MINUET

Programmer Cruises the Internet—

Without Windows

by RON GABRIELSON

George Gonzalez:
A Legacy of Success

- Minuet: A point-and-click DOS-based desktop program packaging together FTP, WWW, e-mail, gopher, telnet, and a newsgroup reader in an integrated format. Rather than a network reader, the program downloads the data onto the hard drive of the computer for permanent storage. Simple, easy-to-use, and smooth flowing.

- POPmail/PC: A point-and-click DOS-based desktop program for accessing e-mail from one's personal computer, this program was the foundation for Minuet.

- Hearing Research Lab: Involvement in the programming of minicomputers for the purposes of controlling experiments and gathering data from laboratory equipment.

- MMOS: An early version of an easy-to-use operating system & text editor.

- COM: A terminal emulator program/file transfer program for the IBM-compatible and Apple II computers.

- Several earlier small projects, working in the DOS, Apple II and Macintosh computer environments.

"IF cars had advanced like computers have, a car would cost $50, have 50,000 horsepower,

SURFING the Internet can be tricky at best, with confusing UNIX commands and user-unfriendly software making simple tasks into the Info Search From Hell. If you've ever thrown your hands up in frustration, swearing never to go near the Information Superhighway again, you're not alone. If you despair of ever mastering this often arcane lingo, fret no more: in George Gonzalez you've found a voice of reason crying out in the wilderness of technological confusion.

George is a computer programmer, and a pretty darn good one. A University of Minnesota alumnus, George is a member of the Minuet programming team located out of Shepherd Labs on the East Bank of the University's Minneapolis campus. In the past, the University of Minnesota has been one of the leading educational facilities in designing Internet software. Chances are, if you've ever used Gopher anywhere in the world, you will find a listing to connect to the Home Gopher at the good old U of M.

George is a member of the same team that produced the POPmail/PC electronic mail program—a point-and-click Dos-based desktop program that took the worries out of e-mail usage. From the success of POPmail sprung his latest project: using a point-and-click interface to tackle the other monsters of the Internet—FTP (File Transfer Protocol), Telnet, newsgroups and the World-Wide Web. Minuet—short for Minnesota INternet User's Essential Tool—is the near-finished product of George and his compatriots, with the Beta 18a (experimental?) edition being downloaded at sites all over the world.

Bundled with most of the powerhouse utilities necessary to cruise the Internet in style, the point and click interface and pull-down menus of Minuet make it possible for the inexperienced "newbie" to get up and running in no time. This project has been George's life for roughly three years now; with most of the Telnet, FTP and WWW sections of Minuet showing signs of George's programming signature, he often finds it hard to keep his life in balance. "The world isn't all bits and bytes and 486's," says George. "I try to forget about Minuet after working hours and spend as much time as possible on other things, like nature and family."

go 600 mph . . . and crash every hour, destroying EVERYTHING "

—George Gonzalez

Forgetting about work problems may be difficult, but George seems to do a pretty good job of it—playing catch with his 7-year-old son Eric or trying to jog a mile a day depending on the weather. Married, George doesn't have far to travel to see his wife Nancy—Mrs. Wicklund Gonzalez works as an academic advisor at the Continuing Education and Extension office on-campus.

George is "easy going," according to Kim Pearson, a co-worker on the Minuet team. "He combines innovative thinking and new approaches to problems with programming talent to single-handedly create systems that would usually require a large team of programmers." Pearson, who worked on the PC/POPmail team with George before this project, said that George was very talented in programming down at the machine instruction level, and is "knowledgeable about a very wide range of topics."

"George is truly a guru," said Earl Schleske, another Minuet coworker of George's. "He's a world-class programmer. His programming skills are a blend of intellect, knowledge, experience and intuition that we all have had the opportunity to admire and appreciate at one time or another." Schleske, who has collaborated with George on various programming projects over the years, credits George's intricate knowledge of DOS helped make it possible for the team to wring such a powerful program out of the limited DOS environment. Minuet is the only DOS application in the world that has a WWW browser which supports graphics, said Schleske.

George's life has revolved around computers ever since 1969, when he used his high school's "clunky teletype terminal" to access a remote mainframe. "(It was) just one big mental jigsaw after another," said George of the experience. Finding computers a challenging field, he went on to get a B.S. in Computer Science from the University of Minnesota back in 1975. George was hired by the University to work in the Hearing Research Lab under the auspices of Dr. David Nelson in 1976, where he worked for three years as a programmer for lab equipment used in experiments. Since then George

Minuet in One Stanza

Purpose: To create an Internet access program that combines an easy-to-use desktop point-and-click interface with the latest Internet applications—all in a combination that would enable those with the most minimal of IBM-compatible computers to surf the Information SuperHighway.

Rationale: There are many people out there who cannot afford the high-end machines necessary to run the latest in Internet applications. By creating a multipurpose integrated Internet program capable of running under the most minimal of memory allotments (8086's), the program would enable those people who could not afford to upgrade their machines to enter into the formerly "exclusive" world of the Internet.

Capabilities: Minuet was created to allow usage of FTP, newsgroups, e-mail, gopher, telnet and the WWW together in one single package of excellence. While there are many single-purpose programs out there that work quite well, Minuet tackles all of the main Internet powerhouse applications in a well-integrated format. It takes the guesswork out of newsgroups by placing them in the same format as the e-mail composer & reader. Capable even of allowing Graphical WWW links without the need for Windows, it also includes an FTP section rated faster than NCSA's!

has worked for Distributed Computing Services on various projects in the DOS, Apple II and Macintosh environments.

One gripe of George's regarding the atmosphere surrounding the academic programming world is how competitive it has gotten recently. "The academic competing scene used to be pretty sedate and isolated from the real world," said George. "Now that (it) is more mainstream, we have to compete and keep up with the commercial world. It's much less an ivory tower existence than it was even 5 years ago." While George said that they still have time for experimentation and abstract thought, it tends to have to be channeled into areas most likely to be productive—leading to a"notable loss of creativity."

Working on the Minuet team has been satisfying for George for many reasons. Many other companies today are cashing in on the need for multi-function Internet shell programs, and are charging people outrageous prices for their ignorance. Minuet, when finally finished, will ship for under $100. Other programs make use of the Windows graphical environment—which is great if you've got it, but will set you back roughly $100 if you don't and the program needs it. Minuet has its own graphical environment; though it might look somewhat primitive in comparison to Windows, it gets the job done quicker than memory-munching Windows programs can. "I think simpler is often better," says George.

Most of the multi-function programs available or soon to be released are memory monsters, gobbling up huge chunks of disk space and memory to feed their voracious appetite for power. This leaves those with older computers on the outside looking in—only those with expensive systems may feast from the delicacies offered up by these companies. According to George, Minuet was specifically designed with the needs of the larger population in mind. "There are many schools out there with (low memory and power) computers," says George. Feeling that non-profit organizations and schools shouldn't have to suffer for lack of expensive systems, George and his fellow programmers designed Minuet for use on any IBM clone.

All noble aspirations aside, this project has taken a lot out of George. "We peck at our keyboards most of the day," says George. "Sometimes we make some progress toward a better Minuet. We go home, walk our dogs and kids, and collapse. We repeat this day after day." With the end in sight, George looks forward to "a long rest."

George's biggest challenge in his work is having to work inside the DOS system. Finding DOS to be clunky, stingy on memory and deficient in quality graphics or network software, George found it much easier working in the Macintosh environment. "It's sort of like building a house and having to hew your own beams from tree trunks, make your own nails, pour your own glass, etc . . . Hi-tech and primitive all at the same time," says George of working with DOS. "PC's and the Internet are 15-20 year old designs and we're pushing their limits all the time . . . (their) limits are always hampering us."

George credits the team effort for the success they've met with so far in Minuet, with special thanks to Schleske for keeping him on track and focused. He also is grateful for management's support: "They do their job and let us do ours," he said.

"I'd like to be able to start over with some fresh new ideas," said George of the future. "Minuet is fine, but it's pretty utilitarian. I think it's time to start all the Internet stuff over from the user's perspective...figure out what info people need, how they can express their needs, and how best to find that info and present it." Ω

- Ron Gabrielson is a senior in the School of Journalism at the University of Minnesota.

For more information, contact the E-Mail and Internet Helpline at (612) 626-7676.

Minuet is available as a self-extracting file (minuarc.exe) for downloading at the minuet.micro.umn.edu FTP site in the /pub/minuet/latest/directory.

Minimum requirements:
- 512K RAM
- DOS 2.1 or higher
- 8086 IBM compatible computer or higher

Questions about the World Wide Web or "Netiquette?"
Ask someone with "a master's degree . . . in Internet."

Ask Dr. Internet

How big is the Internet? When did it start? How did it grow?

The Internet is actually much smaller than most people think. It is primarily composed of fiber optic cables no thicker than a human hair, which can be conveniently rolled up and stored in a foot locker. Janitors at the National Science Foundation do this on the third Tuesday of every month when they wax the floors.

Since fiber optics are the size of human hairs, they also make attractive wigs. The next time you watch a Sprint commercial, you'll see that Candice Bergen's alleged hair is really the T4 backbone.

The earliest origins of the Internet can be traced to Ancient Greece, where a loosely connected set of networks was used to discuss exploration in the Black Sea. The Argonets, as they were then called, were entirely subsidized by the government, and won one of William Proxmire's first Golden Fleece awards.

The Internet grows hyperbolically, but is usually described elliptically.

Who owns the Internet?

There is no one person or agency that owns the Internet. Instead, parts of it are owned by the Illuminati and parts are owned by Free Masons.

What do the Internet addresses mean?

Precise meanings are often hard to determine. The address baker.lib.washington.edu—which is sometimes written baker@lib.washington.edu—seems to refer to a computer either owned by a baker or by someone named Baker. This can be deceiving however; names like this actually refer to where a computer is located. This one is on top of Mt. Baker.

In addition to names, computers on the Internet also have numbers. This is part of the whole right brain/left brain thing.

Tell me how to get on and off various lists and discussion groups.

Getting off on various lists is currently the subject of pending legislation.

What is "Netiquette?"

"Netiquette" is one of many cutesy neologisms created by combining two other words. In this case, "network" and "tourniquette" combine to describe a program that shuts down a computer if it starts transmitting information too fast.

What is "Flaming?"

Along with an improvisational approach to floating point arithmetic, early Pentium chips were noted for generating heat. While some hackers speak fondly of roasting marshmallows over their first P60s, others found themselves badly singed as the chips caught fire. This "flaming" sometimes occurred while the user was composing e-mail, resulting in poorly chosen or excessively vitriolic verbiage.

What is "Bandwidth?"

As capacity on the Internet has increased, people have begun to transmit material other than simple text. One notable example is audio recordings of rock concerts. These audio files are much larger than even very long books, so they have become a standard unit of network usage. One Rolling Stone song equals one "band" width, and so on.

Why can't I FTP to some places?

There are two main reasons for this. The first is that the site you want to ftp files from is exercising a certain degree of control over its network resources; in network parlance, this is called "fascism."

The second reason is that the remote site may be dabbling with such network fads as gopher or the World Wide Web. This is called "keeping up with the times."

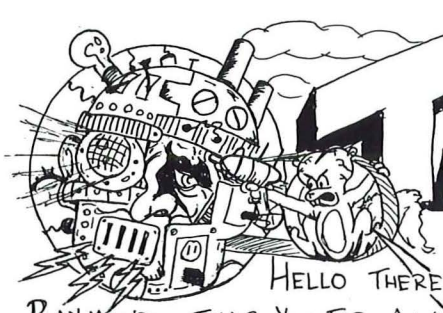
What is the World Wide Web, Gopherspace, etc?

The World Wide Web, or WWW, is an experiment in generating acronyms that are much more difficult to pronounce than the words they replace.

Gopherspace is an older network term. In response to the Soviet space program's early use of dogs in space, NASA mounted a program to orbit a number of different rodents. The programmers involved in this project adopted the motto "Gophers in space!" which has since been shortened. The only actual gopher to go into orbit had been digging up the carrots in Werner Von Braun's garden, and was named Veronica after his daughter.

Why can't I get some WWW stuff via FTP?

It can be hard to say this, but some users of the Internet are unable to do things because they are stupid. Ω

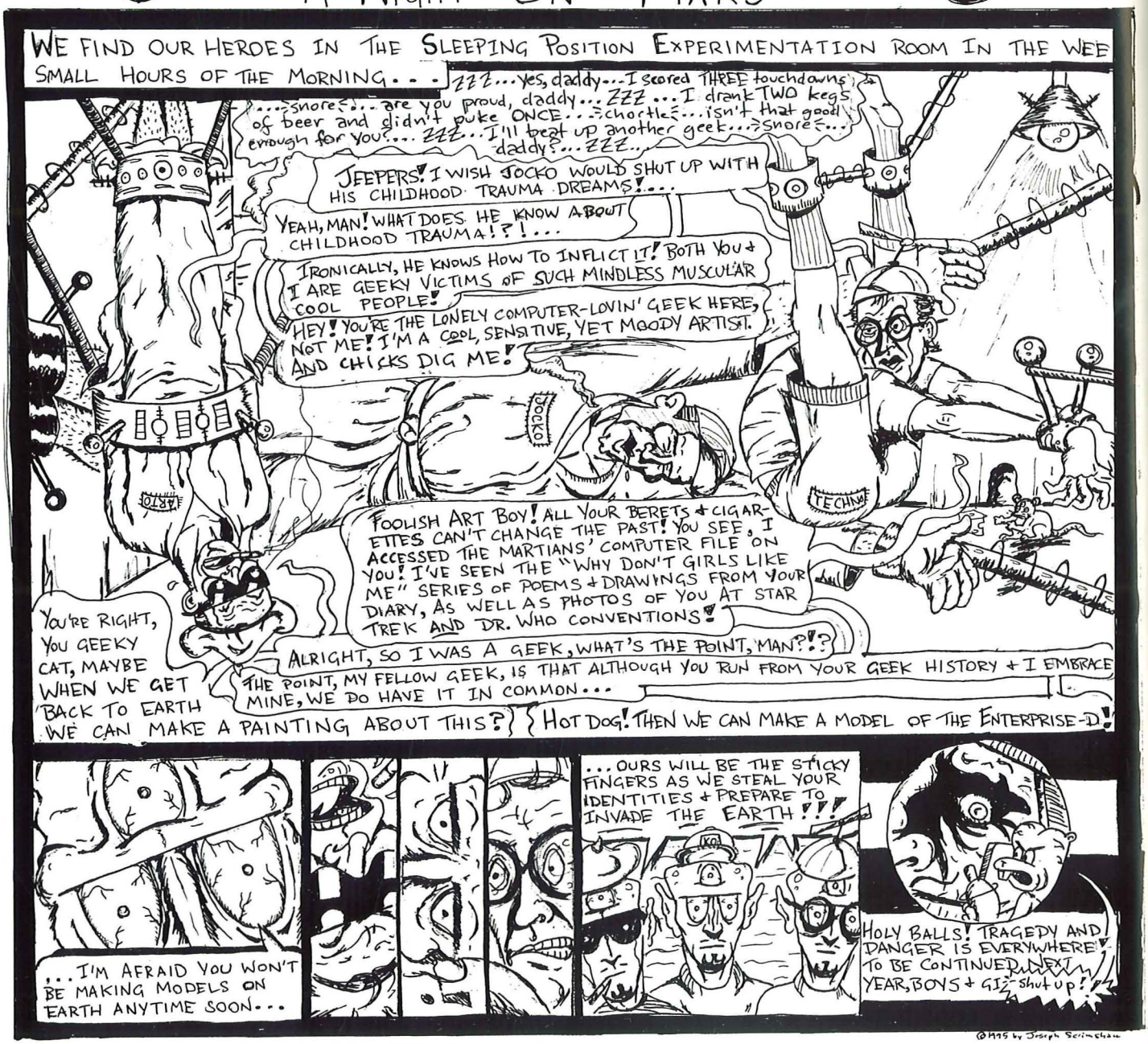


Tales of Technology

by Joseph Scrimshaw

Hello there, boys & girls! This might be the last scary story your ol' pal, Raymond, tells you for a while! 'Cause my master accidentally zapped my back-up squirrel with a brain growth ray, and Mr. Squirrely's kinda unbalanced & he don't like my stories. My master said he'd save me, but then he got chased away by them torch-carryin' villagers, and... shut up and tell the story! ... Anyways, here's The Mars Bros. In:

"A Night On Mars"



So how then, can we, as the 1995 graduates of the Institute of Technology, influence society for the better, instill in our children respect for the accomplishments of our generation? We can do so with our unique store of knowledge and understanding of how that wealth of information can be applied. We are the educational elite and will make a significant contribution to our generation's impact on the future. As the world begins to depend more and more on technology and computers, those who are familiar with their use will attain a distinctive status in society. Not only will the world look to them to answer questions of the nature, "How can this technical problem be remedied?" but also, "How can this technology be applied to cure diseases or end poverty?"

In spite of the growing influence of technology, today's government is focusing more narrowly on social issues. Federal funding for research, development and production in engineering and the hard sciences has decreased dramatically since we entered college. Current government leaders feel that in the short term, solving America's social problems is not compatible with technological progress. As most members of our electorate are not scientists or engineers themselves, it is easy to see why this view might prevail. However, the incompatibility notion is in error. History has shown that scientific advancements have overcome environmental, financial, and educational ills. Therefore, these societal issues are tied to a national initiative for technological progress. This interaction is often overlooked. For example, wanton industrial expansion is often implicated as the cause of environmental problems. The fact that these environmental problems are being overcome by advancements in technology itself is often ignored.

In addition, the pursuit of technological advancement n order to improve society is one way to keep blind progress in check. The ethical questions lying along the path of scientific advancement are astounding. It is important that scientists and engineers question what they are doing and how it will affect others. A particular ethical question that we currently face is: do we advance science for the sake of science or only if immediate benefits are present? Lawmakers, who fund scientific research, seem to be leaning towards the latter, but we know all too well that many innovations have arisen for curiosity alone. Examples include microwaves, superconductors, and MRI machines.

It is our obligation to inform others of what technology can do to improve our lives. We must look beyond the boundaries of our scientific degrees. A new avenue has opened for expression of these sentiments. I encourage each of you to email your representatives in Washington and remind them how critical it is that scientific funding be consistently maintained. If every one of us can accomplish this simple task, we will present a unified voice for people of our generation graduating in technical fields. Inherent in governmental funding of our jobs, our research, and our goals is the promise that we will produce benefits for society as a whole. We will disprove the logic of collective action.

We must also keep in mind that we are part of a global community. Are we ready to take on the responsibility of being not only an American citizen but also a global citizen? I say "Yes." If we pursue the global interaction of society and technology, we will continue to learn and grow. Learning doesn't end today, it is a lifelong process. Strive not for satisfaction in learning but pursue that elusive dream. If we cease to dream, we cease to be scientists and engineers.

As a final note, I would like to modify President Roosevelt's words. To our generation, much has been given and much should be expected. Destiny is ours to shape. Let us not be Generation X but Generation Excellent. Ω

- Dawn Hastreiter delivered this address to the graduating student body of the University of Minnesota Institute of Technology for 1995. She now holds degrees in aerospace engineering and mechanics and electrical engineering.

EXCUSES

by James Mathewson and Joseph Scrimshaw

WRITERS WANTED

Minnesota Technolog is looking for writers for 1995-1996. We're looking for IT undergraduate and graduate students who'd like some experience writing for publication! We have several beats in mind, including environment, ethics, new technology, personal profiles and features, editorials, and personal reports on the specific projects you're working on for school.

Although our editorial board mainly consists of creatures from outer space, we've been known to work well with humans. If you'd like more information, or would like to come in for an informal interview with the editor, please leave a cover letter, a resume and any available writing samples in an envelope outside the *Technolog* office in Room 5, Lind Hall.

You can also call the editor directly: Josie Rawson, 637-7821 (pager) or 879-9055 (home).

And, if you're not quite up to writing, but have interesting ideas for stories you'd like to see in upcoming issues of the *Technolog*, please jot them down on this form and drop it by the office.

MINNESOTA TECHNOLOG

Description of story idea(s):

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Would you like to write the story? _____

Name (optional)_____

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