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TECHNOLOG
Volume 71, Number 1
September/October 1990

Journey to Japan

Inside

Also

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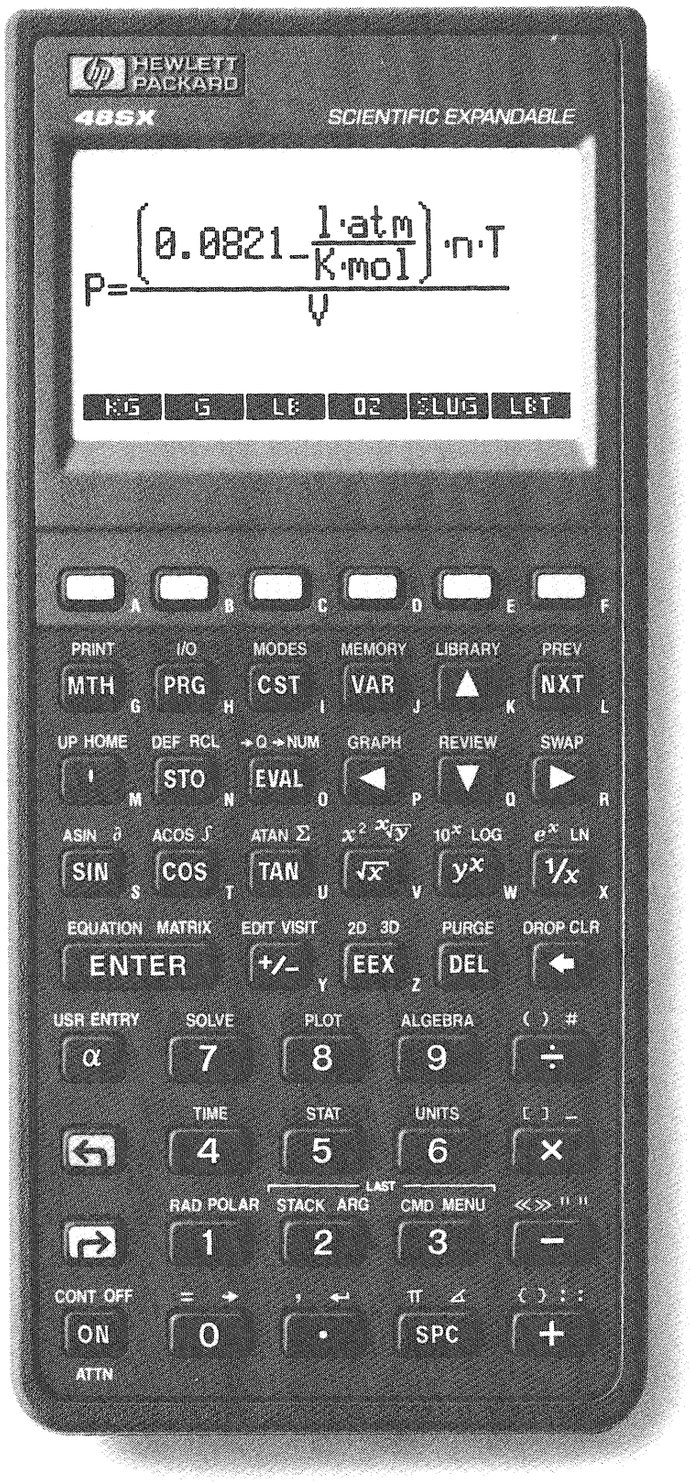

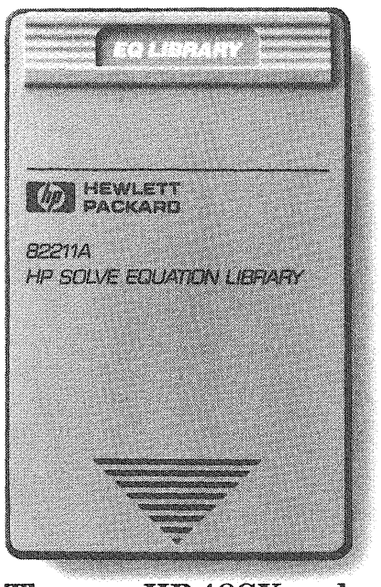

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TECHNOLOG

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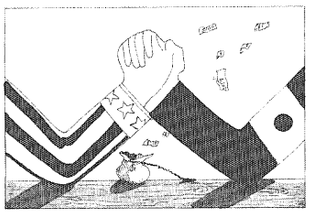
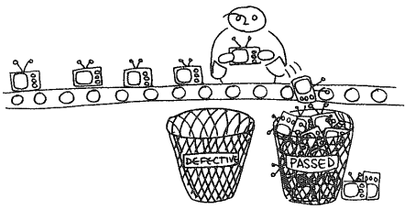
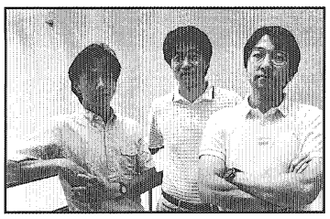
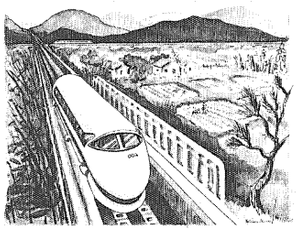








About the Cover...

We have the honor of a Ket Khamboumny illustration once again gracing our cover. Ket is a studio arts student and, as some of our readers may recall, creator of the cover of last spring's science fiction issue.

Departments

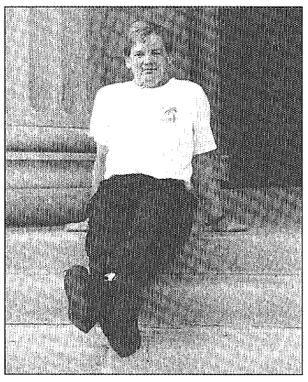
Editorial

Fuzzies and Techies

Can CLA and IT students peacefully coexist?

A friend of mine recently told me about fuzzies and techies. Fuzzies and techies, she said, are terms students at Stanford University use to describe liberal arts majors (fuzzies) and science or math majors (techies). I thought the terms aptly describe stereotypical CLA and IT students.

I could picture the fuzzy: politically liberal, Cliff Notes in hand, and majoring in "14th-Century Left-Handed Bourgeois Reconstructionism." The techie, on the other hand, is politically conservative, carries a Cray pocket-supercomputer and majors in "Microtheoretical Fluid Dynamics of Winkler Widgets."



As stereotypes, of course, they do not apply to individuals. Individuals refuse to obey any laws or restrictions and fit into their own particular niche. The individual must be judged on her or his own merit.

Yet, the more I thought about my images of techies and fuzzies, the more I realized there is some truth in them. Many liberal arts students regard math and science as inexplicable and unimportant. They tend to ignore these subjects in their studies and may view technology as a cold, faceless wall beyond their capacity of understanding.

Math and science students can be equally blind, viewing a liberal arts degree as a complete waste of time, something without any "real life" worth. If a class does not yield hard answers or solve clearly defined problems, techies may conclude that it has no value.

The truth of the matter is that today's society demands knowledge and understanding of both the "hard" concepts of math and science as well as the "soft" concepts of the liberal arts.

Science and technology permeate our society. In order to understand the rapidly changing world around us, we must be able to understand technology and the workings of science. The pure liberal arts student, the fuzzy, may ignore these subjects as a whole and consequently will be limited by ignorance.

Ronald Reagan was not technically knowledgeable and the U.S. suffered for it. Any competent engineer can tell you "Star Wars" space defense was a fairy tale. In fact, several of Reagan's top scientific advisors knew this, but Reagan refused to listen. Consequently, millions of taxpayers' dollars were spent developing an unusable dream toy.

Our leaders are not the only people who need to understand science and technology. Businesspeople need this understanding in order to make correct management decisions. Should the company spend $X million on Ronco's latest automated parts splicer? Will this widget work? What does this gizmo do?

Journalists cannot accurately cover what they do not understand. Doctors cannot operate efficiently without their increasingly high-tech tools. I would go even so far as to argue that poets cannot reflect their surroundings without understanding the technology that is a critical facet of our culture.

On the other hand, those without knowledge of the "softer" skills and topics of the liberal arts are equally crippled. Without liberal arts knowledge and skills, the world can be inaccessible in many ways. Math and science students may graduate with extensive technical knowledge and skills, but may be disabled by a lack of other skills.

Without knowledge of history and culture, the technical individual is not qualified to make decisions that will affect the surrounding world. Scientists and engineers may say technical knowledge is all they require. Yet, as creators of the atom bomb, the automobile, and the personal computer, it is apparent that scientists and engineers dramatically affect society.

Civil engineers must understand the needs of a community to properly manage city planning. Industrial scientists must know and apply the basics of group dynamics and management or they will remain at the mercy of non-technical managers. Theoretical mathematicians with undeveloped imaginations will never create an original theory.

As a student, it's easy to ignore this. Most math and science majors, especially engineers, are almost guaranteed jobs at a good wage. These students may be unconcerned about the societal impact of their work or what their education lacks. They just want a good job. Moreover, these students are probably struggling just to survive their classes. There may not be much time left to study the liberal arts, even if the student is so inclined. Consequently, these students will probably suffer.

One day this summer, a middle-aged man came into the *Technolog* office, asking about reprints. When asked who he was, the man said, "An unemployed engineer."

He was not a happy man. He complained about those "damn MBA's" running research and development and of company priorities having little or nothing to do with efficient, or even competent, engineering. He was not satisfied with the pay, which had started well but had not increased much since. As he left, he remarked that he wished he had broadened his education, so he would have had the skills necessary to advance his position.

The man's point is well-taken. Knowledge of science and technology is not enough to succeed. In the same light, a liberal arts education is not sufficient. Just ask any unemployed liberal arts graduate; they aren't hard to find.

Perhaps schools can be blamed, but the burden of success lies with the student. Success in today's society requires some crossover between the world of the techie and that of the fuzzy. One or the other is not enough.

TECHNOLOG

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Letters

The Dilemma of *The Dilemma*

Dear Editor,

This letter was prompted by my reaction to the first-place science fiction award winner, *The Dilemma*. I thought the storyline seemed familiar. *The Dilemma* has remarkable similarities to the story, *The Choice*, by Wayland Young. I have used *The Choice* in some of my classes.

My daughter, Riawa, who reads much more science fiction than I (I only read the science fiction in the *Technolog*) says The *Dilemma* is much more interesting and a better story than *The Choice*. She was also struck, however, by the remarkable similarities—length, title, specific lines. In science, giving proper attribution to sources of ideas is the norm. Is it so in science fiction?

I am just troubled that a first place award-winning piece, presented as original work, has so many similarities to a previous piece. I'll leave it to you to address my concerns, if you so choose.

Karl A. Smith
Associate Professor

Dear Editor,

A friend of mine who attends the University, knowing I'm a science fiction fan, gave me a copy of your April, 1990 issue. It's ironic that the winning story was about time travel since it was written before the author was born. Also interesting was the introduction about the "forgotten subtleties of time travel," since your judges obviously forgot about this one.

The Choice, written by Wayland Young, was first published in the March, 1952 issue of *Punch* and has been anthologized a half-dozen times since. The enclosed copy comes from "Fifty Short Science Fiction Tales," edited by Isaac Asimov and Groff Conklin.

I think it's great that you have a science fiction contest; you just have to watch out for things like this.

Jim Detry
Bloomington, MN

Dear *Technolog* readers,

When writing my short story, *The Dilemma*, I remember thinking to myself, "My god! This story is too good to be true!" I thought it short and concise and it had that "ponderous" quality; the quality that drives a reader nuts thinking about its meaning long after the page has been turned. I thought of the *tons* of stories that had been written speculating about the future (from *Blade Runner* to *Bill and Ted's Excellent Adventure*) and decided to spin it around. What if we actually *saw* the future and *didn't want to know about it*?! After that idea popped into my mind, writing *The Dilemma* was pretty easy going.

In short, my story was a punchline story, one that counts on a specific idea in order to make an impact.

Unfortunately for myself and the *Technolog*, those words turned out to be prophetic. That punchline had already been used in a story called *The Choice*, a fact that was pointed out to the editor, who then informed me.

Thus my letter to you. I have read *The Choice* and although it is vastly different stylistically, has a simpler focus, and is shorter than *The Dilemma*, I must admit that the stories are damn similar. They have the same "punchline." Because of this, I concede that Wayland Young had the idea first and therefore has the copyright to **my** story.

Oh well. I guess **I** am faced with a bit of a dilemma. On the one hand, I thought that *The Dilemma* was one of the best things I had written and am **very** reluctant to give Wayland Young the credit for something that I wrote. I see the problems that the *Technolog* and its staff face if I do not. I guess the best thing is to keep this event as a once in a lifetime thing and keep writing.

Oh yes, and watch out, Technolog staff, for my next contest entry. It's going to be a doozy. I promise.

Ed Peschko

The editorial staff, after much deliberation and consultation with our high-powered media law consultant, has disqualified The Dilemma *from the 1990 science fiction contest. Ryan Christiansen, author of the second place story,* The Glow, *is now the official winner of the contest. This has been a difficult decision and we feel it is important that the readers understand several things. First, that we are basically at the mercy of the contest entrants. We are forced to trust them to submit original work. Our judges have extensive knowledge of science fiction, but they cannot access and recall every science fiction story ever written. Second, that Ed Peschko may or may not have committed plagiarism. That is not for us to decide. Coincidences can and do happen, and he makes a believable case that he had no knowledge of "The Choice" when he wrote "The Dilemma." However, we simply cannot, under any circumstance, award material which may infringe upon copyright law.—Ed.*

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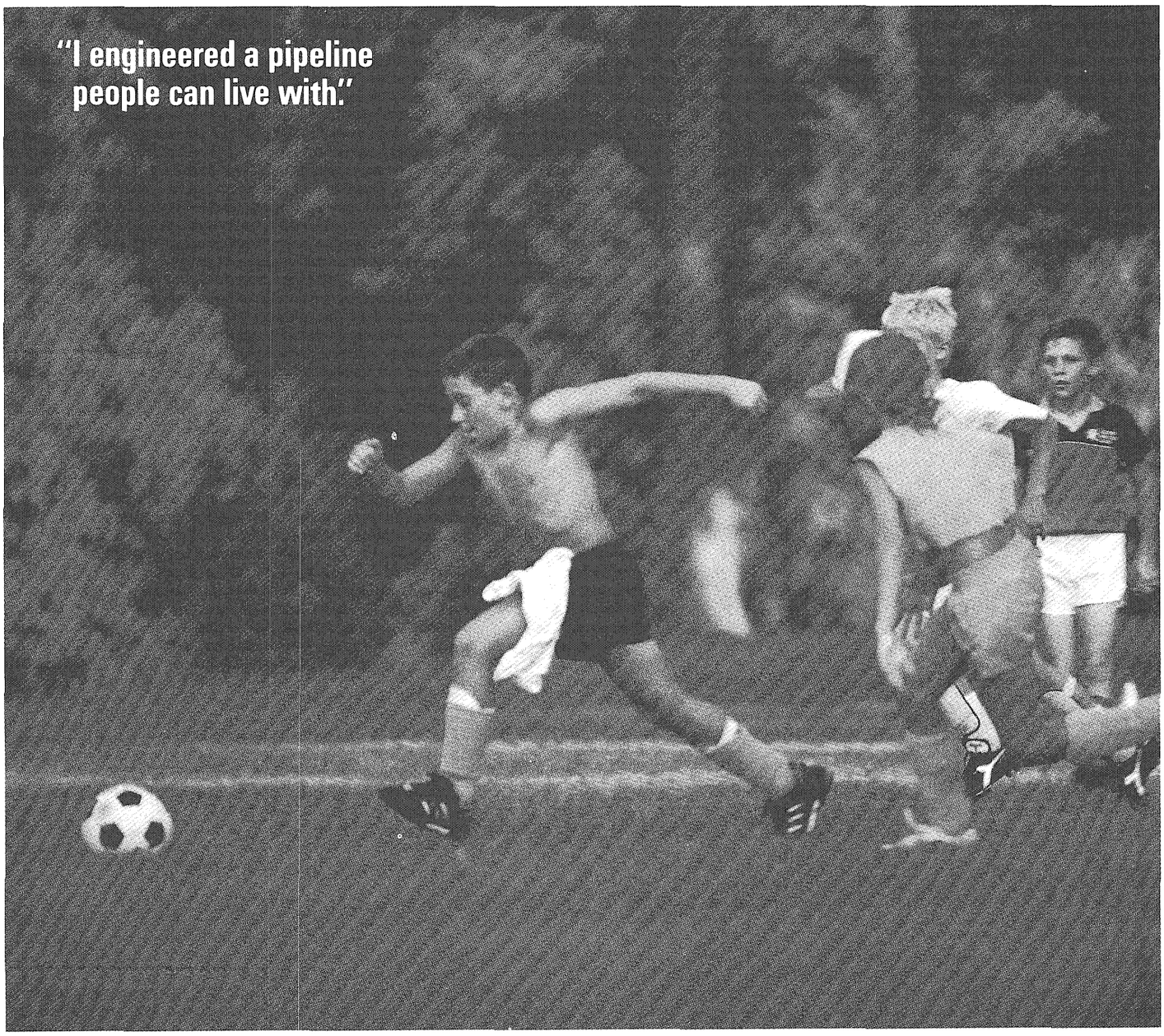

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Perspectives

Reflections on a Japanese Barn

Understanding Japanese traditions may be the key to interpreting trade decisions

by James P. Houck

Out among the far suburbs of Tokyo sits a large, white, wooden barn. Inside is a museum of sorts; resting on dusty shelves, hiding in dark cabinets, and crouching on old wooden floors are hand tools and mechanical implements used by Japanese farmers for several centuries. These range from exquisite old scythes and rakes, crafted by ancient hands, to ingenious, miniature grain harvesters and hay balers, self-propelled and operated by walk-behind drivers.

Nothing in this out of the way museum is big. Nothing would remind a visiting Midwesterner of the awkward, mechanical giants that lurch across Corn Belt farmland, plowing, spraying, harvesting, and hauling. Everything is wondrously compact and precise. Nonetheless, the dusty sunlight filtering in through the windows illuminates devices whose basic form and function are familiar. While they possess no real mystery, these farming tools of yesterday—and today—radiate cunning design and, to foreign eyes, an engaging cleverness seldom seen at home.

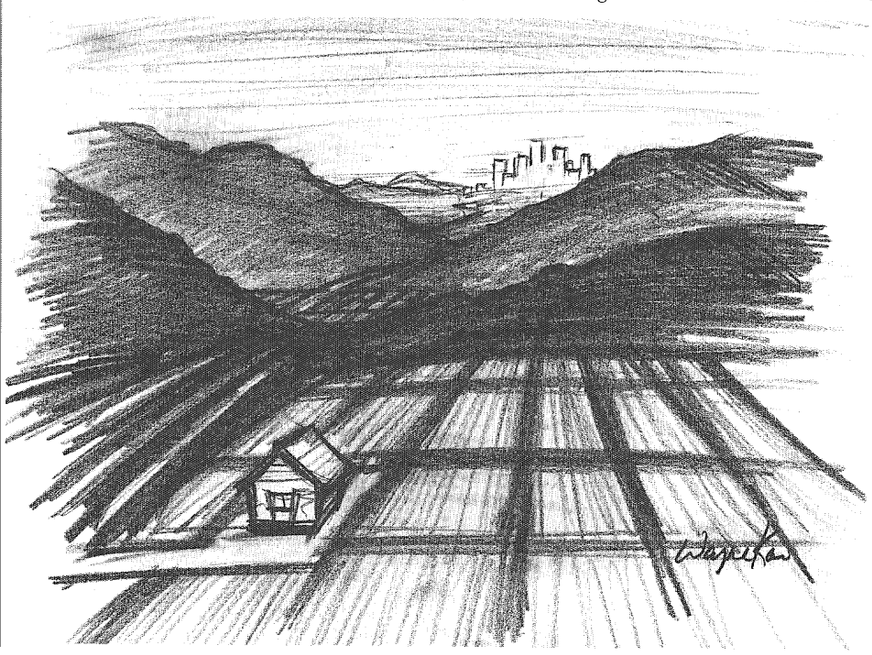


Illustration by Wayne Kao

Of course, these implements were created for use at home, in Japan, not for the international marketplace. In fact, the earliest items come from the days when Japan lived in a relatively austere, self-imposed isolation from the rest of the world. However, these rustic artifacts speak eloquently about how and why modern Japanese products—especially those designed for personal use at home and on the job—have fascinated the world's consumers for over 30 years.

Perhaps 80 percent of the items resting in this museum were made specifically for the cultivation and handling of rice. In the Japan of long ago and even today, rice was mystical. For centuries, rice defined the core of Japanese society's collective awareness. Both the production and consumption of rice have deep symbolic value that most outsiders only faintly grasp. For instance, readers of James Clavell's celebrated novel *Shogun* might recall that the basic unit of value in that feudal era 400 years ago was the *koku*, an amount of rice sufficient to feed a family for one year, or about 350 pounds. All income, gifts, taxes, fines, and prices of other goods in the kingdom were expressed in *koku*. Even the land awarded by feudal nobles to devoted vassals was measured in *koku*. Today, faint echoes from those distant days still resound across the country's political landscape.

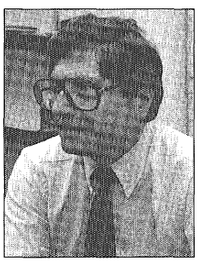
To sustain and safeguard self-sufficient rice production, the national government supports farm prices for rice that are several times higher than comparable world levels. In addition, they firmly prohibit imports. Much of this higher price is passed along to consumers who, despite spending an average of 30 percent of their income for food, seem quite willing to pay it, although they are eating less and less rice per

person each year. The motive for this generous, even lavish, treatment of rice growers cannot be attributed solely to the considerable political muscle of farm interests. Rather, it can be best explained by the mystical status that rice holds within the Japanese psyche. For most citizens, a Japan without self-reliance in rice would simply not be Japan.

High rice prices over many years in crowded Japan have raised rural land values to astronomical heights and have created higher production costs for other crops or livestock enterprises that compete with rice for the farmer's land or time. Hence, the political pressure for tighter limits on virtually all competitive, low-cost food imports is intense. Agricultural exporters and their political allies in the United States, Canada, and Australia chafe at these imposed trade barriers but make only limited headway with wheedling or bluster. Also, any Japanese leader with the will and power to confront the interlocked coalition of domestic producers and consumers bought a one-way ticket to political oblivion.

So here in the dim interior of this old-fashioned white barn, these metal and wooden devices tell us at least part of the story behind Japan's peculiar stance in today's world market. While international buyers eagerly book orders for Japan's superbly designed and crafted automobiles, electronics, and myriad of other products, Japan's arcane devotion to self-reliance in rice keeps immobile political barriers against balancing the trade of Western food products at the nation's borders. To Americans, Japan's behavior may seem like only an annoying puzzle, but we must come to understand why they operate this way, if we want any positive change to occur. ❐

James P. Houck is acting head of the University's Agriculture and Applied Economics Department. He has traveled to Asia, Africa, Australia, South America, Thailand and Europe. His professional interests are in agricultural prices, policy and trade.



Commencement Address

by Loren Eyres

When I think about the significance of this ceremony and what I might be able to say about it, my mind turns to the various changes that today symbolizes and celebrates.

Most obviously, we will now be paid for our research, analysis, and design instead of paying to learn about them. But I think we all understand this change well enough; I doubt there is much I can add that you don't already know.

Instead, I will focus on another change: the implications and effects of our technological activity are about to widen. Up to this point, we have borne most of our work's consequences upon ourselves. When we skipped classes, blew off assignments, or even studied, those things came back to affect primarily us. What will be new is the potential our work carries to affect others, from those close to us to quite literally the millions of people who will buy our technological products.

Nowhere has this become more evident to me than in the environmental ethics class I took this spring. Again and again technology entered the discussion. The various authors we read agreed that technology has given humankind a previously undreamt of power to reshape human society and the environment as well. However, they disagreed about its effects.

Some authors saw technology as a destructive force; something that has taken control of our society and should be restrained. Others demonstrated extreme faith in technology's progress and its ability to solve its own problems.

I was struck by the almost religious character of these views. There are technological fundamentalists, their blind faith in technology's goodness allowing them to see no wrong. At the opposite pole are "technological atheists" who condemn technology for its false promises and destructive consequences.

There is no question that technology has immense power to shape our lives, from the tools we use at work, to the games we play for relaxation, to the quality of relationships we have with other people. In some ways, technology takes on a religious character in this society. There are believers and dissenters. There is a power to touch and transform the most personal parts of peoples' lives. The incredible momentum of technological progress and development overshadows its individual practitioners. Even the "technological atheists" participate in its rituals—the television show, the telephone call, the airplane flight, the medical x-ray diagnosis.

If technology functions like a religion, then here in this auditorium sit its priests, bishops, and theologians. Tonight we witness the ordination of a new generation of priests, a new generation of mediators between technology and the world it serves. Some of us will be the scholars and theologians, researching and arguing about the fundamental principles. Others will be more practical, taking those principles and placing the resulting products into human lives.

The question is how we deal with this role. We might not like it. We can choose to ignore it. But ignorance cannot change the role itself because the role derives from our knowledge, skills and positions. We condemn episodes in history where the clergy placed its own interests above the needs of the people. Unless we wish to follow their example, we must acknowledge our priestly roles and perform them to the best of our abilities.

This is a huge task—how can we do it? I have no clear answers, but one strong suggestion, learned in my struggle to study both engineering and the humanities. We must learn to see our scientific and technological activity within a societal, human and environmental context. In the religious realm, ignoring context is often the first step down the road to destructive practices. As technological priests we run the risk of someday finding our work to be irrelevant, incorrect or even destructive.

This focus on context is especially relevant today, at a commencement ceremony. Our education has been almost entirely technical. We have learned about engineering and science but sometimes very little about its context and consequences. At the same time, we are leaving the University, with its vast resources for learning about context, and moving into extremely specialized practices, whether in graduate school or industry. There is a risk that our awareness of context may fall through the cracks. To become a responsible clergy, we must not allow this to happen.

That is why I would like to encourage myself, my fellow graduates, the faculty and all other people here to actively pursue an awareness of the context in which we do our work. That context may include the technological ethics of the work we do or the products we design. It may even reach as far as political activity or constructive criticism of our technological society. As we understand the context of our activities, we can become more effective in our role. We have a loose grasp on a power with greater potential and consequences than we understand. Let us understand more, so that we may use this power wisely. ❐

Loren Eyres was the 1990 commencement speaker. He received a degree and Electrical Engineering and spent last summer finishing a degree in English. Eyres will be going on to graduate study at Stanford or Cornell. His long term goal is to become a university professor.

A Word From the Dean

by Ettore F. Infante

I have been asked by the *Technolog* editors to say a few words to the IT student body, imgaing that they were assembled in one place. Such an assemblage would be a distinguished gathering, for you are, as a student body, the University's best. All of us in IT take great pride in the quality of our students.

One of the things that you would notice is that there are now about 1,500 fewer undergraduates than a few years ago. We have deliberately reduced the number of students in order to improve the faculty/student ratio and the laboratory resources available to individual students. Given the nation's need for scientists and engineers, it was with regret, and only after painful analysis, that we undertook this action. Given your needs, it was something that we had to do.

We have also brought about improvements in our advising structure, better access to quality instructional laboratory and computational equipment and significant improvements in tutorial and place-

ment activities. My usual theme for alumni, legislators or friends of IT is to talk about such improvements, for which we feel considerable pride, and of our plans for the future. But given the audience in this case, such a talk would be inappropriate, for you are benefiting from and conscious of the improvements we have made; the future ones will not be realized until you have graduated. This was a point made by President Hasselmo in his discussion of improvements in undergraduate education in the last *Technolog*. I would like to expand on his observation.

Each year we will realize improvements in IT's instructional, research and service activities. But during your stay as IT undergraduates these improvements will not be obvious to you.

What prompts me to voice what may be viewed as a less than enthusiastic statement? I want to make sure you realize that the person most capable of improving your educational experience is you, not the faculty, the staff, President Hasselmo or myself. How you take charge of and manage your educational opportunities will be of far more value to you than any improvements in the institution. We, the faculty and staff of IT, are committed to help you to the utmost for this purpose. But you are fundamentally in charge.

The person most capable of improving your educational experience while you are here at the University is you, not the faculty, the staff, President Hasselmo or myself.

There are always plans at this university and others for improvements. Such plans may create the impression that there someday might be the perfect university and that in such a university learning would be easy. Professors would all be excellent, equipment would be brand new and tuition would be low (or free!). Of course, there will never be such a university, although we shall always strive for it. Even if there were, students would not learn as much as they thought they should, as I sometimes hear students lament.

I knew a student who thought he could learn simply by being in the presence of competent instructors and by doing exactly what he was told to do, even if he did not understand why. This student was upset when he did not think he was learning as much as he should be. Each of my colleagues has known a similar student. I was that student and, most probably, I felt like any other first-year student studying at a college or university.

But most of us come to realize early on that learning is work; that we must be active, not passive; that we must assume the responsibility to manage our own education and take advantage of the opportunities available to us. IT offers great opportunities, but you are the ones who must choose to pursue them.

Our buildings may not be the best. Our equipment may not be the best. Those who teach your classes may sometimes fall short of whatever ideal you hold them to. However, none of these circumstances need impair your ability to acquire a quality education here.

I am talking about more than studying hard. It is important that you understand the advice you are given and that if you do not understand it, actively question it rather than passively accept it. All courses that you take, whether inside or outside of your major field, are important and should be treated as such. Make an effort to know your instructors and take advantage of co-op opportunities, the undergraduate research program and other such activities. Work with your advisors and instructors to make sure that your education here is more than an aggregate of courses, that it is cohesive, carefully planned and thoughtfully carried out. All of these things require initiative, but are worth the effort. I do know that the faculty and staff of IT will respond to your initiative.

It is an important part of our responsibilities in IT to encourage our faculty and provide them with the resources needed to do an excellent job. It is just as important a part of our responsibilities to issue the same encouragement and challenge to you, the excellent students that make up our student body.

May this coming year represent, as a result of your active involvement and initiative, the fruitful educational experience that IT can provide. ❐

Ettore Infante has been dean of the Institute of Technology 1984. Born in Italy in 1938, he has taught at Brown University, The Weizmann Institute in Israel, the University of Paris, and Notre Dame.

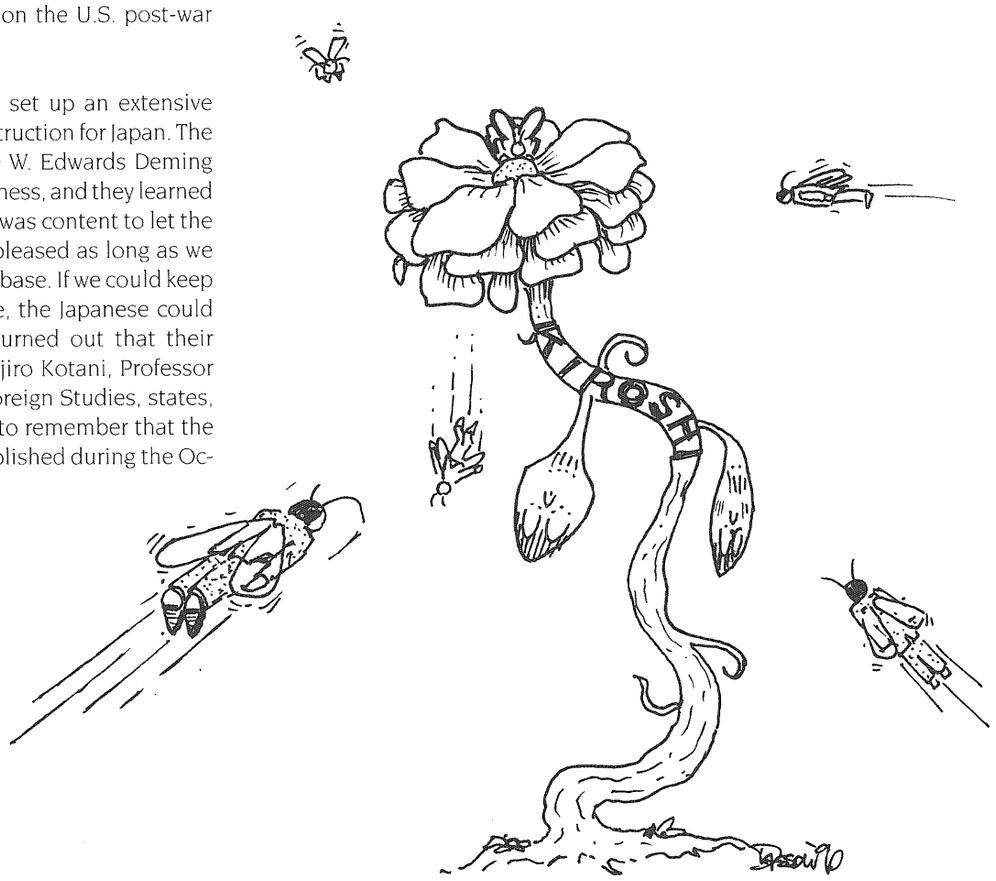
Winds of Change

by Matthew Kirkwood

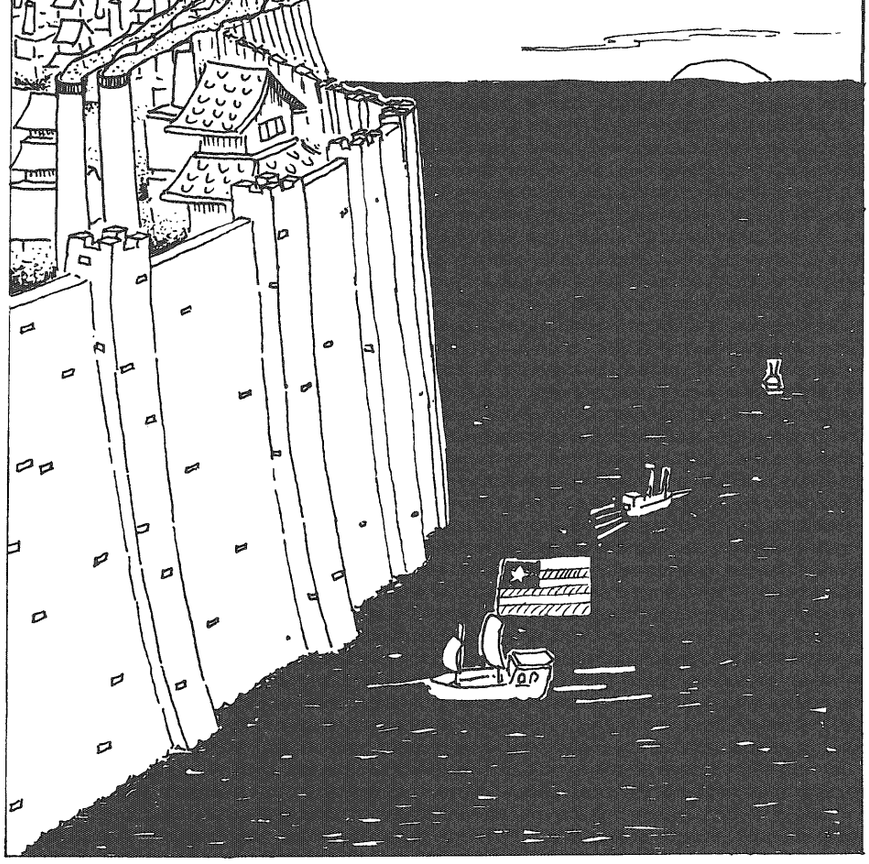
Will Japan continue to be an island of prosperity in an ocean of economic woe? Will their traditional business practices keep them at the top? Our author details the double-edged sword of success.

The word "Japan" strikes fear in the hearts of American business people. Over the past decade, Japan has burst the bubble of American economic superiority. But how did they get to be so good, and what are they doing to stay so good? While American business leaders like Lee Iacocca blame the U.S. Government for not implementing trade barriers and other protectionist measures, the blame can be partly placed on the U.S. post-war policy.

After World War II, the U.S. set up an extensive program of economic reconstruction for Japan. The Japanese invited people like W. Edwards Deming to teach them how to do business, and they learned quickly. At the time, the U.S. was content to let the Japanese do whatever they pleased as long as we could use Japan as a military base. If we could keep troops and equipment there, the Japanese could tend to their business. It turned out that their business *was* business. Hidejiro Kotani, Professor at the Kyoto University of Foreign Studies, states, "We want the United States to remember that the American democracy it established during the Occupation implanted in the minds of Japanese capitalists ideas on how to buy the 'pride' and 'soul' of America." With the help of Americans the Japanese built the foundation of their modern economy. This foundation, combined with characteristics of Japanese society, has resulted in their climb to the top of the world market.



Illustrations by John Dassow



The Japanese had much success in the 1980s. For example, in some parts of the U.S., the Japanese auto makers gained up to a 50 percent share of the market. However, there is change on the horizon. The collapse of the Tokyo stock market, the rising yen and increasing consumer costs mean that adjustments must be made in how the Japanese do business.

The Price of Success: Working Themselves to Death

Much of the way Japan does business is based on the people involved. The workers have traditionally been seen by outsiders as happy worker bees whose reward for a satisfying day at work is a lifetime of job security. Although the Japanese are hard workers, happy does not seem to be the right word to describe them. Working 12 to 13 hour days six to seven days a week is typical for the average Japanese worker. They also take very little of their paid vacation.

Obviously, all this work boosts production. Japan is able to transform new technologies into products and bring them to market faster than other nations. However, hard work takes its toll on workers. Alcohol abuse is rampant. Gary Katzenstein, an American who worked for Sony Corporation in Japan for a year as a management trainee, describes nightly drinking binges by his co-workers. They would get so drunk that they would denounce their company and managers loudly in public. In the morning they would remember nothing of the night before.

Another result of overwork is the *karoshi* syndrome. *Karoshi* is a Japanese word coined about a decade ago that means "death from overwork." According to Anne G. Pepper, a columnist for *Business Japan*, the exact number of *karoshi* victims is unknown, partly due to a Japanese government attempt to hide the true severity of the problem, and partly due to a lack of reporting suspected *karoshi* deaths. The problem is severe enough that the Japanese government does acknowledge *karoshi* but keeps a very narrow definition of what constitutes death from overwork.

According to Pepper, change is on the way for Japanese workers. They no longer silently endure the hard working conditions they face. In mid-1988 a group of doctors and lawyers banded together to counsel family members of *karoshi* victims. The group found that some of the victims had worked more than 50 days without a day off and put in over 100 hours of overtime per month. Even in cases like this the families were unable to prove the death was a result of overwork, due to the government's overly strict definition of *karoshi*. Groups such as these are working to pressure the government to broaden its definition of *karoshi*, allowing more families of the victims to be compensated. There has been similar pressure to regulate companies that require excessive overtime from their workers.

As a result of *karoshi* and other factors there has been a change in attitude among younger workers, Pepper shows. A young worker is less likely to accept a job that requires exorbitant overtime and is more likely to follow a normal eight to five work day. Workers are no longer guaranteed lifetime job security in return for lifetime loyalty, so they are more willing to resist tradition and work fewer hours.

These changes will alter how the Japanese do business. Fewer work hours mean decreased productivity, which could have a drastic effect on Japan's economic standing. Since Japan has relied on quality and productivity to create its current position, it will need to change tactics to compete in the world market.

Tradition on Trial

Japan is a nation based on tradition. This tradition has great impact on how the Japanese do business and how they treat people. Hard work, loyalty to

family and loyalty to the company comprise part of the tradition. Racism and sexism comprise another part.

Due to its geographic isolation, there is little racial diversity in Japan. As a result, the Japanese are less tolerant of other races than Americans. The Japanese think that they are somehow different and better than other races. Katzenstein reports that in many cases racism is infused into the Japanese language. One example is the phrase *ware-ware Nihonjin*, which roughly translated means "we Japanese," and is used to assert the superiority of the Japanese people. Although such elitism can be found in most races, it seems to be more prevalent among the Japanese. Pepper states, "As long as large numbers of Japanese continue to believe that being Japanese sets them markedly apart from everybody else in the world, then it will be difficult for them to deal comfortably and naturally with non-Japanese."

Sexism is also a big problem in Japan, in the business sector as well as society at large. Sexual harassment is slowly being recognized as a problem and more people are speaking out. A large part of Japanese culture is to downplay one's individual rights and to conform. These traits pose a barrier to reporting and acknowledging sexual harassment, according to Pepper. However, like most things in Japanese society, this is changing. People seem to be getting fed up with tradition and are willing to break from the norm. Pepper points out that groups have formed to gather information about sexual harassment and the Tokyo bar association plans to press for a change in equal work opportunities law that would include provisions against sexual harassment.

Empire or Oblivion?

The techniques the Japanese use to do business have brought them great success. However, these techniques will have to change over the next decade due to economic changes in the country.

For years most Japanese corporations have relied on the Tokyo stock market as a safe, ready supply of cash. By issuing stock, corporate Japan could raise as much as $150 billion a year. This easy cash allowed Japanese companies to modernize faster than U.S. companies, with plenty of money left over to purchase American movie studios and real estate. Early in January of this year, however, the Tokyo market dropped 30 percent. This effectively ended the availability of easy money for Japanese corporations. Kenneth S. Courtis, Deutshe Bank's Tokyo economist , states, "The money pump may be out of action." Consequently, there will likely be a drastic change in how freely the Japanese spend their money, particularly on paintings and things like Rockefeller Center. However, Japanese misfortune represents an American opportunity: The fall of the Tokyo stock market gives U.S. companies a chance to catch up with the Japanese.

They wanted us to eat in the cafeteria and go through the rain to the parking lot like everybody else. We don't go for that. —Lee Iacocca

Much has been said of the Japanese style of management. Their "bottom-up" practice has been the subject of repeated study by American corporations and educators. Based largely on Deming's idea that every worker is an important part of the team, the Japanese management structure is different than that in America. In most cases Japanese workers eat in the same cafeterias as their managers and are seen more as teammates than workers.

Winds of Change — *continued on p. 23*

TECHNOLOG

Writer Profile: Matthew Kirkwood

Matt is a first-time writer for the *Technolog* and is a man of clear thought and strong convictions. As the founding member of SMASOMM (Sensitive Men Against Sexist Oppression of Masculine Males), he is a champion against the squashing of delicate male egos.

Two Hot Dogs for Some Sushi?

by Pat Kellogg

Have American markets become easily digestible for the Japanese?

Spices, green jade, silk with intricate patterns, exotic art, and beautiful pottery. In the seventeenth century, travelers visited an island called *Zippangu* and brought back treasures never seen before.

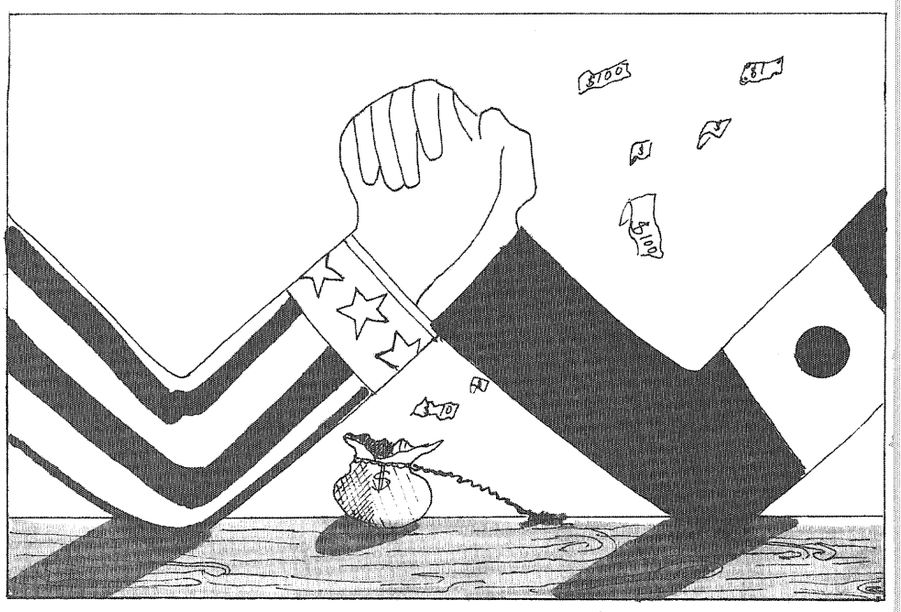
Today, we know *Zippangu* as Japan, and we are still importing its wonders: semiconductors, cars, computers and VCRs. Unfortunately, our lust for Japanese goods created a trade deficit of $49 billion in 1989. This trade imbalance is causing tension in foreign relations and threatens to erupt into a full-blown "trade war."

Rough Beginnings

Trade between Japan and the West has been difficult from the start. In 1853, Commodore Matthew Perry sailed to Japan with four warships and demanded provisions and refueling facilities. After eight months of negotiations, Japan agreed to open its ports and signed a trade agreement with Perry. Two years later, the treaty fell apart, and Japan fell back into seclusion, rarely importing or exporting any goods.

The episode with Perry taught Japan that it needed a strong central government to ward off expansionism by Western imperialist powers. For the next eighty years, Japan built up its strength, becoming a powerful and self-sufficient country.

Illustrations by Ket Khambounmy



In fact, Japan's economic start was similar to our own. The Japanese economy was built by risk-taking entrepreneurs who invested in untried products—sometimes failing and sometimes succeeding spectacularly.

Japan's government and economy were very strong at the start of World War II, but, despite this, the Japanese attack on Pearl Harbor was a military and logistical mistake. America had almost 10 times the military strength, and, by the end of the war, Japan was virtually devastated. Approximately 40 percent of its buildings were destroyed by aerial bombings and almost ten percent of its population was killed. In 1945, an editorial in the *New York Times Magazine* said, "The economy of Japan is not ever likely to expand sharply.... The prospect [is for] a return to Japan's status as a small, self-contained nation."

Surprising the world, Japan, with assistance from the United States, almost immediately implemented a concentrated nationwide recovery program. Laws and regulations were established to promote capitalism: commercial laws, banking laws and compulsory education were among several measures that had not previously existed. The Japanese government's first priority was to cultivate key industries, such as steel and electric power. They also set stringent quotas and high tariffs on imported goods, so Japanese firms could advance without competition from other countries.

According to the Japanese, America is trying to cover up the fact that it is slipping as a world power.

The Current Trade Situation

Many of Japan's tariffs remained in place for decades and are just now starting to be dissolved. Last June, the United States and Japan signed a major trade agreement called the Structural Impediments Initiative (SII), which will remove quotas on beef and citrus fruits by 1992 and help American businesses compete in Japan. In return, the U.S. government promises to reduce the federal deficit and promote Japanese investments here. For example, the Chicago Board of Trade recently introduced nighttime hours, so Japanese traders can purchase American bonds during Japanese work hours.

Strangely enough, just as Japan is reducing their tariffs, a group of American politicians advocate increasing ours. These "protectionists" claim Japan is a closed economy excluding American businesses. Many Japanese companies are formed into loose business groupings called *keiretsu*, which often lend money to each other through a group bank. American critics view this as nothing short of a monopoly and a violation of anti-trust agreements. According to rumor, Nissan chose to buy a Hitachi supercomputer last winter instead of a Cray, just because both companies belong to the same *keiretsu*.

Making matters worse, American protectionists claim Japan is using illegal business practices. Reportedly, Japan is guilty of "predatory pricing" or flooding the market with a surplus of cheap goods until all competitors go bankrupt, then raising prices to normal levels, a practice which was reportedly done with computer memory chips in the early 1980s. Also at issue is "reverse engineering," the process of stealing American inventions (often using industrial espionage to obtain secret technology), refining the products and then selling them

cheaply. Critics also claim the Japanese government makes it impossible to patent or protect an invention overseas, allowing Japanese companies to sneak in with a similar product.

Many Japanese consider the suggestions made by critics about Japanese economics unwanted and unnecessary. According to the Japanese, America is trying to cover up the fact that it is slipping as a world power, and other governments no longer obey its every command. Last spring, Japanese Prime Minister Toshiki Kaifu suggested that America should "save and invest more, increase education and job training, and force companies to see long-term goals instead of short-term profits." American economists were aghast that anyone would dare tell the United States how to run its economy, and scathing editorials were written against the prime minister.

America and Japan must work together to decrease the trade deficit and alleviate tension in international trade. Otherwise, the current friendship between the U.S. and Japan will deteriorate. A seventeenth-Century Japanese philosopher, Hondu Rimei, wrote, "Foreign trade is a war in which each party seeks to extract wealth from the other." Unfortunately for the United States, the Japanese are winning the war. ❐

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TECHNOLOG

Writer Profile: Pat Kellogg

Pat, intrepid champion of the society of hard-core sword battlers, is a repeating phenomona here at the *Technolog*. Shown here in preparation for interviews with professors and administrators disgruntled with our editorial content, Pat is a man unafraid to battle authority.

The Man with the Plan

by Tom Halvorsen

The decline of American industry in the context of Japan's overwhelming success is old news. Few people realize this transition was initiated by an American quality-control expert. When his words fell on deaf ears at home, he gladly took his message abroad where he found an eager audience in the Japanese.

The Story Begins

The story begins back in 1947 when an American statistics expert named W. Edwards Deming was hired to help with the Japanese census. Mary Walton, in her book *The Deming Management Method*, recalls Deming's first impression of Japan. He found a nation where "the industrial base was in ruins; agricultural production was off by a third. The once prosperous populace had first gone without consumer goods, then without food for the wartime effort."

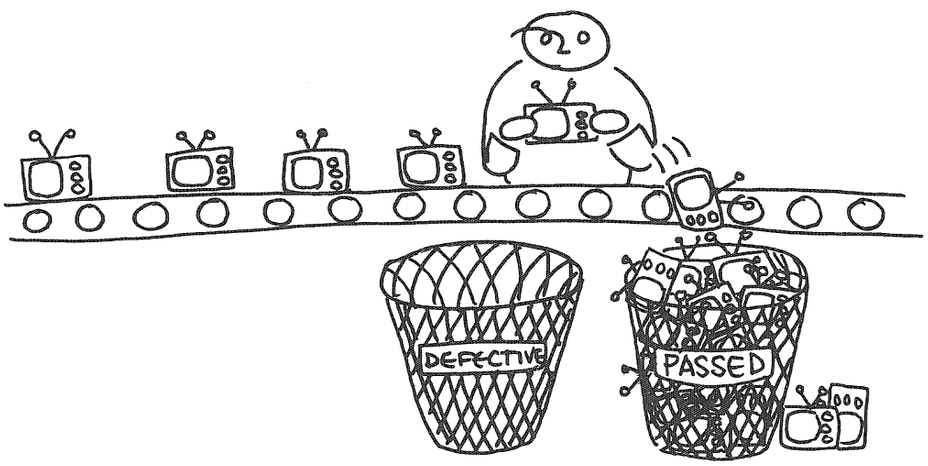
A small group of Japanese industrialists, determined to aid their country in the reconstruction effort, joined together to form the Union of Japanese Scientists and Engineers (JUSE). Having become acquainted with Dr. Deming and his work, they invited him, in March 1950, to deliver a lecture on quality-control methods. Dr. Deming told them, "You can produce quality. You must carry out consumer research, look toward the future and produce goods that will have a market years from now and stay in business. You can send quality out and get food back." Reflecting on this lecture, Dr. Deming recalled, "I told them they would capture markets the world over within five years. They beat that prediction. Within four years, buyers all over the world were screaming for Japanese products."

Deming's initial contact blossomed into a long and prosperous association with Japanese industry, an alliance continuing to this day. Japanese industry adopted Deming's principles wholeheartedly. Walton reasons that perhaps it was because they had nothing to lose. "The Japanese embraced the Deming philosophy, channeling the energy that had made them such a fearsome military enemy into making them a formidable economic opponent." The results were immediate and dramatic. The key JUSE personnel were trained by Deming and soon began training others. Within 10 years, almost 20,000 engineers received rudimentary training in Deming's methods.

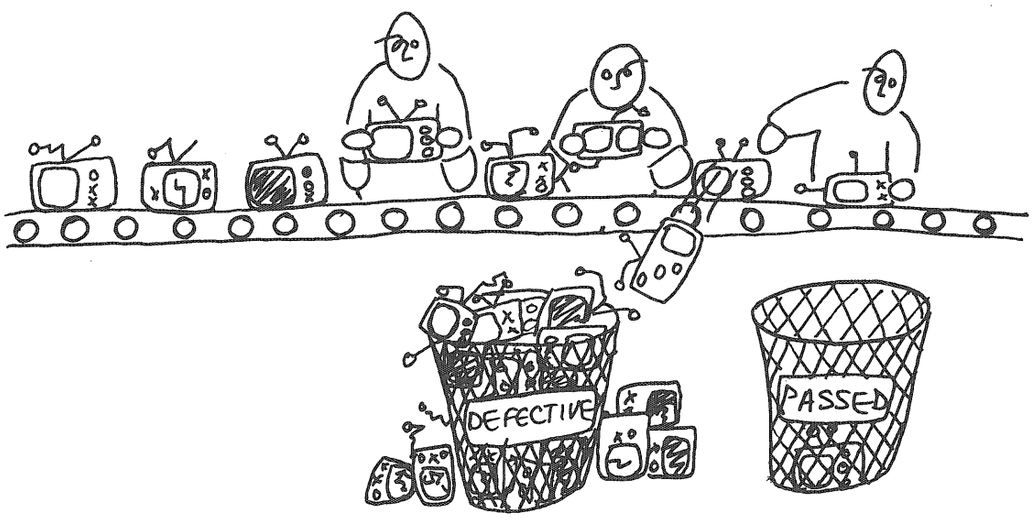
Do we have only ourselves to blame for Japan's business success?

As a show of appreciation JUSE established the Deming prize in 1951, to be awarded in two major categories: to an individual for accomplishments in statistical theory and to companies for accomplishments in statistical application. The status of this prize has grown over time until it is now one of the most sought after awards in Japanese industry. Recently, an American company, Florida Power and Light, became the first non-Japanese company to win this coveted honor (see page 17).

During this time, America's industrial giants seemed unaware of and unconcerned with the



Illustrations by Joyce Rajendren



strides that Japanese industry was making under the tutelage of Dr. Deming and other quality-control experts. By affirming the Deming principle of continuous improvement in quality, Japan progressed from student to teacher. In the mid to late 1970s, the American public became enamored with the quality of Japanese-made consumer goods. American industry was "suddenly" faced with the crisis of Japanese competition.

In 1980, NBC aired a documentary entitled "If Japan Can... Why Can't We?" Dr. Deming was interviewed on the program and the next day he was bombarded with calls. Walton notes many of the callers were desperate, "They had to see him tomorrow, or yesterday, or their whole company would collapse." America had finally discovered its native son.

In recent years, W. Edwards Deming has become a major player in the resurgence of interest in Total Quality Control (TQC) within this country. Corporations such as Honeywell, Ford Motor Company and AT&T have implemented his methods with great success. Despite this achievement, there remains much ignorance within this country about the man and his approach. During my research, I encountered a pervasive lack of knowledge and information about the Deming management method. This situation is an obvious conundrum. Given his spectacular success in Japan and proven track record in America, why has the Deming method failed to galvanize American industry into action?

American Company Saw the Light

American industry received a much needed boost in its quality-control efforts last year when an American company, Florida Power and Light (FP&L), became the first recipient of the Deming Application Prize for Overseas Companies. As reported in *Quality Progress* magazine, this milestone was achieved after the company had spent the entire decade of the 1980s establishing its Quality Improvement Program.

In 1981, while searching for a way to improve quality in the face of spiraling costs, FP&L contacted a Japanese utility company that had already implemented a program of Total Quality Control (TQC). Kansai Electric Power Company had successfully applied the principles of W. Edwards Deming to a company in the service rather than the manufacturing sector. With the help of Kansai, FP&L became affiliated with the Japanese Union of Scientists and Engineers (JUSE), the sponsors of the Deming Prize.

The managers of FP&L learned, from their Japanese mentors, that policy deployment is the engine of a quality-improvement program. It was the responsibility of top FP&L management to take the corporate vision and determine priority issues that would make the vision a reality. Each department in FP&L was responsible for drafting plans to make improvements in the areas of reliability, customer satisfaction, and employee safety. JUSE counselors stressed the need to focus on no more than three problems, but to focus in great detail.

In July of 1988, FP&L announced its intention to seek the Deming Prize. The application process was long and arduous. In the process of writing the documentation for the prize, executive vice president Wayne Brunetti realized the Deming Prize was the means, not the end. "The corporate vision for Florida Power and Light will continue to be total quality control. The Deming Prize was a way to help achieve that goal. It's not the other way around. Winning the prize is not the end result; improvement in the company and achieving customer satisfaction—that's the end result."

Why Not in America?

The reasons behind the lack of acceptance of Deming's philosophy are many and varied. Walton believes American industry did not embrace Deming in the post-war period because it had no need to do so. America finished World War II with a strong economy, well-positioned to take advantage of the vast consumer demands existing in the world. Walton notes that in such a seller's market, American managers equated their profitability with good management. In fact, any management style would have worked in such a situation.

Dr. Deming recalled, "I told them they would capture markets the world over within five years. They beat that prediction."

In the late 1960s, the first hints of Japanese competition began surfacing. When the reality of Japanese economic ascendancy became undeniable, American management adopted the simplistic approach of attempting to copy the Japanese. This attitude led Dr. Deming to remark, "I think that people here expect miracles. American management thinks that they can just copy from Japan. But they don't know what to copy. (In Japan) they are using statistical methods. They have not only learned them, they have absorbed them, as Japanese absorb other good things of cultures."

Kevin Dooley, a professor in the Mechanical Engineering department at the University of Minnesota, contends there is a sociological difference between Japan and the West that has prevented the Deming method from taking root here. In Japan, the Deming approach blends well with a culture emphasizing collectivism and intrinsic reward systems. On the opposite end of the spectrum, the dominant individualism of American culture often becomes an obstacle when companies attempt to implement TQC.

Dooley's words were confirmed recently when newspaper reports revealed aircraft manufacturer McDonnel Douglas was running into problems implementing a program of TQC. Apparently, in a heavy-handed attempt to change overnight (we'll copy the Japanese, and we'll do it all at once), McDonnel Douglas had enacted a TQC program across the board. According to the July 22, 1990 edition of the *Minneapolis Star Tribune* the result of McDonnel Douglas' action was the "firing or demotion of hundreds of middle managers and the assembling of virtually autonomous teams of workers." McDonnel Douglas and fellow aerospace giant Northrop Corporation were "running into the age-old problem of egotistical supervisors unwilling to act on an employee's suggestion."

Looking Towards the Future

Despite America's dismal record in the past, there are signs we may have finally acknowledged the importance of quality control. In 1987, President Reagan signed the Malcolm Baldrige National Quality Improvement Act, which established a national prize for excellence in TQC. In an article analyzing the differences between the Deming Prize and the Baldrige Prize, Professor Dooley notes the two prizes reflect the individual country's view of TQC and statistical methods. Both prizes, however, promote quality control.

Professor Dooley has been actively promoting the Deming method locally and is optimistic about the future of TQC. Through his consulting work, Dooley has observed the transformation of several local and national companies. From his perspective as an instructor of future engineers, Professor Dooley is concerned that technical students become acquainted with the principles of quality control. He cautions students to avoid placing an inordinate amount of emphasis on the technical side of their education, while failing to realize our endeavors are ultimately directed towards satisfying the needs of a customer.

American industry will be transformed, Dooley contends, when engineers forego their passive support of the status quo and take the risks necessary to implement a system of TQC. As the experience of McDonnel Douglas suggests, this includes the risk of relating to production workers on an equal level. Deming repeatedly states the "man on the floor" is the expert concerning his particular job. Dooley cautions students to avoid the intellectual snobbery that may cause them to look down on blue-collar workers. Total Quality Control will succeed only where free and open communication exists from top management down to the lowest worker. ❐

Fourteen Points for Success

Dr. Deming has distilled the essence of his teachings into fourteen points. In *The Deming Management Method*, Mary Walton summarizes these as follows:

1 Create constancy of purpose towards the improvement of products and services with the aim of staying in business. Innovation, research and education, and maintenance of facilities are essential for this goal.

2 Adopt the new philosophy. As Walton phrases it, "Quality must become the new religion."

3 Cease dependence upon mass inspection. Strive to build good quality in rather than inspect bad quality out.

4 End the practice of awarding business on the basis of price tag alone. A company is better served by developing long term relationships of loyalty and trust with a single vendor.

5 Constantly improve the system of production and service. Management must lead the way on this effort which never ends.

6 Institute training and retraining for all employees.

7 Focus managers and supervisors on leadership of their employees.

8 Drive out fear. Do not blame employees for "system problems." Facilitate communication.

9 Break down barriers between departments. Encourage teamwork between different areas such as research, design, manufacturing, and sales.

10 Eliminate slogans, targets, and exhortations for the work force without providing better methods of work.

11 Eliminate numerical quotas.

12 Remove barriers to pride of workmanship.

13 Encourage the education and training needed for continual adaptation to new processes.

14 Take action to accomplish the transformation.

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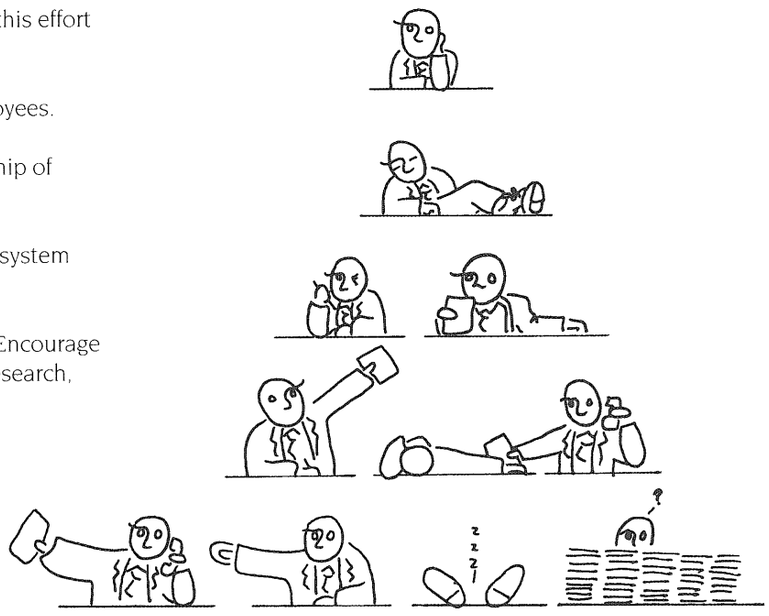
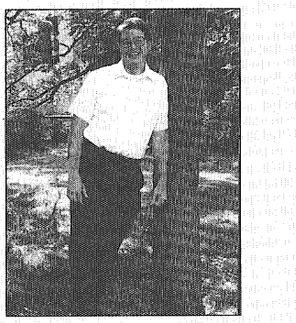




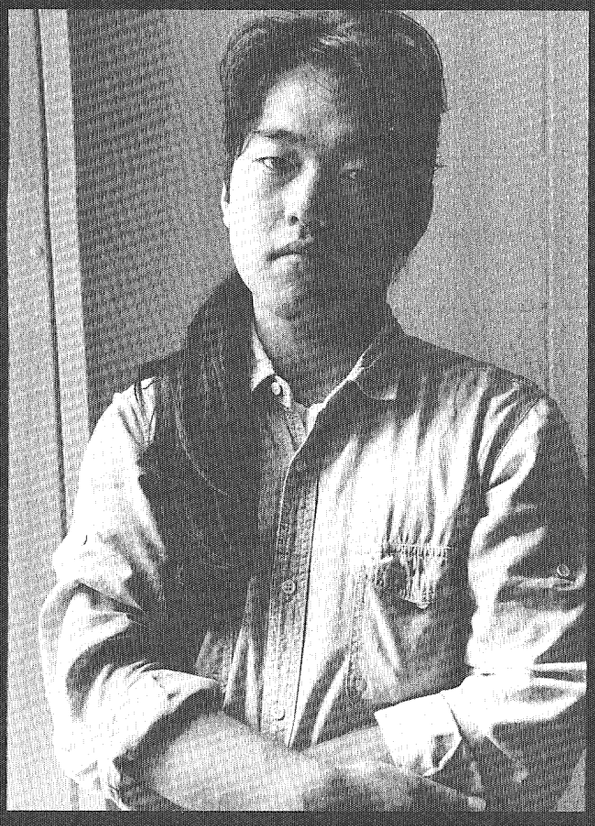
TECHNOLOG

Writer Profile: Tom Halvorsen

A family man, Tom is a great admirer of Dr. Deming and a disciple to his techniques. In the Halvorsen household, decisions are made after lengthy consultation with the underlings (his children). Spankings, dinner courses and bedtime are topics sure to cause lengthy debates.

Hard Times at Hirohito High

by Paula Zoromski

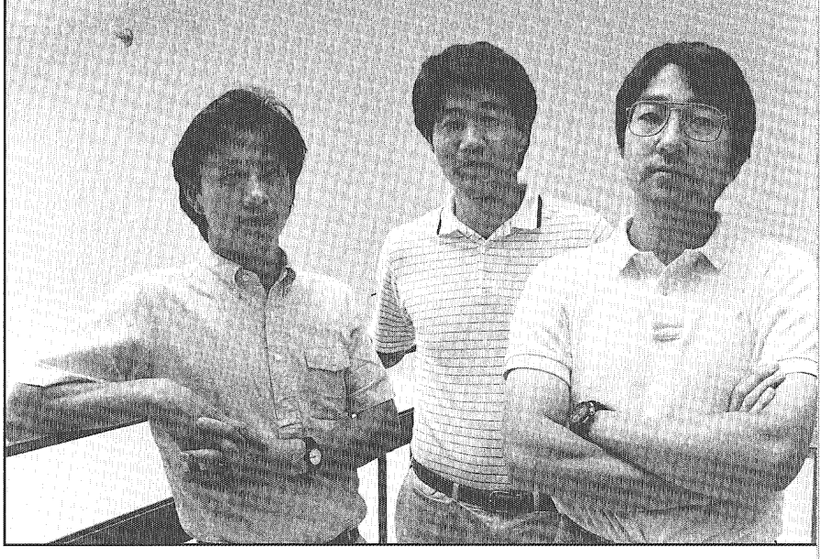


岸上 輝久

Teruhisa Kishigami was surprised to see professors performing these types of tasks at this university. He said that, in Japan, students prepare the classrooms for their professors.

When was the last time you saw a student rush to the front of the classroom to erase the blackboard or operate the slide projector? Have you ever seen a student carry a professor's supplies?

境 ゆかり



Above, from left to right, are Teruhisa Kishigami, Mitsuho Seki and Atsushi Suzuki. Pictured on the previous page, from top to bottom, are Toshihiro Shinomiya and Yukari Sakai. All of these people are natives of Japan.

In general, professors are more respected in Japan than in the United States. Atsushi Suzuki stated, "Professors are great!" They are highly regarded by community members as well as students. Mitsuho Seki stated, "Their social status is first level." Not only do professors have prestige in Japan, but so do elementary and secondary school teachers. In fact, the Japanese Social Mobility Survey of 1975 ranked elementary school teachers higher in status than civil and mechanical engineers.

In addition, university professors were ranked lower than only two other professions: high court lawyers and presidents of large companies. Because of the status associated with educators many Japanese people want to become teachers, even though the pay is not especially good. In 1986, for example, the ratio of applicants to available positions was 5:1. (Business is the only profession that is more popular.) Because there are so many applicants, the field is extremely competitive, with jobs going only to the best teachers.

Besides the gap in status between teachers in Japan and those in the United States, many other differences exist between the educational systems. Ranging from actual class time to entrance exams, the contrast is apparent as early as the elementary school level.

Japanese youngsters attend classes six days a week, are given homework on a daily basis and have only forty days of summer vacation.

Japanese youngsters spend more time in school than their counterparts in the United States. They attend classes six days a week, are given homework on a daily basis and have only 40 days of summer vacation. During these vacations, they do drills and practice problems in preparation for the upcoming year.

Students do not automatically progress to high school in Japan (only elementary and lower-secondary schools are required). Students must take entrance examinations in English, math, science, social studies and Japanese to get into upper-secondary schools. These exams determine which schools a student is eligible to attend. The schools are clearly ranked according to their university placement, and these ranks are known and valued by the public. In Japan, attending a prestigious upper-secondary school is important for one's career.

To study for these exams, students often enroll in special private classes called *juku*. These classes are available for students as early as the first grade. Two *juku* classes are usually offered after school every day, and each class consists of hour-long tutorials that are extensions of their regular classes. Most students go to *juku* three days a week, but they may attend as many as six.

Approximately 94 percent of Japanese students attend an upper-secondary school. Discipline is not a problem in these schools because attendance is not mandatory. If a student is not happy, she or he is free to quit, said Yukari Sakai. By this point in their careers, most students have the ability and motivation to excel.

Most of the students in a class have the same level of skill, so emphasis is placed on teaching the average students. Kishigami said that the top students receive very little attention, unlike American schools which focus on those with extraordinary abilities. When they teach, Japanese teachers treat their classes as a whole rather than as individuals; students compete so they won't fall behind or get too far ahead of their peers.

The last two years of high school are often referred to as "examination hell." Students rarely get more than five hours of sleep a night because they are so busy studying. Clubs for sports, cultural and recreational activities exist, but they are not nearly as important in Japan as they are in the United States. Most Japanese

students just do not have the free time to get involved in extracurricular activities.

Besides limiting the free time of upper-secondary students, exam preparation produces many negative side effects. The emphasis on the entrance exams forces upper-secondary schools to teach test-taking skills and rote memorization, at the expense of creativity. Students are allowed to choose less than 10 percent of their classes, and, according to Toshihiro Shinomiya, social studies and living-skills courses are generally neglected. Throughout upper-secondary school, students take national practice tests which are then reviewed by teachers, parents and students. Together, they decide what schools each student should try to attend. If a student is having problems, she or he may attend *juku*, or another type of preparatory school called *yobiko*.

Yobiko classes are large, unlike *juku*. These classes are offered after school, on weekends and during vacations for upper-secondary students. They are also available all day for students who have finished school but did not pass their exams during the previous year. Students can only take the exams two years in a row without affecting their careers, so they need to be well prepared for the second set of exams. Exam scores are so important that *juku* is now available in some parts of the United States for Japanese students who plan to attend universities back home. The exam scores are a serious concern because they determine a student's university placement. Like the upper-secondary school, the universities are ranked and the prestige of a school is a significant factor in future job placement.

Because students have proven their abilities by examination before they enter the university, Japanese universities focus on understanding concepts rather than memorizing them, and grading is subjective. Seki said that most university students receive A's. While high grades are necessary for employment, the prestige of the university is more important than what the student learned.

The last two years of high school are often referred to as "examination hell."

The Japanese educational system has many advantages over the U.S. system, yet it also has disadvantages. For example, most Japanese people are not able to attend university classes at any point in their lifetimes. Suzuki is impressed with U.S. higher education and said that it "is open to anybody who has a mind to study. I envy your nation, during your lifetime you have many opportunities to learn." Even in mid-life, a person can change careers by going back to school.

Not only do people of all ages study at the university, but people from various backgrounds study here as well. For instance, Americans representing many ethnic groups, as well as people from countries all over the world, study in our universities. In Japan, however, 98 percent of the students are Japanese with little racial diversity.

The educational system in Japan is certainly different from our own and, while you probably won't ever see a student preparing the classroom for a professor at this university, you might see one presenting an opposing viewpoint in class or giving the professor direct feedback.✪

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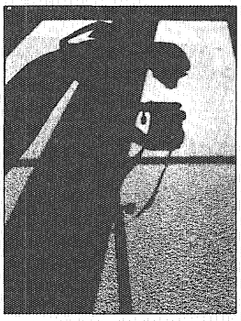

TECHNOLOG

Writer Profile: Paula Zoromski

Paula is a long-time contributor to the *Technolog*, as a writer and photographer. The long years of slave labor for the magazine's tyrannical editors has made her, as you can see, only a shadow of her former self. Rumor has it that Paula will be receiving a degree in Chemical Engineering and departing the U for parts unknown sometime soon.

Winds of Change

(*continued from page* 12)

American businesses have been reluctant to accept this practice. Much of Lee Iacocca's success in turning around Chrysler in the early 1980s was based on the team idea, but he was unwilling to fully eliminate barriers such as separate cafeterias and executive washrooms. In response to a group from Chrysler that studied the Honda management structure, Iacocca said, "They wanted us to eat in the cafeteria and go through the rain to the parking lot like everybody else. We don't go for that."

The teamwork idea, combined with societal factors, has made the Japanese management structure very successful. Nonetheless, their management structure faces new challenges that likely will demand change. With a growing rebellion against long working hours and decreased job security, Japanese managers may have to be even more willing to make workers part of the team and give them more power and input.

In the post-war era, Japan has shown strength and ability in overcoming adversity to create an empire, much as America did when it turned wilderness into the nation it is today. When America succeeded, we got fat and lost our edge. Japan has also succeeded, although at the expense of the workers. Katzenstein quotes one of his Japanese co-workers as saying, "We Japanese don't see trying harder as the only solution. We say '*Shikata ga nai*,' which means, 'It can't be helped; there is nothing we can do. We must accept things beyond our control.'" With the winds of change blowing across Japan we will get to see if Japanese business managers have also gotten fat, or if they will be able to both satisfy their workers and survive change and adversity to stay at the top. ❐

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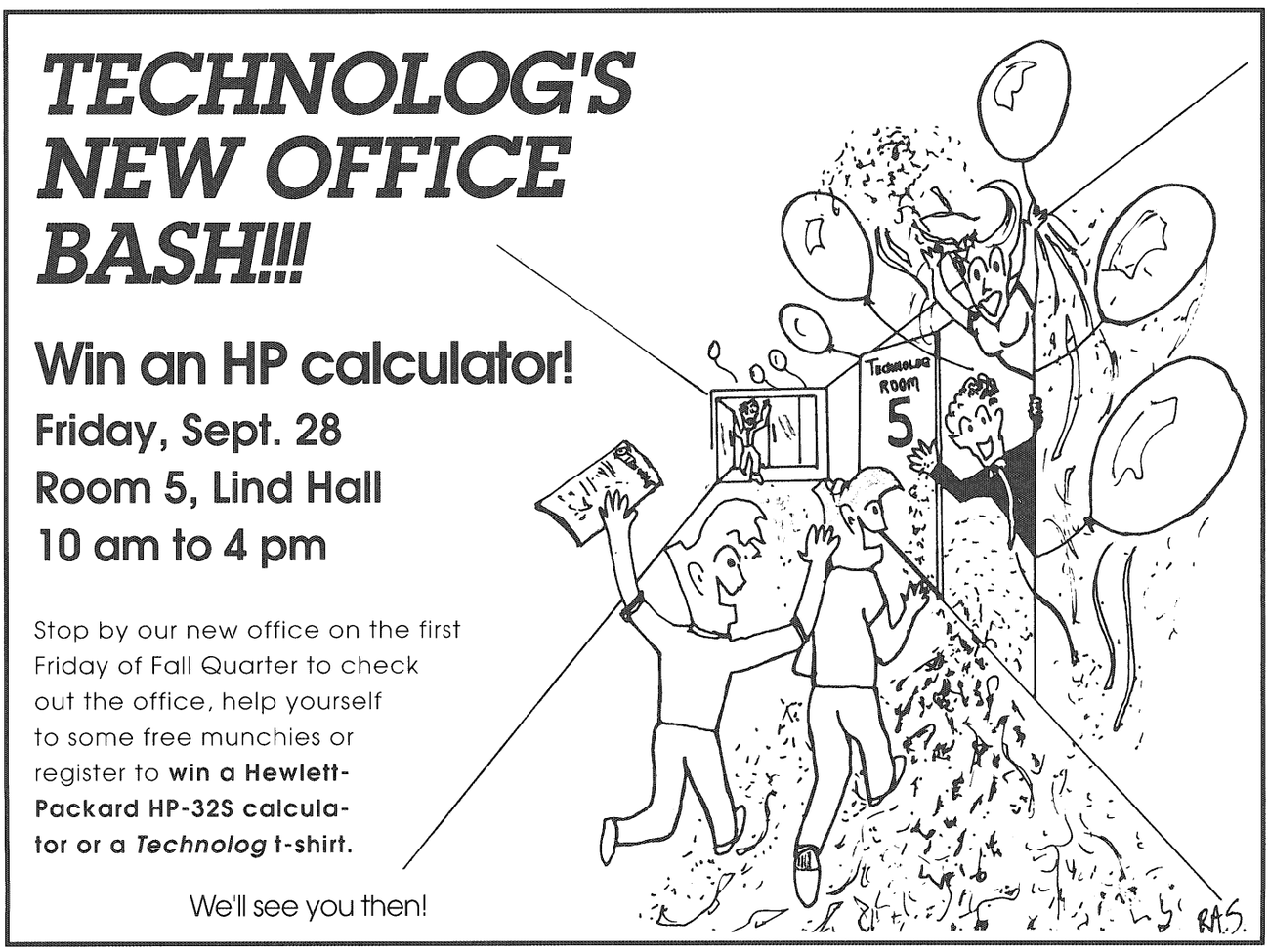


Say Goodbye, Casey Jones...

by Paul Kim

Time is running out for the United States in its race for maglev. Will we ever catch up? Can we?

The year is 1992 and the town is Vegas—the city that never sleeps. I was at Caesar's flirting with the Lady of Fortune but my luck was fading fast and so was my money. I decided to hit one of the other joints—I was sure the bums had these tables rigged—so I hopped the maglev down the Strip. There wasn't much happening at two in the a.m. and my luck was lousy at the tables. I paid my fare, found a seat, and a few seconds later we was doin' almost a mile a minute but it felt slower than the Topeka Two-Step. Cripes but I missed the old days. It seemed like everything was changing but me. Even the trains were changing—no more rails or brakes. No whistles, no conductors, and no bumps. Transit Authority still sunk you for two bits though. Some things'll never change...

Below: Las Vegas will have the first maglev in the country. Unless the U.S. can generate more interest, however, the commercial benefit may be lost.

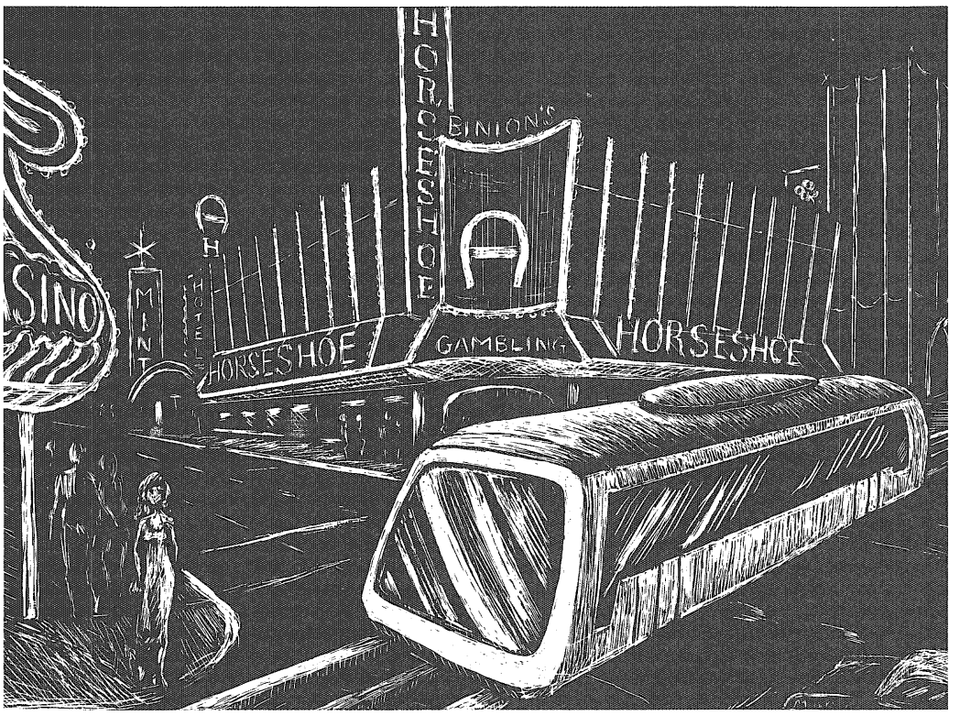


Illustration by Melinda Maurey

The Application of a Simple Truth

This is magnetic levitation technology—maglev for short—and welcome to it. At 60 mph all you'll hear is the air conditioner and the conversation next to you. The jolts, squeaks and clatter you've come to expect from a conventional train will become a thing of the past; instead of wheels, a magnetic strip is attached to the train's underbelly and suspends the train in midair by the repulsive force of magnetic coils imbedded in its "tracks." If construction goes as planned, the 1.3 mile, $65 million Las Vegas maglev project will soon become both a reality and the first commercial maglev system in the country.

The system works on the basic principle that magnets of the same polarity repel and magnets of opposite polarity attract. This simple truth, when applied correctly and with a little technical finesse, can be used to propel a train under nearly frictionless conditions. Suspending the train in the air can be accomplished by either attraction or repulsion: if the magnets attached to the bottom of a train are given the same polarity as the magnets on the surface of the track, the force of repulsion will push the train off the ground (figure 1). Similarly, if metal arms attached to the bottom of the train wrap around a single rail guideway much like that of a monorail, the arms' magnets will be attracted to the lower surface of the rail and the

force of attraction will be balanced by the weight of the train (figure 2).

Movement is produced by employing the same principles used to suspend the train. Permanent dipole magnets are positioned along the length of the train (figure 3) and electrical current magnetizes the coils imbedded in the track. Each magnet will be attracted to the guideway coils in front of it and repulsed by the coils behind it, producing forward motion. As each section of the train passes by, the coils reverse polarity and the cycle is repeated. The maglev's speed depends on the rate of these reversals—the faster the cycle is repeated, the faster the train goes. If the train begins to stray off course, the coils along one side of the U-shaped guideway apply an attractive force while those on the other side produce a repulsive force, thereby correcting the drift (figure 4). The timing and control of the coils is coordinated by on-board computers, and electrical substations are placed at relatively short intervals to ensure that only the section of track the maglev is currently passing over will be magnetized, thereby reducing energy costs.

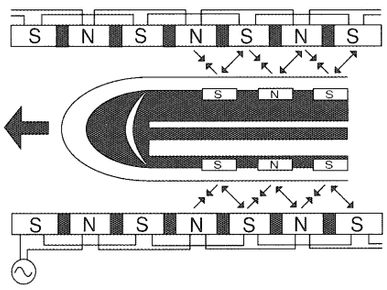


Figure 3: Superconducting magnets and propulsion coils send the maglev forward.

An International Undertaking

While commercial maglev trains have only recently become reality, the technology has been around for more than thirty years. Beginning in 1967, James Powell, a nuclear engineer at New York's Brookhaven National Lab and his colleague Gordon Danby, a physicist, developed the concept of a wheelless train propelled by superconducting magnets. Soon after, during the early 1970s, maglev research was taken over by the government and a federally-funded, $32 million high-speed maglev test facility was constructed in Boulder, Colorado. Unfortunately, it was shut down in 1975 due to a lack of political backing, even though U.S. maglev research was running neck and neck with that of other nations.

The maglev concept never fully recovered in the United States, but it bloomed in other countries. Japan, for example, has done most of the world's research on superconductors and is now applying this research to its maglev program. Most Japanese maglev designs employ superconducting magnets because of their relatively light weight and the strong magnetic fields they produce compared to conventional magnets. These magnets, which are cooled using liquid helium in order to bring about their superconducting characteristics, must be strong enough to raise the train five to seven inches off the ground (figure 5) and provide a buffer zone that can absorb the large number of mini-earthquakes that plague the Japanese islands.

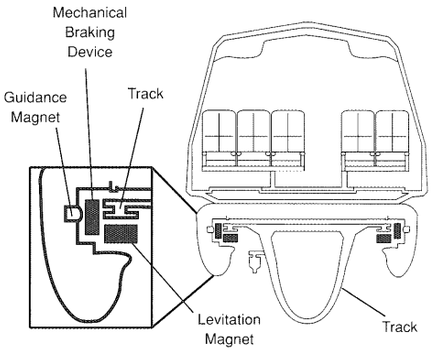


Figure 2: Attraction force. A metal arm wraps around a single rail while guidance magnets on either side balance the train.

The magnets needed to produce this lift put out approximately 40,000 Gauss of magnetic force and expose passengers to nearly 200 Gauss. Unfortunately, this is a health risk since 200 Gauss of magnetic force will stop both digital watches and pacemakers. Shielding will be required by 1992 when Japan's new 350-mile commercial route between Tokyo and Osaka becomes operational. The maglev will consist of 14 cars, each accommodating 40 to 90 passengers, and it will run at speeds well over 300 mph.

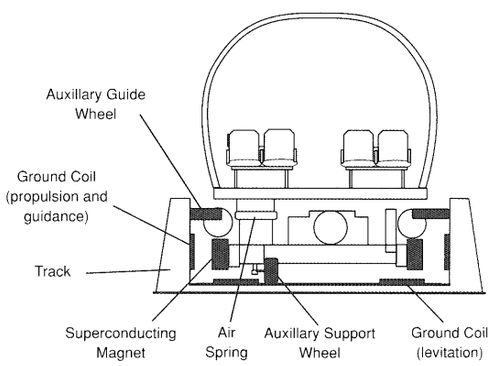
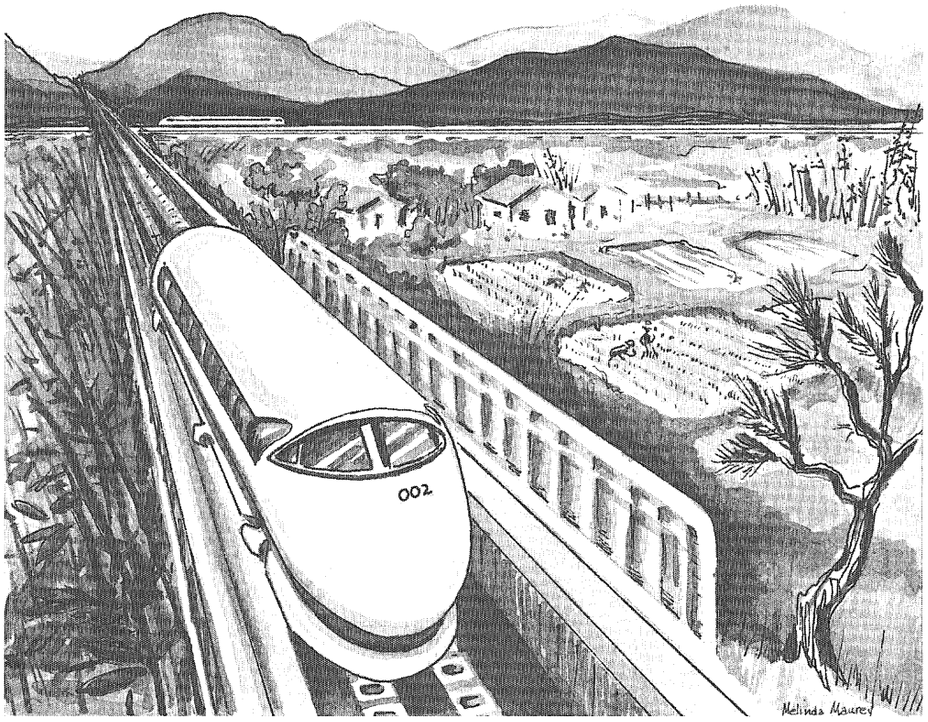


Figure 1: Repulsion force. Bottom magnets push against the track to suspend the train.

West Germany's latest prototype, the Transrapid 07, is the result of nearly $2 billion in government aid. Propulsion for the Trans-rapid is provided by something called a three-phase long-stator linear inductor that spans the entire length of the track. This inductor can produce a travelling magnetic wave by sending AC current through the tracks, a phenomenon not unlike a beachball being passed along by a human wave at a baseball game. The maglev's speed is adjusted by simply varying the strength of the current.



For distances under 500 miles, the maglev is more cost efficient than both airplanes and highways, with little effect on the environment.

The magnets used in the Transrapid are conventional, non-superconducting electromagnets and tip the scales at nearly 100 tons per train car. They are part of a design that uses the attraction method to suspend the train; however, levitation by attraction is inherently unstable since the train's magnets are continually trying to clamp themselves to the monorail beam. In order to provide enough force to pull the train into the air and yet retain enough clearance to absorb irregularities in the track, a very small gap—less than half an inch—must be maintained by computer sensors that continually monitor changes in the gap and vary the flow of current to the magnets to compensate for small variations. The track itself will account for nearly 90 percent of the total cost of the project—the price of the guiderails alone will be around $10 million per mile for Germany's new 95-mile, 250-mph commercial route from Hanover to Hamburg, which is scheduled to be completed by the mid-1990s.

Is It Too Late for the U.S.?

The U.S. is also making an effort to revive interest in maglev on both a national and local level. The construction of commercial maglev routes has already begun in both Nevada and Florida and another dozen states are studying the feasibility of such projects. However, the private investors who are undertaking these projects are employing Japanese and German technology, not American.

According to Senator Daniel Moynihan of New York, who is leading the fight for maglev on Capitol Hill, America is "on the verge of losing potential advantage in maglev technology and may well permit the commercial benefit to go to others." Two bills have been proposed by Senator Moynihan to provide nearly $300 million for maglev R&D and the construction of a national maglev system.

However, only a handful of people in the U.S. have experience in maglev technology and they are scattered among government, industry and academia. Time will be needed to bring these people together and generate interest among new college-level engineers and scientists; unfortunately, only three to five years remain before we are left by the wayside for good.

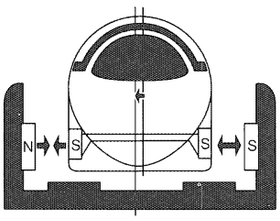


Figure 4: If the train veers, magnets repulse on the near side and attract on the far side.

Why maglev? Because while aircraft are ideally suited for covering very long distances efficiently, they are poorly suited for short and medium distance travel. The average length of an interstate flight is 500 miles and the average cost to transport

one person one kilometer on this flight is approximately seven to nine cents; a short flight from New York to Washington, D.C. costs nearly 19 cents per passenger-km. Distances of less than 500 miles are well suited to maglev technology, which can operate at six to nine cents per passenger-km. Maglev routes are also more efficient than interstate highways: one mile of maglev costs around $10 million, whereas one mile of interstate can cost up to $25 million. While an interstate can serve more people, it also uses more land than maglevs since maglev guideways can easily be elevated and routed over existing buildings and roads.

Travel doubled from 1970 to 1985 and is projected to double again by the year 2000. The number of cars on American roads is also predicted to double within the next 30 years. Many metropolitan freeways are already congested each and every day and, like airports, room for expansion is limited. High speed, interstate maglevs and slower, intercity and airport maglevs will help to ease this congestion. Maglevs won't face the same noise complaints that airports face, nor will they contribute nearly as much to smog, acid rain and global warming. Magnetic levitation technology possesses many advantages and relatively few disadvantages. It remains to be seen whether the United States can beat the clock in its race to generate interest in a nationwide maglev system, or whether it will once again be left at the wayside by other, more technologically-advanced nations. ❐

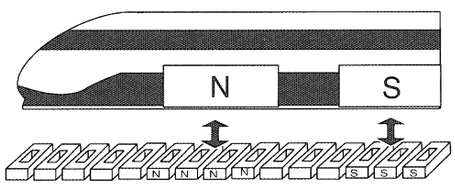


Figure 5: Japanese design. The magnetic fields must be strong enough to lift the maglev 5-7 inches off the ground.

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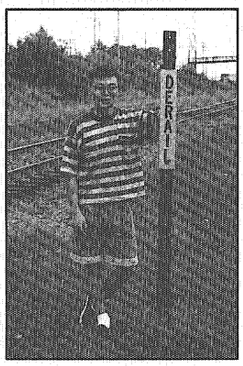


TECHNOLOG

Writer Profile: Paul Kim

Paul once dreamt of becoming a mechanical engineer and designing the world's fastest trains. When Paul changed his major to physiology/pre-med, he remained true to his vision of working with trains. He plans to surgically reassemble the broken bodies of crash victims thrown from 300-mph maglev trains.

Wolves Den

by Darin Warling

The Target Center Arena, the Minnesota Timberwolves' new playground, located across from First Avenue in downtown Minneapolis, contains one of the Twin Cities' newest large-scale engineering projects. The $60 million arena features some of the most sophisticated technology in the NBA. Two of those features are the court floor and the high-resolution color scoreboard with replay capabilities.

The floor was specially designed by a team of architects and engineers to provide the best sightlines of any NBA arena while retaining the ability to host other events. These events include hockey games, ice shows, concerts, circuses, rodeos, conventions—and maybe best of all—the World Wrestling Federation.

The arena floor is lowered for basketball games to give the feeling of being on top of the action and to allow the first-row seats to be directly on court level. For most other events, the floor is raised five feet to provide a ready-made stage that enhances sound quality, viewing and safety.

When the $2 million floor is prepared for hockey games or ice shows, it weighs 4.1 million pounds, but has the capability to move more than five million pounds when fully loaded. Even under full load, the floor can move five feet in less than 20 minutes while bending no more than 1/16 inch over its entire 200-foot length.

When the $2 million floor is prepared for hockey games or ice shows, it weighs 4.1 million pounds, but has the capability to move more than five million pounds.

The floor is raised and lowered by 98 computer-controlled screw jacks driven by a synchronous motor. To keep the floor on an even keel, each jack is allowed to move independently while adjusting as needed to maintain the synchronous movement.

According to Peter Levy, construction project manager for the Timberwolves, enough redundancy is built into the system so if one jack failed, the floor would continue to operate without interruption.

"We could even lose more than one jack, depending on where it is in the floor, and it won't affect the operation," Levy said.

The Rosemount Horizon in Chicago has the only other movable floor in the U.S. The Rosemount's surface, however, was a retrofit and maintain an ice surface. It also sits directly on a bedrock foundation, while the Target Center Arena sits on a set of pilings and caissons that run through the 150,000 square foot health club located beneath the arena. The foundation of the Wolve's 18,000 seat arena, which has an underground river running beneath a corner of the site, was difficult to construct because the entire building is compressed onto only two square blocks—the smallest site of any major league arena in the U.S.

The complete project is expected to generate $30 million annually and draw two million people to 200 events per year. The arena's grand opening is tentatively scheduled for mid-October.❐

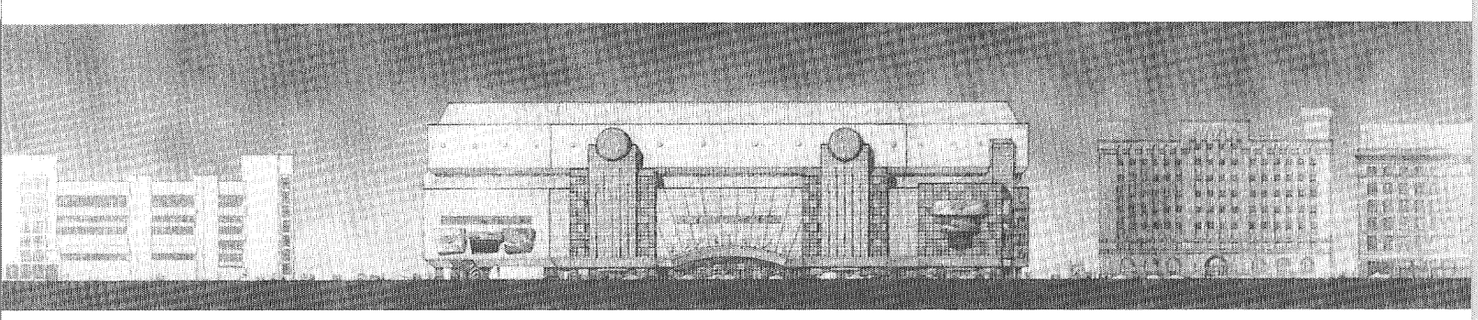
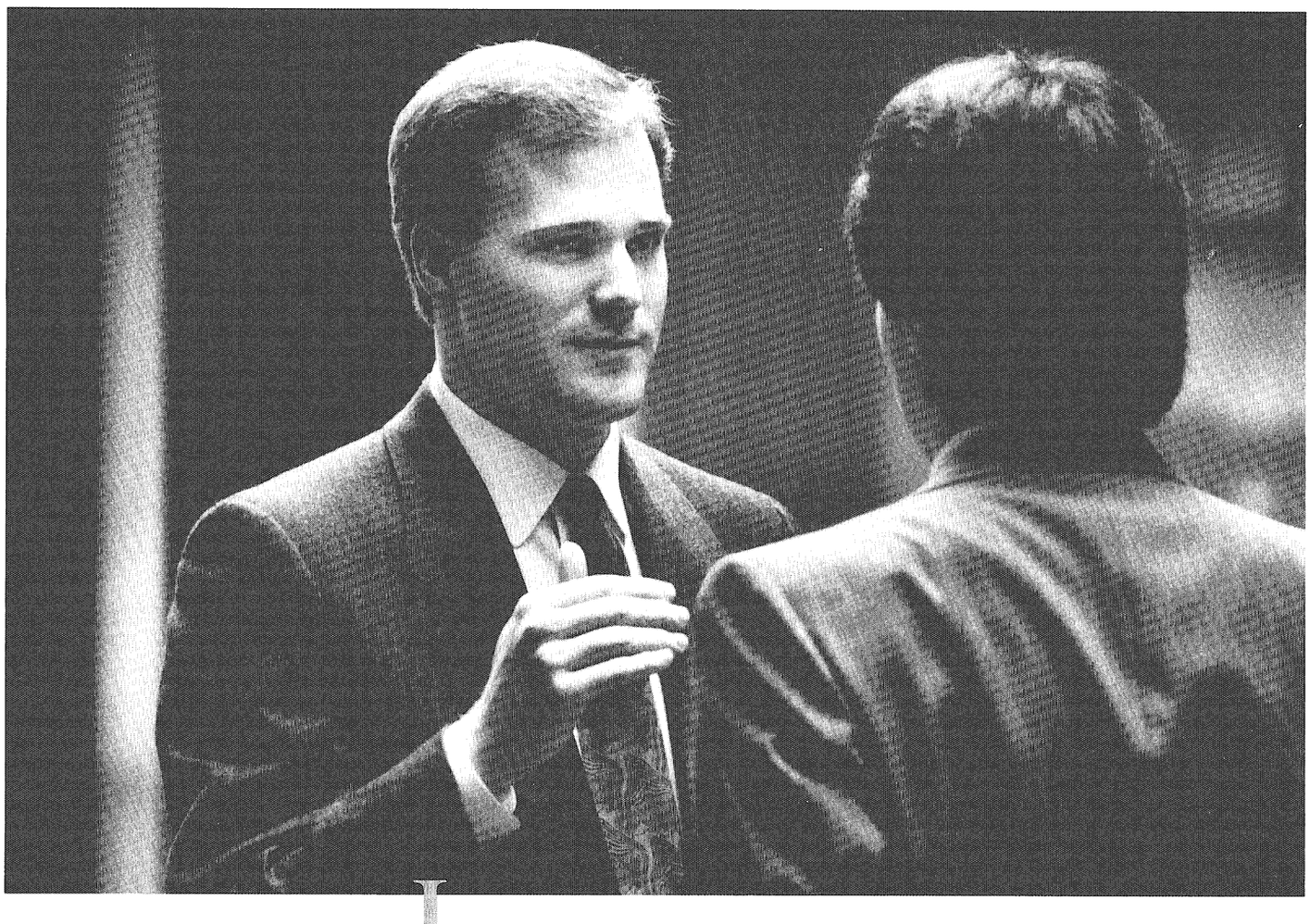


Illustration courtesy of the Timberwolves

Jeff Lime never turns down a challenge.



Imagine walking into a management opportunity straight out of school. That's what happened to Jeff Lime when he entered GE's Chemical & Materials Leadership Program.

GE needed a replacement for an experienced engineering manager—someone to set up the new waste treatment system for a major manufacturing plant. Jeff was asked to step in and he did, right into a leadership role.

Jeff helped GE plant managers and environmentalists join forces with the EPA to ensure a clean operation. It challenged not just his technological skills, but also his ability to communicate and take charge.

That may seem like an awful lot of responsibility for a job right out of college. But that's the GE way. We hire exceptional people. Then we give them the chance to show just how exceptional they are.

If you're looking for a challenge to live up to, start looking at GE.

World of opportunity.

An equal opportunity employer.

Diversions

Back by Demand

Caption Contest 90!

The tradition continues. Suggest the funniest caption for the picture at right and win fabulous prizes. Enter as often as you wish.

FIRST PRIZE: MacWrite II or $25

SECOND PRIZE: *Technolog* T-shirt

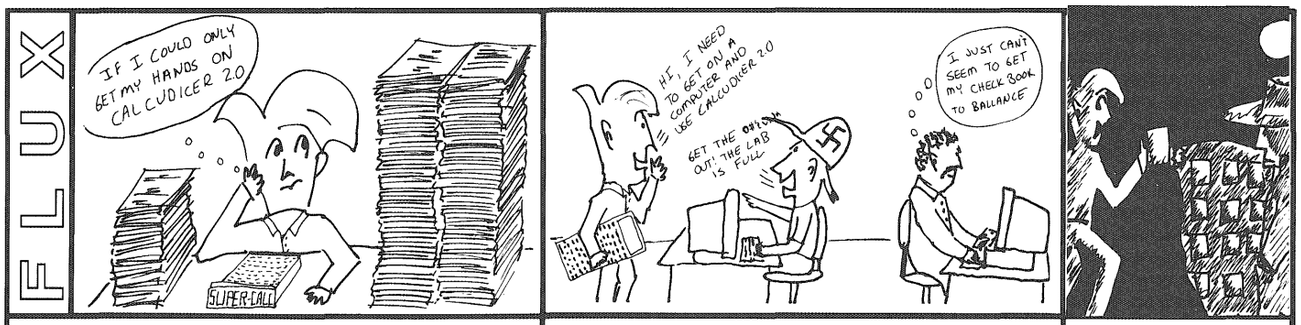
To enter, drop your caption(s) off at our new office in Room 5, Lind Hall by October 10. Be sure to include your name, major and phone number. The winners will be printed next issue.

Entries will be judged at the whim of the staff. All entries become property of the *Minnesota Technolog*. Winning contestants may not be members of the *Technolog* staff or the ITBP, past or present. *Technolog* is interested in obtaining IT-related photographs for use in future caption contests. Drop by our office with your suggestions.

Loren Thomsen and John Dassow

Photo courtesy of Westinghouse Corp.

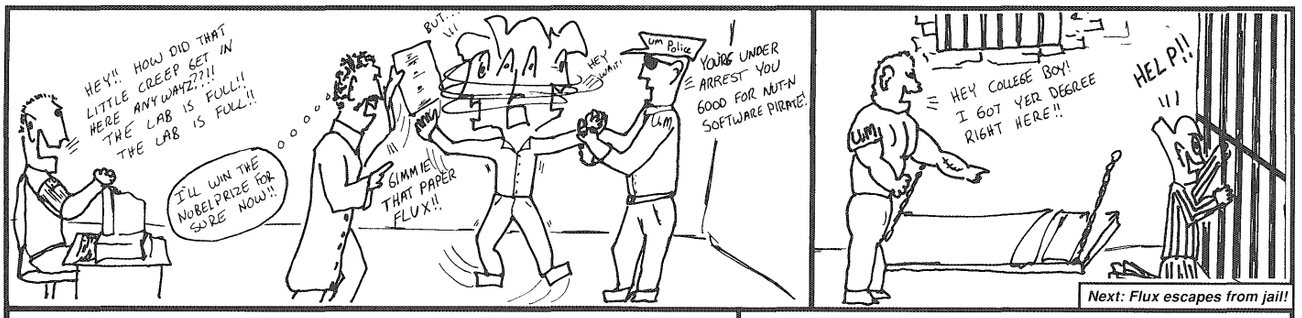
Robert Schroeder



Flux, a typical IT student, is trying to finish his project on titanium diaelectric biscuits for Dr. Hoop. Unfortunately Flux will be unable to complete his project in time without Calcudicer 2.0, the latest in engineering software.

Flux tries to get into the computer lab, but it is full. Dr. Hoop is on the last computer and is doing personal research with Calcudicer 2.0. Flux is in utter panic. The project must be in to Dr. Hoop the next day.

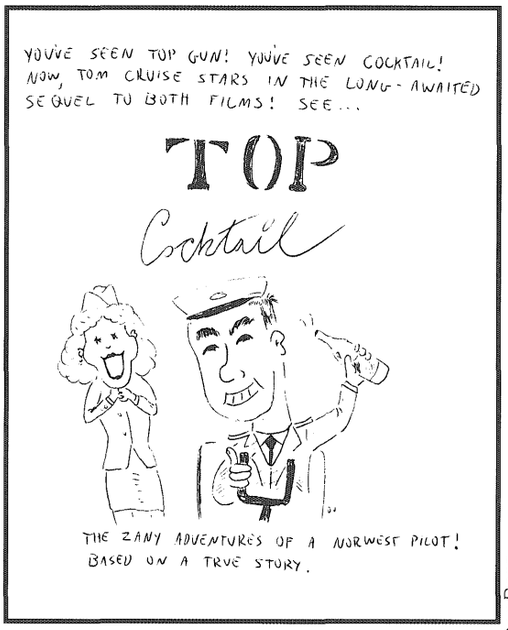
That night, Flux ventures into Hackers Ally to buy Calcudicer 2.0 at a highly-discounted cost.



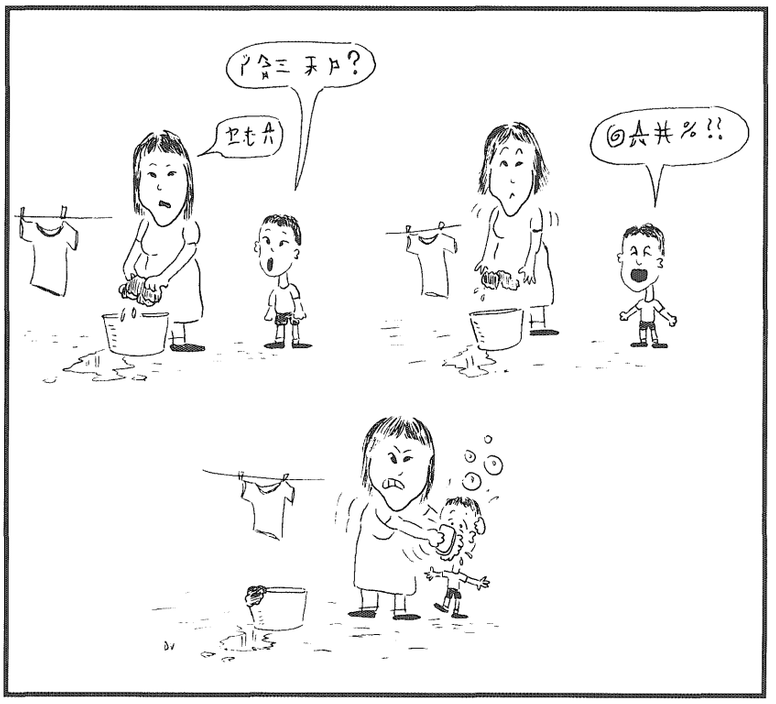
Back at the U, Flux finally gets into a computer lab. He finishes his project in less than an hour by using his pirated software. On his way out of the lab, Flux is seized by the University Police. Dr. Hoop grabs Flux's project. Flux is immediately taken to jail and bond is posted at $1.5 million.

Flux is now in jail and awaiting trial. Dr. Hoop just won the Nobel prize by using Flux's research. The University intends to make Flux an example of punishment for all software hackers.

Dennis VanDenBerg



Dennis VanDenBerg



Clocks of a Sort

by Frank McQuarry

One of our most esteemed writers ventured forth to pen a timeless treatise about atomic clocks. After minutes of research, he wrote the following.

I had every intention of writing a poignant yet informative article about atomic clocks. But clocks can wait. Instead, I would like to speak out on an issue that has been a growing concern of mine. I believe this issue warrants serious consideration: We all must foster a close personal relationship with the bathroom.

How does this concern you, you ask? You're on the career fast track and have better things to do with your time than ponder petty, unimportant things such as the bathroom. You are never there anyway. Wrong. Think again. Better yet, reminisce with me.

It is a pleasant Sunday afternoon. You are lying lazily on the sofa ready to nod off when through one open eye you see your father stroll through the room with a newspaper under his arm. You know where he is headed. You hear the familiar squeak of a door and the bolting of a latch. These sounds are the starting guns of your nap. You start exhaling Z's, comforted by the sound of occasional flushing like a puppy sleeping next to a ticking clock.

Have you ever wondered why dad does this? There are some things about growing old that have never been revealed to you. Go ahead and ask. He'll tell you. The older you get, the longer it takes.

This eventuality fills me with trepidation. How old will I be when I deem it necessary to flush twice? Even more frightening, *why* will I have to flush twice?

I have never asked dear old dad what goes on in there on Sunday afternoon. It is a subject too personal for polite discussion. But I must admit my curiosity is piqued. Events have occurred in recent years that I fear are portents of things to come.

It all began when I was 25. I took to reading shampoo bottles. After several months of this habit, I realized that if you've read one you've read them all. There are only so many variations of "wash, rinse, repeat" that any one person can withstand. However, the real reason for giving up this little genre of literature was my completion of Chemistry 1014. I was beginning to understand the ingredients.

Nonetheless, I learned some new things during these nascent potty days. The directions on a shaving cream can (wash face, leave wet, apply lather) are a priceless gem of wisdom. On the other hand, there is plenty of useless information. Take my advice and throw all soap boxes in the trash. There is little real substance on a soap box.

Although I gave up on packaging as reading material, the process had begun and there was no stopping it. Between classes I would grab a *Daily* or a *Technolog* before heading to the men's room. If you have ever heard giggling coming out of the rest room of Lind Hall it was probably me cracking up at those hilarious bios in the *Technolog*. The *Daily*, of course, is never funny; I read it in abject silence.

During the summer of my 27th year the inevitable happened. I brought an entire book with me. I read *Jonathon Livingston Seagull* in one sitting and still had time to flush. I remember getting teary-eyed at the sound of that particular gurgle.

Later that day I thought about this dubious accomplishment and knew life had something in store for me for which I was not prepared. I began to make plans to accommodate my condition, which seemed to be worsening with age.

First, I must someday live in a house with a tremendously large and spacious bathroom. Next to my throne I want a

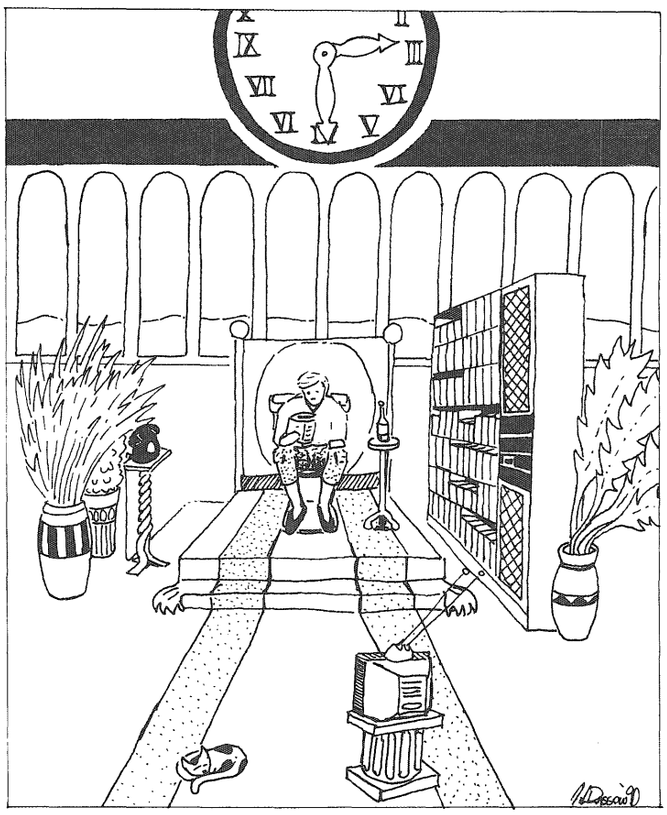


Illustration by John Dassow

bookshelf stocked with literature that will satisfy my every whim. Perhaps I could design a Dewey decimal system especially for my bathroom. After all, I want to be able to find things quickly. I intend to have one shelf devoted to authors whose writing I consider most appropriate to be rotting away next to a toilet. Books by Ayn Rand, Alexander Pope, Kahil Gibran, and anything written in 19th-century Russia would be suitable. I wonder if it is possible to get Harlequin romances printed on rolls of toilet paper?

Second, I am not always in the mood to read so it may be prudent to provide access to a television set. At the very least, this TV should be a 19-inch color set with stereo sound. However, I would prefer a big screen TV. Maybe the screen could double as a shower room door.

Third, I die on humid days. How can I enjoy myself if I am melting on the pot? An air conditioner is an absolute must. And in order to create a nice, homey ambience, some posters, plants, and rugs should be generously scattered around the room. Of course, I will need to install a special entrance for my pet. We wouldn't want kitty to get lonely.

Finally, it would be tragic if I let my disability interfere with any important phone call I might receive. A telephone on the shelf would be a good idea. However, I am leery about getting a speaker phone. It might be too revealing. It should be a small phone with one of those shoulder holder things. You know how it is when your hands are occupied.

So here I am with my perfect bathroom planned. A little grin crosses my face as I imagine telling people, during the glory days of my old age, "Hey, I'll give you a call later." I can hardly wait for the first time I get to say, "Could you hold for a minute? I think I heard the newspaper arrive."

Frank McQuarry is a secretive, elusive man and we were unable to photograph him. We, in fact, have no idea what the man looks like, where he comes from, or why he exists. A lovely and heartrending self-portrait was sent to us with Frank's article, but what little taste we possess forbids us from printing it.

minnesota
TECHNOLOG
November/December 1990

Inside

Also

Space

Volume 71, Number 2

Minnesota: cloudy and cool. clear and breezy. partly cloudy, mild.

The Daily Planet

THURSDAY, NOVEMBER 15

NASA DOES IT AGAIN

SECRET MISSION FOR SHUTTLE IN KUWAIT

By Elusiva Peck

NASA sets up once again to launch the Space Shuttle

By Lumus de Lunar

Seen here is NASA's newest space shuttle, The Pluionic, readying itself for a prospective launch date early next week. NASA officials announced today that there would be "absolutely no more delays in shuttle launc

Minnesota Supercomputer Institute

Undergraduate Internship Program

in Scientific Computing and Graphics

The Minnesota Supercomputer Institute is an interdisciplinary research program spanning all colleges of the University of Minnesota. Minnesota Supercomputer Institute supports supercomputer research at the University, the Minnesota Supercomputer Center, and other educational institutions in the state of Minnesota. We are pleased to announce a new opportunity for undergraduates to participate in our programs and to enrich their experience. Two types of appointments are available for undergraduate interns in scientific computing and graphics.

Type A Appointments

15 Hours per week

1-3 Quarters

$175/Week

Type A appointments are available to undergraduates to participate part-time in the internship program while they take courses. The standard Type A appointment will be 15 hours per week for one to three quarters. The stipend will be $175 per week. Appointments at the 12 or 20 hour level will also be available upon special request, with stipend levels of $145 and $225, respectively. Type A appointments will be available beginning Winter quarter, 1991.

Please apply at least one month before the quarter you wish to work.

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10 Weeks

Summer appointments will be full-time, ten-week appointments. These are available to both University students and undergraduates at other institutions who want a summer visiting appointment.

The deadline for summer applications is February 28, 1991.

All student interns will work closely under the direction of their project supervisors. In most cases, these supervisors will be University faculty members. A document describing available projects and opportunities is in preparation.

To obtain a copy of this document and an application form contact:

See Cathy Duvall, Executive Secretary
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Undergraduate Internship Program in Scientific Computing and Graphics
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1200 Washington Avenue South
University of Minnesota
Minneapolis, MN 55415
(or use campus mail)
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You can also contact:

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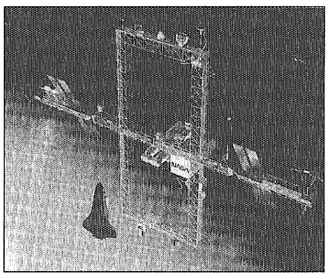
TECHNOLOG

Volume 71, Number 2 November/December 1990



10 Space Station

by Trisha Collopy

The concept of an orbiting space station has fascinated researchers for decades. NASA has plans in the works for the space station *Freedom*, but whether the plans become reality remains to be seen.

14 Conquering the Fourth Planet

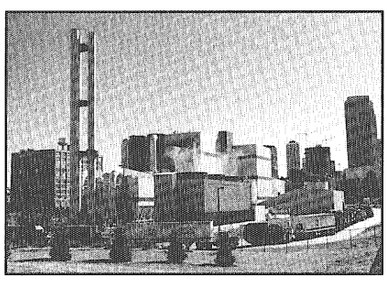
by Peter Gumulak

Mars: the planet, the treacherous journey. Our writer finds that the most difficult obstacle for the Mars mission may be the perilous path through Congress.

18 The New Zoo?

by Loren Thomsen

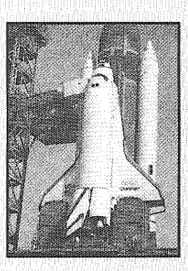
Many students assume that the IT is the only course for engineering education in Minnesota. UMD offers some attractive alternatives to the research-orientated world of IT. Our staff writer journeys 150 miles north and finds a haven for teaching in the port of Duluth.



22 Burn, Baby, Burn

by Deborah Hinrichs

Burning garbage for power seems like such a great concept. Our writer explores the hows, whys, and maybes of garbage incineration in Minnesota. In addition, Darin Warling takes a closer look at how the garbage burner works.



About the Cover...

This innocent-looking photo, after a little retouching in Adobe Photoshop, became a monumental NASA screw-up. Cover idea is from Brian Neurauter, layout and design by Robert Schroeder, technical support by Eric Scouten, and miscellaneous bits and pieces from most of the staff.

Departments

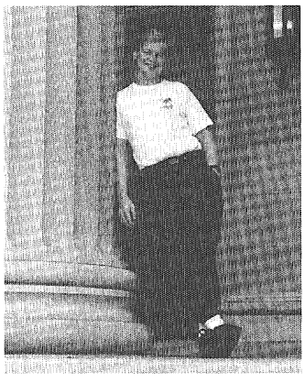
Editorial

Ship of Fools?

NASA's Titanic Troubles

It has been over 20 years since we first put a man on the moon. Since that time, what has the space program accomplished? Nothing especially significant or remarkable, as far as I can tell. Sure, the space shuttle, Skylab, and the Hubble Space Telescope were all nifty, but one blew up, another burnt up, and the latter is merely screwed up.

Neil Armstrong's famous first steps on the moon enraptured the American public. What has happened to those days? The folks at NASA would have us believe that dwindling public support and political budget slashing has brought the space program to its knees.



The decline of the U.S. space program was not because of a fickle public nor a lack of funding. NASA is the problem with our space program. It has become an overly bureaucratic organization skilled only at self-preservation. According to University Astronomy Professor Kris Davidson, "NASA is not a functioning institution." As columnist Gregg Easterbrock said, "NASA now stands between the United States and success in space."

Incompetence and bumbling infest the organization like a plague. Further in this issue you'll find features on the space station and the Mars mission. Both projects are suffering severe technical, managerial and/or financial difficulties. Critics severely doubt that either project has any base in reality. Problems were found with all of the NASA projects investigated by our writers.

The roots of these woes are not hard to find. Did you know that Marshall Thompson, the man who supervised design and construction of the solid rocket boosters that destroyed the *Challenger*, is now the number two person at NASA? Believe it or not, this is the same man who supervised the testing of the Hubble Space Telescope , a telescope whose optics were, in fact, never tested at all!

What could NASA have been thinking when it made this man second-in-command? How did he get promoted?

"Oh, by the way, that rocket booster I built blew up. Seven people are dead and a billion dollar shuttle was destroyed. CBS is running a film at five o'clock," says Thompson, "and it seems I forgot to test that telescope thingy and now, darn it, it won't work."

"Really?" says the boss, "Well, gosh, you're promoted!"

I don't get it. But never fear, just when you think all is lost, the White House has sent in a masked avenger determined to put all to right. Yep, you guessed it, the media's favorite putz, Vice President Dan Quayle, is the man running our space program. Danny boy isn't going to take any more guff from those NASA folks, either. He appointed a special committee to evaluate NASA's "priorities and performance." The fact that the committee will be chosen by NASA members doesn't worry Mr. Quayle one bit.

NASA must be torn down and rebuilt. Our space program is too important to be managed by careless administrators and dim-witted politicians. Perhaps the whole enchilada will have to be shut down for a few years. Postpone the big projects and bring the private sector in on smaller, more realistic tasks.

In his column, Easterbrock calls for simple, cheap space boosters, a spaceplane that could be launched from a commercial jet, and a science module to be fitted to the space shuttle. He recommends simpler projects that use existing technology in practical, economical ways. These projects may provide opportunities for the private sector to enter space research.

Photo by Doug Sutton

Conglomerate firms such as DuPont and 3M already have independent research departments. These departments perform research on the premise that independent research will generate new products, even if the research is not directly applicable to current products . Space is a logical step for these companies.

It is an accepted fact that the space program has benefited the consumer. Anyone in doubt can check out the "Space Spinoffs" exhibit at the science museum, which showcases 100 items selected from over 30,000 products developed from space research. The private sector would undoubtedly profit from independent space research.

In addition to profit, the companies could put together a spectacular public relations campaign (EXCO: A Company Exploring the Limits of Our World...) and would attract some of the industry's best and brightest researchers. The government could easily sweeten the pot with tax breaks or financial support for companies performing space research.

Such a program would free NASA's hands to take some time to restructure and then concentrate on grandiose projects such as the Mars mission, establishment of a moon base and a space station, all of which would be prohibitively expensive for the private sector.

Now is the time for a strong space program. NASA, as it currently exists, can only bungle space research. Its incompetence has already set back efforts to explore beyond this squalid little planet by at least a decade. Without sweeping change to our space program, space research and planetary exploration may, like free sex and love beads, be heralded as phenomena of the sixties.

TECHNOLOG

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Letters

Dear Editor,

The May/June 1990 issue of the *Technolog* contained a good article on photovoltaic solar cells, plus a letter from a nuclear engineer who commented that solar power is only available during daylight hours, requires a large area for generating power, and is too expensive.

I suggest a follow-up article that would consider several items about solar power. First, our electric load is significantly higher during the daylight hours than at night. (A recent newspaper article described a proposal to pump Mississippi River water into a holding pond at night and let the water run back and generate electricity during the day). What portion of the peak load could be supplied by solar cells? The base load would continue to be generated by the nuclear plants and the better coal-fired units, but solar power could keep some of the less efficient generators off line much of the time.

Where can we install solar cells? In Minnesota, the energy of sunlight is about 1 KW per m^2. Today's less expensive photovoltaics are about six percent efficient and would yield about 60 W per m^2. Well, the roof of my home has about 100 m^2 facing south, which could generate six KW at high noon. I would have no objection to covering that area with solar cells. How many rooftops are available for solar cells in the seven county metro area? If 200,000 buildings each have 100 m^2, 1200 megawatts could be generated, which would be equivalent to the power output of a large nuclear or coal-burning plant.

The cost of photovoltaics is a problem, of course. The last price I was quoted for solar cells was about $6 per peak watt, although that is supposed to go down to about $2 in the next few years. Compare that to the cost of a nuclear power plant. The Shoreham plant on Long Island cost about $5 billion and would have generated 840 megawatts. That works out to a cost of...hmm...$6 per peak watt!

Some other factors to consider: How much would the cost of solar cells drop if we ordered enough to cover the rooftops? How much load-shifting could be done (for example, store heat for off-peak use, as is done in Europe) to take advantage of the solar energy? How much atmosphere-warming CO_2 from fossil fuel plants would NOT be generated by using solar cells? Finally, what would happen to our energy economy if a significant percentage of the means of energy production are owned by the consumer?

Jim Garrity
IT Alumnus

We don't know about the rest of you, but considering the situation in the Mideast, *I say we put this guy in charge of energy in the* U.S.—*Ed.*

Dear Editor,

What the hell is that weird thing on the top left of the cover? My buddy Bill says its an ink spot but I think its supposed to be a bowling ball. Let me know soon 'cause I've got a six-pack of Pabst riding on this.

Faithful but Confused

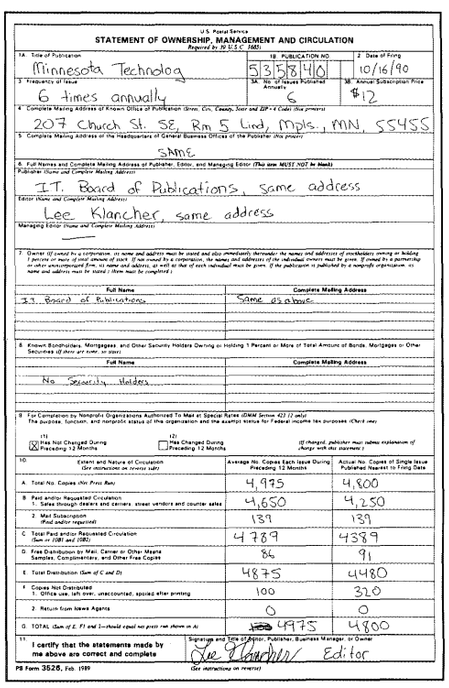
You both lose (which makes you both losers). It is actually a surrealistic rendition of Captain Jean-Luc Picard's head.—Ed.

Dear Editor,

Your magazine sucks. The editorial content is poorly-written and of no value, your layout unbalanced and gross, and the art looks like it was peeled off my grandmother's refrigerator. In fact, I don't know why I take the time to read the crummy rag.

Yelmer Yohannsen
GE Engineer
(The guy in the shower cap from the caption contest photo last issue)

Drop dead and die.—Ed.



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The 1991 *Technolog*

SCIENCE FICTION CONTEST

Wealth and fame can be yours!

Each year, the Technolog accepts science–fiction manuscripts written by University students. A panel of judges choose the top three entries. The top three are printed in our April issue and the winning authors will receive prize money.

First Prize:	$150
Second Prize:	$100
Third Prize:	$50

Contest Rules:
The contest is open to all registered U of M students, except *Technolog* and ITBP members. Entries must be typed and double-spaced and no longer than 3500 words. Attach a cover page indicating your name, address, and phone number; don't put your name anywhere else on the manuscript. Turn your entry into room 5 Lind Hall.

DEADLINE: January 25, 1991

Perspectives

Income Taxes and You

How to Save a Quarter of a Million Dollars in Taxes

by Gary Gould

Because money is scarce and calculus exams are not, the subject of income tax is of little concern to most IT students until they have graduated or entered the workplace. The effect that taxes will have on wages and investment earnings may come as a surprise to many. Nearly one-third of wages and investment dollars can go directly to Uncle Sam if tax reduction measures are not taken.

Jane Engineer recently graduated from IT. Her annual salary is $30,000 ($2,500 per month). Her first paycheck is broken down as shown below.

	Monthly	**Annually**
Gross Wages	$2,500	$30,000
Minus Income Tax Withholdings		
Federal	<460>	<5,520>
State	<170>	<2,040>
FICA	<190>	<2,280>
Take Home Pay	**$1,680**	**$20,160**

Nearly 33 percent of this paycheck is taken by Uncle Sam and the state of Minnesota. Going one step further, let's assume Jane receives a 5 percent raise to keep up with inflation each year to age 65.

Gross wages to age 65	$4,500,000
Federal Income Taxes	<828,000>
State Income Taxes	<306,000>
FICA Taxes	<344,000>
Net Take Home Pay	**$3,022,000**

Jane will pay nearly $1.5 million in income taxes, assuming the tax rates stay where they are and that her income increases only keep up with inflation.

Protecting Your Savings

A common place to save money is within a bank savings account. These accounts are currently earning around 5.5 percent excluding taxes. Once factored in, taxes will reduce the net yield to 3.69 percent (assuming combined state and federal tax rate of 33 percent). That is not enough to keep pace with inflation. The investment is actually going backwards. Fortunately, the Internal Revenue Code offers a few options to help reduce the effect of taxes on investments. These include tax–exempt and tax–deferred investments.

In a tax–exempt investment no taxes are paid on the earnings from the investment. This can be a powerful savings tool because taxes will not affect net yield. In a tax–exempt investment your return is typically lower than a comparable table investment, but because taxes are not withdrawn the net yield may be higher.

	Taxable	**Tax Exempt**
Rate of return	10%	7%
Less Taxes	<3.3%>	0%
Net Yield	6.7%	7%

To match the seven percent tax–exempt rate of return in this example, a person would have to find a taxable investment with a rate of 10.44 percent. For this reason, tax–exempt investments can be attractive for young engineers.

A tax–deferred investment allows postponement of income tax on your earnings until money is withdrawn from the investment.

	Taxable	Tax Deferred
Rate of return	10%	10%
Less Taxes	<3.3%>	0%
Current Net Yield	6.7%	10%
Net Yield at age 65 (after taxes)	**6.7%**	**8.9%**

Unlike tax–exempt investments, the earnings in a tax–deferred area must eventually be taxed. Because of this, tax deferral is normally used for longer term savings.

For example: Jane has $100,000 to invest in a 10% taxable or 10% tax–deferred investment.

	10% Taxable	10% Tax Deferred
Investment	$100,000	$100,000
10 years	191,000	259,000
20 years	366,000	672,000
40 years	1,338,000	4,525,000
Minus Income Taxes	<0>	<1,493,000>
Total after 40 years	**<1,338,000>**	**<3,032,000>**

The nearly $1.7 million dollar difference show the power of tax deferral over time. To get comparable results out of a taxable investment, a person would need a 14.92 percent rate of return.

Protecting Your Earnings

Up to this point, we have primarily discussed the effect of taxes on investment income, and what is available to help curb this problem. Taxation, as illustrated earlier, will not only affect investments but also greatly affect earned income. Typically, engineering firms offer a retirement benefit program called a 401(k) plan. This plan is designed to reduce taxable income and help save money for retirement. An employee may contribute a percent of wages which may be deposited without taxation. Because these dollars go into the program before taxes, it reduces the employee's taxable income, thus reducing liability. Jane decides to deposit five percent of her wages into a 401(k) plan. The table below shows the effect on her income.

	401(k)	Without 401(k)
Gross wages	$30,000	$30,000
401(k) Contribution	<1,500>	<0>
Taxable Wages	28,500	30,000
Taxes Withheld	<8928>	<9840>
Take Home Pay	**$19,572**	**$20,160**

Jane put $1,500 into the 401(k) plan, but her take home pay was reduced by only $588. The difference is the tax savings on the $1,500 contribution to the plan.

Typically, an employer will match a portion of 401(k) plan contributions. This match normally ranges from 25—50 percent of the contribution up to a specified percentage, usually 4—6 percent of the person's annual income. If Jane's employer matched 50 cents on the dollar up to five percent of income, Jane would receive $750 from the company in addition to the $1,500 she contributed. The $2,200 would then be invested within the 401(k). Taking into account the deductibility, employer match, and the fact that interest accumulates tax–deferred, first year returns of 80—90 percent are possible within a 401(k) plan.

These benefits do have a price; the future use of those dollars. There is basically no liquidity in a 401(k) plan. Once a deposit is made, don't expect to use that money until you are 59.5 years old. Money can be withdrawn only for the following reasons:

1. Termination of Employment (If the money is not "rolled over" into another qualified retirement plan within 60 days it is fully taxable and subject to a ten percent penalty).
2. Retirement
3. Death
4. Disability
5. Financial Hardship
   A. College Education (Taxable and subject to ten percent penalty)

B. Primary Residence (Taxable and subject to ten percent penalty)

C. Medical Expense (Taxable and may be subject to ten percent penalty)

A 401(k) plan is a great tool for retirement savings and tax reduction, but its lack of liquidity should certainly be a factor in determining the extent it will be used.

Rent or Buy?

Jane is faced with a dilemma; should she spend $400 per month to rent an apartment or should she buy a home? Purchasing a home can be a viable method for reducing your taxable income because interest payments can be deducted. For example, Jane could purchase a home for $85,000 with a 30-year mortgage at 9.5 percent. She would pay $714 per month, which comes to $8,568 per year in mortgage payments. Of the $8,568 made in payments only $524 would go toward reducing the principal in the first year. This may sound discouraging, but as mentioned earlier, interest payments can be directly deducted from your taxes.

For example:

Monthly Payments	$714
×12	
Total Annual Payments	$8568
Principal	<524>
Interest Payments	$8044
×33%	
Tax Savings	**$2665**
Monthly Out of Pocket Expense	$492

This sounds great in theory, but the fact remains that a $714 check must be written out every month. To help ease the burden of these monthly payments, Jane can add another exemption on her W-4 form, thus decreasing the amount of taxes withheld.

I have shared some ideas on how to minimize taxes on not only income, but also on investments. If Jane were to implement the 401(k) plan, purchase a home rather than renting, and use tax–deferred or exempt investments, what would the net effect be?

	Before	**After**
Gross wages	$30,000	$30,000
401(k) Contribution	<0>	<1,500>
Mortgage Interest	<0>	<8,044>
Taxable Wages	30,000	20,456
Taxes Withheld	<9840>	<6,444>
Rent	<4,800>	<0>
Disposable Income	$15,360	$14,012
Difference $1,348		

Jane invested $10,068 in a home and 401(k) plan but her disposable income was reduced only $1,348. By taking advantage of tax–exempt and deferrable investments, Jane has no additional taxable income. She has maximized use of her money while minimizing taxation.

I hope these ideas can give you an edge in developing a personalized tax reduction strategy as well as an idea of what is available and how it works. ❐

Gary Gould is a financial advisor with the Principal Financial Group

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10. Get your own *Technolog* T-shirt
9. Beats writing for the *Daily*
8. More money than you can possibly imagine (well, a few bucks, anyhow...)
7. Access to high-tech equipment in plush new office
6. Wow future employers
5. Overload on stress
4. Beats cheesy "Brady Bunch" reruns
3. Good excuse to blow off homework
2. Sneak previews of future *Technolog's*
1. The thrill of seeing your name in print

Yes, working for the *Technolog* will be an experience you'll never forget. We can use people with talent of any kind, so don't rule yourself out just because you can't write. In fact, we have people on staff with no talent at all.

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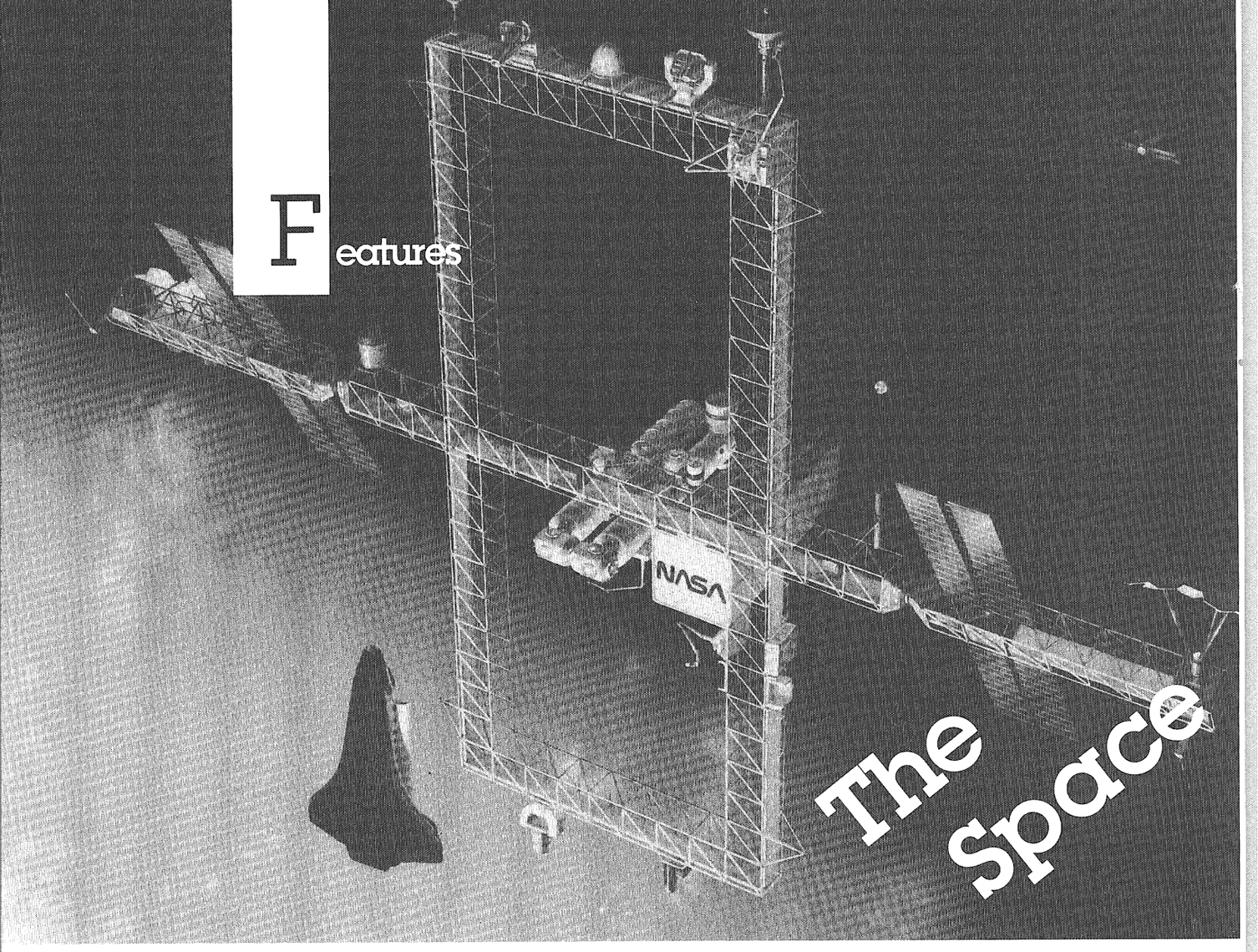
The *Technolog* is expanding their advertising department and is looking for motivated people to design promotions, set up a database, and bring in new accounts. Experience is not a must. First-year students and sophomores are preferred.

Stop in at room 5 Lind Hall to pick up an application or call 624-9816 for more information.

Application deadline: **January 7, 1991.**



The Space

by Trisha Collopy

NASA's "pie in the sky"?

Recent years have not been kind to NASA's efforts at space exploration. After early successes with the Apollo and Gemini programs, the organization seems to have lost its magic touch and the public's confidence along with it. In the last two decades NASA has proposed massive, but ill-conceived, projects in an effort to maintain its funding at Apollo levels.

The space station *Freedom*, the program intended to launch NASA—and the United States—into the 21st century, so far seems to be little exception. By 1989, five years into the program, the space station had already gone through "four directors, four agency chiefs, and 11 planning reviews," as well as several complete redesigns that year; further revisions were necessary this year after significant design flaws were discovered.

Station

This uncertainty, added to recent NASA problems with the Hubble Telescope and the space shuttle fleet, has made Congressional members seriously question their support of the $37 billion space station program. In July, the House of Representatives cut President Bush's budget request for NASA from $800 million to $14 million. More recently, several members of various congressional appropriations committees have said that the Space Station program should be scrapped altogether. Carolyn Townsend, a spokeswoman at NASA, says that in a worse-case scenario, NASA's budget could be cut almost entirely.

The current situation does not leave much optimism for a program that started out with such high expectations. In 1984, President Reagan signed a bill authorizing NASA to build a space station. At that time, the purpose of the station was to further technological development in the areas of space science and microgravity research and to serve as a launching point for future missions to the moon and Mars. The program advanced in 1987 when NASA completed an agreement with Canada, the European Space Agency (ESA), and Japan to share the costs and benefits of the space station.

The original design envisioned by the U.S. and its international partners was a two–phase plan of construction and habitation. In Stage One, NASA would use the space shuttle to assemble the central 500-foot-long I-beam structure of the station, the solar panels that would provide the station's power, and two of the four modules attached to the central beam. One of the American modules is devoted to research, the other is for housing the astronauts attending the station. A mechanical arm contributed by Canada, as well as European and Japanese research modules, would also be launched during this stage of construction.

During Stage Two, the central beam would be expanded into a rectangular structure which could house astronomical instruments and facilities to service satellites. In addition to their laboratories, the ESA would build an unmanned, free-flying module, and Japan would provide a remote observation platform for further research.

Total costs were projected at $16 billion for design and construction and $10 billion for assembly and launch costs. Assembly was scheduled to begin in 1995 and to be completed by 1999.

Then the budget troubles began. When 1989 fiscal allocations cut the space station's budget by $400 million, NASA scrambled to redesign the project, extending the construction schedule and reducing the initial capabilities of the station without consulting its international partners. The Europeans and Japanese were dismayed to find launch dates for their modules delayed and the power available to their modules reduced to six kilowatts for the first eight months.

Since then, the program has undergone several more reviews and redesigns as NASA has attempted to satisfy its international partners. As a result, fiscal constraints and congressional doubts about the value of financing space exploration have increased at a time when social programs are on the chopping block.

The program has currently been scaled back to a "level zero" stage. European and Japanese modules will be launched earlier in the construction process, but the station will initially only house four astronauts, and power will still be cut in half until all the solar panels can be installed. NASA has also reduced the program by cutting design costs, using older, previously developed systems instead of pursuing the new technology which was to be one of the benefits of the system. For example, at Johnson Space Center, a hard space suit which would eliminate the extensive pre-breathing time required in current soft suits was being developed. This will now be scrapped. NASA also plans to save money in the short term by fueling the station's thrusters with hydrazine, a known technology, rather than proceeding to develop a hydrogen-oxygen fueling system which would offer better efficiency in the long term.

By 1989 the space station had already gone through "four directors, four agency chiefs and eleven planning reviews."

Engineers have also had to cope with weight problems and predictions of 2,300 hours of Extra-Vehicular Activity (EVA) time necessary to maintain the station each year. Although a recent brief in *Aviation Week and Space Technology* reports progress on weight and power problems, "the hardware is now only 7% overweight and draws 8% too much power." Fundamental questions raised about the necessity of the space station program and the future of American technological leadership in space remain unresolved.

There are several conflicting reasons for why we are currently supporting the space station. National prestige seems to be an underlying motive. A report by the U.S. Congress Office of Technology Assessment in 1984 provides the rationale that "other countries are providing growing economic competition for the U.S. in space technology."

President Reagan tried to justify the station for commercial development. Microgravity research in metallurgy, biology, and crystallography is a rapidly growing field with many commercial applications. The market for exotic semi-conductor materials, such as gallium arsenide, which can only be grown in pure form in space, "will reach $1.8 billion by 1992" according to a report in *High Technology Business*. Also, large pharmaceutical companies are interested in the benefits of growing protein crystals under zero-gravity conditions. The purer crystals grown in space allow better analysis of the molecular structure by x-ray crystallography. Improved molecular models help biomedical researchers create new drugs that interfere with the molecular binding process. Limited opportunities to do microgravity research in the U.S. space program have even led American companies to contract with the Chinese and Soviet space programs to get their experiments aloft.

Although the Soviets are accepting commercial contracts, which could help fund their *Mir* space station, many scientists and legislators feel that microgravity research is not an adequate justification for building the *Freedom*. It "has not provided a strong political or scientific foundation for the program," according to a report by the National Academy of Sciences entitled "Toward a New Era in Space."

"You can't justify the space station by its research and development capabilities," echoes Jake Waddington, professor of physics at the University of Minnesota. He argues that to convince taxpayers to support the program, Congress needs a much broader vision, something to inspire the imagination.

Waddington, who was a member of a NASA committee that discussed ways to accommodate small research projects on the station, says "If we've got the space station up there, we might as well use it," but he also admits that confining the station to a commercial program will limit the vision and usefulness of the program. Instead, what is at stake is "the long-range health of a technological society."

Because of the high expense of space research, alternative technologies are being developed on Earth. For example, many biomedical researchers are using the new technology of Nuclear-Magnetic Resonance (NMR) crystallography to analyze protein crystals with unmatched detail. "There is currently very little that can be cost-effectively manufactured in space," agrees Ben Huset, president of the Minnesota Chapter of the National Space Society. There are also less costly options for launching these experiments, such as booster rockets.

Recent NASA problems with the Hubble Telescope and the space shuttle fleet have made Congressional members seriously question their support of the $37 billion space station program.

The National Academy of Science report proposes that the best rationale for the space station is to undertake the research necessary to send humans to the moon or Mars. Just as President Bush has responded to these concerns, proposing a "Space Exploration Initiative" to establish a base on the moon and send people to Mars, Congress abruptly cut funding from even the first stage of the Mars initiative. This leaves the space station foundering once again.

Most scientists agree that the U.S. will lose an edge in space technology if it doesn't participate in the program. There is little doubt that programs to get humans into space, with space stations as a vital first step, will continue to be developed in the next several decades. "Eventually a space station will go up," says Waddington. "Humans will be in space in the near future," agrees Rod Nerdahl, director of the Minneapolis Planetarium. The question that remains is whether we can afford to be among them. ❐

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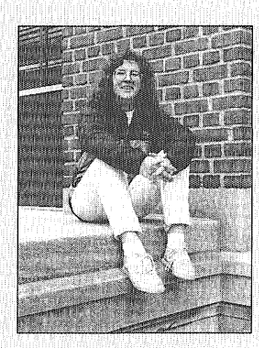

TECHNOLOG

Writer Profile: Trisha Collopy

Trisha Collopy majors in Chinese, of all things. As we understand it, she aspires to master the language, travel to the land of the Great Wall, grow a goatee, and spend her days writing esoteric, deeply profound philosophy and smoking opium. With luck, we'll squeeze another article or two out of her before she leaves.

Conquering the Fourth Planet

by Peter Gumulak

On July 20, 1989, the 20th anniversary of the Apollo lunar landing, President Bush proposed "a long range continuing commitment to space exploration" that included a space station, a Moonbase, and a journey to Mars.

Whether or not this ambitious program will work depends on Congress, and members remain divided over the issue. Those who believe in the Space Exploration Initiative (SEI) think it will provide an excellent opportunity to keep America at the forefront of high technology. They hope to entice more students into science and engineering careers in the same manner that the Apollo program did in the 1960s.

Such an endeavor would create an excellent opportunity for cooperative efforts between the United States, the Soviet Union, and other countries, thus promoting international relations. Mars, which was once a dynamic planet with active volcanos and flowing water, could teach us much about our own environment. Why the Mars we see today is a cold, dry, and quiet planet may provide insight into our own looming environmental problems.

The technology needed to make the journey could have spin-off applications here on earth. One news magazine declared that the Apollo program "would have been a bargain at twice the price" and deemed it "the best return on investment since Leonardo da Vinci bought himself a sketch pad." Hopefully the Mars mission will enjoy the same success by improving the quality of life and creating new jobs.

On the downside, many congressmembers feel that SEI is too expensive. During the 1960s Apollo program, the annual deficit ranged from $507 million to about $27 billion, a mere shadow of what it is today. From a purely scientific point of view, it is also argued that unmanned probes could perform similar experiments at lower cost and reduced risk to human life. Finally, it is felt by some that the space station, the Mission to Planet Earth (in which a series of satellites would monitor climate changes on Earth from orbit), the planetary probe program, and the existing space shuttle program are enough to guarantee NASA healthy funding through the 1990s.

Preparing for the Journey

Mars, although hospitable compared to the rest of the solar system, is a hostile place for delicate humans to survive. The planet's surface temperatures vary from a warm 30° F in summer to a brutal -200° F in winter. The thin atmosphere is equally harsh, and the surface pressure is so low that one's blood would boil without protection. Dust storms are frequent and can last up to several months.

Much of our current knowledge about Mars was obtained from Viking 1 and Viking 2, two probes that landed on the planet's surface, making the United States the first country to successfully land a probe on the surface of another planet. Although on-board experiments found no life, the question remains whether or not life once existed there.

Preparation for the trip to Mars will begin with an intensive exploration of prospective landing sites. Scientists, using data from the Mariner and Viking probes, can better select a target area suitable to the missions many goals. The broad plains would be the easiest and safest place to land. The poles, where frozen water and carbon dioxide exist, would be the place to look for evidence of climate changes as well as life itself. The bottoms of extinct volcanos would be the place to uncover Mars' volatile history, while the dry water channels would be the place to look for insights into Mars' watery past. However, it is unlikely that any one site could answer such a myriad of questions.

On a 2.5 year trip, 8 people would require 75,000 pounds of food, water, and oxygen, assuming no allowance for showers or laundry.

Assuming we do go to Mars, there are tremendous technical challenges to be faced. One problem is weight. Each day the average person requires three pounds of food, five pounds of water, and two pounds of oxygen. On a 2.5 year trip, 8 people would require 75,000 pounds of food, water, and oxygen, assuming no allowance for showers or laundry. Living in a space environment for such a long period is also a problem. Planners must consider radiation from the sun, weakening of muscles (including the heart) due to lack of gravity, the psychology of isolation, and most seriously, weakening of the bones due to a process known as demineralization. Another obstacle is distance. In an emergency, astronauts in earth orbit can return within an hour. The Moon is at most three days away. Mars is considerably further, at best several months away. Thus, we will have to assemble structures in orbit, develop propulsion systems, learn how to store and transfer fuels in orbit, and most importantly develop a new technique called aerobraking.

In theory, aerobraking would allow an enormous savings in fuel expenditure. In all previous flights, spacecraft approaching a planet have applied rocket power to slow and achieve orbit. With aerobraking, however, the spacecraft would deploy a saucer-shaped heat shield; by dipping in and out of the outer atmosphere, atmospheric drag would slow the craft enough to park it in an orbit around the planet. The theory has yet to be tested, and may prove extremely difficult to use. The slightest miscalculation in the angle of attack could be disastrous. If the craft descends too steeply, it will burn up in the atmosphere. If it's too shallow, the craft could skip back off into space beyond recovery. Scientists have tentative plans to drop several prototype heat shield shapes from an orbiting space shuttle to learn more about maneuverability, re-entry temperatures, and optimal size and weight.

The next step toward sending a person to Mars is to land a probe on the surface, collect rock samples, and return them to earth for analysis. To achieve this, NASA is currently working on a plan called the Mars Rover / Sample Return mission. This mission would involve two flights scheduled to arrive at Mars within a month of each other. The first spacecraft, carrying the surface rover, acts as a

communications satellite, while the second craft hauls the return sample system. The sample system descends to the surface, carrying the rover as well. Upon landing, the rover would range up to twenty miles from the return craft while carrying out the task of collecting rock samples. The samples are then transferred to the sample craft, which blasts off and returns to an earth orbit. The flights would also serve as an additional test bed for the aerobraking theory.

Two Mission Strategies

Once preliminary preparations are complete, there are basically two strategies on landing a person on Mars with different dates for possible completion of the mission.

If it is desired to get to Mars as soon as possible, then the best strategy is a manned sprint mission that could arrive before 2010. Each sprint mission would be conducted in two parts, one involving a cargo ship and the other being a crew transport. The cargo ship would arrive first with everything needed on the Martian surface, including the landing vehicle, surface habitat, exploration gear, and the ascent vehicle. It would also carry fuel for the crew's return to earth. Only after the cargo was safely in orbit around Mars would the astronauts depart.

Some (scientists) don't want to go back to the Moon because they feel the resources found there might prevent investigating a far more interesting place: Mars.

The crew transport ship, assembled and fueled in earth orbit, would leave with eight astronauts aboard. After an eight month journey the manned craft would rendezvous with the cargo ship, and four of the crew would descend to the surface. After a short stay, the crew would leave Mars and return to Earth nearly six months later, making the total length of the trip 14—15 months.

One advantage of such a scenario is the significant reduction in the volume of equipment that needs to be hauled into earth orbit. Also, by keeping the flight time to 15 months, there would be fewer concerns about space's debilitating effects on the astronauts. Furthermore, a sprint mission would allow the United States to put people on Mars by as early as 2005.

These proposals have been extensively criticized as being Apollo-like, nationalistic missions. Many scientists don't want a dead-end, plant-the-flag-and-stick-out-our-chests approach, but rather a long term effort that emphasizes the establishment of scientific bases for continuing operations. Most long term strategies involve the Moon as a stepping stone toward Mars.

There are two schools of thought on returning to the Moon. Most scientists recommend the establishment of an outpost on the Moon where people could practice skills for a Mars mission as well as conduct scientific experiments. The Bush administration supports this mission profile. Another school of thought, which includes the likes of Carl Sagan, doesn't want to go back to the Moon because they feel the resources found there might prevent investigating a far more interesting place: Mars.

Studies exploring a long-term mission to Mars envision chemically-propelled rockets sending people to the Moon as early as 2004, as well as a fleet of cargo ships with material for a Moon base. Construction crews would spend several years building a home for scientists who will experiment with aspects of planetary habitation, life sciences, psychological effects, and group dynamics, exploitation of natural resources and exploration dynamics. One important goal is to produce liquid oxygen from the lunar soil for use as a propellant .

After several years, people would be ready for the next step toward Mars. A cargo ship would be assembled in earth orbit and equipped with all the gear to be sent to the Martian surface. It would perhaps be fueled with liquid oxygen from the Moon. As the ship approaches Mars it would drop off communications satellites, send robot probes to Deimos, and deposit equipment to make pro-

pellant from the soil on Phobos. The astronauts would follow later, landing on the surface in 2014.

In its 1988 report, NASA's Office of Exploration states that this approach "shows considerable promise for scientific and exploration benefits and opportunities as well as having the budgetary and policy advantages of a reduced and essentially constant requirement of resources." This concept is most likely to be the next step for NASA's manned program.

It still remains to be seen whether or not this nation will choose to go to Mars alone or with international cooperation. One thing is certain—if NASA gets the green light to put humans on Mars, it will mean a tremendously exciting adventure for the "technology people" that will make it happen. For those who have their doubts, William Jennings Bryan once remarked that "destiny is not a matter of chance, it is a matter of choice. It is not a thing to be waited for, it is a thing to be achieved." ❐

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TECHNOLOG

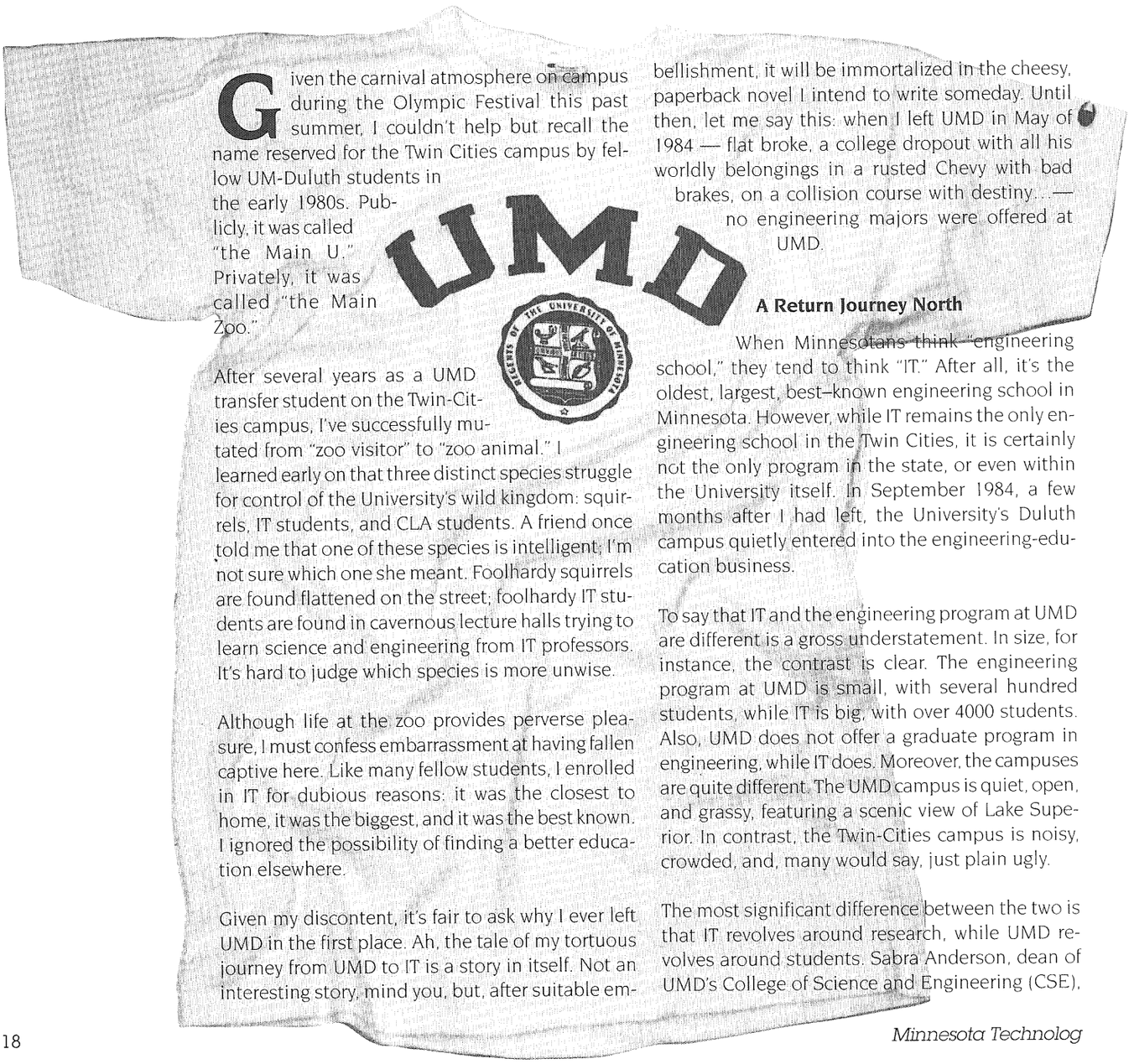
Writer Profile: Peter Gumulak

Last spring, Peter Gumulak came to us a quivering mass of first-year student. Initiation into the hallowed halls of authordom and a year in IT has thickened his chest and lengthened his stride. We even received uncorroborated reports that he was seen swilling beer, hollering obscenities, and pounding his chest at a Gopher hockey game.

The New Zoo?

by Loren Thomsen

If UMD maintains its excellent reputation, many future students will choose the port of Duluth when charting their engineering careers.



Given the carnival atmosphere on campus during the Olympic Festival this past summer, I couldn't help but recall the name reserved for the Twin Cities campus by fellow UM-Duluth students in the early 1980s. Publicly, it was called "the Main U." Privately, it was called "the Main Zoo."

After several years as a UMD transfer student on the Twin-Cities campus, I've successfully mutated from "zoo visitor" to "zoo animal." I learned early on that three distinct species struggle for control of the University's wild kingdom: squirrels, IT students, and CLA students. A friend once told me that one of these species is intelligent; I'm not sure which one she meant. Foolhardy squirrels are found flattened on the street; foolhardy IT students are found in cavernous lecture halls trying to learn science and engineering from IT professors. It's hard to judge which species is more unwise.

Although life at the zoo provides perverse pleasure, I must confess embarrassment at having fallen captive here. Like many fellow students, I enrolled in IT for dubious reasons: it was the closest to home, it was the biggest, and it was the best known. I ignored the possibility of finding a better education elsewhere.

Given my discontent, it's fair to ask why I ever left UMD in the first place. Ah, the tale of my tortuous journey from UMD to IT is a story in itself. Not an interesting story, mind you, but, after suitable embellishment, it will be immortalized in the cheesy, paperback novel I intend to write someday. Until then, let me say this: when I left UMD in May of 1984 — flat broke, a college dropout with all his worldly belongings in a rusted Chevy with bad brakes, on a collision course with destiny... — no engineering majors were offered at UMD.

A Return Journey North

When Minnesotans think "engineering school," they tend to think "IT." After all, it's the oldest, largest, best–known engineering school in Minnesota. However, while IT remains the only engineering school in the Twin Cities, it is certainly not the only program in the state, or even within the University itself. In September 1984, a few months after I had left, the University's Duluth campus quietly entered into the engineering-education business.

To say that IT and the engineering program at UMD are different is a gross understatement. In size, for instance, the contrast is clear. The engineering program at UMD is small, with several hundred students, while IT is big, with over 4000 students. Also, UMD does not offer a graduate program in engineering, while IT does. Moreover, the campuses are quite different. The UMD campus is quiet, open, and grassy, featuring a scenic view of Lake Superior. In contrast, the Twin-Cities campus is noisy, crowded, and, many would say, just plain ugly.

The most significant difference between the two is that IT revolves around research, while UMD revolves around students. Sabra Anderson, dean of UMD's College of Science and Engineering (CSE),

points out, "In the last year, this college has won two national awards: one for the best advising program for a campus of this size, and one for an outstanding retention rate. We take a very personal interest in students. We work very hard to meet student needs."

This doesn't mean research is nonexistent at UMD, just that it is de-emphasized. Anderson notes that professors recruited to UMD are happy with the balance between teaching and research. "If you come to a school like UMD, you have to want to teach. You have to enjoy students. *And* you have to plan an active research career. So it puts us between the universities, which are totally research-oriented, and the teaching institutions. The professors we have feel they have the best of both worlds."

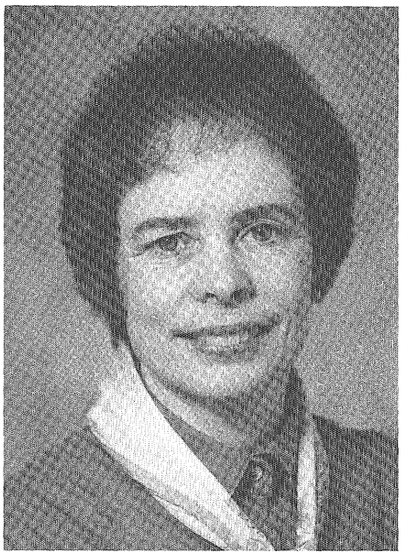
"We put a big emphasis on quality instruction for undergraduate students, and I don't see that changing."
-Sabra Anderson

Skeptical that such a balance could be struck at an engineering school, I recently drove 150 miles north to see UMD's program firsthand. The three engineering majors offered at UMD—computer, industrial, and chemical—put IT in perspective, providing much food-for-thought about what engineering schools can be and, perhaps, what they should be.

Computer Engineering: Chips, Software, and Systems

UMD's oldest and best-known engineering program is computer engineering (CpE). Begun in 1984, computer engineering's enrollment has shot up from 26 to approximately 200 this fall. Accredited in 1989, the department now has ten professors.

Though engineering, in general, is not easy, this program is definitely not for the faint-of-heart or weak-of-mind. Rod Strumbel, CpE senior, says, "What's expected of you in the computer-engineering program is a complete computer-science degree—practically—and a complete EE degree, along with a minor in math and a minor in physics. So basically, you're really loaded down." Dr. Nazmi Shehadeh, department head, points out that computer engineering is more inclusive than standard EE curriculums, containing "many courses on software engineering, as well as the architecture and operating systems for computers." Although software and architecture are important, Shehadeh says the program covers the entire spectrum of computer technology, from microchip design to fiber optic networking. "Some students will do integrated circuit work, as well as communications work, networking, [and] interfacing. Our program gives background in both systems and devices." Additionally, the CpE Department will soon offer an EE major.

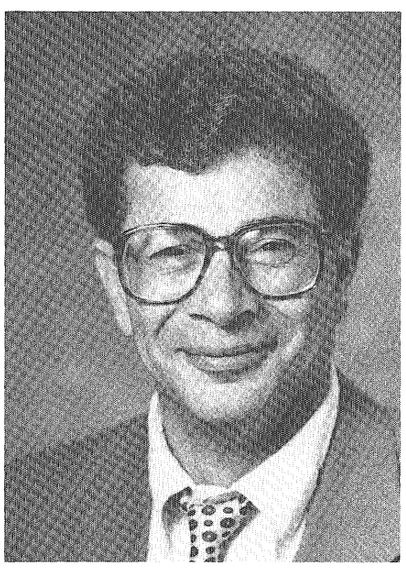


Sabra Anderson, dean of UMD's College of Science and Engineering

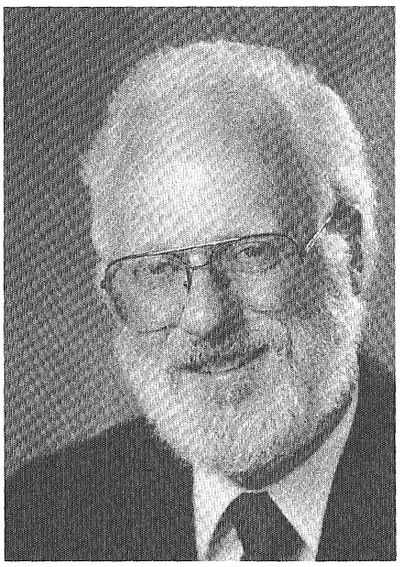
Though small, the department's performance is impressive. According to Shehadeh, placement is running over 90% for the past four or five years, with graduates finding jobs in the Twin Cities and across the nation. Starting salaries are roughly equivalent to those earned by EE majors—around $30,000 per year—though sometimes larger. Shehadeh says, "Our relationship with industry is very good, in terms of providing them with good students and [our receiving] generous donations."

Generous donations indeed: the CpE department has received tens of thousands of dollars in cash and equipment from benefactors including Intel, Fluke, Hewlett-Packard, and Minnesota Power, not to mention Cray Research. Recently, the National Science Foundation donated over a quarter-million dollar's worth of signal processing and data-acquisition equipment for instructional use.

Strumbel testifies that the department's equipment is good and that students have access to it. "The equipment is exceptional in my opinion....The lower [division] labs are kind of crowded, but, as you progress upward, the equipment is there to use...and you have access to the labs pretty much around the clock."



Dr. Nazmi Shehadeh, head of the Computer Engineering Department



Dr. Alden Kendall head of the Industrial Engineering department

Industrial Engineering: Home of Hands-On Learning

Housed in UMD's new engineering building and blessed with new, state-of-the-art equipment, the industrial engineering (IE) program has also grown dramatically, from a dozen students in 1986 to approximately 100 in upper division this fall. Dr. L. Alden Kendall, head of the IE Department, believes the labs—robots, advanced machine tools, and CAD systems—are a strength of the program. "Our labs here are as good or better than some of the labs I've had association with at major universities. That's one of the benefits of being a new program; you can put into your labs better quality equipment than some of the programs that have been around 40 years."

IE is most similar to mechanical engineering in curriculum, Kendall states, but it also emphasizes courses in efficient use of an organization's labor, materials, and machines. In fact, Kendall says, "Our industrial-engineering program could really be classified as industrial/manufacturing, because manufacturing is a strong emphasis."

"There's real good industrial experience on our faculty, either in their research efforts or in their experience," Kendall adds. "I'm pretty sure that everybody on our faculty, at one time or another, has had employment as an engineer. Most of the research being done right now is being done in cooperation with industries—solving problems industry has posed." Kendall aspires for his department to make a significant contribution to manufacturing companies in northeast Minnesota. "I want to see our department become a technology player in the northeast Minnesota Arrowhead Region, in terms of what we can do for small- and medium-sized industr[ies]."

Perhaps as a result of faculty experience and the available lab equipment, Kendall emphasizes, "We have a very applied program. There is good opportunity for hands-on learning." Jeff Vangsness, IE senior, agrees, citing the importance of lab facilities. "I think they're fantastic. I think that's the strength of this program: [the] excellent selection of equipment. It's easy to access, and students are actually encouraged to use it. It's a real hands-on atmosphere."

Chemical Processing Engineering: Students React Well with Small Program

Though small and least well-known, the chemical-processing engineering (ChPE) program seems most remarkable. Begun in 1986 and accredited with high marks in August of this year, the department currently has 6 professors and 29 upper-division students.

Dr. Dianne Dorland, department head, has been at UMD since the department's beginning, bringing 14 years of industry experience with her. Dorland states that, in spite of its unusual name, "chemical *processing* engineering," the program is a traditional chemical-engineering program. "We just happen to have a name with 'processing' in it, and ABET [Accreditation Board for Engineering Technology] has recommended that we drop the word 'processing' to avoid confusion. Our students are hired as *chemical* engineers."

Nonetheless, Dorland is careful to distinguish the mission of UMD's program from that of the IT's highly-respected ChemE program. "IT is excellent in engineering science. They have excellent research, marvelous facilities, [and they're] well funded. Their graduate program is "number one" in the country." In contrast, Dorland says, "We tend to turn out a bachelor's-degree student who has the knowledge necessary to begin work as...an applied engineer immediately. And that's heavily related to the fact that most of our faculty have industrial experience."

As in the other UMD engineering departments, the lab equipment is brand new. Rather than large, obsolete systems handed down by industry, the instructional equipment is scaled-down versions of apparatus currently used in the field. Furthermore, according to Brett Ballavance, ChPE senior, the department's labs and computers are not locked away from students. "The labs are always open. [We have] excellent computer facilities, and we have access to them all the time, 24 hours a day."

Dr. Dianne Dorland, head of the Chemical Processing Engineering Department

Ballavance lauds the quality of instruction in the ChPE department, "It's a fabulous faculty. They'll bend over backwards to help you, and I think that's the key to this whole program. You can get help at any time. They'll put their work aside and help you."

There is little doubt that UMD is turning out chemical engineers that industry craves. UMD graduates have found jobs in paper and chemical companies throughout the nation, including Georgia Pacific, Champion Paper, Conoco, and Texaco. The performance of graduates in the field has established a good reputation for UMD's young program. According to Dorland, "The best feedback we've had from industry so far is the fact [that] they call up the next year and say,'How many are you going to have for us this year? We want everything you've got.' Industries that have hired our students want more."

"Our labs here are as good or better than some of the labs I've had association with at major universities."
-Dr. L. Alden Kendall

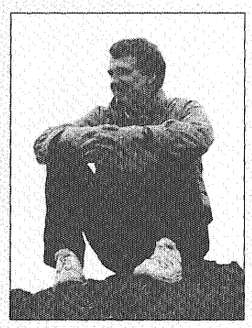
All Things Considered

Regrettably, UMD students face some of the same problems as IT students, or worse. For instance, lower-division calculus, chemistry, and physics lectures are just as large as those in IT. Registration for lower-division courses can be just as much of a headache for UMD students as it is for IT students. And, due to small enrollment, upper-division courses are not offered as often. More seriously, due to limited industry in the Duluth area, many students have difficulty finding internships and summer jobs in their field.

Somewhat ominously, research is on the rise at UMD, increasing the possibility that it will become more like IT during the coming decade. Dean Anderson wants UMD's engineering programs to grow, but says that research contracts would have to fund such growth, given the lack of money within the University itself. Asked if such an emphasis on research won't ultimately compromise UMD's teaching mission, Anderson acknowledged, "I can look at other schools and see where that is a problem. But we put a big emphasis on quality instruction for undergraduate students, and I don't see that changing."

By any measure, UMD is off to a good start and provides many students with a welcome alternative to IT. Jeff Vangsness, IE senior previously quoted, is living proof. Intending to transfer to IT after completing the pre-engineering program offered at UMD, he decided to stay after meeting some IE faculty members. "I don't regret the decision at all," says Vangsness, adding, "I'm going to be sorry to leave this place. It's been a good experience."

Meanwhile, back at the "zoo," the squirrel population is growing, and the IT student population is shrinking. Administrators interested in reversing this trend have much to learn from UMD. ❐

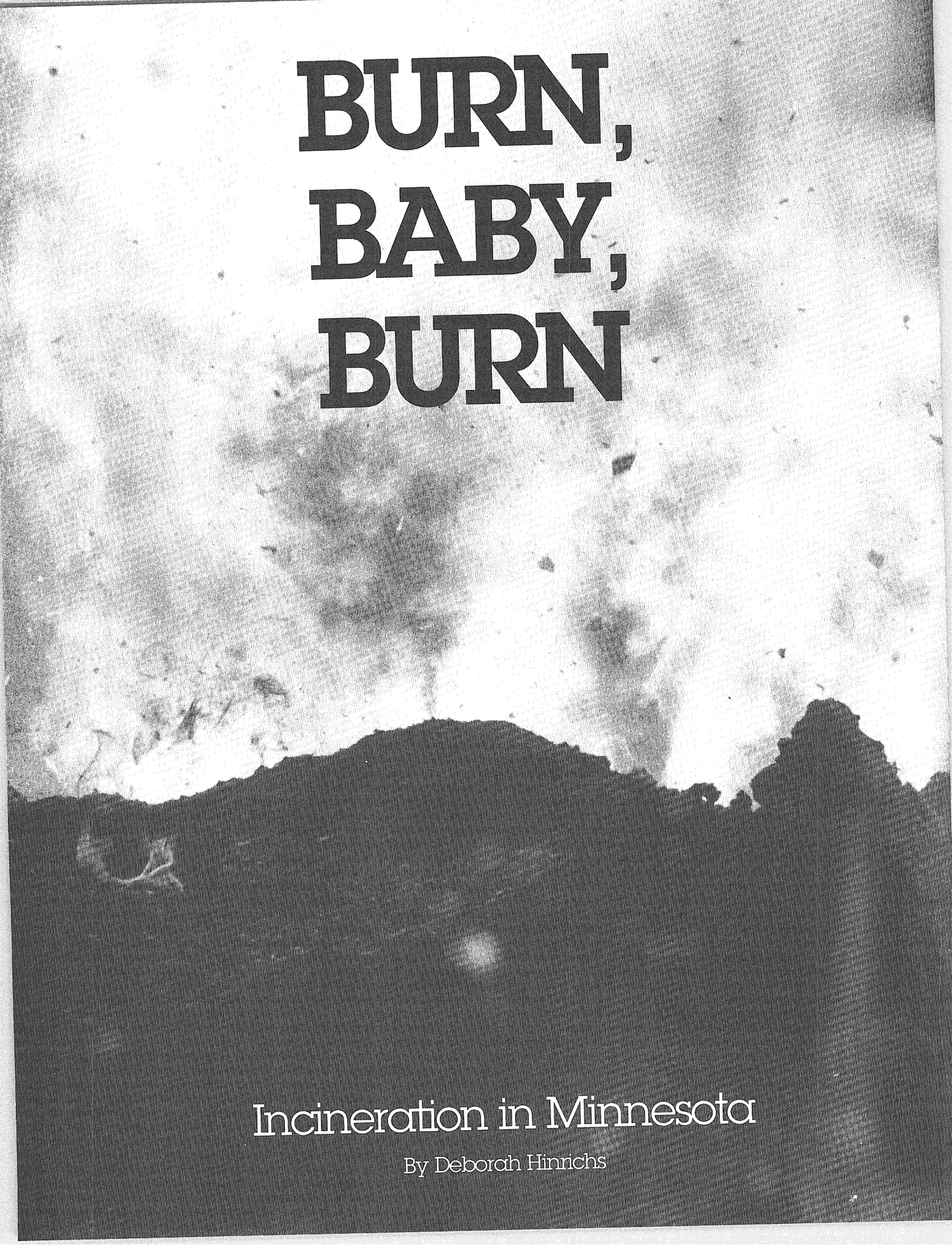


TECHNOLOG

Writer Profile: Loren Thomsen

Loren, EE senior, was last year's *Technolog* editor and is now an underground force at the magazine. Before coming to the magazine, he was a highly-esteemed cookie engineer. In fact, every Keebler "Magic Middle" cookie has a little Loren Thomsen in it.

BURN, BABY, BURN



Incineration in Minnesota

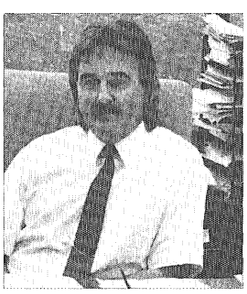
By Deborah Hinrichs

Is garbage incineration too hot to handle? Learn more about this heated topic.

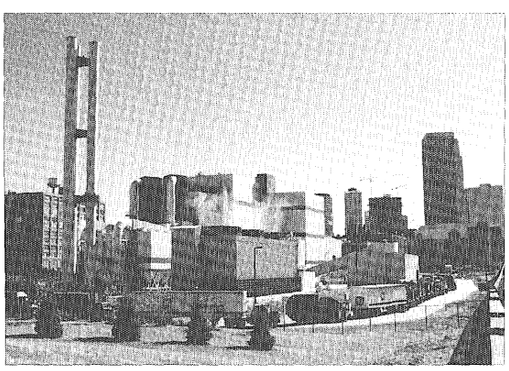
Dakota County residents say there is a stench in the air reeking unmistakably of the Dakota County Board's answer to handling garbage in their area: a garbage incinerator.

Residents say NO to the proposed incinerator. "We don't believe the alternatives have been explored enough to warrant the building of an 800 ton-per-day garbage incinerator," said Dee Richards, co-director of the Dakota County Citizens Against the Burner group. The Minnesota Attorney General's office agrees with the group. Richards said influence from the Dakota County group recently prompted the Attorney General's office to stall the new incinerator's building permit by requiring the Minnesota Pollution Control Agency (MPCA), the agency responsible for issuing the permits, to explore alternatives to the incinerator before granting the permit. Richards said this is the first time a proposed incinerator plan might be cancelled. Until the Attorney General's office intervened there were no checks and balances on the permitting system, she said.

Rick Grubb, Hennepin County Resource Recovery Facility



Frank Hornstein, co-director of Clean Water Action



Landfills vs. Incinerators

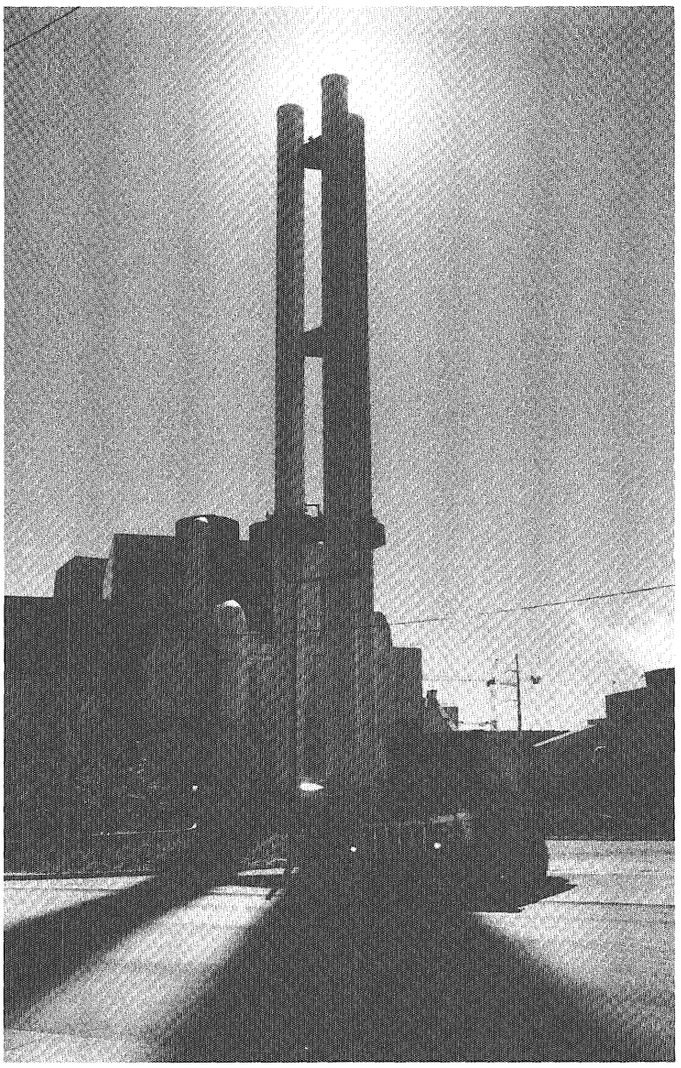
Historically, landfills have been the primary solution for solid waste disposal. The garbage truck comes on its scheduled day of the week, hauls garbage to the landfill, and dumps it. But there is more to solving the solid waste crisis. The solution is neither as quick nor as easy as putting the trash in the dumpster or out on the curb.

In 1980 the state legislature passed the Waste Management Act. The act stated that groundwater (the source of our drinking water) must be protected from contamination by reducing the amount of garbage sent to landfills. The act also established priorities for managing solid waste. Topping the list were waste reduction (reducing the amount of garbage generated by modifying packaging guidelines) and re-use. Composting, a method of reusing vegetable matter, and recycling were listed as the next priorities. Incineration and landfills were at the bottom of the disposal priority list.

"People are basically saying that it's burning or landfilling, implying that you will not landfill if you burn. Well, you can't burn everything," Richards said. Despite the limitations of burning, it was Hennepin County's answer to the disposal problem. When the state legislature required alternative methods of waste disposal to be explored, the county began planning for the Hennepin County Resource Recovery Facility (alias, the garbage burner). Some residents think it was a hasty decision.

"On the surface it's a quick-fix solution to a bad problem," said Tom Mouel, an opponent of the downtown garbage burner. Although the beautifully-landscaped facility, located on North Sixth and Seventh streets in downtown Minneapolis looks harmless, opponents of the burner think the facility is a band-aid solution that creates more problems than it solves. "We're not solving the landfill problem; we're just creating a new one," Mouel said.

Photos by Chris Sikorski



According to burner advocates, incineration reduces waste to 90% of its original size. However, opponents still argue that it is a poor solution. "We don't want to bury garbage yet we have to bury its by-product—ash," said Frank Hornstein, co-director of Clean Water Action, an environmental organization working with the Dakota County group.

Rick Grubb, facility manager at the Hennepin County Resource Recovery Facility, feels the plant is an idea who's time has arrived. "You're taking a throwaway product...converting it into usable electricity and conserving natural resources in the process," said Grubb.

Solid waste became a more immediate problem in 1989 when the legislature ruled that beginning in 1990 it would be illegal to dump unprocessed garbage into landfills. So, garbage incineration has become the band-aid solution to a growing problem. "The priorities are upside down. All the eggs are in the incineration basket clearly at the expense of a much more doable recycling program," Hornstein said.

Despite the low priority of landfills as a disposal option in the Waste Management Act, the legislature required each county in the state to choose four possible landfill sites in an effort to force them to deal with their solid waste. In 1984, an estimated two-thirds of the existing landfills in Minnesota were already contaminated and the counties had not come up with landfill alternatives. Amending the Waste Management Act in 1989 was the legislature's way of forcing counties to explore other alternatives.

Then and Now

In 1984 Hennepin County was already looking for a site in Minneapolis to build a waste-to-energy plant, more commonly known as a garbage incinerator or burner, and the legislature's deadline gave the county the green light to continue its search. The search was not an easy one. For nearly a year the county and the city disagreed over 12 possible locations. They settled on a site near the river, only to have public opposition render the location inappropriate. Finally, in December of 1984, the downtown site was agreed upon and in 1985 Blount, Inc. was contracted to build and operate the facility. The MPCA granted the building permit for the facility in 1987 and in October of 1989, the plant began operating.

Now, one year later, the plant burns a daily average of 1,000 tons of garbage and generates a net of 33 to 34 megawatts of power, enough to power 40,000 homes. Both figures meet the projected levels for the facility.

However, the incinerator's first year of operation could hardly be described as smooth. The plant has gone through public image problems, permit violations due to unsafe plant emissions, and ash disposal problems. "For a lot of people the plant is a symbol that our society is too wasteful—a symbol of what the real problem is. And if you talk about the importance of recycling no one shows up, but when you talk in front of our smokestacks, all the media shows up," said Steve Platisha, environmental coordinator at the Resource Facility.

"It's hard to disagree 100% with those opposing the facility because no plant has

zero emissions and people are genuinely concerned. That's not all bad," Platisha said. He said the plant is really a transitional way of eliminating waste and there will be a time when we won't need incineration.

Clean Water Action's Hornstein advocates mandatory recycling as an alternative to incineration. He says the mandatory recycling guidelines should include every household, individual and industry. Greater expansion of recycling programs, such as more extensive pickup (e.g., include apartment buildings, etc.) and more items to be recycled should also be mandatory.

Plant personnel disagree that the incinerator interferes with recycling programs. "We're not forcing people to throw away their recyclable material. The purpose of the plant is to reduce in size what people throw away. It is a way to deal more safely with the generated waste than landfills," Platisha said.

How Safe Is It?

Safety was an issue last December during one of the initial pollution control tests. During the test, mercury levels were recorded at three times the .002 ppm levels (level is designated by the permit). According to a *Twin Cities Reader* article, the incinerator's mercury level was greater than the amount of mercury that would fit inside the typewritten letter "o," which is enough to cause a fish advisory in a medium-sized lake.

According to Lew Chamberlain of the air quality division of the MPCA, it only takes three button batteries (the kind used in calculators and cameras) per ton of waste to surpass the incinerator's mercury standard. Although Chamberlain said he isn't sure button batteries caused the high level emissions, Minneapolis started a button battery collection program last December. He speculates a large battery may have caused the high emission levels.

In a recent interview, Grubb said current mercury emissions, which are tested every three months, are averaging .0003 ppm. "There is a real misunderstanding of how tightly regulated this plant is," he said. The Hennepin County plant has the strictest emission standards in the nation. "Environmental standards are much more stringent for resource recovery plants than for other forms of electricity," Grubb emphasized.

Despite mercury emissions below required levels at the Hennepin County burner, Chamberlain is concerned about the volatile nature of mercury. "We're looking for more information on mercury emissions before we grant the permit for the Dakota County Incinerator—options such as using a carbon filter with a dryer system," he said.

Other incineration problems have been listed as toxic emissions; dioxin, furan, lead, HCL (Hydrogen Chlorine Gas) emissions which release chlorine, a component in the disappearance of the ozone layer, and NO_x.

And then there's the question of what to do with the by-product of burning—ash. Dis-

posal problems delayed the burner's operation by two months last year. Bottom ash (ash that drops to the bottom of the burners) and fly ash (ash caught in the stack by a vacuum-like mechanism) must be disposed of in specialized facilities for this type of hazardous waste. 200 tons of ash is produced at the plant daily and the county is required by contract to find a disposal site for it. The ash is currently being shipped to a facility in Joliet, Illinois.

Tests have shown levels of lead in the ash that exceed federal drinking water standards by 160 times and exceed federal hazardous waste standards by 60 percent. Grubb said the Illinois landfill is able to prevent any leachate from the ash by using a thick layer of clay and a synthetic liner to trap any leachate water and then draining this water into an appropriate container. Regulatory concerns in Illinois have caused the county to investigate sending the ash to a disposal site near Minot, North Dakota and to find ways to reuse the ash.

However, the plan to reuse the ash has been delayed. Officials proposed to pave a 1,000 foot section of road in Dayton, Minnesota with asphalt mixed with pellets made from garbage incinerator ash. Public opposition of the project in Dayton was overwhelming. In late August, the MPCA announced it would delay the project because new lab tests on the proposed ash pellet indicated that chromium can leach from the pellet at levels slightly above the highest state level of drinking water guidelines. Legislation passed in 1989 required Hennepin County to develop a demonstration project using the ash in a roadway. In addition, the MPCA was told to issue a permit for the project.

Meanwhile, as the mounds of garbage grow in Dakota County, the fight to jump off the burner bandwagon continues. "Not one shovelful of dirt has been turned. There's still time and we're not stopping our efforts. We're very happy about the Attorney General's statement," Richards said.

While it may be true that the Hennepin County Burner is a transitional solution, Dakota County could be the place to try a transitional recycling program. Dakota County residents, who already recycle at the highest level of any county in the state, could break new ground by stopping another band-aid solution to a long-term problem. ❐

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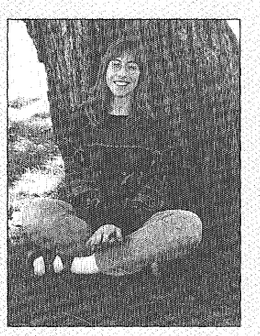


TECHNOLOG

Writer Profile: Deborah Hinrichs

Deborah Hinrichs, a senior in journalism, likes to write about the environment and use her bare hands to climb sheer, rock cliffs. According to Deb, she falls occasionally, but safety ropes keep her from falling to her death and slam her into the cliff in the process. We don't quite understand it all, but she assures us it's a great time.

Turning Your Trash to Ash

by Darin Warling

Commissioned by Hennepin County and built by Blount Energy Resource Corporation of Alabama, the burner is both a large incinerator and small power plant rolled into one. From its central location, on the site of the former Greyhound bus garage, it can handle one third of Hennepin County's trash—about 1,000 tons of garbage a day or 365,000 tons per year. Another 626,000 tons is recycled, composted, and hauled to other waste facilities.

The Incineration Process

Here is a brief overview of the incineration process.

1. Between 200 and 250 trucks enter the receiving room each day and tip their trash into the plant's storage bunker .

2. The trash is lifted out and dumped into the hopper before being forced into the furnace.

3. Burning garbage turns water into steam that drives electricity-generating turbines and provides heat for downtown businesses.

4. Heavy bottom ash falls through the grilled floor to the recovery system, where magnets collect ferrous material mixed into the trash. The remaining ash falls into an ash repository beneath the plant.

5. Lighter fly ash is blown through a scrubber that sprays a calcium compound on the escaping gasses; this binds with some of the pollutants and removes them from the air. The rest of the fly ash passes through three large fabric filters called "bag houses." The residue collected by the scrubber and the bag house is returned to the ash repository by conveyor belts.

6. Flue gasses pass through the plant's stack and into the atmosphere.

7. Ash is hauled from the repository, by covered trucks, to a landfill in Joliet, Illinois.

What Goes in Must Come Out

According to Carol Andrews, head of the Minnesota Pollution Control Agency's ash disposal program, only 25% of the mass entering the burner is collected while the rest escapes as fly ash and gas, which, as in most combustion processes, consists mainly of CO_2 and steam. Nevertheless, according to Ann Jackson, head of the MPCA's air quality board, significant quantities of pollutants are emitted each year.

However, "the plant is currently operating at or below its rated limits; [fly] ash, for example, is only emitted at 50% of its rated limit," Jackson said, adding "NO_x, CO, CO_2, and HCl are constantly monitored as they leave the smokestack."

Not Everything That Comes Out Is Bad

The incinerator turns water into steam, and while most of this is used to generate electricity, Hennepin Country is also working on a project to sell the remainder to downtown users for heating. As Jackson points out, "If the price of oil continues to rise, steam will become a more and more attractive alternative."

The burner generates 35 megawatts of electricity worth approximately $10 million annually. This is purchased by NSP and provides enough energy to power 40,000 homes year round. However, according to Andrews, the burner is a breakeven operation, neither sustaining a large loss nor generating a large profit. Jackson says the plant recovers 10 to 15 tons of ferrous material per day and gives it to recyclers; this takes it off the hands of the plant and the recyclers receive free material. "It's a good situation for both sides," she said. ❐

Darin Warling fans, please relax. He will write a complete article for the magazine before the year is out. In fact, we will be releasing a special limited-edition Darin Warling issue (autographed copies available) in the near future.

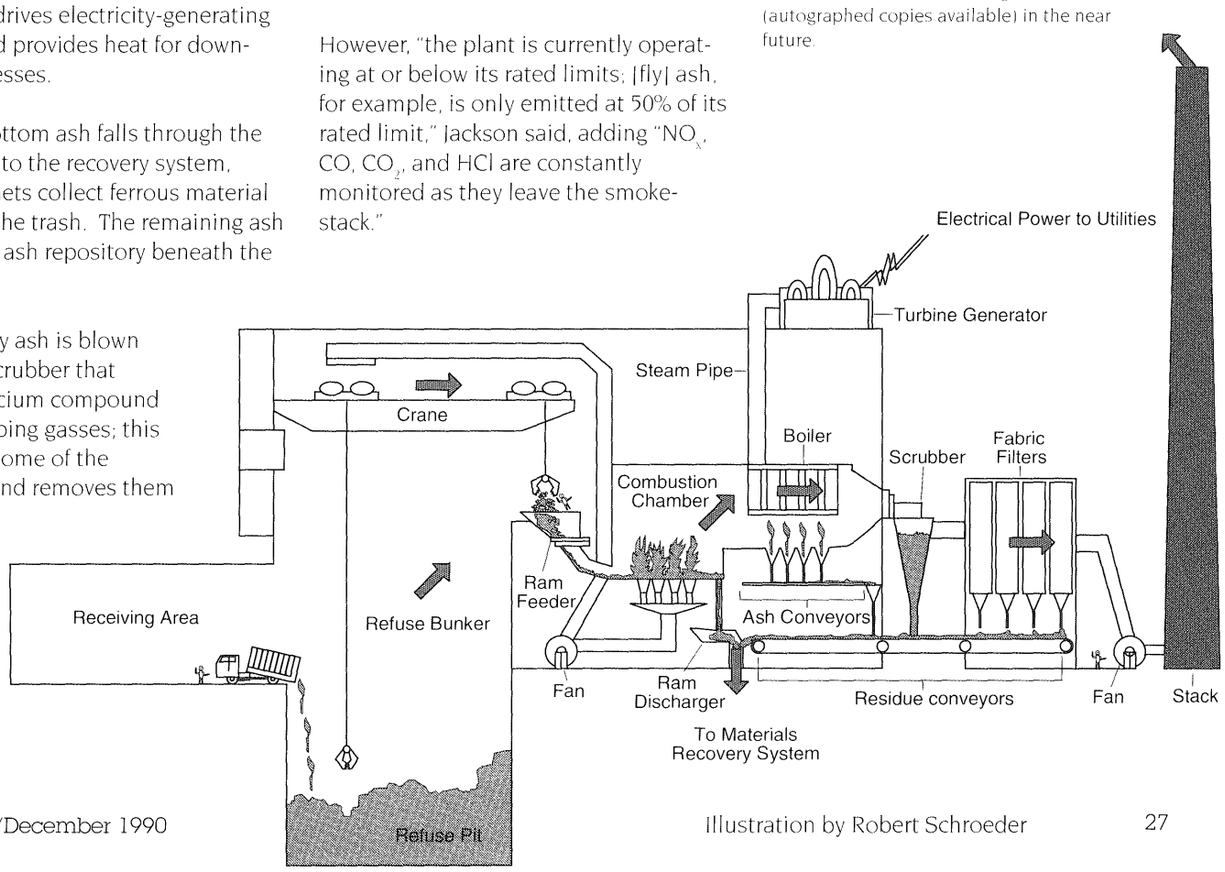


Illustration by Robert Schroeder

News

Those Darned Zebra Mussels

by Matt Kirkwood

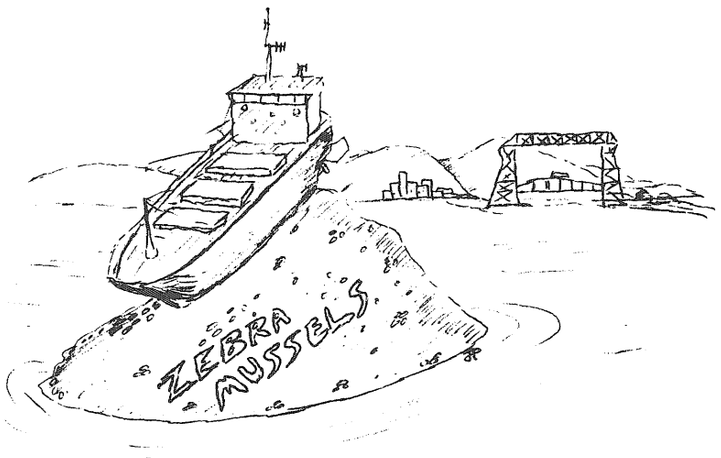
About five years ago a visitor from Europe came to Lake St. Clair. The Great Lakes region normally welcomes tourists, but this visitor decided to hang around, be fruitful, and multiply. And multiply. In fact, these creatures can increase their numbers by an order of magnitude each year and biologists say that females can produce as many as 40,000 offspring per gestation.

The oh-so-fertile visitor is the zebra mussel, a fingernail sized mollusk named for the alternating black and white stripes on its shell. Zebra mussels attach to hard surfaces and are infesting the Great Lakes. The pesky little creatures most likely traveled from Europe in the ballast water of a ship.

These eco-invaders present many problems to the region. They feed on plankton, the lowest member of the local food chain. If the plankton supply is significantly decreased, all other aquatic life in the lakes could be dramatically affected. Commercial and game fishing could be devastated.

The population has been found to be as high as 10,000 mussels per square meter. Such dense populations clog water inlets used by local industries. Low concentrations of chlorine kill the mussels, but they still must be mechanically removed. Such removal is extremely costly.

The mussels spread quickly and some scientists fear that the mussels could infest the Mississippi river and surrounding waterways with frightening consequences. Because they can attach themselves to objects like boats and even birds feet (!), their spread may be inevitable. According to Ronald Griffiths, an ecologist with the Ontario Ministry of Environment, "There's no stopping them." ❐



A Little Light News

by Brian Neurauter

This fall, a group of IT students joined the ever-growing ranks of solar car enthusiasts. Rising fuel prices aren't the only reason for the sudden interest, though. While colleges around the country are using only innovative design techniques and the sun's energy to power single and double-passenger race cars, the University of Minnesota has yet to enter the field of competition.

That may change, however, as the University's first solar car is currently in the planning stages. Students from most majors in IT are combining their efforts to work on the project. If all goes as planned, the first solar car will be complete two years from now, in time for the next GM Sunrayce.

In anticipation of things to come, a group of twenty-two University students recently visited Mankato State University, the only university in Minnesota with its own solar car, the *Northern Light*. Mankato's car participated in the 1990 GM Sunrayce, and finished 16 of 32 entrants. *Northern Light* holds another record as well; it was the first solar car to attempt the 12.42 mile climb up Pike's Peak, altitude 14,110 feet, in a 1:03:48 running time.

The success of the *Northern Light*, a car entirely designed by MSU students, gives University students hopes that they too can build and compete a "car of the future." ❐

Biosphere II

by Joyce Rajendran

On December 5th of this year, eight people will embark on a journey of sorts, a journey concerned not about "where" but about "how long."

Eight people will spend two years confined to the 2.5 acres of Biosphere II, a self-supporting system based on the Earth's natural ecosystem.

Inside, the occupants hope to discover new ways to combat the pollution problem and to stabilize the Earth's troubled environment. Information gathered about working within confined areas over prolonged periods of time will be invaluable for future space missions, also.

There are two major sections in Biosphere II, one for humans and the other for wildlife. The human area will house the living quarters, office and laboratory spaces , and recreational facilities. The wildlife area will house 3800 varieties of plants and animals which will be contained in mock-ups of a tropical rain forest, a savannah, a desert, an ocean, and salt and fresh water marshes.

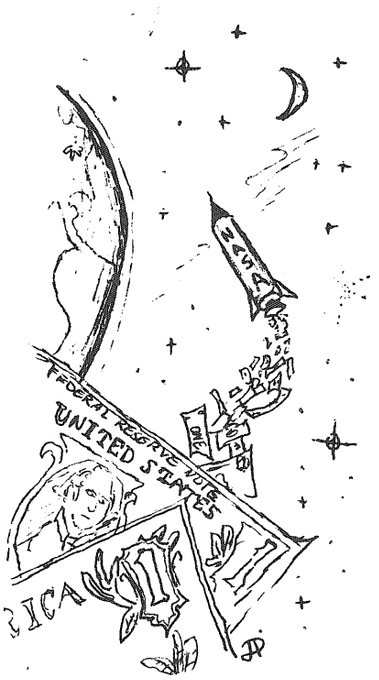
The sphere is completely self-sufficient. Carbon dioxide and oxygen will be exchanged by the plants and animal life. Microbes will be used to break down wastes. And filters will be used to purify the water and air. There are even accommodations for a child, should the need arise.

The only links to civilization will be electricity, telephones, and computer lines. Other than these few amenities, Biosphere II is completely sealed off from Earth. ❐

Space Spinoffs Circle the World

by Alice Chen

Have you ever wondered how the Dustbuster, scratchproof eyeglass lenses, and vacuum food packaging came into being? The "Space Spinoffs" exhibit at St. Paul's Science Museum of Minnesota showcases commercial innovations that resulted from space research. The items were selected from more than such 30,000 products produced since the space program began. Supercushioned tennis shoes, Videodisc players, and superconductivity are among 100 items on display.



The exhibit will be open until Jan. 6, 1991. The Science Museum is located on 10th and Wabasha in downtown St. Paul and entrance fee is $4. Call (612) 221-9488 for more information. ❐

Five, Six, Seven, Eight, We Don't Think, We Demonstrate...

by Lee Klancher

On October 23, a group of protestors gathered inside the Placement Office in Lind Hall to protest Shell Oil Company. Shell was interviewing students and the protestors apparently felt that Lind Hall was the proper place to voice their frustration with the situation in the Middle East. The group repeated chants of, "Oil's not worth dying for," and (our personal favorite), "Shell, no, we won't go."

Shell is undoubtedly making piles of money due to oil price increases that were a direct result of Iraq's invasion of Kuwait. No one took the time to point out to the group that Shell Oil, of all companies in this country, would be the last to advocate American involvement in the Middle East. In fact, Shell has and will continue to benefit from an endangered oil supply.

The police came, and the protestors marched out of Lind Hall, chanting, "One, two, three, four, we don't want your oil war." ❐

Illustrations by Joe Pocrnich

Diversions

Caption Contest 90 Winners!

Our Fall Caption Contest was a close one. There were two obvious winners, and yet the staff could not choose between them. Thus, we turned to the help of the U.S. Treasury Department for the winner.

First Place: "Now say AHHH!" (Vasanth Siuan, EE Junior)

Second Place: "Our business is designing precision lefse-rollers." (Mike Thorad, ME Masters)

Vasanth wins MacWrite II or $25, and Mike wins a Technolog T-shirt. Thanks to all who entered.

Space Rock Trivia Quiz

How well do you know rock music? More specifically, how well do you know rock music pertaining to space?

1. Name three groups and three songs that have "star" in their name.

2. Name three bands that have used spaceships for stage sets?

Given the lyric below, name the title and performing artist.

3. "We headed for their starship and sailed into the skies.

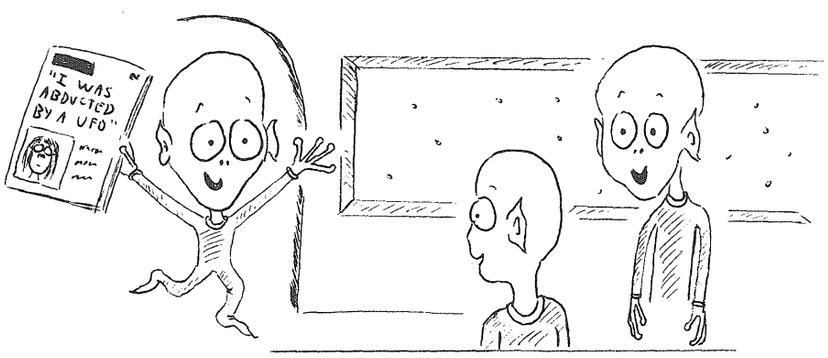
4. "I hope my legs don't break, walking on the moon."

5. "Mars ain't no kinda place to raise a kid, in fact, its cold as hell."

6. "Am I floating in a tin can?"

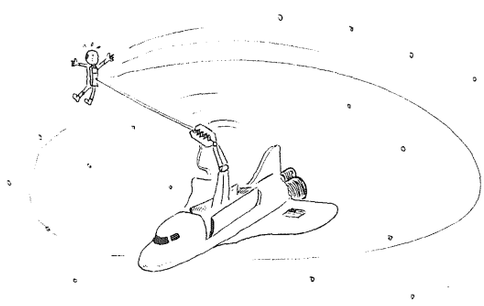
7. What well-known rock group sang a song about a space shuttle launch called, "Countdown." (Hint: The band consists of only three members and the album cover features a black and white dog sitting next to a bright red fire hydrant.)

8. For extra credit, what band had a hit song called, "Why Me?" The song was about a man sent into space and was a top 40 hit in the early 1980s.



"Guys! Guys! We made the *National Enquirer* again!"

Dennis VanDenBerg



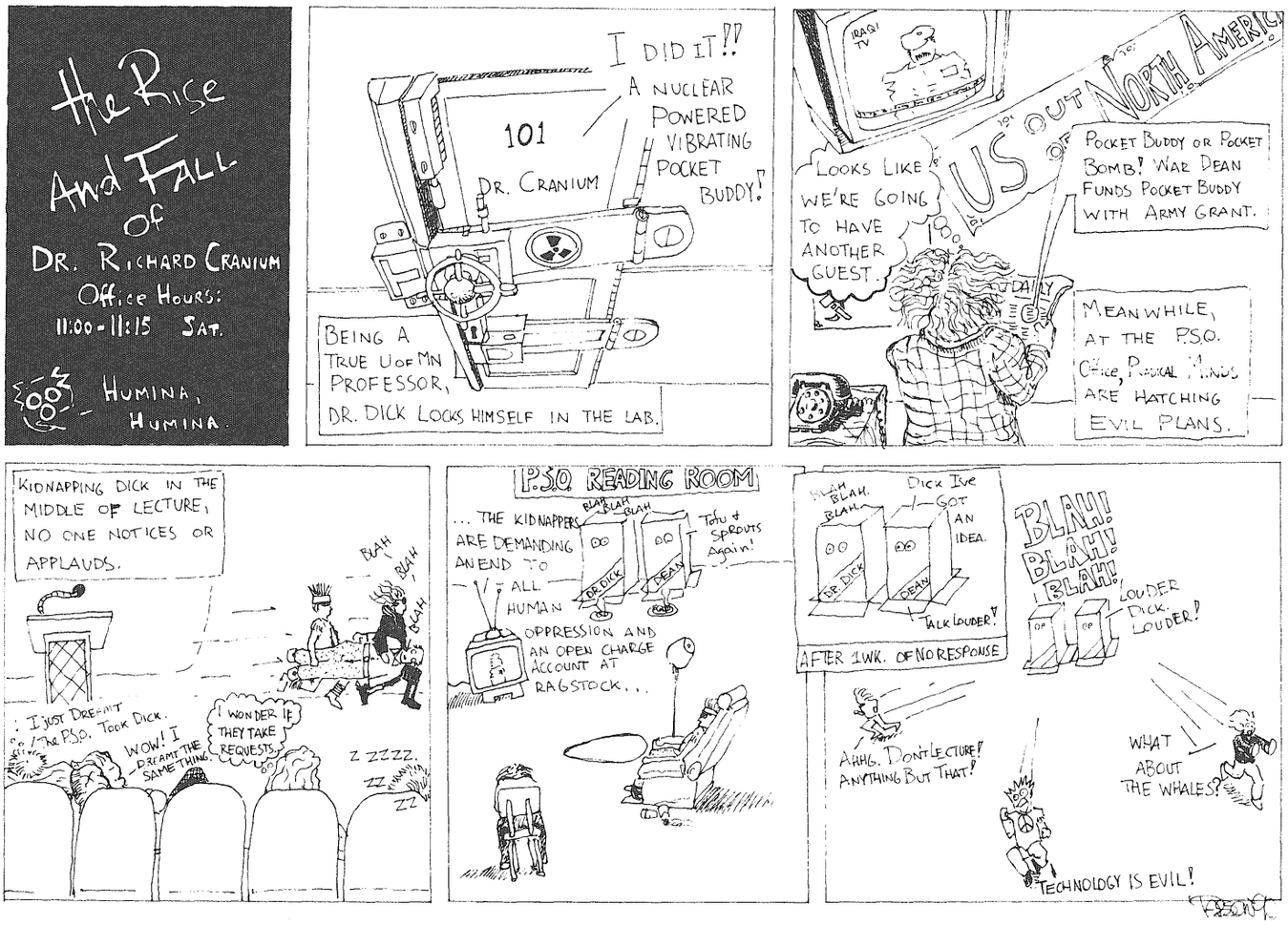
"I don't care what he did with your dehydrated granola snacks, Jenkins! You let go of that lifeline this instant!"

Dennis VanDenBerg

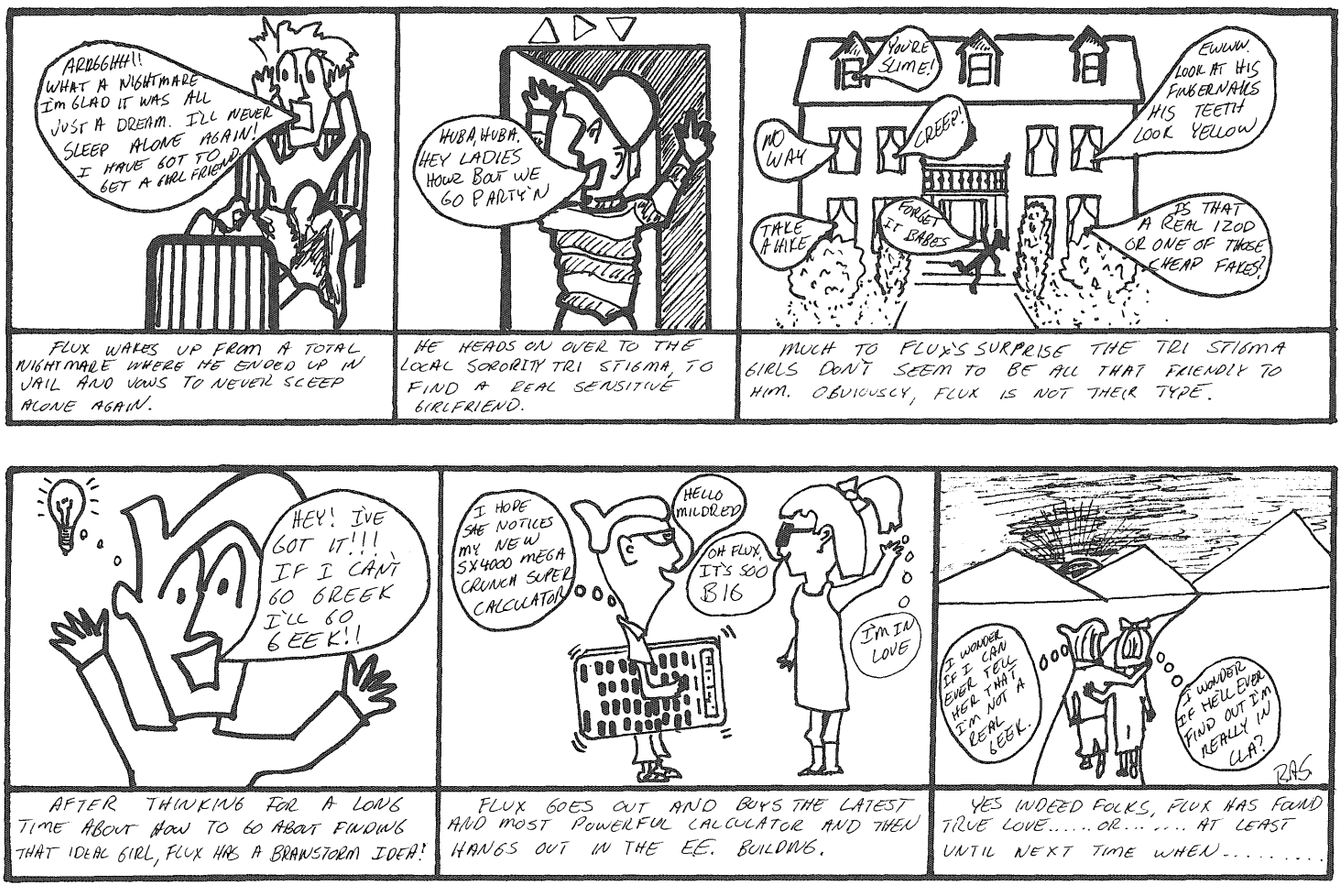
Trivia Quiz Answers

1. Shooting Star, Jefferson Starship, and the Starland Vocal Band (remember "Afternoon Delight?"). Three songs are Shining Star (by Earth, Wind, and Fire), Shooting Star (by Bad Company), and Starship Trooper (by Yes). We are sure you thought of others, also. 2. Boston, the Electric Light Orchestra (you know, ELO), and ZZ Top all used spaceships as stage sets. 3. Come Sail Away by Styx. 4. Walking on the Moon by The Police. 5. Rocket Man by Elton John. 6. Space Oddity by David Bowie (remember, the one about "Major Tom"). 7. Rush, off of the *Signals* album. 8. Planet P

Loren Thomsen and John Dassow



Robert Schroeder



Antenna

by Loren Thomsen

In the church of stars and shine and dark distance,
Humanity squirms,
Killing time with culture and conquest,
Inventing imaginary friends and impractical ideologies,
Pooping their pants,
Poking one another in the eyes,
Scrawling histories full of stomp and riddle.

A child oblivious to sacred ceremony and its minister,
Unmoved by the solemn stillness of space,
Humanity babbles.
Cups of multi-frequency gibberish spill across the spectrum,
Used car commercials stray light years,
Smurf signals modulate Saturday mornings in remote corners of the cosmos.

Weary of the hard pew,
Bored with its own noise,
~~Humanity~~ throws a tantrum.
Probes are flung far and wide,
Until the ancient elders in the congregation are aroused.
The electromagnetic yawp coming from earth could be ignored,
But now the young hooligan is tossing paper airplanes about the galaxy.

At last humanity's irreverence is rewarded.
A gentle pleading rebuke comes in unambiguous binomial code,
Exactly one thousand twenty-four wavelengths long:

Hush child
We hear you
We are your brethren from a thousand supernovas ago

~~Hush child~~
Sit still
You have imagined more than is safe
Four dimensions must suffice til supper

Hush child
We beg of you
Listen
The silence is a psalm
The echo is from infinity
God is speaking to us
~~Can~~ you not hear?

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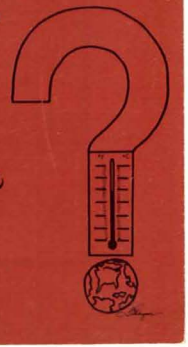
TECHNOLOG

January 1991

BIO-LOGICAL? WAR-FAIR?

Also Inside; Global Warming

A Hot or Cold issue for the 90's?



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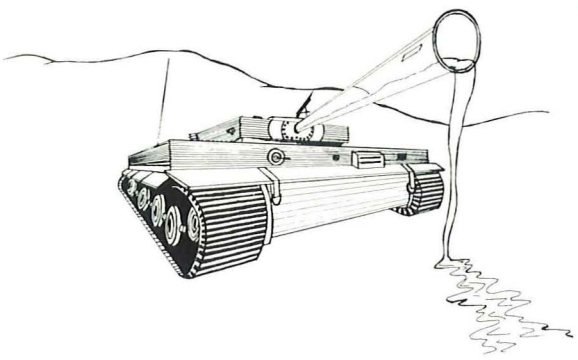
TECHNOLOG

Volume 71, Number 3 January 1991



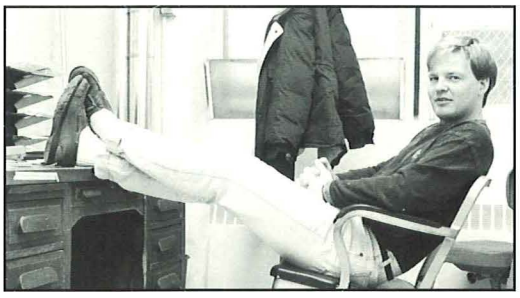
Departments

Editorial

Saddam Hussein, the Draft, and You

As we come closer and closer to war in the Middle East, the motives for action become less and less clear.

We are on the fringes of our generation's first war. January 15, 1991, is the deadline for Saddam Hussein to back off his invasion of Kuwait. President Bush is beating the drums of war and the pulse of the country pounds, "War, glorious war!" The military itches to try out its newest bombs, tanks, and planes. Politicians prepare dramatic speeches and dream of ticker-tape parades. The media lusts for Pulitzer Prizes and skyrocketing ratings. The masses forget domestic troubles and imagine the booming economy of the American war machine. And thousands of people, perhaps even you or me, have feverish nightmares of fighting in the sand and coming home as rotting corpses zipped in green plastic bags.



If you and I don't fight this war, then our friends and colleagues will. The generation that takes us to war will not die on the battlefield. They will play war games and call 40 percent losses victory or play power games and ply the masses for votes while you and I eat sand, bullets, and blood.

The military people are going first; enlisted, ROTC, and reserves, are being drained from our country like water from a bath. When this pool runs dry, the draft will begin. Bush claims that there will be no draft. This is the man who said taxes would not be raised, that he knew nothing of the Iran Contra affair, and that the budget would be approved. The "read my lips" man has lied to us before and will lie to us again. When Saddam's troops have killed enough regulars, the government will start picking birth dates and sending out letters reading, "report to duty."

The Iraqi troops will kill plenty of regulars, make no mistake about that. One million battle-hardened Iraqi soldiers are waiting for us in Saddam's desert. Our troops are green and unaccustomed to facing the extremes of the desert and hostile gunfire. When the two forces clash, the more experienced Iraqis will litter the sand with American dead. In addition, experts predict that Iraq will have nuclear capabilities sometime in 1991. As a wild card, Saddam is willing and able to use chemical weapons. If half of the American forces are vaporized or poisoned, the war will be dramatically prolonged. War with Iraq will not be like overpowering Panama or Grenada. We will not win this war with a few tanks and attack choppers. In this war, victory will cost untold dollars and countless lives.

The why of war with Iraq is unclear to me. If it is for the economy, why are billions upon billions of dollars being spent? How can that be economical? If the fight is for freedom, justice, and

morality, why have the atrocities committed by monsters like Pol Pot, the Ayatollah Khomeini, and the South African government been virtually ignored? As near as I can tell, Saddam is far from the worst of the maniacal leaders in this troubled world. If this war is not for money or for higher principles, then why should we die in the Arabian desert?

When Saddam's troops have killed enough regulars, the government will start picking birth dates and sending out letters reading, "report to duty."

Much has been made of the United Nations first truly united action, but the U.S. seems to be the most deeply involved in enforcing the resolutions of the U.N. council. Why is this so? I don't believe it is because our country has stronger morals than any other. I believe it is because of our political system. President Bush has used this war to distract attention from domestic problems. His popularity was on a big slide downhill around election time. He was critically indecisive with the budget and broke his promise to maintain tax rates. After a little warmongering, the public has forgotten these shortfalls and Bush's popularity has pulled out of the basement.

I am not ready to lie bleeding in the sand in order to preserve Bush's popularity or for the sake of cheap oil. These are not validations for my death sentence. As those who will die for our leaders' decisions, we must actively question the motives driving this war. Do not forget that when President Bush beats the drums of war, he is marching our generation to the bloody sands of the Middle East.

Lee Klancher

TECHNOLOG

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Letters

Dear Editor,

I was shocked to see an upside-down shuttle on the November/December issue of *Technolog*. Just who do you think you are? You obviously did not do your homework before you slandered NASA. I don't know what your major is, but I hope it's not astronomy. If you think NASA has not done anything "significant or remarkable" since they put a man on the moon, you are probably quite incapable of being impressed by anything beyond your narrow scope of interest. I would also suspect you think Andrew "Dice" Clay is actually funny. Is putting an unmanned craft on the surface of Mars insignificant? Oh yeah, those pictures of Neptune were pretty dull, too. I guess it would be pretty easy for you to launch a spacecraft from your back yard and send it to the outermost reaches of the solar system. I suggest you pick up a copy of *Astronomy* or *Sky and Telescope* and brush up on the "insignificant" things that NASA is doing these days. Your article was much too superficial. I think your magazine should grow up a little and drop the Enquiresque style of front page. After all, the magazine is free, you don't need to grab attention in that way. What are your contributions to the space program, Ed? Certainly not this drivel. C'mon, make this a magazine I want to read! Your humor is a great insight to your personality, Ed. Too bad it has no place in a "technical" journal.

Jim Muehlberg
CLA Freshman

It's always nice to know that someone out there is taking an interest in what we're doing here at the Technolog. (*By the way, my name isn't Ed*)—*Ed.*

The 1991 *Technolog*

SCIENCE FICTION CONTEST

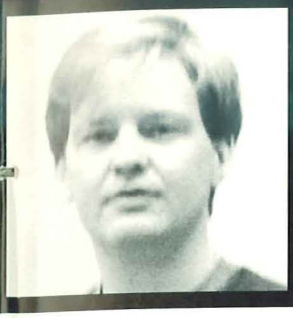
Wealth and fame can be yours!

Each year, the Technolog accepts science–fiction manuscripts written by University students. A panel of judges choose the top three entries. The top three are printed in our April issue and the winning authors will receive prize money.

First Prize:	$150
Second Prize:	$100
Third Prize:	$50

Contest Rules:
The contest is open to all registered U of M students, except *Technolog* and ITBP members. Entries must be typed and double-spaced and no longer than 3500 words. Attach a cover page indicating your name, address, and phone number; don't put your name anywhere else on the manuscript. Turn your entry into room 5 Lind Hall.

DEADLINE: February 1, 1991



Ego-Shattered Editor-in-Chief falls from grace

"Technolog is my life I don't know how to go on!"

MINNESOTA
ENQUIRER

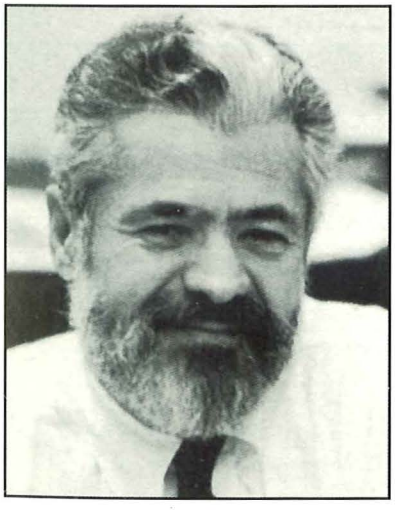
January, 1991 5¢ "Journal of Malcontented IT Students" Vol. I, Issue 1

IT Board of Publications Appalled by Editor Scandal

"We have positions open for next school year," says horrified board member, "APPLY NOW!"

IT DEAN WEARY

of "libelous schizoid rag"; Vows to replace Editor with puppet regime



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Perspectives

Plan Now for the Next Fifty Years

by Brian Jensen

Larry Hasnone, a recent graduate from IT at the University of Minnesota, is excited about the thought of getting out into the real world. He has just accepted an offer of a $35,000 position with a big local company, and he can't wait to start. Larry has decided that he has had it with the life-style he has been forced to live as a working student. No more macaroni and cheese dinners, no sir! Also, he has decided that his vintage 1959 Volkswagen Beetle has got to go. When he gets his first paycheck, things are going to change!

Larry, like many other graduating students, is looking forward to finally being able to splurge on himself. Unfortunately, Larry has nothing financially to show for his five years as a student, except for his student loan.

Shortly after starting in his new job, Larry has acquired numerous new luxuries, luxuries which he feels he deserves, especially after living close to the edge of poverty for the last five years.

Larry has rented a two bedroom apartment, for which he is glad to spend $1250 per month. He has a new car in his garage stall, for which he is paying another $425 per month. Larry is enjoying his freedom from classes, and tends to do a lot of entertaining for his coworkers and friends. He seems happy, but he is beginning to complain about being broke at the end of the month. He just can't seem to figure out what has happened to his money. Where has it all gone?

The High Cost of the "Good Life"

How often is a scenario like this played out? To students, a salary of $35,000 or even $25,000 sounds like a lot of income. The trouble is, once they get out into the real world, they will be rudely awakened. The "good life," such as Larry had, costs a lot of cash. Many students, when they get out of school, expect to live at least as well as their parents. However, there is one thing that must be pointed out: your parents have taken 40 to 50 years to get where they are. A lot of them planned ahead to achieve their goals and positions. Most didn't start out with the "good life," expensive apartments, or even high incomes like Larry's.

Unfortunately, Larry Hasnone is spending all of his income on his current lifestyle. Unless he is willing to change, Larry will not have anything to show for his effort, except for a few memories. What Larry really needs to do is sit down and figure out where he is headed. For example, does he want to settle down and purchase a house, a piece of land up north, or some wild fantasy best left unwritten?

The fact is, if Larry is willing to make a personal commitment at this stage in his life, he would be much more financially secure later on. For example, suppose Larry was to stash away $10,000 in a bank account earning ten percent per year, compounded annually. (*See Figure* 1)

Years	Principal	Value
1	$10,000.00	$11,000.00
2	10,000.00	12,100.00
3	10,000.00	13,310.00
4	10,000.00	14,641.00
5	10,000.00	16,105.10
10	10,000.00	25,937.43
15	10,000.00	41,772.48
20	10,000.00	67,274.99
30	10,000.00	174,494.02

Figure 1. Your investment can dramatically increase as interest accrues over the years.

Note that at the end of 30 years, Larry has only contributed $10,000.00, But the value of his account is $174,494.02! This is an exaggerated situation, as I have assumed a risk free interest rate higher than normal, and I have excluded taxes from the calculations. However, it shows the power of compound interest over a period of time. Basically, compound interest is interest earning interest. If I were to carry this example further, we would see that the compounding interest increases the value of the account very rapidly. In fact, if Larry could contribute to his account each year , it would grow even faster. Another point to consider is the longevity of the account. The earlier Larry starts accumulating capital, the longer he is able to let it grow. Thus, you can see it is in Larry's best interest to begin saving for his future as soon as possible. Even if he can save only a few dollars a month, it will compound over time into a very tidy sum.

Many students, when they get out of school, expect to live at least as well as their parents. However, their parents have taken 40 to 50 years to get where they are.

There are many ways to set up a personal investment plan. Many people simply put away a part of their paychecks because they have always been savers. Others plan their investments meticulously with specific goals in mind. It is important to realize that there is no one plan which will suit everybody's needs; each person should have a plan tailored to their individual situation. However, there are several points which I feel are important to any successful investment program, and I have listed them below.

Have An Objective

This can be as simple as saving $100.00 per month. Or you could plan to make a major purchase in the future. In any case, I would advise you to set up short term goals in addition to any long term plan you may have. This is so you can see the results quickly. Without any short term goals, it is easy to spend the funds instead of investing them. It is far preferable, for example, to have a new stereo now than saving for a home purchase 5 years from now, especially if there is no way to judge the success of your savings program.

If you do have a long term plan, any short term goals you set up should support the long term plan. That way you can measure your progress, and achieve a feeling of accomplishment as each goal is met or surpassed.

Diversify Your Dollars

For instance, certificates of deposit are safe, but so are the higher yielding government bonds. An even higher yield may be had by purchasing some mortgage-backed securities. A good investment plan will spread the funds around into different areas. This keeps a disaster in any one area from seriously affecting the investor's nest egg. Consider what would happen if Larry had placed all of his savings in a bank not covered by the Federal Deposit Insurance Corporation. If the bank declares bankruptcy, Larry may loose all of his savings. On the other hand, if Larry places his investments in different areas, such as 25 percent in a certain bank, 25 percent in US Treasury bonds, 25 percent in mortgage backed securities, and the other 25 percent in his local credit union, he would not be nearly as devastated financially if that same bank goes under. In fact, he would loose only 25 percent of his investments. Of course, that is still a tragedy, but it is easier to take than if the entire portfolio of investments is lost!

Know Your Limits For Risk

As we all know, you can't get something for nothing. In the investment world, a higher rate of return implies a higher risk level.

I would define risk as the potential for losing the value of an investment. There are many types of risk, such as specific company risk, interest rate risk, default risk, and so on. Prudent investors want to be compensated for assuming more risk, and so the return is correspondingly higher. Risk is assumed by investors once they enter the investment world. In fact, many people have already assumed an inflation risk simply by putting their money in a bank passbook account. While the principal is physically safe, the value of that principal is not. The principal in that account won't purchase as much after a period of high inflation as it did before. Thus, even though it may not be obvious, risk is present in nearly all investment decisions.

Many people thrive on risk, while others can only sleep if they know their money is safely locked up in someone's vault. You are the only one that can determine your risk tolerance.

Start Early

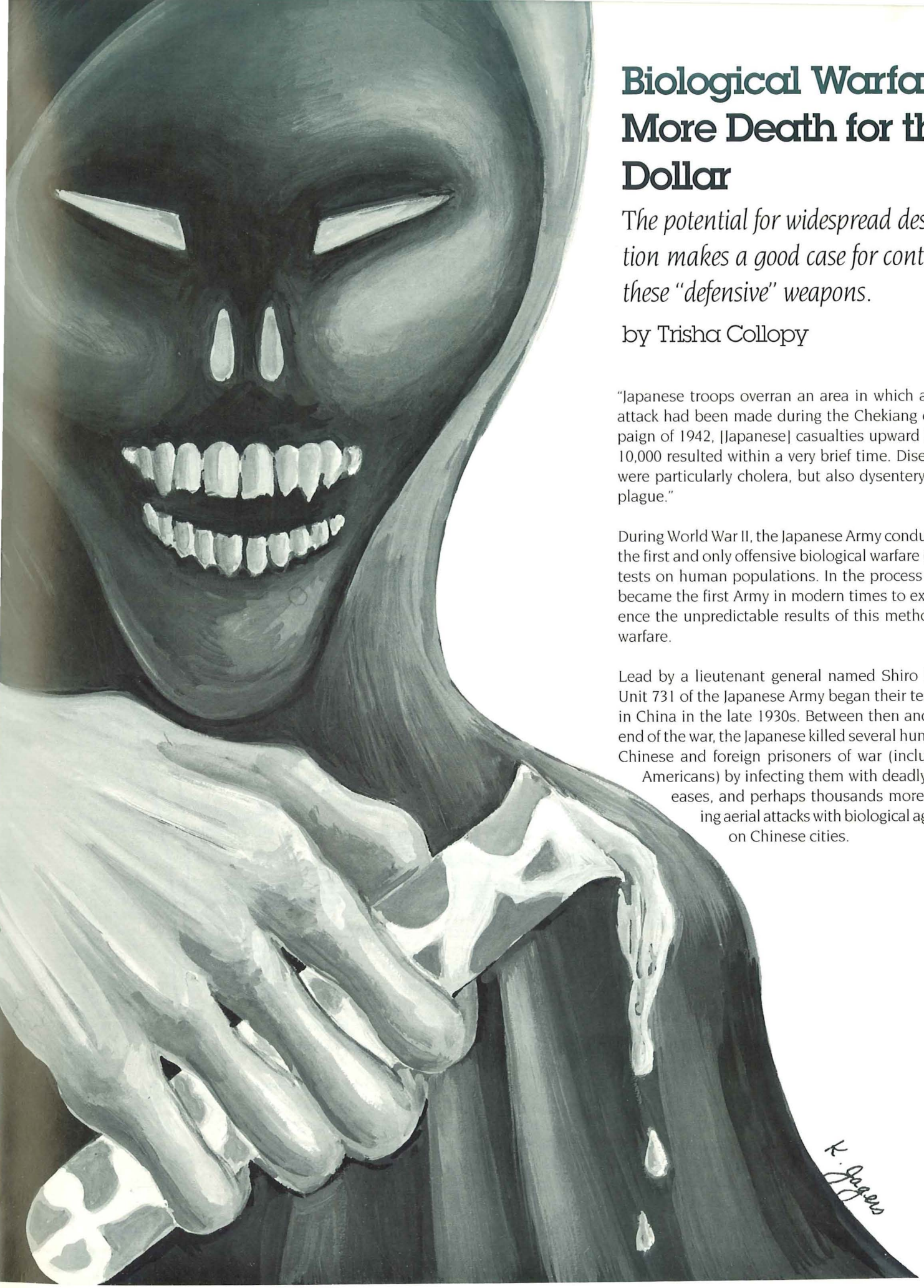
The sooner you start accumulating an investment portfolio, the better. Don't try to rush things. If you start early, the magic of compounding will work for you—in fact, over a long period of time, it will do most of the work! I can't stress this part enough, and it is one of the main reasons I have written this article. If you, as graduates, begin saving and investing with that first paycheck, I can assure you that you will be able to benefit greatly from both your efforts and that of compounding interest.

These are just a few simple tips on how to manage your investments, but they are the basics from which to base your investment choices. While they certainly are not the whole picture, they provide a little groundwork from which to base future actions. Hopefully, this article will get you interested and involved with planning for your future—the sooner you start, the better.

Larry Hasnone has decided to take charge of his own future, too. He has made the decision to save $100.00 per month, and has it automatically deposited in his company's credit union. But Larry hasn't stopped there. Intrigued by the subject, he has gone to his local library and checked out a few books on the basics of investing. Suddenly, Larry's future is looking a bit brighter. If he sticks with his plan, he should be able to relax just a bit more as he plans for his future. You, as graduates, need to do the same. When you land that first job, remember the ideas presented in this article. If you act on them, you will be glad you did.❐

Many people have already assumed an inflation risk simply by putting their money in a bank passbook account. While the principal is physically safe, the value of that principal is not.

***Brian Jensen** is a senior in Management and is pictured recovering from initiation as a* Technolog *staffer. The initiation is a bizarre ritual that involves the Art Director, a live chicken, and several gallons of Tequila. We are pleased to say that Brian passed the test and has become a valued regular here at the* Technolog.



Biological Warfare: More Death for the Dollar

The potential for widespread destruction makes a good case for control of these "defensive" weapons.

by Trisha Collopy

"Japanese troops overran an area in which a BW attack had been made during the Chekiang campaign of 1942, [Japanese] casualties upward from 10,000 resulted within a very brief time. Diseases were particularly cholera, but also dysentery and plague."

During World War II, the Japanese Army conducted the first and only offensive biological warfare (BW) tests on human populations. In the process they became the first Army in modern times to experience the unpredictable results of this method of warfare.

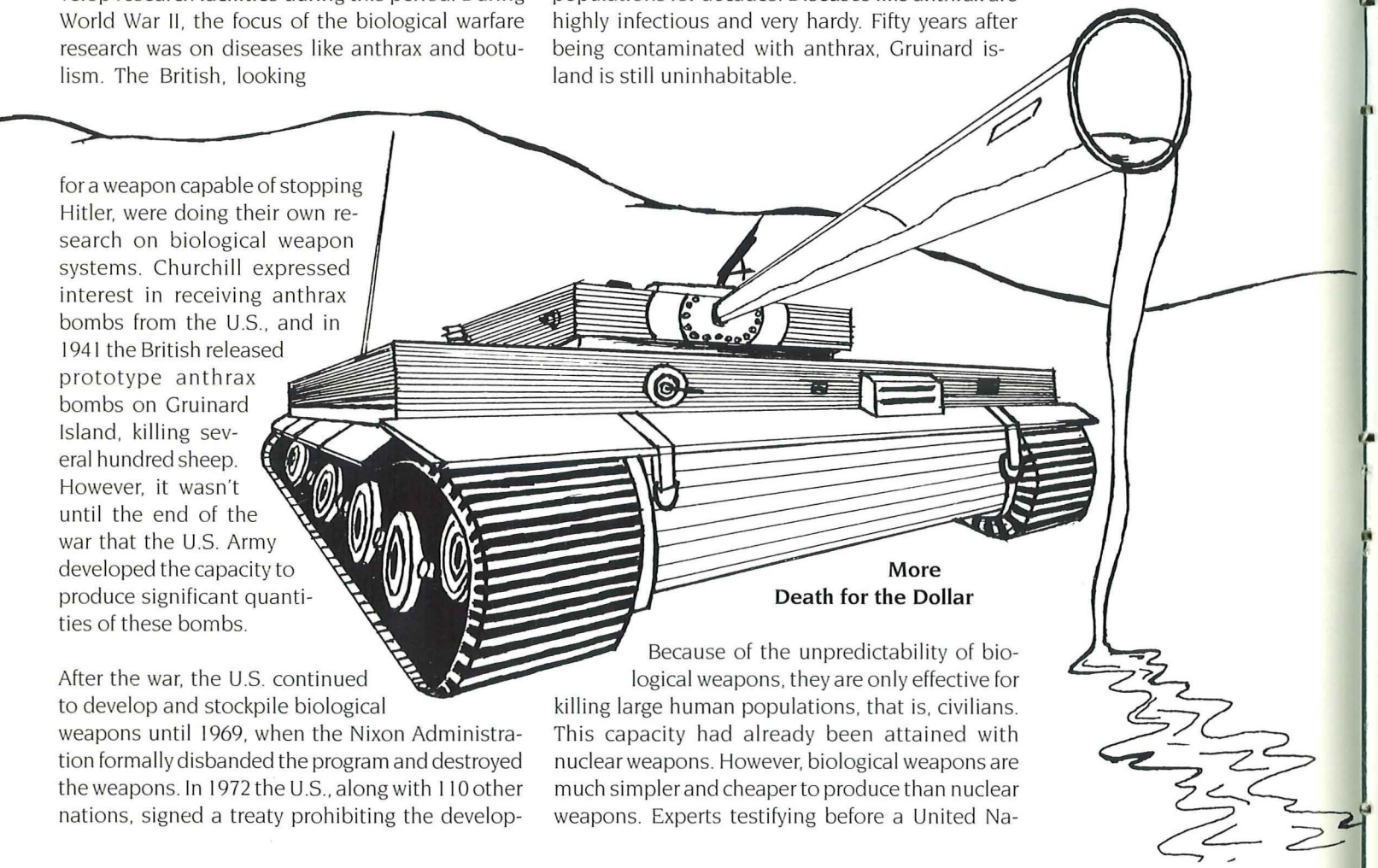
Lead by a lieutenant general named Shiro Ishii, Unit 731 of the Japanese Army began their testing in China in the late 1930s. Between then and the end of the war, the Japanese killed several hundred Chinese and foreign prisoners of war (including Americans) by infecting them with deadly diseases, and perhaps thousands more during aerial attacks with biological agents on Chinese cities.

By the end of the war Japan had "an arsenal of stockpiled germs, vectors and delivery equipment unmatched by any other nation." The Japanese Army destroyed most of this equipment when the Soviets overran China in 1945. By this time active BW programs had been initiated in the United States and several other western nations. Recently declassified documents suggest that after World War II, several Japanese biological warfare experts were interrogated by American intelligence agencies, who may have benefited from their expertise in the field.

The U.S. Army began conducting biological warfare research in 1941. By 1942, the program was formally established with a $200,000 budget. In the next few years the War Research Service, as the program was called, initiated classified work in about twenty-eight American universities. The program also received millions of dollars to develop research facilities during this period. During World War II, the focus of the biological warfare research was on diseases like anthrax and botulism. The British, looking for a weapon capable of stopping Hitler, were doing their own research on biological weapon systems. Churchill expressed interest in receiving anthrax bombs from the U.S., and in 1941 the British released prototype anthrax bombs on Gruinard Island, killing several hundred sheep. However, it wasn't until the end of the war that the U.S. Army developed the capacity to produce significant quantities of these bombs.

After the war, the U.S. continued to develop and stockpile biological weapons until 1969, when the Nixon Administration formally disbanded the program and destroyed the weapons. In 1972 the U.S., along with 110 other nations, signed a treaty prohibiting the development, production or stockpiling of all biological agents and biological toxins.

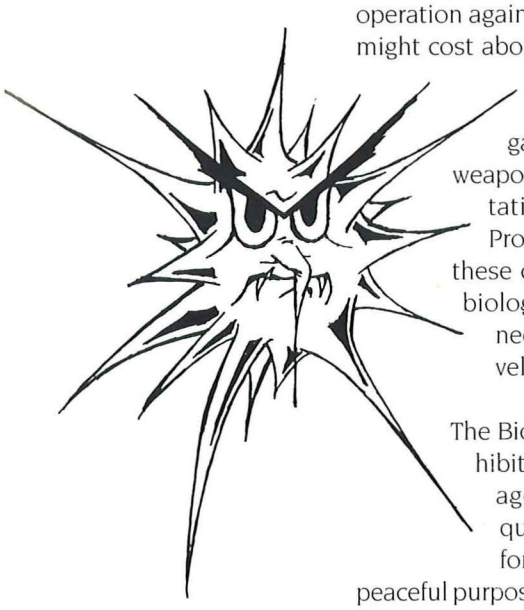
The 1972 Biological Weapons Convention was the first treaty in modern history to prohibit the use of a whole class of weapons. This strong measure against biological weapons was an acknowledgment of their devastating and uncontrollable nature. Biological weapons consist of agents which harm or kill humans, livestock or plants. The agents which are the most effective against human populations are highly infectious diseases for which there are no natural immunities. The disease can be released into the air or water of the target area. Unfortunately, there is no way of controlling the disease after it has been released. Winds can carry the airborne germs in any direction, infection of water systems can disseminate the germs far beyond the original target area, and vectors such as animals and insects can incubate and spread germ populations for decades. Diseases like anthrax are highly infectious and very hardy. Fifty years after being contaminated with anthrax, Gruinard island is still uninhabitable.



More Death for the Dollar

Because of the unpredictability of biological weapons, they are only effective for killing large human populations, that is, civilians. This capacity had already been attained with nuclear weapons. However, biological weapons are much simpler and cheaper to produce than nuclear weapons. Experts testifying before a United Na-

Illustrations by Mike Heinrich



tions panel in 1969 reported that "for a large scale operation against a civilian population, casualties might cost about $2,000 per square kilometer for conventional weapons, $800 with nuclear weapons, $600 with nerve gas weapons and $1 with biological weapons." In a 1990 House of Representatives hearing, Harvard University Professor Matthew Meselson echoed these concerns, "It was realized that our biological weapons program was pioneering a technology that, once developed, could easily be duplicated."

The Biological Weapons Convention prohibited the development of biological agents or toxins "of types and in quantities that have no justification for prophylactic, protective, or other peaceful purposes." Several signatory nations have interpreted the language of the treaty to indicate that a defensive program against biological warfare is permissible. After ratifying the treaty in 1975, the U.S. officially dismantled its offensive biological weapons and destroyed all stockpiles of pathogenic agents. The Biological Warfare Program was officially converted to a "biological defense program." Research continues at the Army's maximum containment laboratories and, according to Army officials, is purely defensive.

Cheryl Parrot, spokeswoman for AMRIID, repeated these assertions in a recent interview. The main thrust of the current research is the development of vaccines to protect American troops against naturally occurring diseases not native to the U.S. and against potential biological warfare threats, she said. Gary Gackstetter, a graduate student in the School of Public Health says that the Army needs to keep track of the spread of disease in other areas of the world because, "U.S. troops have to be ready to go anywhere anytime, like Saudia Arabia." Gackstetter is currently studying vectors of Rift Valley Fever in Africa for an Army research project.

A Good Defense is a Good Offense?

The true nature of the biological defense project remains the subject of much controversy. After a hiatus in the seventies, funding for the program has jumped from $15 million in 1980 to $90 million in 1988. This significant increase in funding has been accompanied by a welter of comments by the Department of Defense and the Department of State claiming that the Soviets are developing an offensive biological warfare capability.

The U.S. Department of State has claimed since 1981 that the USSR and its surrogates employed mycotoxins during conflicts in Southeast Asia, claims that have been recently discredited. Another claim by the Army, that a 1979 outbreak of anthrax near Sverdlovsk was the result of an accidental germ escape from a secret biological weapons installation, has recently come into question.

Perhaps due to these allegations, review conferences on the Biological Weapons Treaty in 1981 and 1986 left the issue of Soviet compliance in "grave doubt" according to one Army representative. In the meantime, the climate of suspicion created by these allegations has made offensive warfare capabilities more palatable to Defense officials.

There is no way of controlling the disease after it has been released. It is only effective for killing large human populations, that is, civilians.

Speaking before a Congressional Review committee in 1988, defense officials stated "our judgement is that the Soviet Union has maintained an offensive biological warfare program." This sort of rhetoric leads defense officials to conclude that the U.S. is supporting a defensive program only, but on the other hand, that we have the biological weapons parity necessary to serve as a deterrent to the Soviet Union and other countries with offensive biological weapons. In the same hearing, Thomas J. Welch, the Deputy Assistant to the Secretary of Defense, described the U.S. "defensive" program: "We do maintain a deterrent, one, in our conventional weapons; two, in our no-first-use retaliatory systems...And third, if we had to go further, we would be prepared to do so."

The Army's resurgence of interest in biological weapons is a result of significant advances in recombinant DNA research that made biological weapons a much more effective military option. A May 1986 report to the House Appropriations Committee stated that these new advances in biotechnology "permit the elaboration of a wide variety of 'novel' warfare materials...The novel agents represent the newly found ability to modify, improve or produce large amounts of natural materials or organisms previously considered to be militarily insignificant."

The Foundation on Economic Trends (FET), a citizens advocacy group, filed a suit against the Department of Defense in 1986, forcing them to prepare environmental impact statements for all of its high containment facilities. A report by the FET confirms that the DOD had been using these techniques in its research programs. The report states that before 1985 the department conducted at least 75 experiments using genetic engineering methods on materials such as snake venom genes, Dengue viruses, Rift Valley Fever, anthrax, Salmonella, Meningitides and others.

Reining in the Research: Does the Army Need Oversight?

This renewed interest in biological warfare research has concerned many scientists and public health officials who question the safety of biological warfare testing. In order to create vaccines for biological agents, the Army must produce these agents, which include new pathogens they think other countries might be developing. This sort of research is barely distinguishable from the creation of pathogens for offensive purposes. The creation of these pathogens could pose a public health threat. "A lot of people don't realize that work has been going on here for fifty years and there has never been a release of agents to the environment or a threat to the community," counters Cheryl Parrot, "even when we had an offensive program to manufacture biological weapons." However, there have been confirmed reports of laboratory workers becoming infected and dying. Since the Army tests several pathogens for which there is no known vaccines, any release of the disease to the public could be potentially devastating.

Biological defense funding jumped from $21.6 *million in* 1982 *to* $90 *million in* 1988.

Another concern is that as research funding has increased in the Army's biological research program, it has decreased in the public sector. A 1983 article in the Bulletin of Atomic Scientists reported that defense department funding of biological research increased by 24 percent in 1982 while in the same period funding for the National Institute of Health, which receives 80 percent of the U.S. total funding for biological research, declined by 4 percent. "Research biologists will probably feel pressure to seek support from military sources," the article concluded. This gap has widened more significantly in recent years. Biological defense funding jumped from $21.6 million in 1982 to $90 million in 1988. "University researchers aren't wildly excited about accepting funding from the Army," says Dr. Myron Gross, a professor in the University's Department of Epidemiology. "There are a lot of restrictions like limits on publishing research, the necessity of maintaining secrecy, and passing military security clearance. But money is really tight right now, and if it's a choice between not having their research funded and accepting a grant from the Army, they would probably accept the grant."

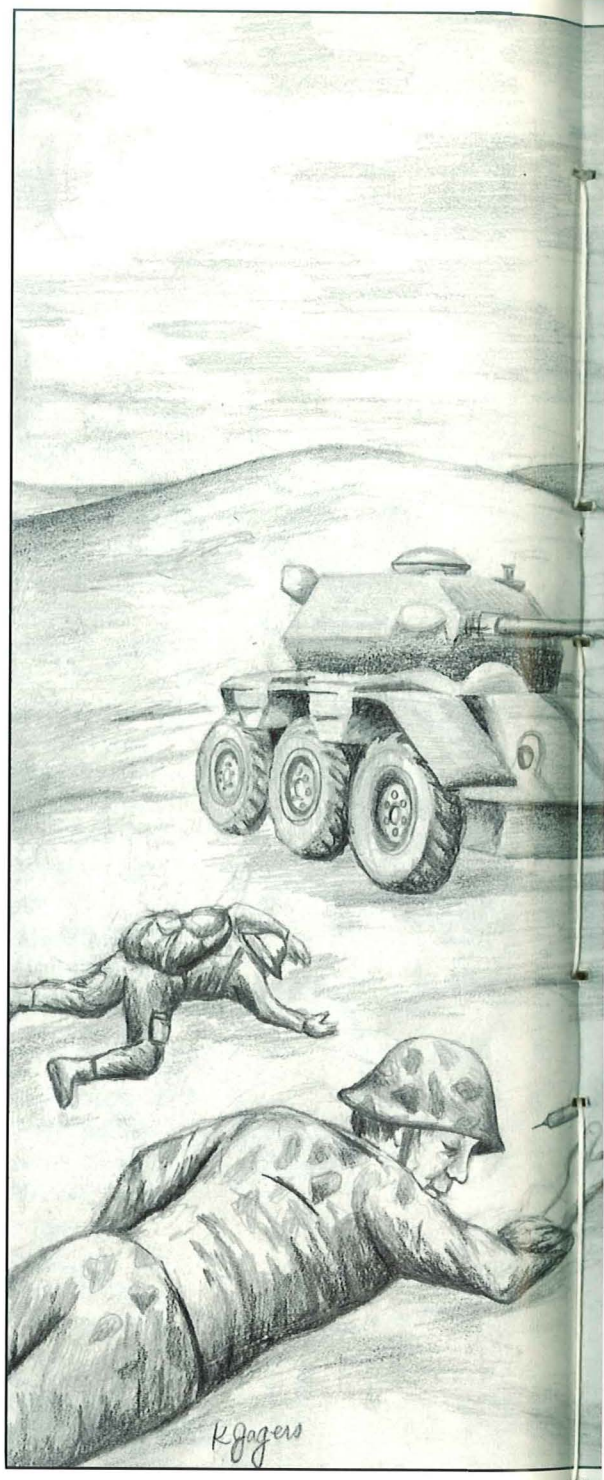
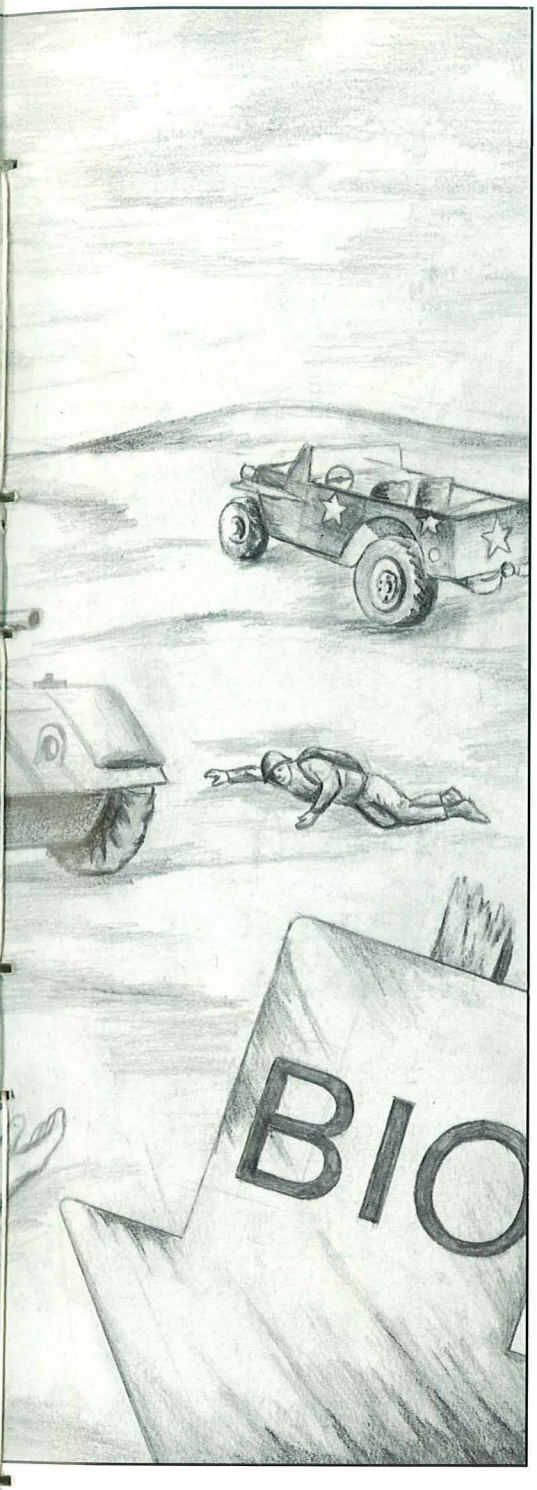


Illustration by Kristine Jagers



In the last several years there has been public opposition to the Army's plans to upgrade its biological testing facility at Dugway, Utah, to a BL-4 (biosafety level four) facility. This facility would convert pathogens to aerosols for testing against protective equipment. A BL-4 rating means the Army can test pathogens for which there is no known vaccine. Congressman Wayne Owens (UT), who opposed the construction of the BL-4 facility is currently backing a bill to change oversight of the program from the Department of Defense to the National Institute of Health.

The official reaction to similar plans has been less than enthusiastic. Cheryl Parrot said that the NIH has a different purpose from AMRIID. "Their mission is to take care of diseases within the U.S." Several similar bills had been proposed, she said, and they tended to get "bogged down" among conflicting interest groups. Security is the biggest stumbling block; although AMRIID conducts purely defensive research, in the last decade the Army has been reluctant to identify specific biological warfare threats.

In a statement defending his proposal, Rep. Owens points out that "there has been more than a 400 percent increase in our Biological Defense Research Program (BDRP) over the last nine years. Unfortunately, this sharp increase in funding has occurred with little oversight or public information." Owens finds that this situation "only serves to promote an international biological arms race."

Dr. Paul Quie, professor of microbiology and pediatrics at the University of Minnesota, says that the military's use of secrecy should cause concern among scientists, the one group that might be able to objectively monitor the biological research program. Quie previously served as a member of the Armed Services Board of Epidemiology and says that "traditionally there was civilian oversight of the Armed Service Health division." He agrees that the biological defense program should have the maximum civilian oversight possible, and that the NIH would be the most appropriate agency to conduct that oversight, because of the similar research conducted in its programs.

Since the Army tests several pathogens for which there is no known vaccines, any release of the disease to the public could be potentially devastating.

The Army's reticence to accept greater public oversight could certainly be due to a need to maintain security, as it claims, rather than a cover-up for dubious activities. It is clear that unless we struggle to gain public oversight of the program, it will be impossible to monitor the sort of research being done. At the present, the consequences are too great for us to ignore. ❐

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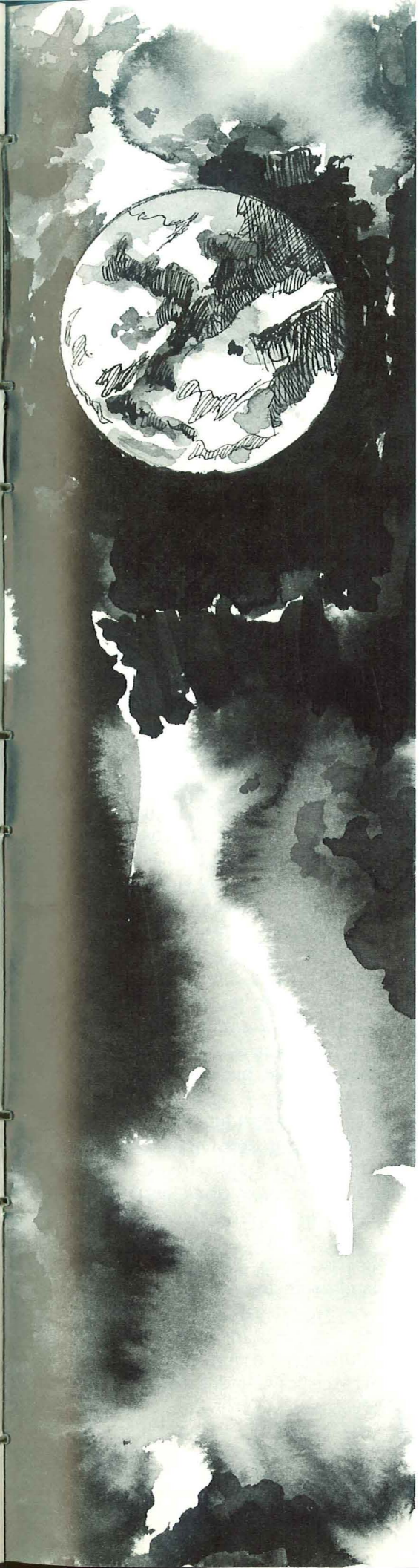
TECHNOLOG

Writer Profile: Trisha Collopy

Trisha majors in Chinese and works in the Epidemiology department where, as a less-than-reliable source informs us, she heads a team researching the dreaded bio-toxic disease *technowritorius*. The bug has most certainly bitten her, as she is writing a storm of articles for us. Hopefully, there is no cure.



The Heat is On

by Dennis VanDenBerg

Recent years have seen environmental issues become matters of great popular and political concern. Much of the debate is characterized by a sense of urgency, a need to do something, anything, to avoid imminent catastrophe.

One of the most important environmental disasters that could occur, and the one that gets the most attention, would be the effects of the so-called "greenhouse effect." This is the gradual warming of the earth's atmosphere, with various adverse effects for its population: melting ice caps flooding the coasts, deathly high temperatures, and so forth.

The debates about whether the greenhouse effect exists and what should be done about it have been fueled by the recent publication of studies showing that the earth is, in fact, getting warmer as predicted. Critics charge, however, that these studies are incomplete or misinterpreted, and go on to cite other research indicating the absence of any climatic change.

What's really happening? In order to find out, it helps to understand what is supposed to be occurring, according to the theory of global warming. This begins with the assumption that the entire earth is a carefully balanced system, capable of being tipped into imbalance by human activities. While this may be taken for granted, it is a matter for debate, as will be seen later.

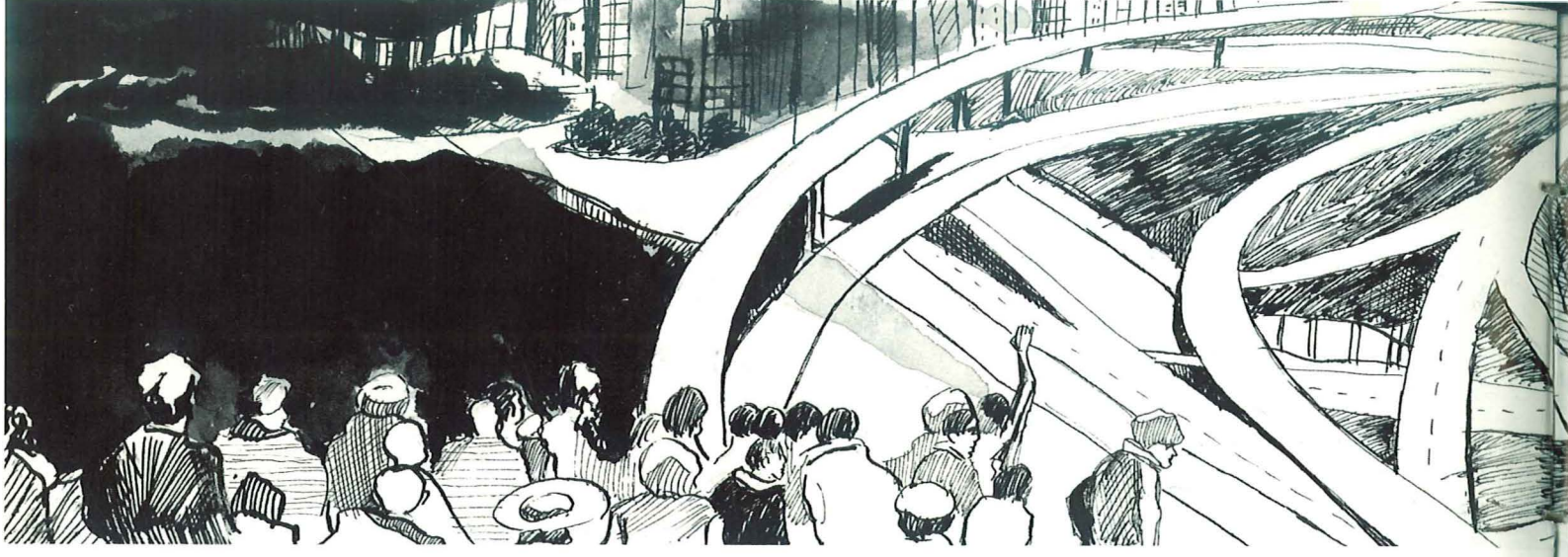
The earth's temperature depends on the amount of sunlight it receives, and how much of the resulting heat is retained. The amount of heat retained is largely dependent on the composition of the atmosphere. This is because as heat is radiated from the planet, it strikes molecules of gas, which become heated themselves and radiate some of their warmth back to the earth. The gas most responsible for this effect is carbon dioxide.

As the level of carbon dioxide in the atmosphere increases, more heat is radiated back to the surface of the earth instead of escaping into outer space. As carbon dioxide levels increase due to industrial pollution, auto exhaust, and so on, the temperature is bound to go up as well.

In addition to simply radiating heat back to the earth's surface, the greenhouse effect could have other consequences, such as an accelerated heating effect. For example, a higher level of carbon dioxide leads to the faster decay of vegetation, causing even more carbon dioxide to be released. Another possibility is that as the oceans warm, more water vapor is released into the atmosphere, reflecting more heat back to the earth. In addition, as water warms, its ability to absorb carbon dioxide decreases. Finally, higher temperatures may melt portions of the polar ice caps. The caps reflect sunlight, and if their surface area is decreased, the earth will absorb even more heat. In each of these cases, the original effect causes conditions that lead to even more temperature increases.

That's the greenhouse effect in a nutshell. What evidence is there that it is actually happening, though? For starters, it is clear that fairly small changes in the earth's temperature can cause major changes in the climate. According to scientific estimates, the earth's average temperature is nine degrees warmer than it was during the ice age.

Illustration by Ket Khambounmy



Carbon dioxide levels, however, are much higher than they were in the pre-industrial era; using samples of ancient air trapped in arctic ice sheets, scientists have determined that the carbon dioxide levels have gone from 280 parts per million in 1750 to 344 parts per million at present.

There is also evidence to support at least one of the "accelerating effect" theories. According to a study by climatologist Veerabhadrean Ramanathan at the University of Chicago, warmer oceans trap twice as much heat as the colder northern seas, lending credence to the theory that the warming of the oceans could aggravate the greenhouse effect.

In addition, climatologists have developed sophisticated computer models that predict weather outcomes using atmospheric carbon dioxide levels as a variable. Although many question the validity of such predictions, the computer models were able to successfully predict the ice age when given data from that era. These same models predict a warming of at least three degrees and possibly as much as eight degrees Fahrenheit by the mid-21st century. Researchers in the Soviet Union have reached similar conclusions.

Finally, the most attention-getting (and least compelling) evidence of a global warming trend comes from the British Meteorological Institute. Having monitored the temperature at its monitoring stations around the world for nearly 100 years, British scientists have noted that global temperatures have risen approximately one degree Fahrenheit since 1900. While the publication of this study received considerable media attention, it really proves nothing; scientists at BMI point out that the trend is probably due almost entirely to naturally occurring climatic cycles. In fact, a similar study by the National Oceanic and Atmospheric Administration found no evidence of any significant changes in temperature or rainfall since 1895.

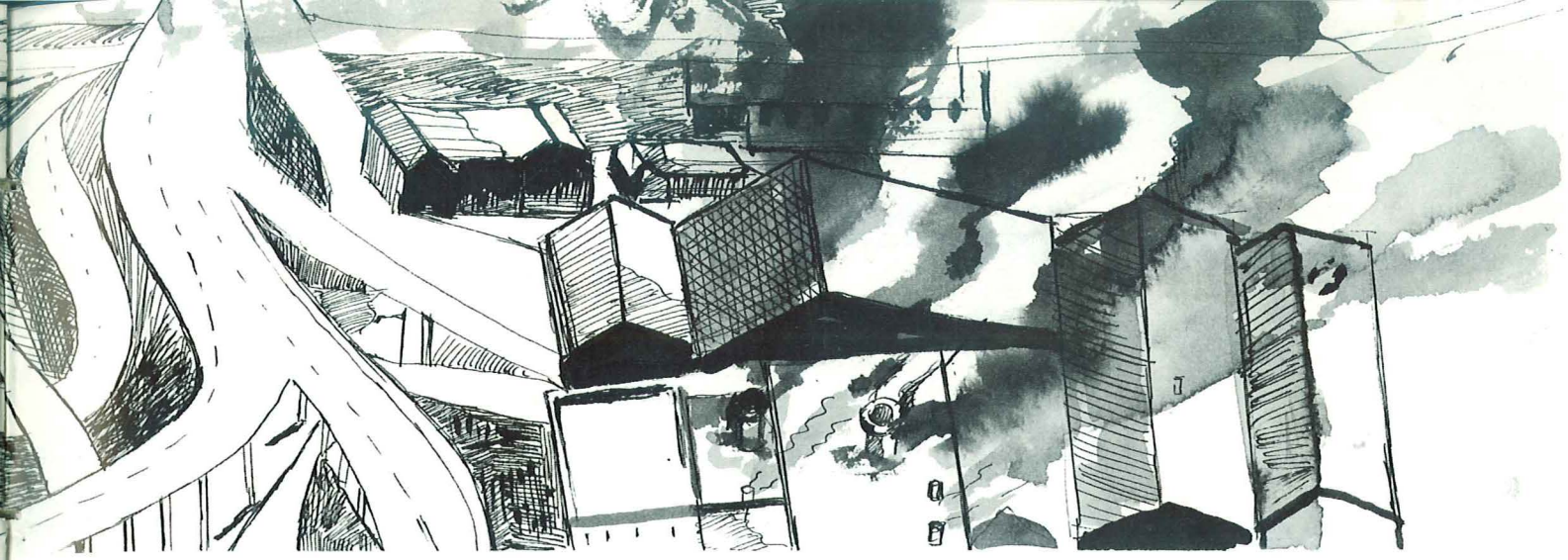
Computer models predict a warming of at least three, and possibly as much as eight, degrees Fahrenheit by the mid-21st century.

The Debate Heats Up for Lack of Cold, Hard Facts

Studies like these provide little help in identifying a greenhouse effect. The temperature changes produced by it are likely to be so gradual as to be indistinguishable from normal fluctuations for some time to come. In fact, some scientists were worried about global cooling in the 1970s because temperatures had been declining steadily since the 1940s.

That leaves the theories and the computer models to tell us whether or not the globe is warming up or not. These also have problems. One of the main criticisms is that, despite their complexity, computer models are still too simple to predict anything accurately. In particular, they fail to take into account certain effects that could cool the earth rather than warm it. For example, the same industrial production that produces carbon dioxide also produces dust that can reflect sunlight away from the earth. (Remember the nuclear winter theory, or the theory that dinosaurs were killed off by cold temperatures due to the dust raised from a meteor hit?) Furthermore, the same effect may occur with water vapor. Anything that reflects heat back to the earth will also reflect it away. In fact, Professor Ramanathan, who found that water vapor does hold heat in the atmosphere, also found that clouds have more of a cooling effect than a warming one.

Another example: While increased carbon dioxide levels lead to more plant decay, releasing more carbon dioxide, it also increases plant growth.. Plants, of course, produce oxygen. Whether or not this balances is anybody's guess.



These complex problems are reflected in the discrepancy between the predictions generated by different computer models. Models at NASA, the Geophysical Fluid Dynamics Lab at Princeton University, and at Oregon State University have all produced widely varying predictions. In addition, the same models that accurately predicted the ice age when the correct data was entered also predicted that the temperature should have gone up considerably more than one degree since 1900, given present carbon dioxide levels. Obviously, these models are missing one or more important variables, such as the effects of cloud cover. At any rate, they're of little use as they are. In fact, Richard Linndzen of MIT and Jerome Namias of the Scripps Institute of Oceanography wrote that such models were so "inaccurate and fraught with uncertainty as to be useless to policymakers."

These uncertainties confuse policymakers, which doesn't leave the rest of us much better off. Climatologists are confused as well. While some predict flooded coastlines by the year 2010, they, along with those who predict a new ice age, belong to a very small minority. Most of those studying in this area can only say the greenhouse theory is valid in principle, and that it will work so as to make the earth warmer. The lack of hard evidence and the uncertainty of the models make it difficult for them to justify this belief, however, and impossible for them to predict when significant warming will occur, or whether it is occurring already, or what its specific effects will be. Basically, they know that pumping the atmosphere full of large amounts of carbon dioxide will do something, eventually.

The most likely explanation is that carbon dioxide levels, high as they've climbed, have not yet reached the level where they will dramatically affect world temperatures. It's too soon to tell whether or not they will affect the climate. Although considerable research has not produced anything like a clear picture of the hazard global warming poses, it has focused popular and political attention on the possibility, and on measures to prevent it. In this way, research could help avert a problem that may not even exist. Hopefully, the questions asked by researchers will be irrelevant by the time the answers are found. ❐

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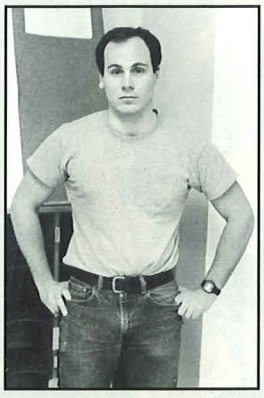


TECHNOLOG

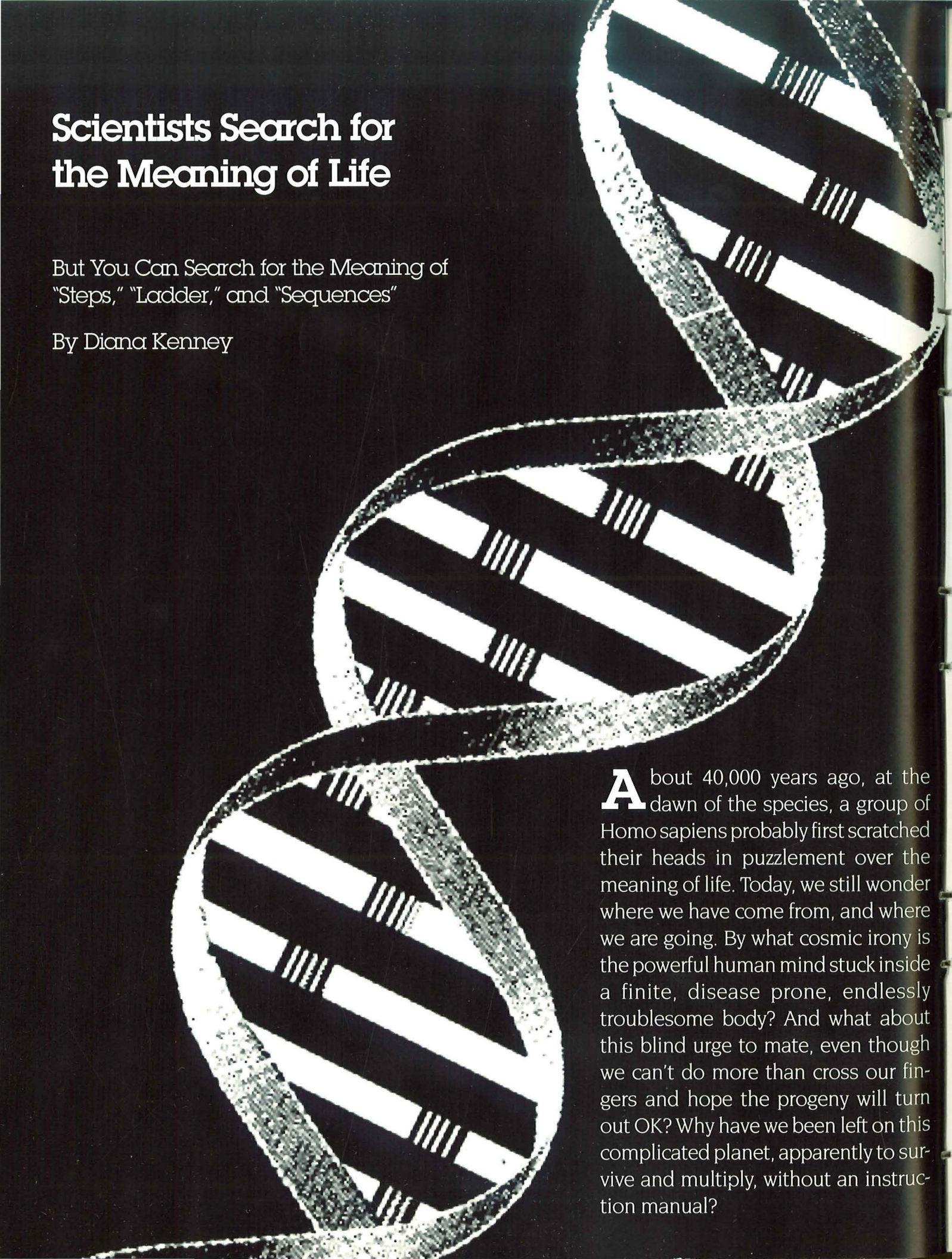
Writer Profile: Dennis VanDenBerg

When Dennis graduated from the Journalism school here at the U, he mistook the Technolog for an uppercrust, real-world publication and sent us a resume. Since that time, we've milked him as an artist, editor, writer, and first-rate cartoonist. Pictured at left is his reaction to the lavish pay he will receive for his labors.

Scientists Search for the Meaning of Life

But You Can Search for the Meaning of "Steps," "Ladder," and "Sequences"

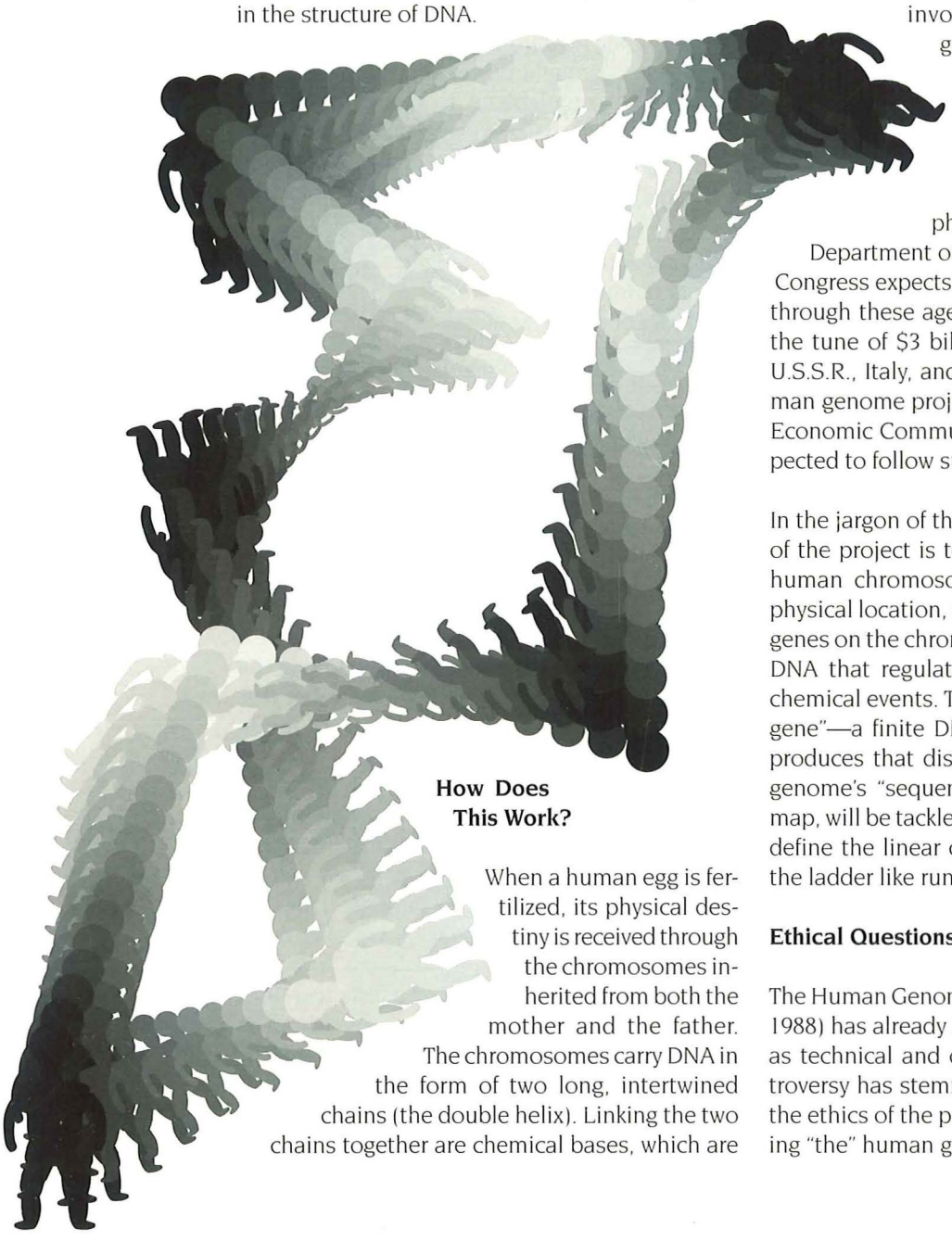
By Diana Kenney



About 40,000 years ago, at the dawn of the species, a group of Homo sapiens probably first scratched their heads in puzzlement over the meaning of life. Today, we still wonder where we have come from, and where we are going. By what cosmic irony is the powerful human mind stuck inside a finite, disease prone, endlessly troublesome body? And what about this blind urge to mate, even though we can't do more than cross our fingers and hope the progeny will turn out OK? Why have we been left on this complicated planet, apparently to survive and multiply, without an instruction manual?

Well, James D. Watson isn't God but he is convinced molecular biologists across the world are on to an important clue to solve such riddles. Watson is the head of the Office of Human Genome Research at the Nation Institute of Health (NIH). The NIH is a major player in the current effort to precisely decode human DNA (deoxyribonucleic acid), the macromolecule that carries genetic information in all cells and many viruses. Watson believes once we understand the genetic messages encoded within our DNA we will have "the ultimate answers to the chemical underpinnings of human existence. A more important set of instructions books will never be found by human beings."

What Watson and the international Human Genome Project seek is no less than a biochemical blueprint of our species. The blueprint is implicit in the structure of DNA.



How Does This Work?

When a human egg is fertilized, its physical destiny is received through the chromosomes inherited from both the mother and the father. The chromosomes carry DNA in the form of two long, intertwined chains (the double helix). Linking the two chains together are chemical bases, which are bonded in pairs to form the "steps" of the double helix "ladder." All the instructions needed to begin, end, and orchestrate the body's production of proteins are given by the linear sequence of the DNA :steps: or chemical bases. For example, the DNA base sequence G-C-G (guanine-cysteine-guanine) is a "code" instructing the body to make arginine, one of the 20 building-blocks of proteins.

The Human Genome Project aims to "read" the DNA sequence contained in one complete set of human chromosomes (a "human" genome). That means figuring out the linear order of an estimated 3 billion pairs of bases. But it also means examining the formulation of over 50,000 different proteins, proteins that make up the body's tissue, organs, central nervous system, and immune system. Conceivably, we will eventually understand—and be able to control—all the biochemical processes involved in human reproduction, growth, and development.

It's a daunting challenge, and the Human Genome Project is to molecular biology what the moon missions were to astrophysics. Along with the NIH, the Department of Energy (DOE) is also involved; Congress expects to continue funding the project through these agencies over the next 15 years to the tune of $3 billion. The United Kingdom, the U.S.S.R., Italy, and Japan have also launched human genome projects, with France, the European Economic Community, Australia, and Canada expected to follow suit.

In the jargon of the researchers, the ultimate goal of the project is to "map" and "sequence" the 24 human chromosomes. The "map" will give the physical location, in correct spatial order, of all the genes on the chromosomes. (A gene is a stretch of DNA that regulates some particular set of biochemical events. Thus one can speak of a "disease gene"—a finite DNA sequence that, if damaged, produces that disease.) Later in the project, the genome's "sequence," a refinement of the gene map, will be tackled. As mentioned above, this will define the linear order of the base-pairs forming the ladder like rungs of DNA molecules.

Ethical Questions

The Human Genome Project (officially launched in 1988) has already faced much controversy, as well as technical and organizational difficulties. Controversy has stemmed mainly from unease about the ethics of the project. Some critics argue defining "the" human genome is a dangerous oversim-

plification, since no one person's set of DNA is exactly the same as another's. Creating a baseline standard implies all individuals who vary are "abnormal"—and when you are talking about genetic traits, abnormal can be construed to mean just about anything, from a severe physical handicap to a certain hair or skin color. Between unrelated human beings, about one DNA base in every 1000 differs: we're all similar enough to belong to the same species, but each of us is different enough to be unique.

Related to these worries is the question, "What are we going to do with this information?" Obviously, there will be enormous benefits for preventive medicine. But how much good will it do to find out one carries a gene for, say, late-onset cancer, if there isn't yet a cure for the disease? What kind of anguish will the ability to prenatally test for a whole range of conditions cause? Will people start demanding genetic profiles from prospective mates? Will prospective employers and insurers use people's genetic prospects to decide who should be hired or insured?

The Human Genetic Project has formed committees to study these issues while pressing forward with its mapping goals. Currently, the project's main technical challenge is figuring out how to integrate the gene mapping data which is being obtained by different groups using different techniques. For example, the traditional route to gene mapping, first developed in the 1910s, is to analyze the inheritance of visible traits (such as height or eye color) in large family pedigrees. If two traits are consistently inherited together, then the two genes for the traits are located on the same chromosome, and the frequency with which the genes are co-inherited can be used to determine the physical distance between them. This approach, known as "linkage mapping" is being combined with other techniques, known as "physical mapping." Most physical mapping techniques determine the order of genes on chromosomes using molecular or chromosomal analysis. Combinations of linkage and physical maps, and a good dose of luck, have already led to the identification of important disease genes, including those for Huntington's disease and cystic fibrosis. Yet there are major problems with inconsistent nomenclature, different measuring scales, and the resolution of data between the various maps, so the development of conversion and comparison scales is a very high priority.

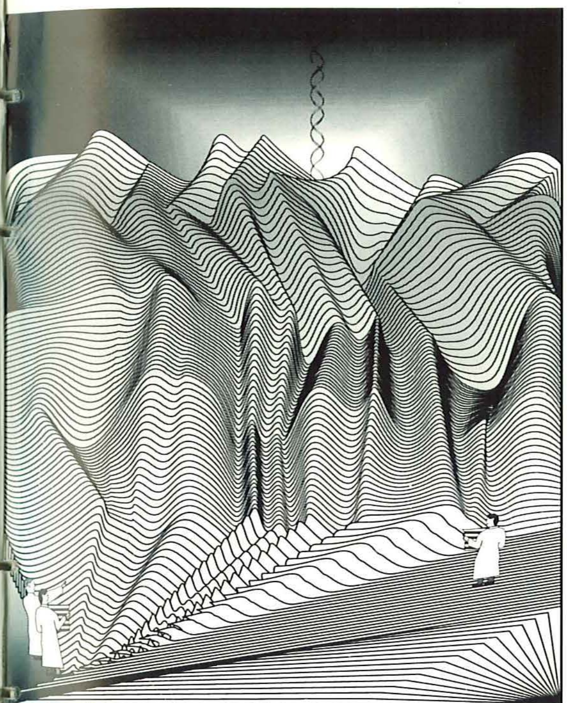
We're all similar enough to belong to the same species, but each of us is different enough to be unique.

Looking Ahead

Once the majority of genes have been mapped, sequencing efforts will be launched full-force. As things stand now, the thought of having to sequence 3 billion space pairs causes researchers to grab their heads and moan, mainly because current sequencing technology is costly, slow, and tedious to perform. The cost of sequencing (currently $3-5/base-pair) has to be brought down, and the sequencing brought up (to about 50,000 base-pairs/worker/day) before the task will be reasonable in terms of time and money. The Human Genome Project is currently working on these improvements. It also foresees the eventual construction of centralized facilities, where large-scale sequencing projects will be run much like industrial production lines. (One researcher has jokingly suggested establishing a prison colony where the convicts have to carry out large-scale sequencing for the duration of their sentences!) There is also a rumor floating around that the Japanese are building a robot that will be capable of sequencing a million base-pairs a day.

Finally, managing the huge amounts of data to be generated is critical. Researchers across the globe will be contributing to multiple computer databases on an ongoing basis, so a network needs to be designed that allows real-time, remote data entry from as many individual hardware and software configurations as possible. Despite a hard push for international

openness and cooperation in sharing the data, conflicts have already arisen. Watson caused an uproar last year when he accused the Japanese of "freeloading" on the project. "It's against the American national interest to work on the human genome and pass it out free to the rest of the world," he declared, and threatened to deny the Japanese access to U.S. data, before he was reminded he lacked the authority to do so. Another problem is that many laboratories, once they have isolated a gene, want to study and characterize it thoroughly before releasing any information, slowing down the whole initiative. As Watson himself has written, "If we are to integrate and understand all the events that lead, for example, to the differentiation of a nervous system, we have to work from the whole set of genetic instructions."



Charles R. Cantor, head of the DOE's component of the project, writes "Obviously, all humanity is represented in the human genome and in this project." Again, the wisdom of generalizing from one sequenced genome to "all of humanity" is debatable. But rather than wait for the complex ethical, organizational, and political issues to be completely sorted out, the U.S. has grabbed the banner and is forging ahead with the human genome initiative. p

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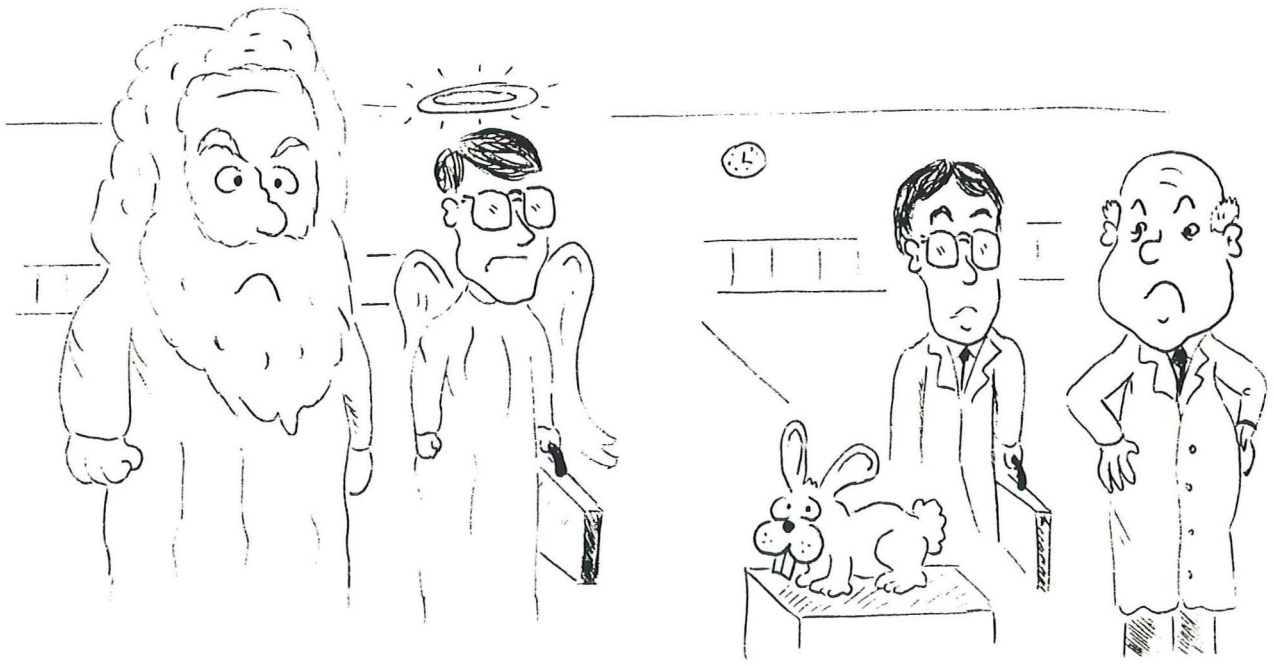
TECHNOLOG

Writer Profile: Diana Kenney

Diana Kenney is a graduate student in the History of Science department. Her life work consists of studying the Human IT Project, a study devoted to analyzing the mating dance of the *humanus studentus technicalis*, a rare breed found lurking in the bowels of IT. These mysterious dances have never been recorded before and, in fact, may not actually exist.

Diversions

Well, that's this week's shipment, Professor Wilkes... And by the way, what did you guys do with them dinosaur bones I delivered last time?



People's Court Episode #325: Judge Wapner rules on whether or not Midland Research Company's "Superbunny" violates current copyright laws.

Cartoons by Dennis VanDenBerg

In 1989, 2nd Lieutenant John Richards was horribly wounded in an accident with a serrated spoon. "We can rebuild him!" said the Pentagon. "Sure we can!" said the Defense Industry. Now he's...

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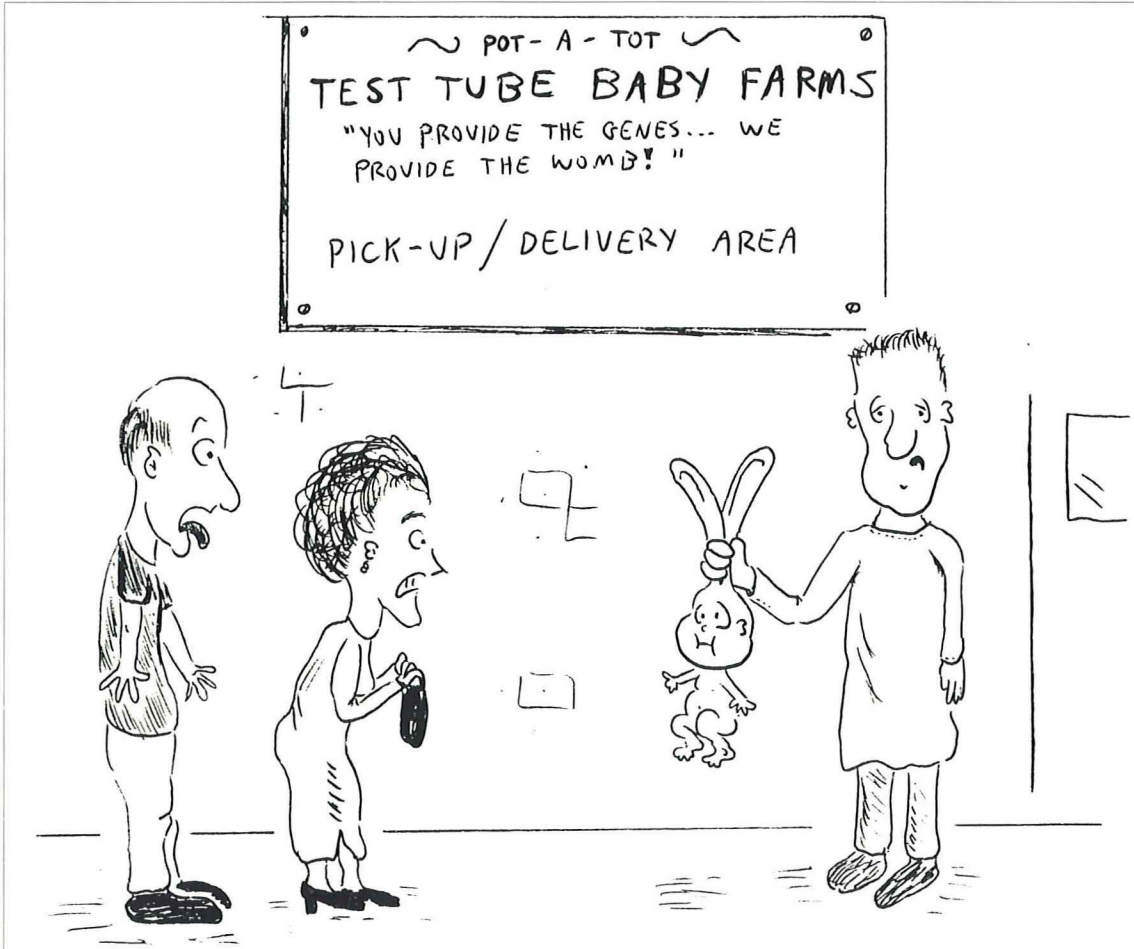

"Yeah, I know... We figure there musta been a typo in that genetic code you gave us."

Cartoon by John Dassow and Loren Thomsen

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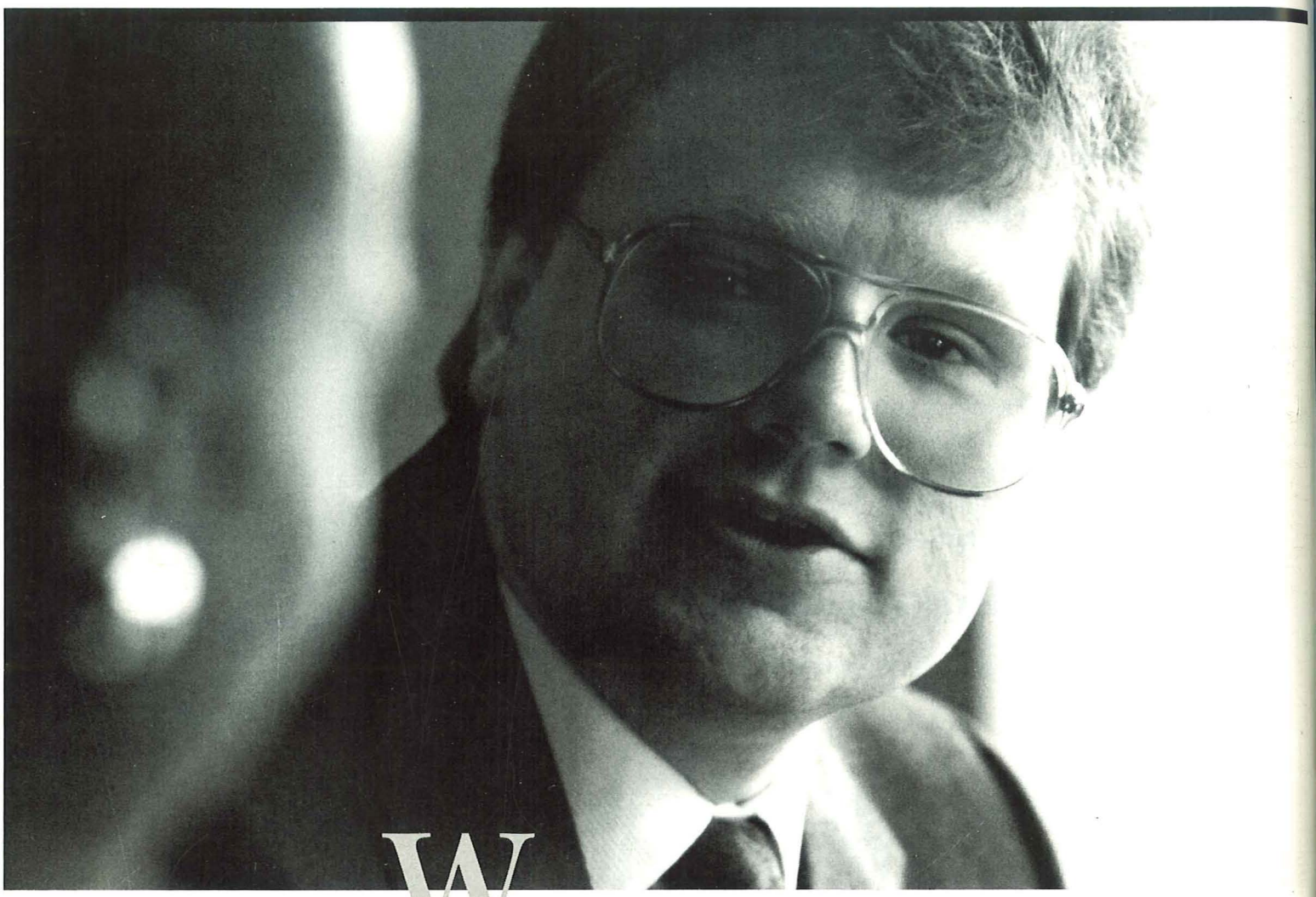

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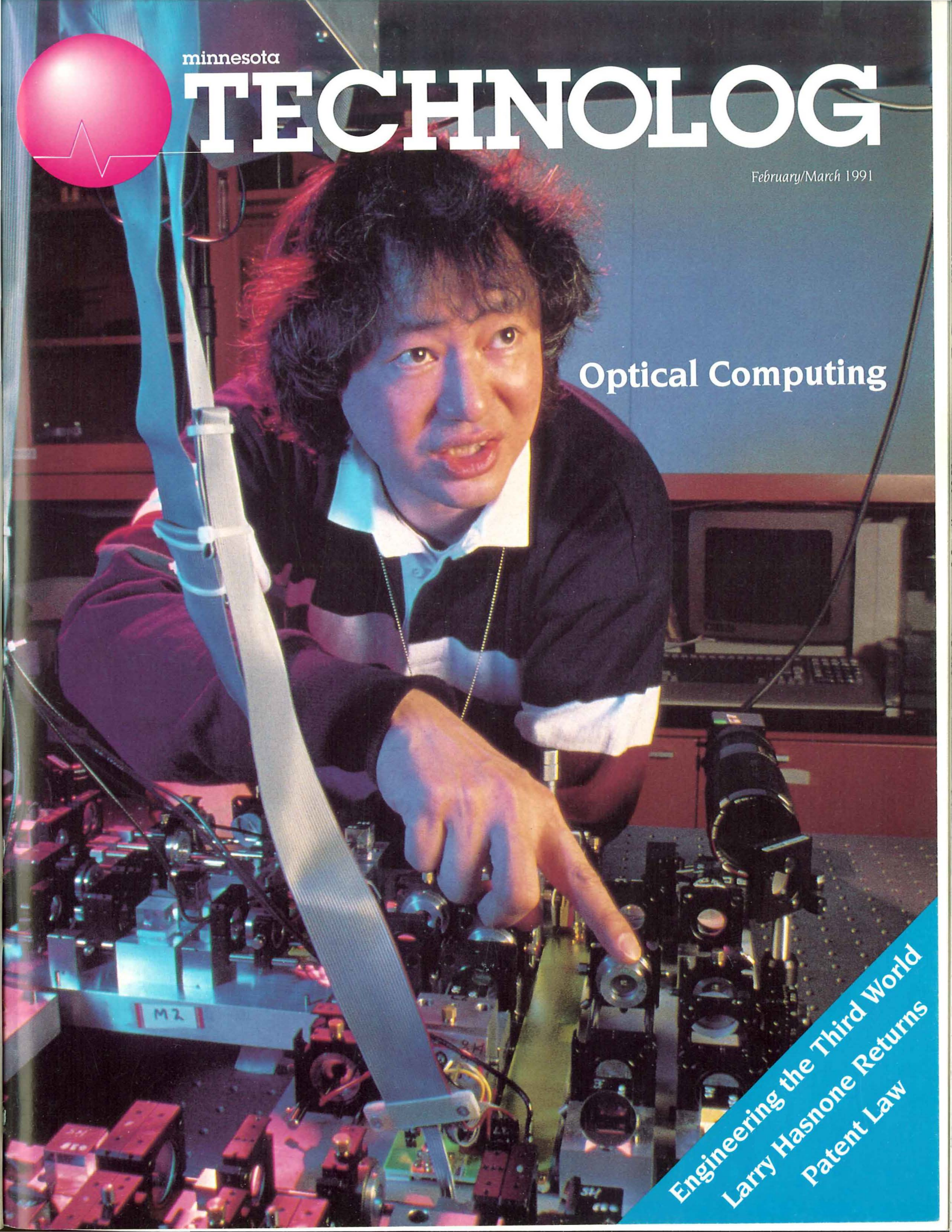
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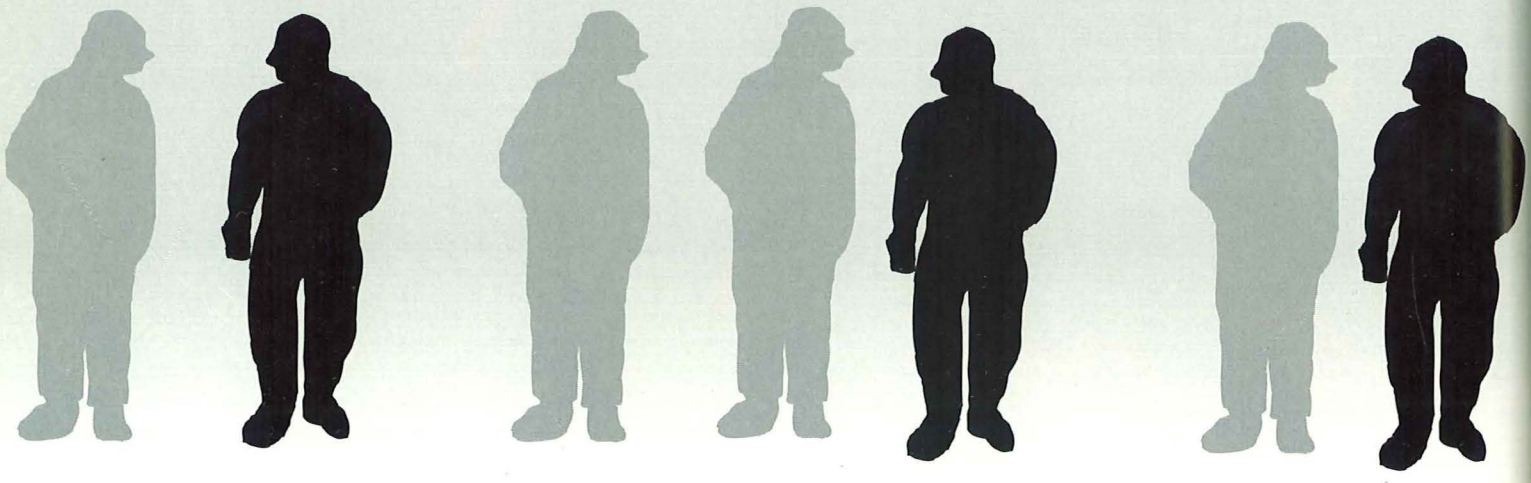

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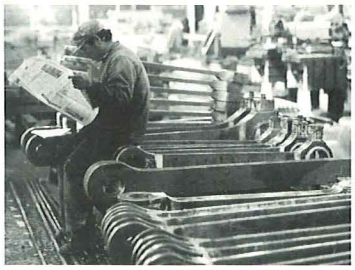

About the Cover...
Researcher Alan Huang shows off one of the first working models of an optical computer. Photo courtesy of AT&T.

Departments

Editorial

HAMMERED

Mind-Numbing Classwork is the Standard Route for Engineering Students; Is It the Only Way?

Engineering education is difficult, dry, and discouraging. You can't deny it. Remember high school? You were a brain there, weren't you? Then you come here and they throw you in a large, sterile lecture hall with 300 other junior geniuses and one extremely dry professor who's paid to keep test averages low and failure rates high. On top of the math and physics, they throw in some liberal arts courses just in case you have some extra time. A social life? Forget it, pal. You've got studying to do.

Traversing the rocky road of a degree in engineering bears more resemblance to crossing a mine field than to garnering knowledge in your chosen field. First-year students especially are bombarded with boring, difficult courses and ambivalent instructors. The experience can strain your brain, blast your self-confidence, and evaporate your interest in the subject. While many students survive the experience, a large percentage of them transfer or drop out due to frustration, lack of interest, or the belief that they cannot finish. By 1990, 53.9 percent of the students who entered IT in 1984 transferred or dropped out of IT.

Such high attrition rates have traditionally been viewed as a sort of natural selection for the field. Those with the right stuff make it and the rest fall by the wayside. This is fine and dandy when applicants are knocking down the door. What if there is a shortage of students showing an interest in engineering? Does it make sense to actively deter prospective engineers?

As most of you have heard, massive shortages of engineering graduates are predicted for the near future and enrollment has been dropping for the past few years. Yet most colleges and universities are still using the weed-out process to educate their engineering students. Is there any wonder that shortages are predicted?

Perhaps the shortage is not a lack of interest in engineering but a lack of interest in the program. Five years of boring and difficult classwork can easily convince students that engineering is not for them. Engineering is and should be an elite profession, but your ability to force yourself through dry and difficult courses may have nothing to do with your potential as an engineer.

Rather than load you up with math and physics, you should be enticed and inspired with introductory courses that show why engineering is interesting and what engineers really do. Bring in some young and excited engineers who are working on interesting projects or present some of industry's state-of-the-art design. There are plenty of hot new developments taking place in and around the University to pump up engineering students. Once they get a taste of where the degree can take them, more of them will wade through the coursework.

Obviously, talented teachers are an integral part of this scheme. As you know, great (or even halfway decent) instructors are a rarity in research-orientated universities. The good ones we have should be reserved for the introductory courses. The University may even have to recruit and tenure a few new profs on the basis of their teaching ability! Administration will have to increase their commitment to teaching to make any of this work.

IT should be one of the first schools to try some of these ideas out. They undoubtedly won't be, which is probably why IT was a no-show in a ranking of the top 25 engineering colleges

recently published in U.S. *News and World Report*. The Chemical Engineering program was ranked second individually, but IT as a whole did not break into the top 25. As strictly a mediocre college, IT has nothing to lose and everything to gain by trying some new methods.

The reality of this University, though, is that nothing will change until IT enrollment drops off the map. As long as enough students enroll to fill the classrooms, IT will continue to grind out engineers in the traditional manner. Decreasing enrollment may eventually force IT to change just to preserve the institution, but you and I will be long gone by that time.

As strictly a mediocre college, IT has nothing to lose and everything to gain by trying some new methods.

A certain percentage of people will continue to apply to IT simply because it is the largest, best-known engineering program in the state. Some of these folks will find IT is exactly what they want, but that doesn't mean you have to agree with them. If you are doubting that you have the right stuff, check out engineering programs at other colleges before you give up the field. The problem might not be your major, but your choice of schools.

If the University wants to bolster enrollment, they must entice engineering students to stick with the program. To do this, they need to initiate challenging, alluring introductory courses, tone down the weed-out process, and commit to professors who can teach. Such steps could bolster faltering enrollment and put the IT on the map as a respected engineering school. The current program—beating students with boring, overcrowded weed-out classes—will consistently drive away potential engineers and, eventually, put IT out of business.

Lee Klancher

TECHNOLOG

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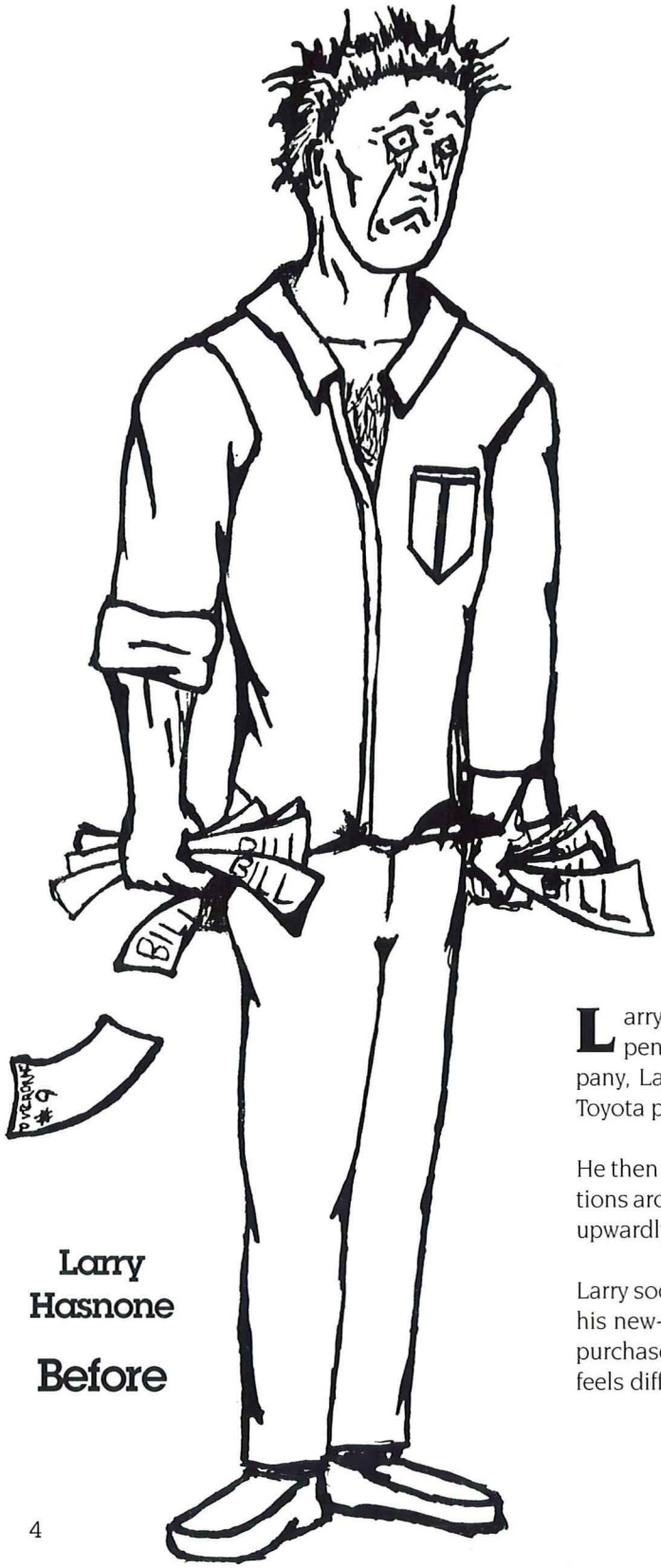


Larry Hasnone

Before

Credit Card Hell

A *caveat emptor* to the potential credit card customer: Beware the dangers that may befall you!

by Brian Jensen

Larry Hasnone graduated from IT in 1988 and soon began living an expensive life-style. After accepting a lucrative job offer from a local company, Larry moved into a new penthouse apartment and purchased a new Toyota pickup.

He then began receiving letters of pre-approved credit from financial institutions around the country. Larry, excited that someone was finally noticing his upwardly-mobile life-style, promptly filled out each one and sent them in.

Larry soon discovered the wonders of the credit card. He was enthralled with his new-found "wealth," for he had access to almost anything he wanted to purchase. Six months later, facing a pile of bills and past due notices, Larry feels differently about his plastic.

Unfortunately, Larry didn't discriminate in his choice of credit sources and amassed over $10,000 in debt, some of which charge an annual interest rate of 20 percent.

Credit is relatively easy to obtain in the United States. Numerous institutions, from local retail stores to national money center banks now offer credit cards and other unsecured loans to consumers in addition to the traditional asset-backed loans for big-ticket items.

Unsecured loans carry a much higher risk of loss for the lending institution. In order to protect themselves, they set interest rates very high—many as high as 22 percent. Currently, a few states still have usury laws, but in many areas these have been relaxed. Now lending institutions set interest rates with less restraint.

Realizing that something needed to be done, Larry called his uncle, Carl Cashola. Carl had given Larry financial advice before, although not about credit card debt. Carl was not surprised to hear about Larry's plight, and provided a wealth of information about debt—information that Larry needed. Fortunately, there was still a lot Larry could do to reduce his high interest debt load.

Look for charge cards with no annual fee. Many issuers are switching to low, or no annual fee cards.

First, Larry decided to get a personal loan from his local credit union because they charge a lower interest rate. In this way he can consolidate and reduce his overall interest payments.

Second, Larry was determined reduce or eliminate his use of plastic in the future. Carl provided Larry with a wealth of tips and rules of thumb for use of consumer credit which would enable him to use the system to his own advantage.

1. Pay off credit card balances at the end of each month. This is perhaps the most important rule of credit purchases. This will help you avoid interest charges from the card issuer, while setting a limit on how much you can charge.

2. Look for charge cards with no annual fee. Many issuers are switching to low or no annual fee cards. Discriminating consumers can benefit from this if they choose their cards carefully.

3. Pick charge cards that offer a grace period. A grace period can be thought of as the amount of time from when the merchandise is purchased to when the bill is sent to the cardholder. A typical grace period is somewhere around 25 days, and is added to the amount of time the card issuer grants for payment of the bill each month. To take advantage of this, make your credit purchases at the beginning of your card's billing period. If your card has the standard grace period, you are in effect getting an interest free loan of up to 50 days. This is assuming that you pay the bill in full at the end of the billing cycle.

4. Pay attention to fees, such as late payment fees and over-the-limit fees. Many consumers are unaware of these fees because they haven't read their contract agreement. It makes a great deal of sense to understand when, and under what circumstances, you will incur such fees.

5. Pay close attention to how the interest charges are calculated. Since there is no standard method for calculating these charges, it can be done in a number of ways. Consider the following points when checking the calculation method:

- Some card issuers allow fees to be included in the interest calculations;

- The priorities of payments, fees, and the interest calculations are sometimes arranged to make the card issuer the primary beneficiary. For example, calculating the daily interest charge and then subtracting any payments.

Here are several tips Carl offered to Larry:

- Average two-month balance method;

- Average daily balance for one month;

- Simple interest;

For example, let's look at the average two-month balance method. In this case, the issuer computes the beginning balance of the account each day. Purchases would be added to this, and any payments subtracted. This procedure is done for each day in the billing cycle, in this case about 60 days. The daily balances are added up, and divided by the number of days in the cycle. This amount is then multiplied by one-twelfth of the annual percentage rate.

The longer the period over which the issuer can spread out the interest calculations, the more interest that is likely to be charged. This is most valid for those of us who charge a large item, and then make payments. In this case, you would be advised to consider cancelling any charge cards that use this method.

Remember that this is only a generic example of how an issuer might calculate interest charges; you can be sure that there are as many variations as there are credit cards. That's why anyone who is applying for a card should first examine the fine print.

The ideas presented here are simple, yet effective. Anyone can and should use them as protection from high interest charges.

Luckily, Larry Hasnone became aware of his situation in time to prevent further trouble. To consolidate and lower the interest rate of his debt, he obtained a personal loan from his credit union. Larry also cancelled most of his credit card accounts, except two that meet the previously discussed criteria. Larry is determined to eventually free himself from debt, and to use credit much more wisely in the future. ❐

Larry Hasnone After

Brian Jensen will soon be graduating from the U with a degree in business. He currently is a mucky-mucky at University Telecommunications (he even got the decrepit *Technolog* phone repaired). Brian has become a bastion of financial advice here at the Technolog and we will be sorry to see him go.

Earth Day Revisited

Will our polluter's legacy ever end?

by Jeff Radford

Earth Day, 1970. Junior high. Remember when they called them that, before the innocuous term: "middle school?" A bunch of seventh graders out on the soggy football field, urged by our environmentally-aware teacher to pick up the trash—the smallest thing we could do to help, but a step in the right direction.

We had seen the rallies on TV, the long-haired, Earth-shod, flannel-shirted and granny-dressed speakers, assailing the bourgeoisie polluters, those huge mega-corporations that ravaged the Earth. We, as junior aspirants to such a cause, wanted to do our part, to fit into the noble purpose of cleaning up this older generation's trail of earth-encompassing garbage. Staring desperately at the ground, we searched for a Juicy Fruit wrapper, someone's torn-off notebook paper, a Big Mac wrapper. Something, anything, that was alien to the natural soil and had to be found and removed. In fact, we boys wanted to perform our duty so badly that we even wished for garbage to appear, so that we could pluck it greedily off the ground and fill the sacks we carried over our shoulders to the bursting point, leaving the grass alone in its pristine green. (Dyed, of course, for the esthetic benefit of football fans). The point was that a full sack meant that we were pulling our environmental weight, something a twelve-year-old had trouble believing he or she could do. But

actually wishing for garbage? Of course, we wouldn't admit to such a thought, but at the back of our unformed adolescent minds we did—this was the first time I was aware of the irony of the environmental movement.

Naturally, now things are more complicated. The older one gets, the more one realizes the morass of complexities that make up the world. The resurgence of concern for the Earth is with us again, after the sordid era of mega-business favoritism and glee conjured up during the Dark, I mean Reagan, years. But as things become more complex, the ironies, both large and small, become twisted and intertwined. For instance...

We Americans, consisting of a small portion of the world's people, use a large amount of the world's energy. We burn gas to run our cars and coal to make electricity and the air becomes foul with pollution. Chemical by-products, barely regulated, pour from corporate smokestacks by the millions of tons and further our atmospheric desecration. Streams and rivers flow with sewage. Acid falls in our rains. Big cities dump their refuse in the ocean. New York itself is guilty of tons each day. Seabirds float atop the scum, choked to death by plastic rings from Budweiser six-packs wrapped tightly around their necks. The groundwater is steeped with toxic chemicals trickling in from ever-expanding landfills. Pesticides are sprayed liberally on the crops we eat; better to risk a few people getting cancer than to raise food organically.

But Americans are among the leaders in crying out about the polluters of the world. We point our fingers at the soft-coal fired factories of the Eastern Europeans, at the huge mountains of slag from their power plants, and the land pocked with craters from mining. We cry out in despair as rain-forests in South America and Indonesia topple, as mercury gleams in the rivers of Brazil and children shake with tremors from its poison. We wince as a Midwestern farmer grimly plows under the last large (hardly) stretch of the virgin prairie that once swept the entire breadth of the country.

We are the "haves" and since we possess, we have the power to deplore what others do—and the power to ignore our own actions, or make necessary changes ever so slowly—due to more down-to-earth causes such as making money hand over fist. The Eastern Europeans, the Indonesians, the Brazilians, and the small-time American farmer are the other side, the "havenots," who possess little money or power. To them, the power plant that spews out thick clouds of smoke also provides the heat for their homes or provides a salary to buy food for the children. To them, the tropical rain forests that create life-giving oxygen also block a field from being plowed and deny a hungry family the food that could be raised on it. To the "havenots," a field of virgin prairie is useful only for the memory of what it was, and is impractical to leave unplowed when the bank wants interest payments.

But we "haves" maintain a blindness toward such things. We overlook the hungry children and refuse to send economic help to newly-formed Eastern European nations for cleaning up the industrial mess left by their old political systems' factories. We urge them to close up their polluting manufacturing plants but offer them few alternatives for jobs or means to retool their factories toward less-polluting industrial methods. We ignore that North American fast-food companies rent the newly-cleared rain forest ground to cheaply graze the cows that become greasy plastic-wrapped burgers. We forget the average farmer, who is being squeezed out of business by corporate factory-farms, and the political, economic, and tax clout that such businesses carry.

We are the "haves" and since we possess, we have the power to deplore what others do—and the power to ignore our own actions, or make necessary changes ever so slowly.

The "havenots" are concerned with the necessities of life that we "haves" possess; shelter, food, and warmth. The comparison is to art: It is hard to care about art when your child whimpers with hunger and you can do nothing. Only when the necessities are provided for does the mind turn to other things—creating a novel or an oil painting, or caring for the environment. And the irony is that pollution will continue as the "havenots" try to obtain what we have.

I wonder about the nature of the "haves?" Are we human beings who live only for today, selfishly not considering the lives of the "havenots," or our children and grandchildren. Do we live just for money without caring for others? Shouldn't we care enough to help others in their quests for a better life and turn from our polluter's legacy? Maybe that was the reason the first Earth Day is only a remembrance from junior high—these questions were asked then and are now only memories; answers were never found. ❐

Jeff Radford is a Wordsworth editor at the *Daily* and is one of those radical, long-haired sorts who thinks the world is screwed-up and should be changed. We like him.

Anatomy of a Lightspeed Computer

by Loren Thomsen

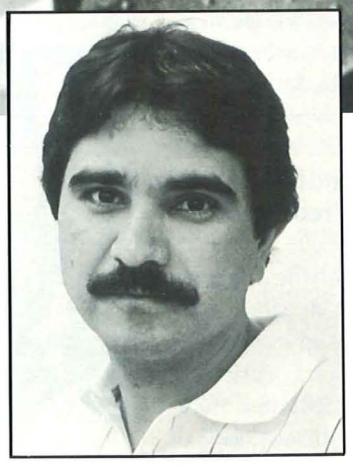
Optics may replace electronics in the race for faster computers. Only time will tell if light is truly the wave of the future.

Just after business hours, Dr. Nasser Peyghambarian leaves his fifth-floor office overlooking Tucson and escorts me through a quiet building, into the lower reaches of the Optical Sciences Center at the University of Arizona. Nearing our destination, our footsteps echoing down a long, poorly-lit corridor, we walk past closed doors emblazoned with DANGER: LASER RADIATION. At the end of the corridor, Peyghambarian leads me into one of his labs. An occupant stops pecking at a computer keyboard, looks up, and walks over to greet us. I glance nervously over the occupant's shoulder. Two large stainless steel tables covered with mirrors and lasers and God knows what lurk behind him. It looks like the set for a grade B horror movie.

Peyghambarian's colleague begins explaining what the apparatus does. My suspicions are confirmed; he takes diabolical delight in zapping things with high-speed laser pulses. In particular, he enjoys zapping crystals. One laser beam, the "pump," drives a crystal sample into metamorphosis for an ever-so-brief instant. Another laser beam, the "probe," measures how severely the crystal material is temporarily altered.

Through most optical materials, the amount of light received is strictly proportional to the amount of light sent. Peyghambarian studies materials that violate this very simple rule. Like camera shutters, the materials he investigates can suddenly switch on and off as the intensity of light hitting them varies. This switching action is fast; very fast. According to Peyghambarian, "We're concentrating on making optical switching devices that have switching times less than a picosecond." Not bad. A picosecond, after all, is a millionth of a microsecond.

Computer designers have much to gain from the work of optics researchers like Peyghambarian. Because binary switches are the heart of all computers, the optical devices Peyghambarian and other scientists study could lead to faster computers, running more advanced programs. However, ultrafast switches are only part of the story; optics could ultimately interconnect a computer's parts in ways so sophisticated that computer design would be revolutionized. Indeed, optics may offer a way to circumvent the limits nature places on electronic computers.



Researchers from AT&T pose with a working optical computer

Dr. Nasser Peygambarian
Optical Sciences Center
University of Arizona

The Death of Electronics?

Given the stellar performance of electronics over the past several decades, we assume the next generation of computers will always be smaller and faster than the last. Unfortunately, transistors and their interconnecting wires have major limitations. Electronics will someday make only small gains, at best, not the quantum leaps we're accustomed to.

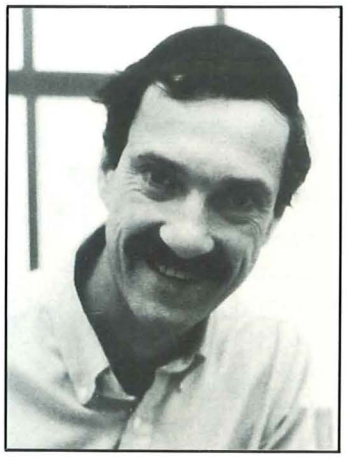
Up to a point, miniaturizing transistors produces good results. Small transistors tend to be fast. And small transistors are, well, small—you can put more of them on a chip, thus creating a more powerful circuit. However, when the wavelength of electrons becomes comparable to the dimensions of a transistor, transistors no longer obey the models engineers and scientists have grown to know and love. In essence, there are physical limits on how

small you can make a transistor and still expect it to behave like a transistor. According to MIT professors Henry Smith and Dimitri Antoniadis, "once the size of transistors shrinks below about 0.1 micrometer, their effectiveness begins to deteriorate beyond any hope of salvaging."

As if the speed and size limit on transistors weren't bad enough, there are other problems as well. Just as there are physical limits on how small you can make transistors, there are practical limits on how many transistors can be interconnected in a small area. Crowding thousands more transistors onto a chip complicates an already nightmarish tangle of connections.

Even if scientists built ultrafast transistors in spite of physical limits, they would find it takes longer for signals to propagate down connecting wires than for the transistors themselves to switch on and off. Basically, a transistor's speed can outstrip the speed of the wires connected to it, making even the simplest connection a bottleneck.

In contrast to the limitations of electronics, light has properties that make it ideal for connections within computers, even electronic computers. Light does not need troublesome, wire-like conductors to travel from one location to another. While electronic signals tend to interfere with each other, light beams can travel near each other, and even intersect, without having the slightest effect on each other. Moreover, given light's high frequency, extraordinarily high data rates are possible, as demonstrated by the fiber optic connections used in telephone networks.



Dr. Raymond Kostuk
Electrical and Computer Engineering
University of Arizona

Waveguides and the Joys of Free Space

Along with the invention of laser diodes, commonly used in compact disc players, optical fibers represent a milestone in the evolution of optical computers. An optical fiber is an example of a waveguide, a device that guides waves. Its construction is quite simple, resembling a pipe. An optical fiber's core, usually made of high-purity quartz glass, is surrounded by a thin layer of cladding material. Any light launched in a waveguide will tend to remain in it over long distances with very low losses, through what is known as "total internal reflection," hence its use in telecommunications systems.

Optical fibers work so well between computers that it's only natural to try to use them within a computer. Not even optical fibers have escaped the relentless urge of engineers over the past few decades to miniaturize anything they can lay their hands on. Since the late 1960s, researchers have experimented with tiny waveguides in an effort to integrate laser diodes, light detectors, and optical switches on a single chip. Initially the primary application for "integrated optics" was to be consumer and telecommunications products. In recent years, optical computing has also been considered a possible, although more distant, application of the technology.

Despite the miniaturization of waveguides, optical computers won't necessarily require miles of optical fibers. Light is quite content to travel through thin air. This means devices in an optical computer can be connected via "free space," adding a third dimension to the two-dimensional interconnection plane that constricts electronic circuits. While electronic signals are confined to roads, optical signals are free to take to the skies.

Free-space interconnects that researchers tinker with contain devices as mundane as mirrors and lenses, and as exotic as photorefractive crystals and holograms. Holograms are often incorrectly thought of as devices that project three-dimensional images or as 3D images themselves. More broadly defined, a hologram is just a special type of lens. Dr. Raymond Kostuk, professor in the Electrical and Computer Engineering Department at the University of Arizona, is interested in using holograms for optical interconnects inside computers.

Holding up a hologram about the size of a microscope slide, Kostuk says,"there are a lot of advantages of these components. They are what we call a free-space imaging element, and by that I mean it works pretty much like a lens does. The difference is that the configuration can be much more compact than a conventional lens and you can get a much more complicated imaging character using the holographic element versus a refractive element."

The very properties of light that make it useful for communication also make it useless for computation.

How can this be?

Referring to a lens as though it was an interconnection or routing element seems rather strange when we live in a world where wires traditionally fill this role. However, even though we don't think of them that way, everything from a camera lens to a funhouse mirror is just a routing device. The millions of resolvable spots of light hitting a lens or mirror are routed to a destination according to the device's "imaging character." Inside a computer, each spot of light would be a data channel, not a pixel in an image. A hologram permits designers to route light beams, representing optical data channels, in sophisticated ways, resulting in intricate interconnect systems.

One application where optical interconnects may find use in the near future is distributing clock signals in supercomputers. A supercomputer contains a central high-frequency clock that synchronizes all activities. Due to significant propagation delays, electronic clock signals tend to arrive at their destinations too late, causing computer subsystems to get out of sync. Kostuk says, "I know there are very serious research efforts at Cray for next-generation systems—it's a competi-

tion between optics and advanced electronic methods for clocking." Besides Cray Research, a host of other companies, such as Lockheed and Hewlett-Packard, are researching optical interconnect subsystems they hope to unveil within five years.

Graduate student Valorie Williams at work in Dr. Peyghambarian's lab at the University of Arizona.

Optical Transistors: Computing Versus Communicating

So far, only light's communications prowess has been discussed in any detail. Now it's time to face a rather ironic fact: the properties of light that make it useful for communication also make it useless for computation. How can this be?

Although we don't realize it, computation, which entails switching, and communication, which entails interconnection, are two contradictory activities. In a communication system, designers do not want signals to interact with each other. Such interaction is called noise, interference, and distortion. Within a computer, most of the communication traffic is between memory and the central processing unit (CPU) where data is summoned to be evaluated. Optics is ideal for this purpose—providing fast, distortion-free communication.

For computation, however, designers want signals, which represent numbers, to combine; this is the essence of processing information. Binary numbers converge on the CPU from memory, then the numbers are calculated and compared, and solutions are produced. In a traditional electronic computer, transistors, acting as switches, fill the role of combining signals. But how can data in light beams be combined if they are oblivious to each other's existence?

Until researchers at Bell Labs observed "nonlinear" optical materials in 1976, this question had no easy answer. To appreciate the significance of nonlinear materials, consider the properties of the "linear" optical materials we encounter in our everyday life, such as glass and air. Imagine the following experiment. Shine a light through a pane of glass and vary its brightness. On the far side of the glass, the output intensity is simply proportional to the input intensity. "Linear" is just another way of saying "proportional."

Now repeat the above experiment with an idealized nonlinear material. At low brightness the material blocks most incoming light. However, when the input intensity is sufficiently increased, the material suddenly allows light to burst through. Transmission through the nonlinear material is nonexistent until a threshold intensity is reached, at which time the material "switches on" and passes light. Properly configured (see sidebar for details) such materials can perform the switching role of transistors—and do it faster. As mentioned earlier, picosecond switching is possible with optics.

Peyghambarian uses the pump-probe spectroscopy apparatus to analyze promising nonlinear materials. "We're working on new and interesting materials, both organic and inorganic semiconductors, and their application to optical switching devices." So far, gallium arsenide, the lesser-known cousin of silicon, is the leading candidate. Since materials like gallium arsenide are already used in the electronics industry to make laser diodes, some of the equipment and processes used to make traditional transistors can be used to make optical transistors as well.

After several years of research, Peyghambarian is not satisfied that he has found a material that can fill the role silicon has played in electronics. "At present we do not have a 'silicon' of electronics. We have gallium arsenide of course, which so far has shown the best characteristics for an optical material. However, it still, as far as I'm concerned, does not provide the best properties..." Peyghambarian points out that you can't make a good switching network without a good switch, and you can't make a good switch without a good material. Thus he believes selecting the right material is of great long-term importance, requiring further research "...in order to make the best decision and say 'this is our material of choice.' "

The State of the Optic

Although the ideal materials and devices are not yet in hand, that hasn't stopped researchers from building optical systems that are bona fide computers, or parts thereof. The most notable effort to date was announced early in 1990. At an AT&T

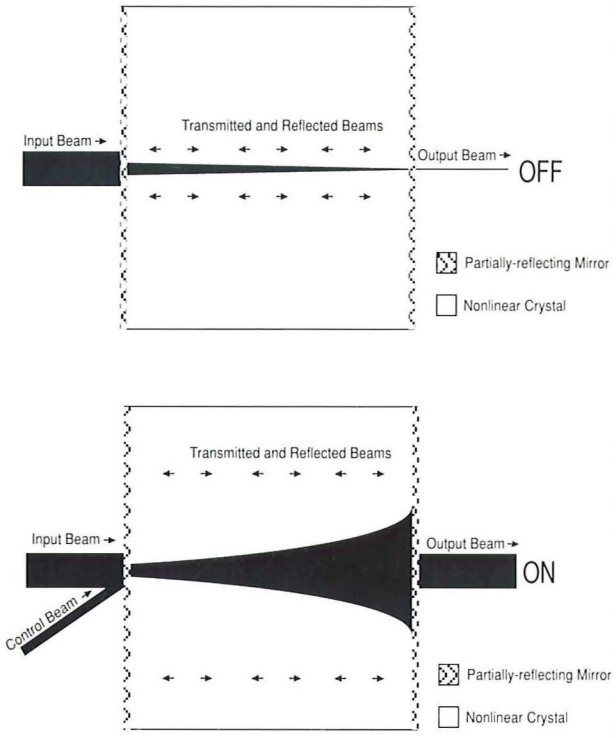
Etalons as Transistors: That's a Switch

During the past decade, optics experimenters discovered several ways to build non-electronic switches that could conceivably revolutionize computer design. One such optical switch is called an "etalon." Though modern, the etalon is based on an instrument invented in 1896 by French scientists Charles Fabry and Alfred Perot, explaining why it's often called a "Fabry-Perot" etalon. Since it's analogous to an electronic transistor, some people call it a "transphasor."

Etalons owe their existence to nonlinear optical materials, substances first studied in the late 1970s. As described elsewhere, the properties of a nonlinear optical material change when exposed to high-intensity light. To be more specific, what changes about a nonlinear optical material is its "index of refraction." Recall from first-year physics that a material's index of refraction is the ratio of the speed of light in free space to the speed of light within the material. For monochromatic light, index of refraction can be viewed as a ratio of wavelengths rather than a ratio of speeds. The numerator is the light's wavelength in free space; the denominator is the light's shorter wavelength within the material.

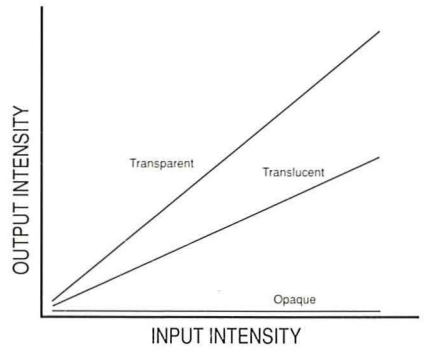
An idealized etalon consists of a nonlinear optical material (usually a semiconductor crystal) snugly sandwiched between two "partially-reflecting" mirrors. For simplicity's sake, assume that "partially-reflecting" means that 90% of the light hitting a mirror face is reflected and that 10% passes through the mirror unscathed.

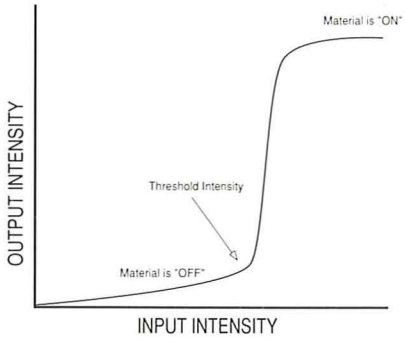
In the first diagram a monochromatic input beam hits the etalon from the left and 10% of its light passes through the mirror and enters the nonlinear material. After this light travels through the nonlinear material it strikes the other mirror. Once again, 10% is transmitted and 90% is reflected. The 10% that's transmitted is the output beam. Since the input has been attenuated twice (once by each mirror), the output is very weak—it's strength is one-hundreth that of the input. The 90% that's reflected from the right mirror hits the left mirror again, this time from the right side. Most of it is reflected and returns to the right mirror where it is reflected yet again. On and on, the light beam bounces back and forth, continually losing strength. In this condition, given the small output, the etalon is said to be "off."



In the second diagram, a control beam is added to the input beam. Though the control beam is small, its effect is large: the crystal's index of refraction changes dramatically. As a result, the light's wavelength inside the etalon changes dramatically as well. The light beams bouncing back and forth between the mirrors reinforce each other at their new wavelength, gaining strength with each pass through the material. In effect, the etalon becomes resonant. During resonance the intensity of light inside the etalon can get as much as 10 times greater than the intensity of the incoming light. In this resonant condition, the output is as large as the input. The etalon is said to be "on."

The third diagram shows the overall input-versus-output behavior of the etalon. The input beam brings the etalon to the brink of switching; the control beam pushes it over the edge.

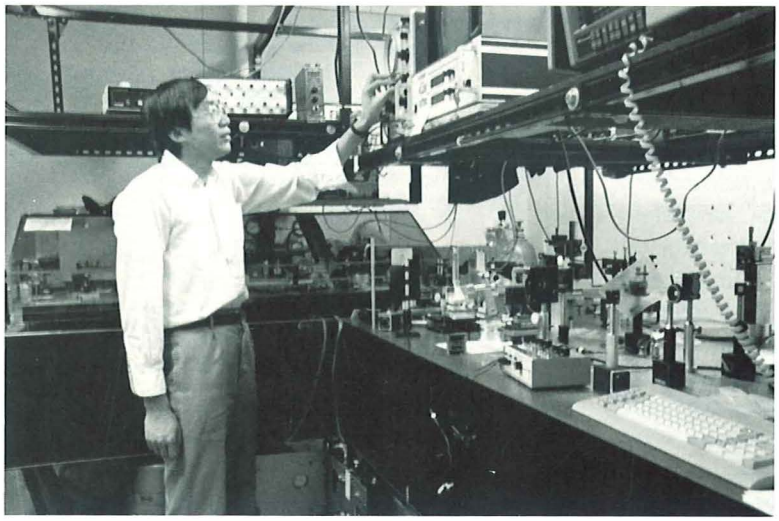




Illustrations by Robert Schroeder

lab in Holmdel, New Jersey, Alan Huang and his colleagues took the best materials and methods available and put together a working optical computer. True, it didn't rival a Cray-2 supercomputer. According to its creators, it was no more sophisticated than the control unit for a dishwasher. Nonetheless, Huang's device showed that a full-scale optical computer is a theoretically feasible.

Huang, head of the Optical Computing Research Department at Bell Labs, is undoubtedly the field's most outspoken advocate. In Huang's opinion, speed is not the only advantage of optics. In 1984, before remotely practical optical switches had yet been demonstrated, Huang pointed out that the inherent "parallelism" of light was its chief advantage, and may ultimately revolutionize the modern computer's internal architecture.



Post-doctoral student Ruxiang Jin at work in Dr. Peyghambarian's lab at the University of Arizona.

To understand what is meant by "parallelism," an important term in advanced computer design, consider how most current computers work; for example the personal computer I'm now sitting in front of. When I type in some information and hit return it appears the computer swallows my data in one big gulp and digests it whole. This appearance is completely misleading. My computer actually processes data in miniscule, byte-sized chunks. However, since it can process millions of such chunks per second, my computer acts as though it handles a lot of data all at once. The speed of this byte-at-a-time "serial" strategy depends on fast switches in a computer's CPU.

Unfortunately, as mentioned earlier, electronic switches have limited speed. To free themselves of this irritating limitation, computer designers in recent years have turned to parallelism. In a parallel computer, many interconnected processors gang up on the input data at once, significantly shortening the time required to run a program. Even if each processor is too slow by itself, many processors working simultaneously makes up for it.

A parallel computer sounds deceptively simple to build—just wire a bunch of CPUs together. Unfortunately, interconnecting all of those CPUs without producing an unmanageable jumble of wires is extremely difficult. According to Huang, that's where optics comes in; once split, a light beam can deliver its information to many destinations at the same time, in parallel. Optics can provide the dense interconnection system needed in a parallel computer. In a 1988 *Discover* article, Huang described the impact of "massive parallelism" as follows: "When you go from a horse and buggy to a Porsche, you don't want to use the same tricks. You want to change technologies entirely. The evolution of computer architecture has been shaped to the advantages and disadvantages of electronics. To work with optics, you have to redesign computers fundamentally."

If successful, the ramifications of such fundamental redesign could be profound. Optical computers sporting massively parallel architectures could make traditional electronic computers look like they're standing still. Optical computers would be extremely adept at matrix multiplication, Fourier transforms, and other time-consuming calculations. In more exotic applications, optical systems would be ideal for image processing and pattern recognition, two tasks that stymie even the fastest of serial computers. An even more advanced use for optical computers would be neural networks, systems loosely modelled on the human brain, a highly interconnected machine indeed. Neural networks, a subject of intense research in themselves, are used to implement eerily-human associative memories.

Optical Delusion?

Despite its potential, the ultimate success of optical computers is far from certain. Just because functional building blocks such as solitary switches are available doesn't necessarily mean that a functional machine can be built with them. In fact, cynics have plenty of good reasons to doubt optical computing's future. Materials are not yet good enough. High-speed optical switches require excessive amounts of power. And other problems, too numerous to mention, exist as well.

Even Kostuk, an optics insider, points out that some people have overblown the capabilities of light, "Probably doing the optics community a disservice." Referring to free-space parallelism, he says "there are a lot of difficulties with optical systems as well. The beams spread out, there's diffraction difficulties, there's alignment problems, there's electro-optic losses....All these things tend to limit these very large, high-density systems that a lot of people have stated are things that could be done...There's just a lot of problems to be worked out."

These technical problems may or may not be solved eventually; only time will tell. But Dr. David Ender, an optics researcher at 3M, points out one more obstacle; even if proven technically sound, users may not accept optical technologies. "Because electronics is entrenched, people will continue to use it because they're familiar with it....New technologies that enter the

marketplace have to demonstrate that they can do a job, not just the same, but quite a bit better...The ideal situation, of course, is to introduce a technology where there's no competition. Unfortunately, except for some niches, there's lots of competition with electronic computing." Ender believes, and many others agree, that optical computers will start with applications electronic computers have difficulty with and grow from there.

Peyghambarian counsels cautious optimism about the future of optical computing. In contrast to some researcher's outspoken support of optics, he prefers understatement, warning, "If you oversell something, then it backfires." Peyghambarian is a man widely published in the technical literature but seldom quoted in the media, he has a record of letting optical materials and devices speak for themselves. After all, when critics analyze the pros and cons of optical computers, it's going to take them longer than a picosecond to change their minds—especially if they get a little help from their electronic computers. ❐

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TECHNOLOG

Writer Profile: Loren Thomsen

Loren, an EE senior, graduates in March and begins a four-year hitch in the Navy as a science instructor. During a recent three-week trip through the western U.S., Loren stopped by the Richard M. Nixon Library in California to pay homage to his hero, "America's most cherished son-of-a-bitch." Though doubtful there is life after *Technolog*, we wish Loren the best of luck in his future endeavors.

What Every Engineer Should Know About

Patents

By Daniel W. McDonald

So you've finally developed an original idea. How do you protect it from corporate theft?

As loyal *Technolog* readers may or may not know, the *Technolog* operates a business subsidiary called EduQuip. EduQuip is a corporation composed of *Technolog* staff members who research and develop new technologies for higher education. Until recently, the company had produced nothing and was at risk of being shut down. However, in a flash of brilliance, Ljoren Blanston, Electrical Engineering senior, finally developed a marketable product.

The product, called CompuBoard, was inspired by a professor who always used dried-up white board markers that were virtually impossible to read. Loren's answer to this problem was to develop a 5 by 10 foot, pressure sensitive, color liquid crystal display. The display's primary function is to replace old-fashioned white boards by allowing an instructor to choose a color on a menu displayed on the board and then write with the provided stylus, a finger or any other blunt object. CompuBoard senses location of the object and displays a line where it was touched. The board can also act as a monitor for a computer, allowing the instructor to display computer graphics or even automate a lecture.

To protect this ground-breaking idea from corporate theft, the *Technolog* contacted Daniel W. McDonald, a patent lawyer, to get the low-down on patenting our invention.

Technolog: *Just what is a patent and what kind of invention can obtain one?*

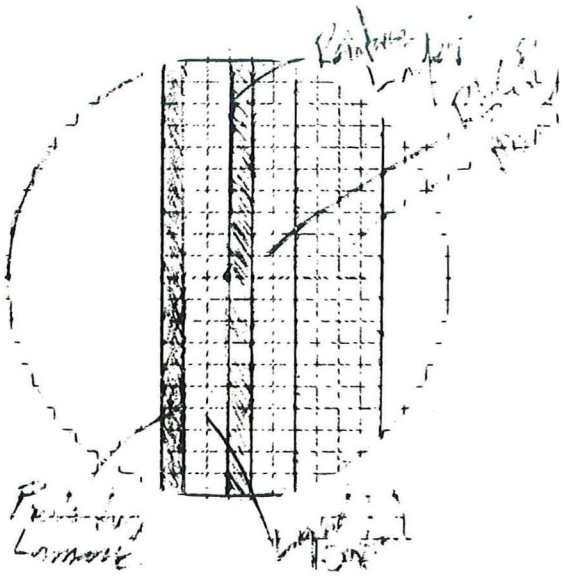
McDonald: The Constitution specifically allows for patents. The U.S. Congress created the U.S. patent system. The U.S. Patent and Trademark Office (PTO) may issue patents to people who invent new, useful, and non-obvious inventions. The most subjective and difficult of these requirements is nonobviousness, which requires a hypothetical inquiry into whether the supposed innovation would have been obvious to a person of ordinary skill in the field at the time it was made. Patent protection is also dependent upon a number of procedural and other requirements.

What rights does a patent entitle to the holder?

A patent remains in force for 17 years. Interestingly, the patent does not grant the right to do anything. Instead, a patent gives the right to exclude others from doing something, namely, practicing the invention as described in the claims.

In essence, a patent gives you the right to sue someone else who uses the patented invention without your consent. If you sue someone and win, what do you get? The typical relief issued by a court includes an injunction against the party who is using your patent without authorization, or "infringing" the patent. The injunction usually states that the infringer may not make, sell, or use the patented technology until the patent expires.

The patent holder may also be awarded monetary relief. This relief, or damages, may take whatever form is necessary to fully compensate the patent owner for the infringer's use of the invention. At a minimum, a patent owner recovers royalty for the use of the patented invention.



If an infringer knowingly infringes a patent, the patent owner may obtain even more remedies. The court has the discretion to award the patent owner attorneys' fees in bringing the suit, which may be very substantial. The court also has the discretion to award up to three times the monetary award to the patent owner.

I understand that another company produced a product similar to ours but did not include color or the ability to display computer graphics. Can we still get a patent?

The vast majority of patents issued are merely improvements on what has largely been done before. The Patent Office does not require a revolutionary invention for a patent to be granted. A patent usually will be granted when the applicant can show differences between his invention and what was done previously, coupled with a showing of practical advantages in the function of the new device, cost or ease of production, etc. that flow from those differences.

The bottom line is that if a modification to a product or process is different and has some advantages over what was done before, it is worth trying to obtain a patent.

Doesn't it take a long time to get a patent?

There are certainly instances where patents have taken many years to issue. One is a 20-year effort involving a microprocessor patent which may cover virtually every chip manufactured.

While such examples are attention getting and alarming, they are extremely rare and the result of unusual circumstances. For most relatively straightforward patent applications, the inventor may expect the patent to issue within about two years.

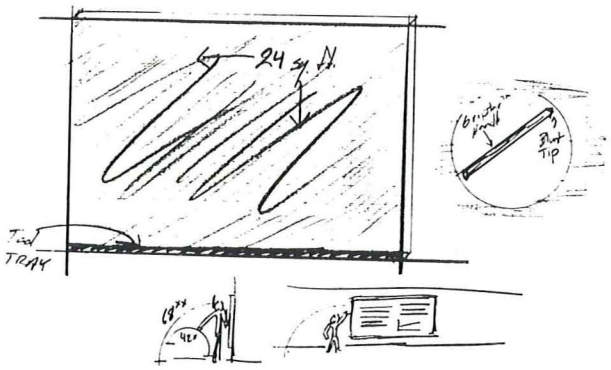
Moreover, even before a patent is issued, it may deter copying by competitors. The inventor may use a "patent pending" notice on products that incorporate the invention that is the subject of a filed patent application. Competitors will frequently be deterred from copying products marked "patent pending" because they risk investing in a product which could soon infringe your patent.

Also, the delay between filing a patent application and the issuance of the patent may often be a blessing in disguise. A new innovation often needs several months, or even years, before its market is created. In some industries, the amount of time it takes to obtain patent protection may well be less than the time the invention needs to "catch on" in the marketplace or among competitors.

Can a company as small as ours really afford to apply for a patent?

Patents can cost several thousand dollars to obtain and maintain. However, patent costs should be compared to the potential benefits from filing and obtaining a patent. For companies that cannot compete on the basis of being a low cost producer, a patent may be the difference between meeting sales projections and going in the red. Profit margins may be enhanced if competition is deterred by the patent protection. Revenues may also be enhanced by an improved reputation in the marketplace or royalties obtained from licensing the patent. Indeed, some companies refer to their patent protection as advertisements.

Another factor to consider in the patent cost-benefit analysis is the potential use of the patent application or patent as a bargaining chip with patent rich competitors. When company A sues company B for patent infringement, and company B has no patents of its own, the only issue may be how much money does B owe A: not a pleasant question for B. If, however, A sues B for patent infringement and B has patents of its own, B is often able to minimize the cost of litigation, or avoid litigation entirely by offering to cross license its patents in exchange for using A's patents. Patent applications cost far less than even an inexpensive patent lawsuit. As expensive as patents are, it may be more expensive not to seek patent protection.



If we did patent the CompuBoard wouldn't we be giving away our company secrets?

Part of the "bargain" the patent applicant reaches with the PTO requires the inventor to disclose the operation of the invention in enough detail to enable a person of ordinary skill in the field to implement the invention. This requirement arises from the basic purpose of the patent system: to publicly disseminate technical innovations so that others may learn from the disclosure and build further improvements.

Such a requirement may mean that the inventor must disclose related technology, some of which may be trade secrets. However, as discussed above, the invention may be a mere improvement on pre-existing technology, not necessarily a fundamental change. Thus, the disclosure

necessary to fully describe the invention may be only a small segment of a company's total technical knowledge. Trade secrets not directly related to explaining how the invention can be implemented need not be disclosed.

Patents can cost several thousand dollars to obtain and maintain. However, patent costs should be compared to the potential benefits from filing and obtaining a patent.

Moreover, while a patent application is pending, all information disclosed in the patent application is kept confidential by the PTO. No competitor may see the information. It is a trade secret until the patent issues, which will only happen following the inventor's final approval at the end of the patent application process.

Obtaining a patent may involve some disclosure of trade secrets. However, the extent of trade secret disclosure may be minimal, and in many cases competitors are likely to engineer the "trade secrets" in the near future anyway.

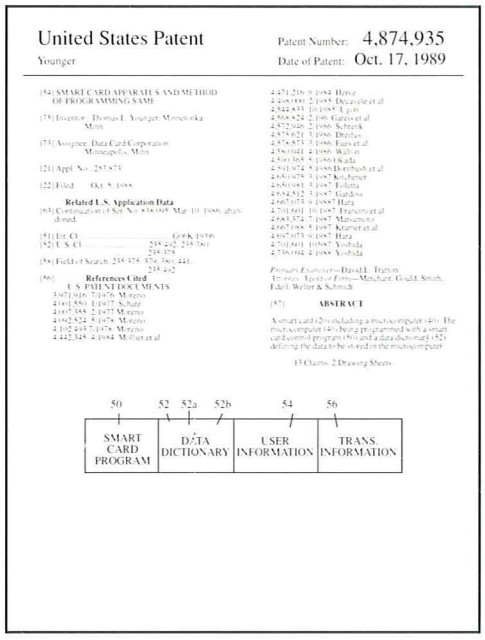
If we ever were in a position to sue for patent infringement would we ever be able to afford the lawsuit?

It is true that patent litigation can cost hundreds of thousands of dollars through trial and appeal. Indeed, overall costs of $1 million are not unusual.

However, for every patent infringement trial which is pursued through appeal, there are hundreds of other patent infringement disputes resolved by other, far cheaper means that still benefit the patent owner. Many patent controversies between companies are initiated by a letter from the patent owner charging the competitor with infringement. Often, the parties will reach an amicable resolution of the matter before a lawsuit is ever filed. In other cases, a lawsuit is filed but the matter is settled in advance of trial and before the bulk of litigation costs are incurred. Alternate dispute resolution is also being used more commonly.

Both the patent owner and the potential infringer face the prospect of high litigation costs. As a result, reasonable business people frequently reach agreement as to what is fair compensation, avoiding a costly trial for both sides.

Thanks to Daniel's expert advice, we have applied for a patent. In addition, the University of North Dakota at Podunk Junction has placed an order for one CompuBoard. This order should save EduQuip and allow us to continue producing new and innovative products at the rate of 1 per decade. ❐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Younger
Patent Number: 4,874,935
Date of Patent: Oct. 17, 1989

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SMART CARD PROGRAM | DATA DICTIONARY | USER INFORMATION | TRANS. INFORMATION

The end result: a finished patent.

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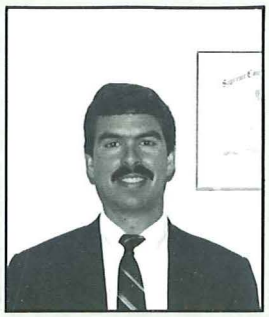


TECHNOLOG

Writer Profile: Daniel M. McDonald

McDonald is a 1982 graduate of the Institute of Technology and a 1985 graduate of the University of Minnesota Law School. Dan is now a patent lawyer for the Merchant & Gould law firm here in Minneapolis. Dan submitted an extremely informative article that was spruced up with comments and editing by *Technolog* staffer Matt Kirkwood. Thanks, Dan!

The Brain Drain

Developing nations find it hard to compete when engineers won't come home.

by Trisha Collopy

People use the term "Third World Nations" to define all the countries in the world which do not possess cutting-edge technology and manufacturing capacities. Embedded in this definition are at least two assumptions. First, that there are only two states of technological development; cutting-edge and underdeveloped. Second, that the lack of high technology development makes a nation inferior (since the technologically developed countries are in the "First World").

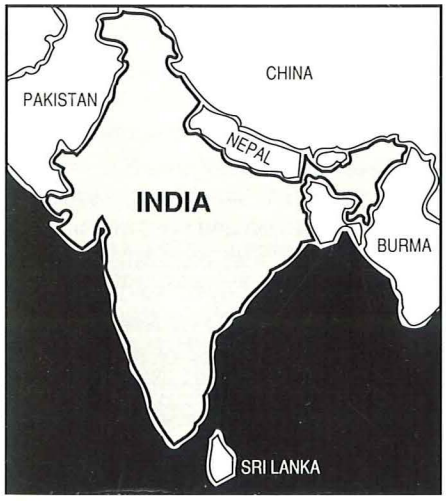
The term "Third World" can be applied to a majority of countries spread across the globe. Obviously, in a group this broad there is bound to be considerable variation in political situations, the level of technological development, and social needs. There remains a pervasive belief, however, that the pressing social problems of all these countries can be solved by the infusion of foreign investment, and especially foreign technology.

If these countries could only develop an infra-structure to support modern technological methods of production, they could begin to produce high technology products that would bring them more money than the unskilled labor or raw materials that they currently offer to the multi-national companies. If they would only stop killing their educated elite, the universities could build a core of researchers and start selling the real commodity in today's market: technological ideas.

South Korea, the latest Asian whiz-kid, is a favorite developing nation. Thirty years ago, when we rescued their dictatorship from the Communists, "made in Korea" was only a hairsbreadth away from "made in Taiwan" or "made in Hong Kong," the plastic toy capitals of the world. Now they have managed to politely restrain their rebellious students without bashing their heads in, and become a serious economic competitor. Starting with little more than the incentive to work hard, they have catapulted themselves to the forefront of high-technology manufacturing, and rebuilt their economy in the process. So what's wrong with the rest of the Third World countries?

That was the question in the back of my mind when I began to interview U of M graduate students from several Third World countries about technological development in their countries. Rather than complaining about the lack of Western aid, their responses seriously challenged the Western perception that technology is the solution to the problems of their societies.

India



Ranbir Sindha is an Indian student currently studying for his Ph.D. in mechanical engineering. Sindha says engineering students in India have access to most of the equipment that students have here, but that there is a time lag of about ten years between India and the West. They have only begun to study applied engineering within the last ten years. "Now they have satellites of their own, and their own rockets and computers," said Sindha. India recently acquired its first supercomputer (a Cray).

Because of the lack of opportunity for advanced research, Sindha estimates that only about 10 percent of the students who study abroad return to India. A handful of these students are sponsored by the government, and those who return have provided somewhat of a technological boost to the country. But these students are not essential to India's education system. "They have had their own masters and Ph.D. programs in engineering for the last 25-30 years." Most of the graduate students prefer to stay in the west for economic reasons. "In India it will take you ten years to buy a car!" said Sindha.

Sindha sees a gradual, root-level development taking place in India. "Unlike China, India can't force the people into development." And unlike many third world countries, India does not permit much foreign investment, so development is not dictated by multi-national companies. "They don't want to become dependent on other countries," Sindha emphasized.

Another graduate student from India, Uday Korde, adds, "The need for change needs to be felt from the bottom, and not from the top down." Korde studied at the Indian Institute of Technology at Bombay before coming to the University.

He sees many differences in the educational systems. "The system is more rigid, and there is no buffer. If you fail you're gone. Everything is dictated by scarce resources being shared among many people."

The research in India takes a slightly different direction than in the West. "Lack of equipment at the university makes research more theoretical. Also, the interaction with industry is not as close as in the U.S. There are very few examples of industry funding research." Rather than funding, or importing technological development, Indian companies have another strategy. "A lot of industries are in a monopoly situation, so they don't need to improve their products. Whatever they produce will be snapped up."

Instead of paying foreign companies for a technology transfer, they simply copy products from other countries. "At a company where I was working, they had a German built machine that had broken down. Earlier, they had sent technicians in to take it apart and figure out how to copy it. When the German technician came he was amazed to see another machine exactly like the one they had sold us," recalls Korde. High import taxes help the local development of expertise, but at the cost of having the technology trickle down slowly.

"Currently the level of education is higher than the industry needs," Korde says. Many post graduates gravitate to administrative positions or emigrate. Korde says that the brain drain is not hurting India under the policy it is currently following, but if they wanted to switch to an open market situation it could be a problem. "They want people staying back to be technicians and entrepreneurs, which is just not realistic."

Map Illustrations by Robert Schroeder

"It also boils down to cultural attitudes to a certain extent. They need change at a lot of levels," says Korde. "Communication needs to be improved; many people living in India have no idea about what their rights are to alternate lifestyles. Then the need for change would be felt from the bottom and not the top. When technological change remains a conceptual thing, it won't do much good unless there's a drastic system—like a military dictatorship—to protest against."

China

China, on the other hand, has a system to protest, but rigidly controls almost all aspects of its citizen's lives. He-hong Zou was educated at the Beijing University of Science and Technology before coming to the U.S. to study Electrical Engineering. He says that the government assigns majors to undergraduates and classes inside the major are predesignated. The engineering programs are very specific, much like industrial or technical training here.

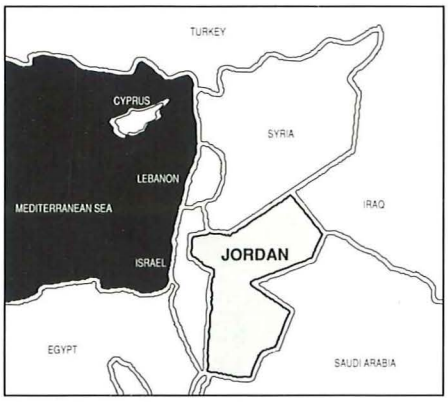
Although the research facilities available to undergraduates are limited, the curriculum is still very rigorous. Only five percent of the high school graduates are admitted to college.

Zou does not recall using a computer for his research before coming to the United States, but he says that for graduate programs in research, there was more academic freedom as well as more equipment available. As in India, the lack of equipment means the research tends to be more theoretical. "For image processing or signal processing you have to use a computer to set up the programs. There, we would just have to study the algorithms," said Zou.

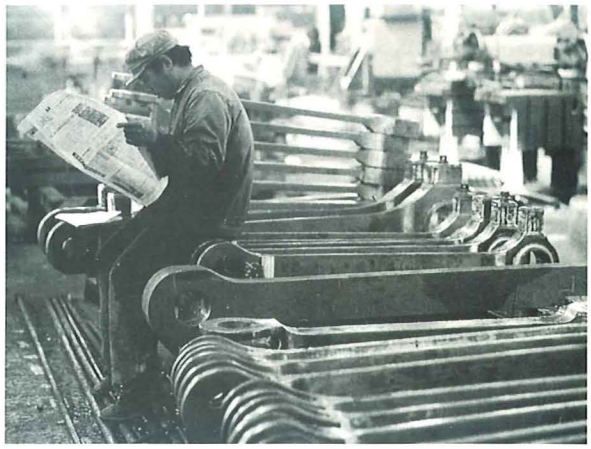
Because graduate programs were initiated only eight years ago in China, they have such a need for teachers that they can spare very few people to do research. They are further hindered from "borrowing" foreign technology by the fact that very few of their professors (about 10 percent) can understand foreign languages well enough to keep abreast of current research.

The Chinese government sends a large number of students to study aboard every year. Zou estimates that 30-40 percent of the graduate students in some engineering departments in the U.S. are Chinese. "Five years ago, almost everyone wanted to go back and help the country" he said, "but now things are different. Only about 10 percent of the students would consider going back, unless they can't find a job." Political repression of intellectuals and economic confusion between capitalist and socialist economic systems have wreaked havoc with attempts to develop an infrastructure for foreign technological development. It is difficult to predict the path that China will take in the coming decades as it juggles attempts to modernize with the needs of its enormous population.

Jordan



Unlike India and China, Jordan is a developing country that imports a large number of engineers. However, Jordan is surrounded by several developing countries of another sort: oil-rich nations that can buy whatever technology they desire. Mohammed Abukdais is a Jordanian who has studied Mechanical Engineering in Iraq and Jordan.



The Iraqi government paid for his undergraduate education. "They encourage the view that they have to help the other Arab countries. They pay for everything—dorm, tuition and a stipend," said Abukdais. The U.S. may have more research facilities, but Abukdais does not necessarily think the education is better. "There it is more challenging, it's not easy to pass. They really push you to study. The year I graduated, only 50 percent of the class passed the final tests, the rest had to go back for another year." Although the facilities for graduate research are not as advanced in Iraq as in the U.S., Abukdais says they are "trying to improve in everything" and have the money to do it, unlike Jordan.

Jordan's universities are hampered by a lack of funds for equipment. "They have no Ph.D. programs in engineering in Jordan because the facilities are not advanced enough to do research. If we are working on a project and need instruments for the research, they are available but it costs too much to buy it," said Abukdais. Because the technological level in Jordan is low, a large number of its educated people look elsewhere for job opportunities, especially to other Gulf states. Abukdais says that the other Gulf states "don't care about developing. They have money from oil, they can pay other people to do the work."

Abukdais says Iraq is the only oil-producing country in the area that does not import engineers. He also claims that Iraq's parliamentary system of government is more democratic than the other countries. "They use the oil money to develop the country itself. In the other countries the king or prince takes the money and no one tells him what to do with it."

Guatemala

Jaime Ramirez has immigrated to the U.S. from Guatemala, a country with neither oil nor a stable political system.

The college programs in Guatemala grant a licenciatura, a degree that allows one to go out and immediately practice in a field. "When you enter a university you start studying the discipline right away. You don't take courses for fun; it's with a pragmatic view in mind."

Only one of the country's five universities is publicly funded. Research in the private colleges is well funded compared to that at the Universidad de San Carlos (USAC), the public university, but it is still very pragmatic. "They have a big lab in materials engineering—studying different construction materials and techniques. They study the use of local materials and the applications to local climate and geological instability," said Ramirez. Other research is done in hydraulic, electrical, and chemical engineering.

The private colleges are relatively expensive, but attending the public university can be politically dangerous. "USAC is very political; the students go on strike a lot. The army views them as communists. Many professors at USAC have been killed by right-wing death squads," Ramirez says quietly. "Last year the president of USAC was killed. He was the biggest academic authority in the country. It really interferes with everything." Surprisingly, engineering is the most political department at USAC.

Some students study abroad, most of them in the U.S. "A U.S. education guarantees that when you go back you'll have the best job around," comments Ramirez. But he also says it depends on the field. "In really abstract, unpragmatic areas, there's not much point in going back. There are two physicists in the whole country. One has a private business and the other runs a school of his own. There isn't much of an opportunity to get funding for theoretical research."

The brain drain is more of an economic than a technological problem in Central America. Because public education in Mexico and Guatemala is virtually free, the problem occurs when people get their licenciatura and end up staying in the U.S. Consequently, they use the country's resources to contribute to the U.S. economy. Ramirez cited the Dominican Republic as an example. "In the Dominican Republic they contribute more to the U.S. by the emigration of educated people than the U.S. gives them in foreign aid each year." This is not such a problem in non-applied fields, but "when it comes to civil engineers, mechanical and chemical engineers, these are people we desperately need."

Many professors at USAC have been killed by right-wing death squads.

Ramirez sees theoretical research as a luxury for Guatemala. "We need some technology, but it has to be very specific to our needs and our culture. For example, many people come to the U.S. to study agriculture. They are very impressed by the high-tech equipment. To try and do this kind of farming in Guatemala just increases our dependence on foreign technology and foreign machinery. It doesn't make sense to try and cut down the amount of labor used because labor is what we have in surplus. Right now there is 60 percent subemployment and unemployment," said Ramirez.

High technology in Guatemala will have to wait until the most immediate problems, such as the 70 percent illiteracy rate, the complete lack of a health system and the 1.5 million internal refugees have been dealt with.

Inventing and incorporating cutting edge technology into manufacturing infrastructures is of economic benefit to First World countries engaged in economic competition with each other, but an examination of the needs of Third World countries quickly reveals that high technology is not always the answer to improving their social problems. ❐

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Ramirez, Jaime. Interview, Dec. 11, 1990.

Sindha, Ranbir. Interview, Dec. 10, 1990.

Zou, He-hong. Interview, Dec. 10, 1990.

TECHNOLOG

Writer Profile: Trisha Collopy

Trisha majors in Chinese, ice skating, and writing for the Technolog. She is pictured at right in front of our award-covered wall, basking in the fame of honors bestowed on long-dead Technolog editors.

News

ComputerSpeak

by Chris Klassen

Once upon a time, a programmer sat burning the midnight oil in a futile debugging attempt. Suddenly, in an effort to vent frustration, the programmer denounced the computer's behavior in words I will not reconstruct. Now usually in a story like this the computer does not respond, but now with voice recognition (VR) technology from ComVoice Systems in Eagan, Minnesota, the computer can be equipped to understand and respond to the spoken word. With this technology, the computer now audibly replies, "Your program code has been deleted. Have a nice day."

To add this capability to any computer all that is needed is a microphone, speaker, and ComVoice System's software and hardware.

The hardware consists of an IBM compatible eight-bit half-size circuit board. Other computers use a "black box" that houses the boards and plugs into a serial port. The price ranges from $495 to $2,995.

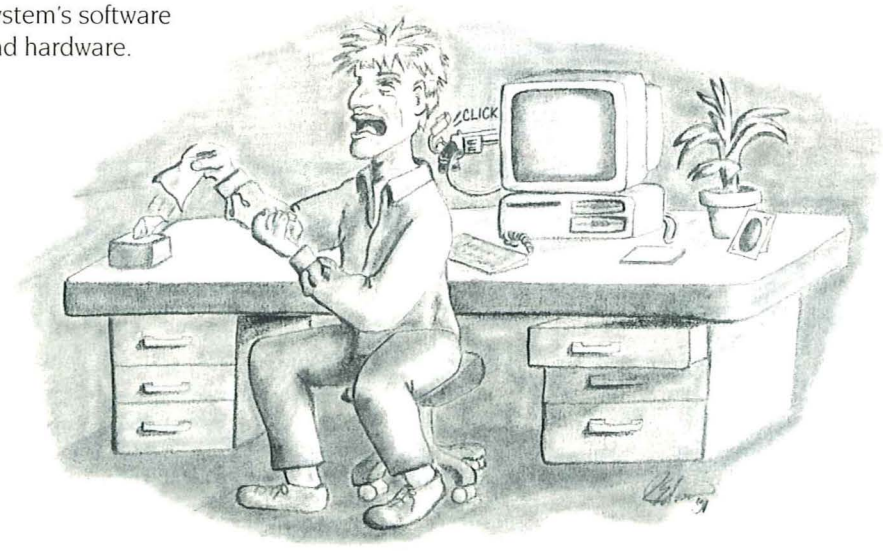
After the hardware is installed, the user goes through a "training" session in which any number of words are spoken into the microphone from five to ten times each. The computer then converts the acoustic waves into a digital code and stores an average composite of each word in memory. The vocabulary must be tailored to the user because the digital codes will vary from person to person. The number of words that can be included in the vocabulary are limitless, however, at any given moment the computer memory only allows operation from a list of 500 to 1000 words. When a word is spoken the computer finds its matching digital code in memory and recognizes the word.

Once words can be recognized some meaning or command must be associated with each of them. This task is performed by the ComVoice software and the user. When words are spoken the computer recognizes the words and obeys the commands associated with them. These commands can designate the computer to print and speak words or even control the telephone and electrical equipment through infrared signaling (provided the computer is attached to an IR remote control device) or through modules that plug into an electrical outlet.

When the system and vocabulary have been installed, the system's recognition is 98% accurate. Even colds do not greatly impede word recognition because the digital pattern of speech is not significantly affected by them. The rate of recognition, the moment a word is spoken to the completion of its command, is such that any delay is not perceivable by the user.

To speak, the computer uses a process called concatenated speech synthesis. A dictionary of spoken syllables is stored in memory and strung together as necessary to form words. The resulting speech is rough at times but may be improved by altering the syllables used to spell the word.

Aside from being interesting in and of itself, this technology holds many practical applications and adds another dimension to computer flexibility. ❐



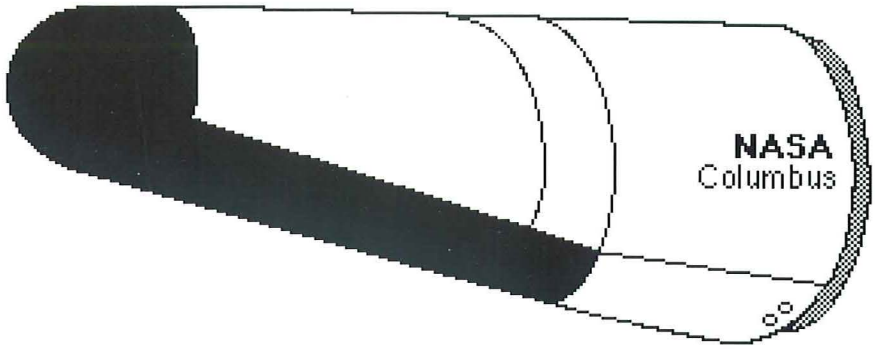
"Oh, Mac, I'm just so glad that you can be here to listen to my problems."

Illustration by Joyce Rajendran

Planning a Trip to Mars?

by Laura Sokol

College students planning a trip to Mars? 76 seniors here at the University are in the process of designing a transport system for NASA's proposed journey to Mars. Aerospace engineering students have the option to take design courses sponsored by the University Space Research Association (USRA) and the National Aeronautics and Space Administration (NASA) George C. Marshall Space Flight Center in Huntsville, Alabama.



Mars Habitation Module. Design by team #1 of this year's Senior Design Class.

The class was offered for the first time last year. Professors Andrew Vano, William Garrard, and Jack Moran submitted a proposal, and received a grant from USRA/NASA. Enough students enrolled again this year, so the department created two design teams, approximately equal in number. Both teams work on the same project, with the guidance of Professor Vano.

Professor Vano was an engineer at the Dryden Flight Research Facility in Edwards, California, for nearly fifteen years. Now, along with teaching at the University, he works as the chief engineer at Bellanca in Alexandria, Minnesota.

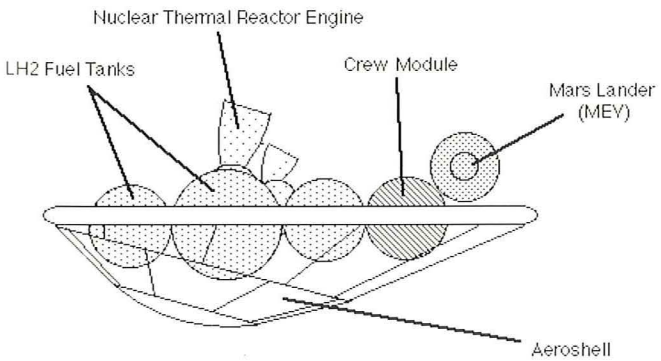
The University Space Research Association Advanced Design Program (USRA ADP) creates a classroom environment much like that of an aerospace engineer's work environment. According to Professor Vano, most students are independent workers and have not had significant prior collaborative design experience. He stated, "In industry, all members of a project must work together in order to complete a project successfully." In order to fill this need for teamwork, the students are divided into different disciplines, each having certain responsibilities. The students submit a job application letter and a resume to "apply" for positions in the disciplines.

Last year, students designed a Cargo Return Vehicle (CRV) for the Space Station Freedom. During the fall quarter, the students studied three basic body designs. The students created conceptual designs for the CRV during the winter quarter. In the spring, they used several finite element analysis programs and wind/water tunnels to test the aerodynamics of each body design. The course will follow the same game plan this year.

The design project the students are currently working on is the Mars Integrated Transportation System (MITS). The mission is planned for the year 2020.

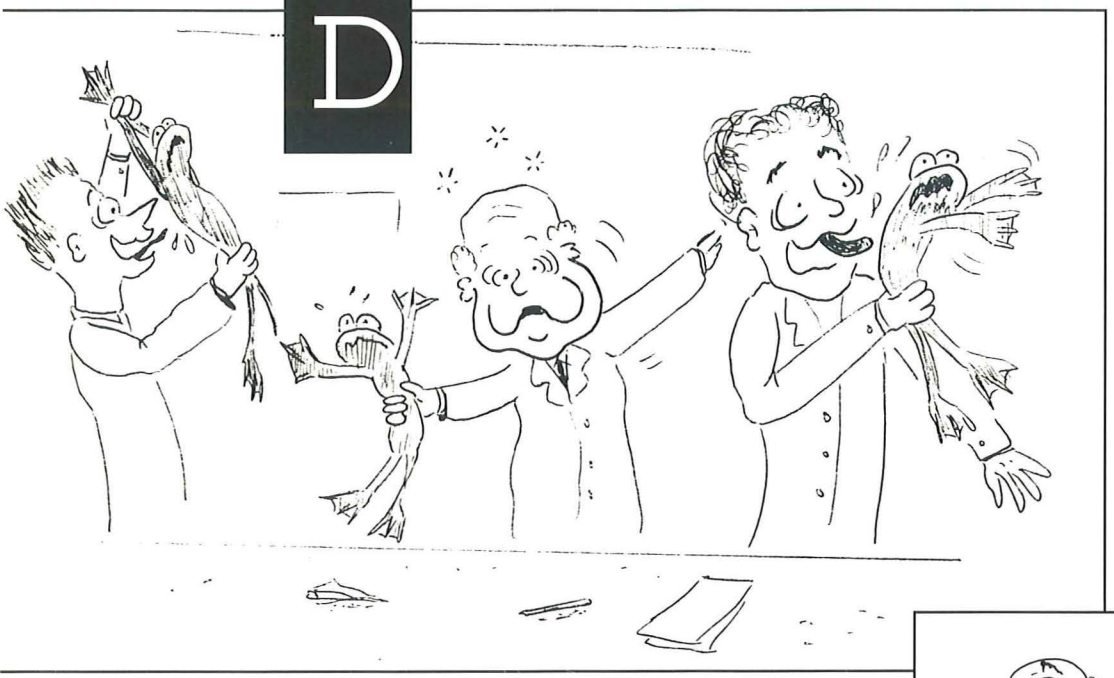
MITS is a design project that will accomplish four objectives. The first objective is to "transport an expeditionary crew of four trained astronauts from Earth orbit to Mars orbit, then descend to a preselected point on the Mars surface." The second is to "establish a Mars outpost site and conduct local science and exploration investigations including local resource evaluations." The crew will reside on the surface of Mars for approximately 30 days. The third objective is to "return crew, surface samples and appropriate hardware/information back to Earth orbit." Finally, the students are to "accomplish the above tasks in a cost effective manner with acceptable levels of safety and redundancy, and design systems which will provide infrastructure for continued future missions."

NASA considers using the student's design projects. Last year, both design teams presented their projects at the NASA/USRA Advanced Design Program conference held at the Lewis Research Center in Cleveland, Ohio, but their designs will not be utilized by NASA. This year's teams will present their designs to NASA this spring. ❐



Ship with the aerobrake

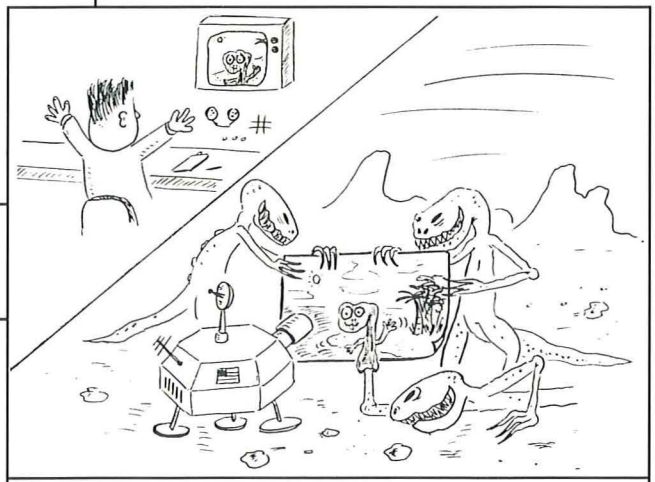
Illustrations courtesy of this year's design teams



Controversial and highly unethical research into naturally occurring hallucinogens.

Well...Sheesh! First I remove the muffler...then I switch drivers...and @*#^*% thing **still** doesn't work!

O.K., I got another one, headed for New York...
O.K...O.K...ooo! Damn it! Can't I hit **anything** today?



"I've found it! A planet hospitable to human life!"

Cindy Mouton keeps looking for trouble.

As a new member of GE's Field Engineering Program, Cindy Mouton trouble-shoots equipment in some pretty wild places. Like the day she spent dangling six stories above the Mississippi River, trying to fix a crane.

Cindy's also gone trouble-shooting at chemical plants, paper mills and steel mills. She's been called on to repair everything from a vintage 1930's motor to the newest programmable controllers.

Field Engineering is not a job for the timid. You need the confidence—and broad-based knowledge—to walk day after day into new situations where you face the unknown.

If, like Cindy, you've got a sense of adventure, then Field Engineering could be the field for you.

In fact, if you're gutsy, outgoing, and capable, GE has opportunities for you no matter what field you're in.

So while you're out there looking around, take a good look at GE.

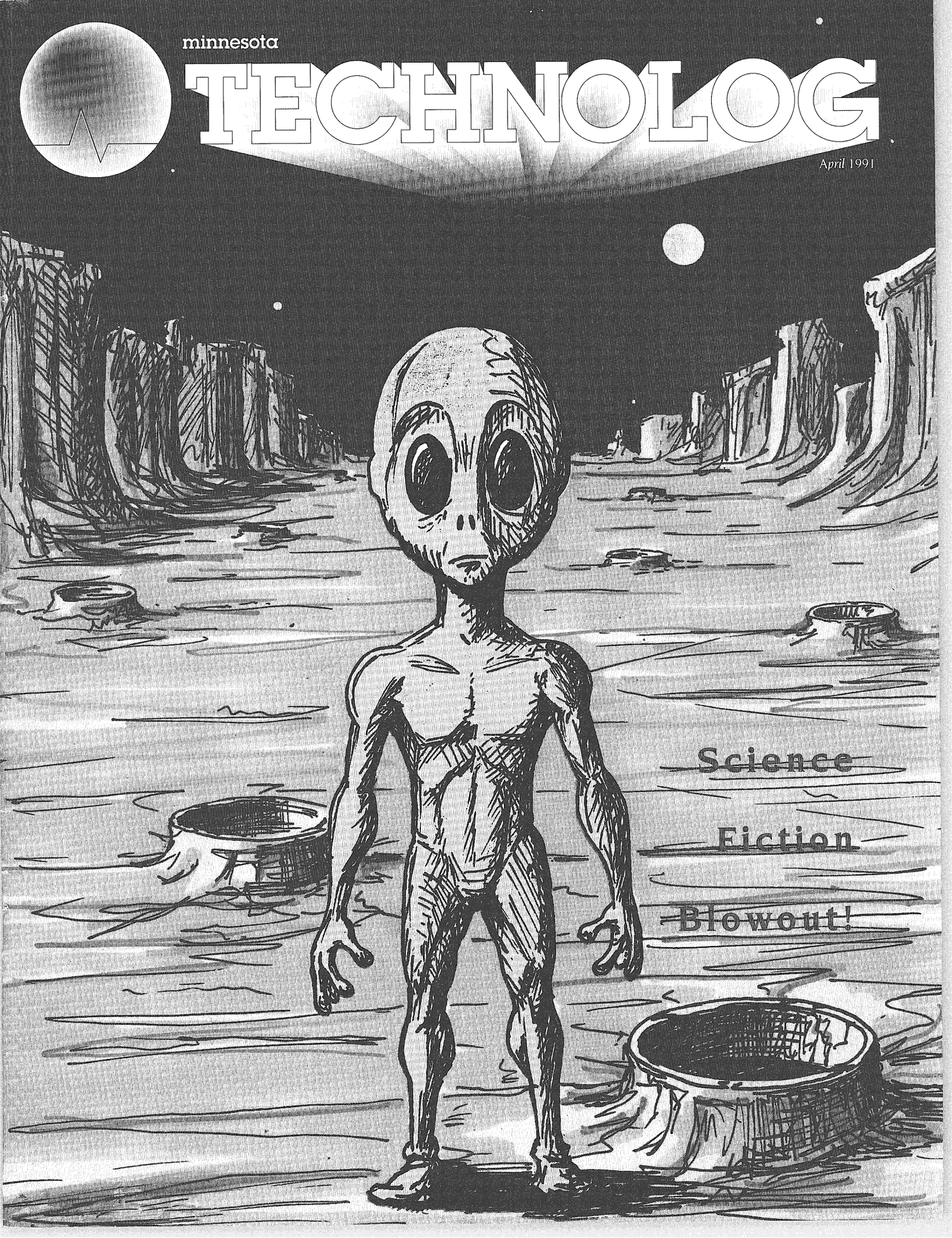
World of opportunity.

An equal opportunity employer.

minnesota

TECHNOLOG

April 1991



In memory of...

Dr. John Clausen
1922-1991

Dr. Clausen was the advisor to the *Minnesota Technolog* since 1979 and founded the IT *Connection* and IT Board of Publications in 1981. He was a mentor, advisor, and friend to all of us and the cost of losing his vision and support is immeasurable.

Students were what Dr. Clausen was about and students were the main beneficiaries of his work. The excellent tutorial facilities available to IT students are a direct result of his work. He was a part of several student organizations and always had a free moment for a student in need.

We dedicate this issue of the Technolog to the memory of a man who gave so much to so many and hope that the extent of John Clausen's efforts do not go unrewarded in the netherworld of the soul.

IT *Connection*
IT Board of Publications
Minnesota Technolog

The Institute of Technology Alumni Society

invites you to attend the

SCIENCE AND TECHNOLOGY DAY SYMPOSIUM
Thursday, May 9, 1991 • 1:00 p.m.
Room 3-180 E.E./Comp. Sci.

"A Regional Response to Global Climate Change"

Dean Abrahamson, professor of public affairs at the Hubert H. Humphrey Institute of Public Affairs, and co-chair of the All-University Council on Environmental Quality at the University of Minnesota, will speak on "The Intersection of Energy and Environment."

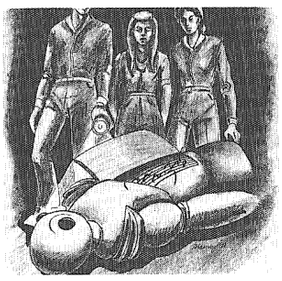
Margaret B. Davis, regent's professor of ecology at the College of Biological Sciences, will speak on "Using the Past to Predict Ecosystems in the Future."

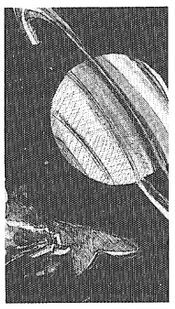
Michael Schlesinger, professor of atmospheric sciences at the University of Illinois, will speak on, "Projections of Global Warming Using Numerical Models: Methods, Results, and Uncertainties."

Please join alumni and friends of I.T. in this fascinating, FREE learning opportunity.
We hope to see you on May 9!

TECHNOLOG

Volume 71, Number 5 April 1991





About the Cover...
Wayne Kao is the artist featured on our cover. (He's the artist, not the little green fellow depicted.)

Departments

Editorial

A Mid-Winter's Dream

A strange sound awakens me from a deep, restful slumber. I roll over and see that my alarm clock reads 6:45 a.m. Why am I awake at this god-forsaken hour?

I hit the snooze button, but the strange noise persists. As consciousness clears my sleep-fogged mind, I realize the strange sound is birds singing.

I pull my shade and am assaulted by the sun, shining brightly above the green grass of my backyard. My neighbor, clad in cut-off shorts and a beer belly, is bent over his beat-up lawn mower. *It's early, I can sleep in. Wait a minute. Green grass. Birds singing. Cut-offs.* IT'S SUMMER!

I must have slept through spring. Ever-so-briefly, I worry about the classes I've missed, bills I haven't paid, and so on. But only until I remember what spring means. The hallowed first ride.

I dress quickly, grabbing my jacket, gloves, helmet, and keys to my Yamaha. I run downstairs and burst out the back door. There sits my bike, among seven others. *Seven?* Oh well, no time to gawk at the neighbor's new wheels. Time to go.

I swing a leg over my Yamaha, turn the key to on, and am greeted by the steady green glow of the neutral light and the familiar *whir-click* of the YPVS aligning. I unfold the kickstarter and give it a quick boot; the engine fires readily.

While the engine warms, I check the bike over. Air in the tires, gas in the tank, lights all work, clutch engages, horn gives a pathetic little bleep. Yep, it all works.

I pull out onto the streets, empty at this early hour. The air temperature is warm but the breeze is cool enough to keep me from sweating in my jacket. The air is crystal clear. *Perfect.*

Traffic is light, unusually so. In fact, the only other vehicles I see are motorcycles. There are six lanes on University Avenue, each about four feet wide. *Weird.*

I turn off University onto the on-ramp for 94 West. The on-ramp also has narrow lanes and the traffic light used to limit access to the freeway is gone. As I travel down the freeway, I realize that there are no cars, trucks, or buses. Just motorcycles.

Big-bore sport bikes with low handlebars and flashy plastic, full-dress tourers with running lights and ashtrays, cushy scooters with little wheels and neon paint, and loud Harley-Davidsons with straight pipes and leather fringes glide down the road in a carnival-ride mix of color and sound.

I *died and went to heaven.* There is no rational explanation for any of this. I exit at Riverside Avenue and pull into a gas station. A man is putting gas into a green and purple scooter. Somewhat nervously, I ask him what happened to four-wheeled transportation.

"It's illegal. President Stallone outlawed it right after the big gas shortages of '93. Where have you been, dude?" the man says.

"Um, asleep, I guess."

The man looks at me strangely. I notice a big sign reading "43⁹." I look back at the man.

"That sign says that gas is 44 cents a gallon," I say.

"Outrageous, isn't it?," the man says, "I was paying 25 cents at Citgo but they went belly up last week." The man walks off, shaking his head. I drive away, thoroughly confused. *I'll just go back to bed and everything will be okay.*

I park in the back and walk into my apartment. My roommate is up, watching television. Sylvester Stallone is on, wearing a triple-breasted purple suit, pigtail, and pink-trimmed wire-rim glasses. "What are you watching, Rocky XXVI?" I jokingly ask.

My roommate laughs and says, "Nope. This is CNN." I laugh and then stop when I realize that my roommate is serious. Stallone is mumbling incoherently. The screen cuts to Peter Jennings, who says, "That was President Stallone, outlining his latest policy..."

The next thing I remember, my roommate is helping me up from the floor. I woozily slump into a chair. My roommate looks at me, concerned. "You shouldn't get up so early. It's bad for your health," she says. I agree and stumble back into my bed.

Several hours later, the harsh buzzing of my alarm clock wakes me from my slumber. I hear a small motor running in the back yard. *My neighbor must be mowing the lawn.* I look outside and am greeted by fresh, white snow and my neighbor, dressed in a purple snowmobile suit, running his snowblower. *It was all a dream. Sly, motorcycles, the whole thing.*

In the future of my dreams, motorcycles become the prime mode of transportation and, due to radically lowered gas consumption, oil companies go out of business.

While this scenario is highly improbable, motorcycles get excellent gas mileage, are cheap to insure, and convenient (usually free) to park. They are an excellent alternative for a student. (I strongly recommend new riders take part in a motorcycle safety course and learn to drive defensively.) On the other hand, I cannot advocate the idea of Sylvester Stallone as President, no matter how attractive the thought may be.

TECHNOLOG

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Letters

Dear Editor,

Why did Saddam Hussein think he could get away with invading Kuwait?

We knew that Iraq was having a border dispute with Kuwait and on July 25, 1990, according to the Jan. 16 *Seattle Times*, Ambassador April Glaspie received the following written instructions from the Secretary of State, approved by the President, to deliver the following message to Saddam Hussein: "We will not become involved in your border dispute with Kuwait and we take no position on this dispute." According to Representative Mary Rose Oakar, Ambassador Glaspie is now incommunicado.

Why did President Bush give the green light to Hussein in July and then, a few weeks later, start calling him "a Hitler?" Was Hussein set-up by Bush?

Now President Bush wants the Emir of Kuwait restored to power (status quo ante). The Emir is not the American way of life—70 wives, seven personal 747s, sole owner of Kuwaiti Oil Company with half of the oil money going into his personal pocket. Are America's sons and daughters to be sacrificed for a guy like this?

Alan Rhodes
Willoughby, Ohio

Push your evening *beyond the limit* at this year's *IT Not-So-Formal Formal*

Friday Night, May 10
Doors open at 8:00 pm 'til Midnight
Tickets available in April
For more details read the *Connection*
or call 626-0093

Make your plans now to go Beyond The Limit!

April 1991

To Find A Den

by John Alexander and Michael Walsh

Jackie Allan pulled on a pair of oil-stained coveralls. She left the warm body sleeping in her bed and made her way to the kitchen. Spring is cold in Minneapolis. Making breakfast, she considered going back to bed. But she decided that she didn't want to be more than half an hour late to her first day on the new job.

She found Kelly Peterson's office behind mirror glass on the seventeenth floor of the new Excon building on Nicollet, and walked in.

"You're late." Kelly, petite and brown eyed with a delicate face, wore artificially long straight hair in the current fashion. Jackie sat down and put her boots on the desk.

"Skip that, there's an automatic farm on the fritz that I'm supposed to fix," Jackie said.

The air between them began to freeze.

"You seem to forget which of us is the boss," Kelly said. "You refused to take a Political Reliability Exam. You refused to give us blood and urine samples, and access to your health records. You're not on time. These are all conditions of employment. How do you expect to get along with your superiors?"

"Go jump in a lake." Jackie rubbed the heels of her boots together, leaving fragments of dirt on the tabletop. "I'd just as soon quit now as next week. But you need an experienced systems engineer, and that's why I'm getting paid twice what you are. Not that money means anything anymore. Besides, I'm insulted. No scientist, engineer, or technician worth his or her salt will give you a urine sample. No one's even dared ask me since I was fresh out of the Institute. I refused then."

"Here at Excon we try to maintain higher employee standards than are unfortunately prevalent elsewhere."

"So fire me. Let's see you beukies, I mean bureaucrats, fix a leaky faucet."

"We have some very competent personnel who are willing to take PRE's and give us urine samples," Kelly muttered, surrendering.

"Sure." War over. Jackie swung her legs off the table and got up. "Where's my terminal?"

"You need an experienced systems engineer, and that's why I'm getting paid twice what you are. Not that money means anything anymore."

"Actually, management feels you probably ought to have a look at the farm in person. There's a van in the basement garage. I'll show you."

Management probably ought to have a look at itself, Jackie thought as she followed.

▼

The garage was dim and smoky. The van was enormous. A shirtless man with a well-defined chest and a bristling mustache was loading crates of equipment into the back.

"This is Mark Eckert, an automation tech who will be coming with us. Mark, this is Jackie Allan," Kelly said.

non

"I know Mark. Hi." (Jackie felt that Mark had the most beautiful eyelashes she had ever seen on a man.)

"Hi Jackie."

"You said...us?" Jackie turned to Kelly.

"Uh, I was told to come along."

Jackie gave her a hard look without saying anything. Then she climbed through one of the side doors of the van.

Automation up front; a manual driver's seat just in case; methanol engine; living quarters; lab space with terminals; and storage space in the back.

Mark climbed in with a four foot satellite dish.

"Hey, Jackie, what's with the beukie coming along?"

She reached out and flipped on a terminal.

"I'm not sure. Excon's been security-fanatic ever since people stopped them from putting microwave receivers on the Greenland icecap. You remember that?"

"Microwave power beamed down from the solar arrays in space? But I thought those things were in the Pacific ocean."

"They are." Jackie was watching her screen. She'd found her login and started exploring while they talked. "Some beukie originally wanted to put them on the glaciers. They didn't realize the conversion heat would eventually melt the glaciers, reduce the earth's surface albedo, and give global warming an extra oomph." She suspended a throat mike around her neck.

"What happened?"

"They were stopped. Mortal blow to the collective ego of top management. So now Excon recruits weak-willed people who give urine samples. I think Kelly's supposed to keep an eye on us."

A door slammed up front. The twitch of Mark's thick mustache did not go unnoticed by Jackie. "So if I gave urine that means I'm weak-willed?" he inquired.

"Just don't do it again," Jackie laughed.

"Do what?" asked Kelly, coming through the door. Mark went back to packing boxes so they wouldn't move around.

"Urinate," Jackie said. "What's the name of that farm?"

"Fnail. Fnail Farm, in Canada. The farm overseer reports that everything is fine and dandy, but the last transport didn't find any produce to load. There are other disturbing reports," Kelly said. She was watching Mark, who was shuffling crates with effortless grace. She decided that the muscle was real, not silicone inserts.

"So, how do you two know each other?" she asked.

"We worked together on a job for General Wind. Repairing power windmills." Mark placed his hands on the edge of a crate behind him and sat down on them.

"They had a joke about us," Jackie called over from the terminal. "About how you remove a generator housing."

"Yes, yes," Mark grinned. "Jackie holds the screwdriver against the screw and Mark rotates the generator. *Then* she had the nerve to write on a recommendation form that I was 'young, but competent.' Tell me what that's supposed to mean." He jabbed an accusatory finger in her direction. Jackie giggled.

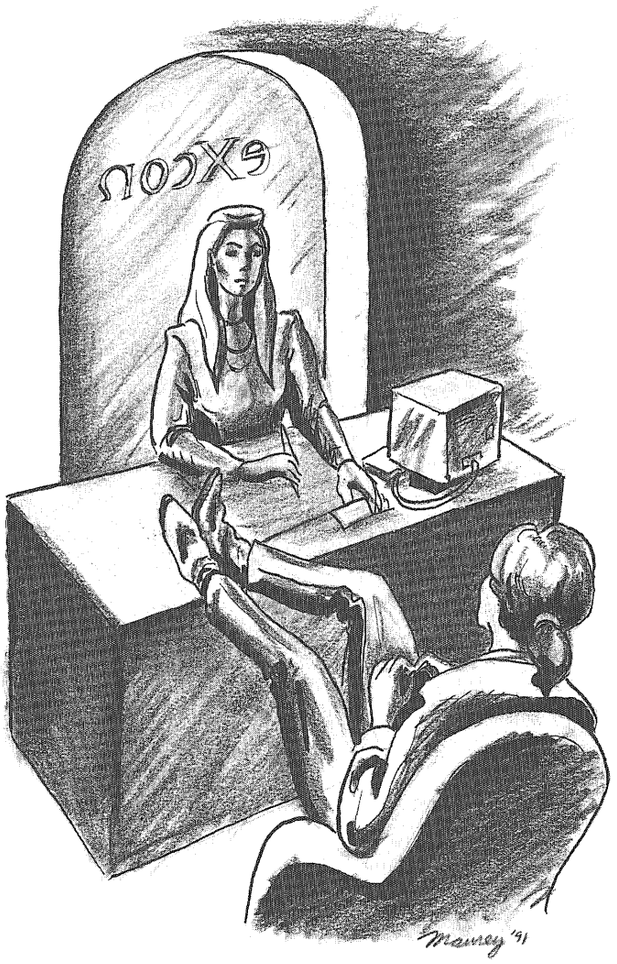
Kelly smiled politely, but she had this image of Jackie with a screwdriver that she found mildly threatening.

"Arrgh, you're right." Jackie's moods seemed to switch without warning, Kelly thought. She had been communicating with the terminal by keyboard and subvocally through the throat mike. Now she turned it off. "From the farm's point of view everything's okay, but the other things flatly contradict that. We'll have to actually go to Canada to find out which machine is right."

"We've been on our way for five minutes," Kelly said.

Jackie looked stunned.

"You didn't notice? Your inner ear must be broken," Mark said generously. "We've been turning corners and everything."



 Illustrations by Melinda Maurey

"Damn modern suspensions are too good," Jackie growled reflectively.

▼

It was growing dark and drizzling when they pulled up to the end of a gravel track and stopped. The black arms of wet bushes and trees stood around a huge shed and a crumbling, low concrete structure. Dull green conifers rose up one hill. In the other directions lay small fields separated by windbreaks.

"...land is poor around here. Vast area, very low level agriculture. It's labor intensive to conserve the soil," Mark was saying as they got out of the van, wearing light hooded jackets and heavy boots.

Kelly went over to the shed and pulled open the big door.

"Machines in here. Tractors...I wish I knew all the names."

Jackie followed her in, clanged around, and came back out.

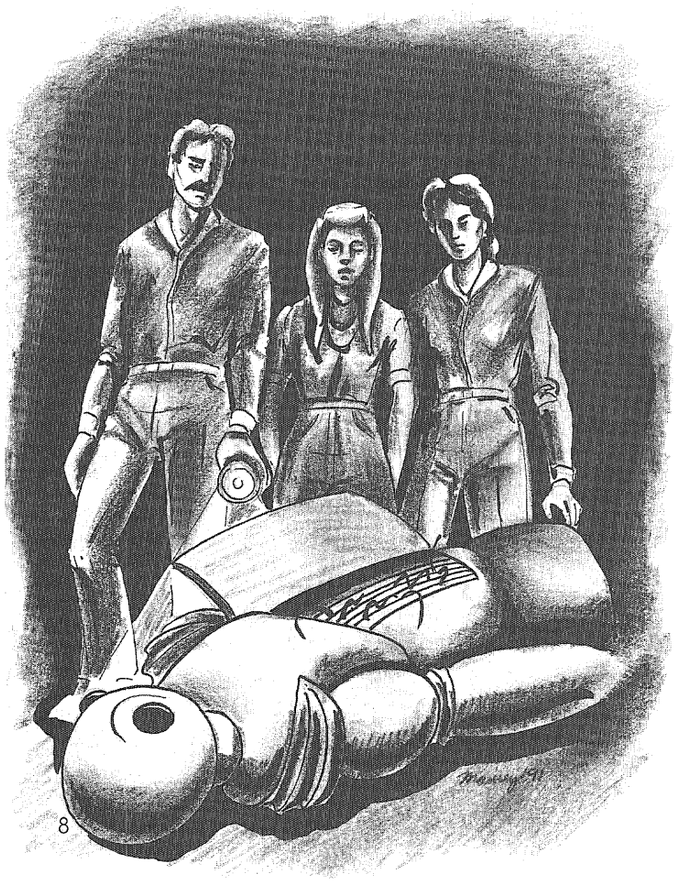
"Most of the farm machinery is out. The storage bins are empty...Mark, what is it?"

Mark had been standing in the rain staring off into the distance. He turned.

"Nothing. Smelling the air. Getting a feeling for the place," he said. "That should be the 'bot den," he added, pointing at the squat concrete building.

They entered by a wide gate with its doors flung open. Lights came on. It was a large cavern with showers and water hoses for cleaning equipment and 'bots, farm robots. Side rooms held supplies. Mark headed purposefully for a heavy door in the back wall. The room behind it proved to be dry and heated.

"Weather can get pretty corrosive, even on the 'bots," Mark explained. "And contacts." He pointed out a series of outlets in the wall. "The 'bots come here to report the day's events, and to get their assignments in the morning, as soon as it's light enough to work. The bigger contacts are for power. Recharging."



"I was told the farm overseer talked to the robots by radio," Kelly put in. Jackie was rattling at a door with a rusted padlock on it.

"Sure, a bit," she said. "But the 'bots can remember a lot, especially botanical details. The data rate's too low. Same reason we'll be putting up a satellite dish. The van radio won't let us talk to the rest of the world as much as we want." The door wasn't giving.

"Mark, can you get this open? Otherwise I have to go back for a hacksaw."

Mark put his shoulder against it and pushed. The bar bent and came out of the frame. The door swung in.

"Cheap metal," he said.

No light came on in here, and there was a musty smell. When their eyes adjusted to the dark they saw several large cables passing through the room. One was connected to a large box on a bench, which was connected in turn to an old-fashioned terminal. There was even a chair lying on its side.

"Hey, this looks like it used to be a control room for real live people," Mark breathed. "Totally antiquated, twenties stuff."

Kelly felt strangely excited. In spite of the jokes, Jackie couldn't be much over thirty-five.

"Cool it. Some of us are old enough to remember the twenties," Jackie said. She righted the chair and sat down in front of the terminal, raising a cloud of dust.

Mark found an outside door and opened it. The last of the daylight filtered in.

"What I wonder is where all the 'bots are. They should be coming home," he said.

Kelly peered out, wondering if she would see the earth-toned hominids ambling toward her through the weeds growing over the foundations of long-gone buildings.

"They are home." Jackie stood up, alarmed. "According to this overseer, its storage bins are full of radishes, its fields are all plowed, and all twenty-four 'bots have been patiently sitting in the room we just came through, for the past hour."

They set off to look for the missing 'bots with flashlights. The drizzle had stopped. An invisible moon gave the cloud cover a uniform glow, enough to navigate by.

▼

Kelly pushed through the underbrush of a windbreak and came out on the other

side. A 'bot was right in front of her, ten paces off. It cocked its head slightly and watched her.

"Jackie, I've found one," she called out. In the flashlight beam it was brown, with black disks for eyes in an otherwise featureless face. Jackie came up beside Kelly.

"Stop. Test. Test," she said. The 'bot emitted a low hum. "That's about all they say." She pulled out a complicated-looking probe and walked over, reaching for an access port on the bot's torso. A third beam of light fell on the brown figure. They heard Mark's footsteps.

The 'bot casually brought up its right arm and knocked Jackie's hand out of the way. She reached out again, and barely dodged a large swipe of the bot's arm—but tripped backward in the grass. Kelly caught her, staggering in surprise at Jackie's weight. Muscle and bone. Kelly felt strangely excited. In spite of the jokes, Jackie couldn't be much over thirty-five.

"They're not supposed to do that. Anything like that. Ever." Jackie was breathing hard, and there was some fear in her eyes. Kelly wondered how she was supposed to feel.

The 'bot didn't show any further aggression, but just stood there. Mark had run up and was now standing next to them.

"Let's stay away from that one," he said. "Come on, I found a disabled one. It's probably safer."

Mark's 'bot was lying on its side at the foot of a grassy incline. It looked considerably less than human with several large panels removed. Mark's finger picked out details.

"See, here, the oil well's dry. I'll bet the joints are ruined. Hydraulic fluid's low. The battery's drained. There's a lot of physical trauma, especially to the computer casing. I've never seen a 'bot so mistreated. Usually the mechanical parts wear out after five or so years. This one's brand new." He straightened up. "It almost looks like this 'bot *tried* to kill itself. And another thing I don't understand is why the operational one over there didn't bring this one in. They're supposed to take care of each other."

"This one was probably ordered to commit suicide," Jackie put in. "I'm sure that this was done through the overseer itself. I doubt we'll find many working ones."

Mark hoisted the casualty across his shoulders.

▼

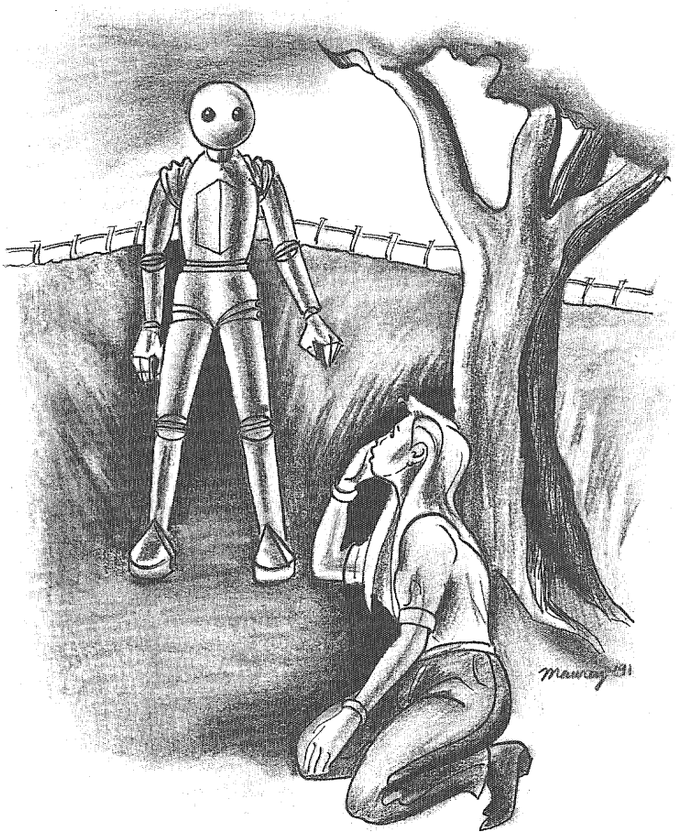
They drove the van around to the outside door of the little control room, carried in a bright light and set up their trouble-shooting gear. Jackie quickly broke the system. It had been set up to deliberately destroy the 'bots, and to deny that anything was wrong.

"There are four 'bots left. They're not hostile anymore," Jackie stated. She yawned.

"Someone must have done that," Kelly said. "I'm worried. Can we use the 'bots that are left as guards?"

"Go right ahead. I'm going to bed."

Kelly got Mark to show her how to get a low-resolution picture (of shadowed



darkness) through the bots' eyes, how to set an alarm on their motion detectors, and how to move them around. For the rest of the night Kelly kept an avid watch on the nocturnal wildlife.

She also watched the two sleeping figures on the floor. She couldn't decide what to think of them. Some great conflict seemed to be brewing inside her.

▼

The next morning before breakfast Jackie dragged them along to a small lake half a mile away.

"I found this place last night," she said, taking off her sweatshirt.

"But it's cold," Kelly said.

"So we get to prove we're Minnesotans."

"I didn't bring a swimming suit," Kelly continued. Mark and Jackie splashed in, both inarguably lacking swimming suits, and loudly proclaimed the water cold.

Kelly shrugged and bowed to fate. She had to admit, it was...invigorating.

When they got back, Jackie immersed herself in the global communications network while Mark drove off to gather up the disabled 'bots, which the overseer was now able to locate. Kelly disappeared on some project of her own.

"Username Ari in Australia," Jackie announced when Mark returned. "Means 'demon' in Icelandic, incidentally. Whoever did this came from there via Kamchatka, France, Argentina, and Estonia. Only thing is, the trail was obvious."

"Um," Mark said.

"I think it's a front doorbell. Here goes."

Several minutes passed before the other end was picked up. A line of text spilled along the bottom of the screen.

"Old union handshake," Jackie said. "Let's see if I can remember how to do this." After several apparently meaningless exchanges the screen cleared to show a bearded man with soft brown eyes and a red face.

"Ah. Jackie Allan," he said. "I've heard of you. You went to the Institute of Wisconsin-Madison? Involved in the Chernobyl cleanup of '27, right? I'm Brent Alberts. Institute of Toronto." he looked at Mark. "Who's our third party?"

"That's Mark Eckert. I know him, he's okay," Jackie said.

There was a pause.

"You're not in Australia," Mark said impulsively. There was full sunlight behind the man's head.

"Not exactly," Brent laughed. "I'm in a safe jurisdiction. Not that Jackie couldn't find me if she really wanted to."

Jackie nodded at the compliment. Then she got down to business.

"I'm fixing a Canadian farm you set on self-destruct. Why?"

"Maybe you heard about Excon's plan to raise a good part of the remaining Indonesian rainforest so they can build golf courses and luxury apartments for several thousand of their executives." Brent didn't waste words either.

"I read in the news. I assumed somebody was going to stop them."

"Me and some other people decided to do it. Only they've gotten smart since the Greenland affair. Hired sharp people as collaborators. They have actual human beings with guns on the site. Several of us got physically arrested and imprisoned under some barbaric Indonesian law."

"*That* I didn't read in the news." Jackie looked disturbed.

"So we decided on war. Excon has operations in automated farming, automated mining, automated manufacturing, and automated transport, all of them more vulnerable than the Indonesian construction site. This was a test. Tomorrow, it all goes. I think Excon will back down, but it'll be hell in a handbasket."

"I don't like the waste," Mark said slowly. "It hurts me to see 'bots ruined."

"Neither do I. If we had something like an executive password, we could get at the bulldozers directly. Failing that, the feeling is that 'bots are more replaceable than untouched ecosystems and endangered species. Also, that making an example of Excon will make Consolidated and the others listen to us the next time they try to pull something like the Orinococ salinization scandal. Jackie?"

"Sorry. They gave me barely enough information to find the farm. We do have an executive, though..."

...who at that moment burst into the room. At a keystroke, a lengthy quote from 'Njal's Saga' covered up Brent's image.

"I saw some large shapes last night," Kelly said when she had ascertained that no one else was talking. "There aren't any footprints out there today, but I found some two-toed tracks, deer or something."

Jackie tried to think of a good way to put it to her and couldn't.

"Kelly, your company's doing something really idiotic in Indonesia. We need your password to stop it," she stated.

Mark almost groaned.

Kelly's eyes widened. She looked back and forth between their faces, trying to decipher the expressions. She flushed.

"I think it is very nice that the company is able to provide beautiful homes for its administrators. Just because...how dare you, you techie anarchist scum!" She turned and ran.

Jackie grimaced and turned Brent back on.

"I assume you heard that."

"What a diplomat you are," he said dryly. Mark grumbled something similar.

"You go talk to her, then," Jackie said. "I'll go tell Excon I fixed their overseer, please send twenty new 'bots."

▼

Kelly ran on past the lake and sat down, tears on her face, under a huge tree not far from one of the 'bots standing in the tall grass. The sky had cleared. The sun was out, and the air had the rich smell of evaporating rain. For several minutes she tried to figure out why she was crying, and what she would report to her superiors.

"What's the matter?" a calm baritone voice asked out of nowhere.

"Who's there?" Kelly looked around.

"Just me." The 'bot in the tall grass turned to face her. She froze in terror. It walked towards her casually, almost as if it were using body language to convey ease and confidence to her. Usually, robots walked purposely.

"You are upset. Why?" The same voice, imperturbably calm.

She tried to talk, swallowed, found her voice.

"Several of us got physically arrested and imprisoned under some barbaric Indonesian law."

"I'm...confused. How should I know about Indonesia, what to do? The techies, I mean the two people I came with, I can't trust them."

"Whom can you trust?"

She thought of her superiors. Suddenly she couldn't remember why she had ever trusted them. Trust was poised in her throat like a boulder on the edge.

"I...do trust them." she said, surprised at the words even as they came out of her mouth. "Jackie and Mark. If someone could just explain to me..."

"They asked for your password so that I would be able to stop the Indonesian project directly. Species diversity is essential to the earth's ecology and is a part of human survival. If I can't stop it directly, I will kill tens of thousands of 'bots the way I killed the 'bots here, to stop it. That would be a great waste."

Kelly bit her lip and studied the horizon. Then she leaned over and whispered the word at the formless head which was bent to receive it.

"Thank you," it said.

Kelly stood up slowly and took a few steps. She wondered if she should say goodbye.

Instead, she said, "Are you human? Or can they make intelligent robots now?"

"They can." The 'bot rose. "But they haven't. I am a human being named Brent Alberts, talking with you by means of a reprogrammed farm robot."

Kelly felt tricked, but she also felt like laughing.

"Why haven't they, then?"

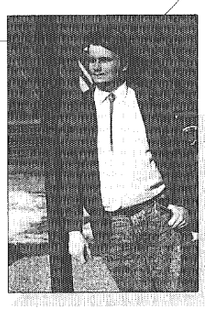
The 'bot paused for a second.

"An intelligent robot would be a citizen. What kind of life could we offer this person? Joints that wear out in five years? Poor eyesight, no sense of smell or touch, accidental death by power failure?" He shrugged. "With power comes responsibility. We must refrain from doing many things that we are capable of doing."

That made sense, Kelly thought.

"Bye," she said.

The 'bot waved in a way that she decided was very suave. ❐



Authors Bio: John Alexander and Michael Walsh

John and Michael co-wrote the winning entry of our science fiction contest last summer. John is a double-major in Math and Secondary Education who wants to become a math teacher. Michael graduated from IT with a Physics degree and is now working on his Ph.D. in Cern, Switzerland. The two hope to go on to greater literary fame, but, according to John, are hampered by the fact that they can no longer spend long nights hashing out story ideas while getting wired on caffeine and silly from sleep depravation.

2nd. Place

White Heart

by Tola Marts

drifting, tail up, near the Dragon's Head
100 ks north of my pack
Rii'ak'nahl sang to me of hunting excellent
at the edge
    of the shield
        this time of cycle

melting White
    fed the Smallfish
        fed the Tastyfish
            that feed me
                and by extension, my pack

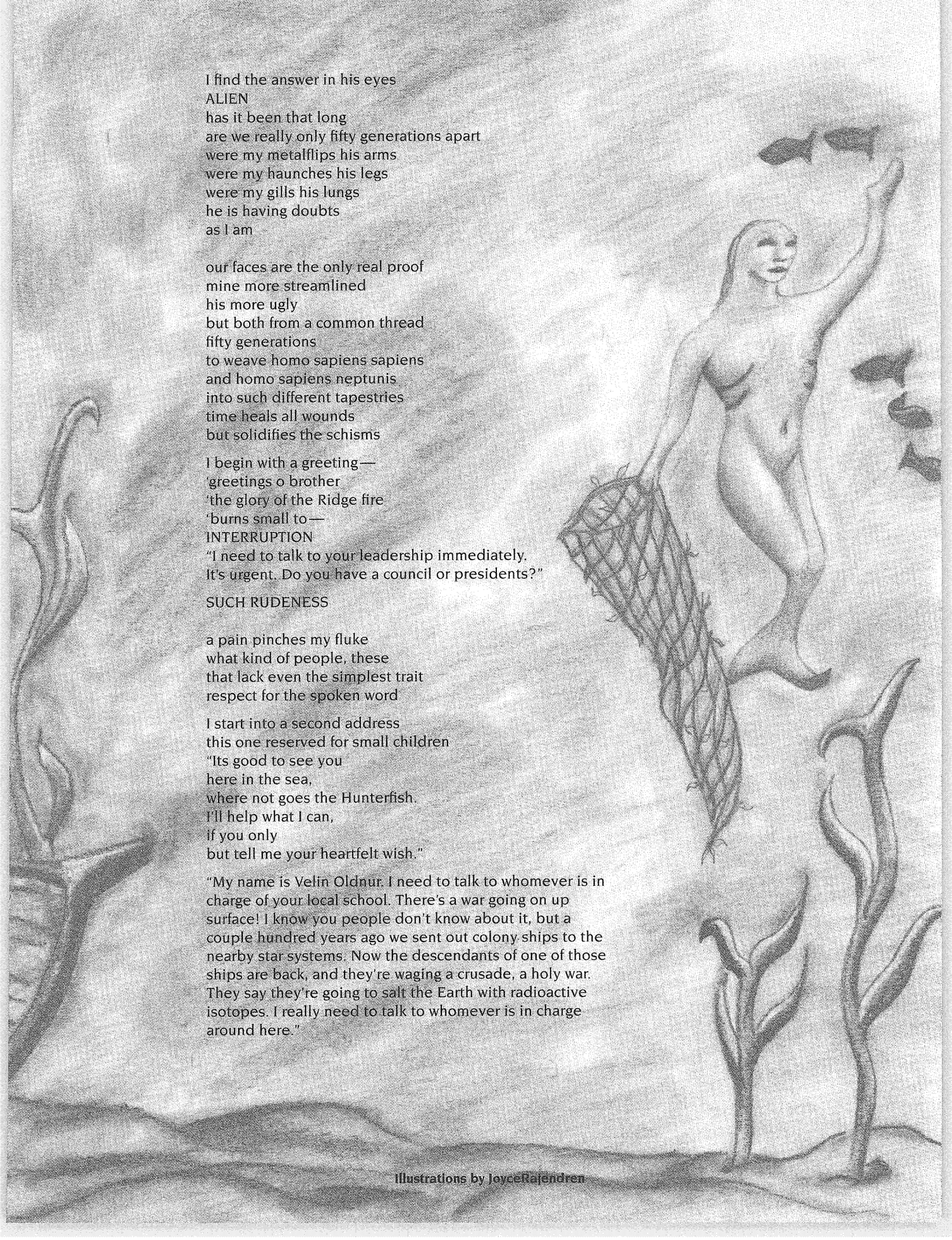
yesterday I soothed hunger
in a style denied me
across the long cold turn of the last cycle
today I will hunt well
bringing home in Seagrass nets
the bounty my pack hopes for

I am skimming under the White canyons
between the sea bottom and the melting White ships
a pattern of white with blue cream streaks
my form is as one with the underwater scenery
hoping also for the occasional Seal
partaking of a breathing hole
oblivious to my stealth

a sound—
to the east, along the White line
not one of my kind but another
older, my ancient cousin

I move east and hear the area
discovering he comes in a made thing of some kind
that is small and frail and weak
—like him—
all brown and small and hairy
needing made things to protect him
from that which nurture us all
thousands of thousands of years ago

I wonder
does he consider us made things
like his vessel
creaking and groaning under the very weight
that I find uplifting



I find the answer in his eyes
ALIEN
has it been that long
are we really only fifty generations apart
were my metalflips his arms
were my haunches his legs
were my gills his lungs
he is having doubts
as I am

our faces are the only real proof
mine more streamlined
his more ugly
but both from a common thread
fifty generations
to weave homo sapiens sapiens
and homo sapiens neptunis
into such different tapestries
time heals all wounds
but solidifies the schisms

I begin with a greeting—
'greetings o brother
'the glory of the Ridge fire
'burns small to—
INTERRUPTION
"I need to talk to your leadership immediately.
It's urgent. Do you have a council or presidents?"

SUCH RUDENESS

a pain pinches my fluke
what kind of people, these
that lack even the simplest trait
respect for the spoken word

I start into a second address
this one reserved for small children
"Its good to see you
here in the sea,
where not goes the Hunterfish.
I'll help what I can,
if you only
but tell me your heartfelt wish."

"My name is Velin Oldnur. I need to talk to whomever is in charge of your local school. There's a war going on up surface! I know you people don't know about it, but a couple hundred years ago we sent out colony ships to the nearby star systems. Now the descendants of one of those ships are back, and they're waging a crusade, a holy war. They say they're going to salt the Earth with radioactive isotopes. I really need to talk to whomever is in charge around here."

Illustrations by JoyceRajendren

THE SHOCK
'school' is no word for a group of Neh'hid
'school' is no word for a group of Neh'hid
I spend the next dozen centsecs
singing for this penguin
the song of the pack
it tells how We are all
one among equals
it tells how We are all
equipped with a voice

through it all I look at his features
He looks as if across a thousand ks
the look of an outsider
He cannot appreciate my song
nor my appearance
nor my voice
nor what I am saying
nor ANYTHING
He has some idea, some point
that He carries
like the burning embers of our common ancestors
blinding Him
to the journey

when I am done, He says
"So let me get this straight, it's a form of democratic commune you
function under? Well can you take me to the others of your school,
because it's desperately important that I—"
HAS HE NOT EVEN BEEN LISTENING?
I SWIM AWAY

He does his best to catch up with me
then gives up, limping away
to wherever he came from

I continue under the White
searching for the Tastyfish and the Seal
tomorrow I will be home
and I will sing to my pack
of white and blue
and White and Water
and mostly
of a crazed, rude airbreather
and of how glad I am that I was born and raised
below the sea

Author Bio: Tola Marts

Tola is an ME senior and plans to go on to Law school. A poet at heart, he dreams of making his science fiction poetry a fixture in great literature. We have it from a dubious source that he plans to take his prize money and hitchhike across the country in search of his inner self, great story ideas, and the perfect banana daiquiri. We wish him luck in his future endeavors, however ludicrous they may be.

3rd. Place

Trapped by the emptiness of deep space, all you have to contemplate is...

Silence

by Trisha Collopy

When she woke, the shuttle was silent. Liz turned her head to listen and bashed her nose against the ceiling of the habitation module. The shuttle's gravity generator must be on the blink again. Still she listened, without moving.

Something had awakened her. Something large and dangerous, crashing into the darkness of her sleeping mind. Her body was sweating and tense with the strain of listening. She pushed herself off from the ceiling, and glided down to the hatch. Above her, Saturn floated, large and gaseous outside the shuttle window. The habitation module glowed faintly orange from its light. But this was not out of place. It was the sight that had greeted her upon waking for the last week and a half. She strained her ears, listening for the alarm signals that would have sounded on the control panel below, but there was nothing.

Earth was a polluted wasteland, stacked stories high with inconsequential human beings. She had known since attending the Academy that she wanted to leave it.

Liz reached for the handle next to the hatch and swung herself easily through the darkness down into the control module. The control panel was dark. Her breath rasped loudly in the silence, as she reached over to hit the emergency power supply. For a brief moment the control room lit up with a crackle of electricity, then it died again.

Liz breathed slowly. The shuttle had been disabled somehow, while she was sleeping. She manually opened the cover to the instrument module and climbed over to the other window, which overlooked the back of the shuttle. A burst of intense light from the distant sun momentarily blinded her, and then she saw the solar panels had been cleanly snapped off.

Something large and soundless had done the damage. The nudge that pushed her out of the darkness of sleep. Most likely an asteroid, though knowing the reason was not much help. It didn't explain the malfunction of the emergency power source, but explanations were useless. She was stranded in space, several weeks from the nearest base. Her oxygen would last four days, at most. "DAMN!" she screamed into the silence of the shuttle. She knew now what was wrong—the complete absence of sound in the shuttle. The steady hum of the solar generators, the periodic beeps of the control panel, the soft whisper of the ventilation system, the quiet dripping of the water recycler, all were gone.

Illustrations by Ket Khambounmy

Now there was only her jagged breathing and the wild pounding of her heart to fill her ears.

The emergency power supply didn't function. She knew the craft was flimsy at best. She had loaded only the most essential instruments. The entertainment systems designed to make weeks of interplanetary travel survivable were a luxury, as were reserve power and oxygen once she had passed the last complete base on Ceres. No one would have the ability or resources to rescue another crazy interplanetary explorer.

A burst of intense light from the distant sun momentarily blinded her, and then she saw the solar panels had been cleanly snapped off.

"Quark it," she muttered and pushed herself back into the control module to sulk. Her situation did have elements of the ludicrous, she had to admit. Liz Marek, the arrogant biocosmology expert lost in space, headed for a dead moon of Saturn on a wild goose chase in a shitbox space shuttle. She could have blamed Cliantha, but it was pointless. No one had forced her to make this journey. It had been entirely her own choice.

The communications station on Callisto would register her silence, she supposed dully. She could imagine the insolent operator shaking his head. "Oh, another one of those idiotic explorers. Headed out to explore the unknown in substandard equipment, I mean, what do you expect? But there's no point in trying to stop them. They won't listen. Just littering the solar system with their failed junk heaps." They would relay her absence back to Ceres, but searching for a disabled craft floating somewhere between Jupiter and Saturn was like searching for a sign of intelligent life in the universe, at best.

She had known all of this before she even left Earth. All of her friends and relatives had attempted to talk her out of the trip, her father yelling at her for hours on the telecommunicator, clogging her databanks with accounts of failed expeditions. By that time, however, she had convinced herself there were no other options.

Marvelous to be considering her options, now that she didn't have any.

There was nothing on Earth that she missed anyway. Her professional career revolved around an esoteric branch of biocosmological science. Her friends didn't really understand her, and her family members could take care of themselves. Earth was a polluted wasteland, stacked stories high with inconsequential human beings. She had known since attending the Academy that she wanted to leave it.

While her fellow students spent hours being entertained or shopping by telecommunicator or trying to reconstruct their bodies at the Academy, she had spent three years indoors, programming or accessing databases that interested her. Her teachers were stunned by her work, her parents were proud, and her classmates said she was stuck-up. None of it made the ache of being different go away. Sometimes she suspected that she was a different species, some other form of intelligence (some form of intelligence at all), but logically that was not possible, intelligent life had still not been discovered in the universe, although humans had spent several centuries searching. (The response from the universe was a consistent silence).

Her grandmother, Cliantha Marek, was one of those scientists. She established the first Biocosmology Institute on Earth in the 20's, after participating in the monumental Solar System Exploratory Expedition (SEE). From time to time, Liz sent programs to her famous grandmother for feedback. They always came back completely reworked. "Your programming style is extremely amateurish. Why don't you follow the patterns your professors give you? You can't expect to speak a language if you don't learn the grammar, my dear."

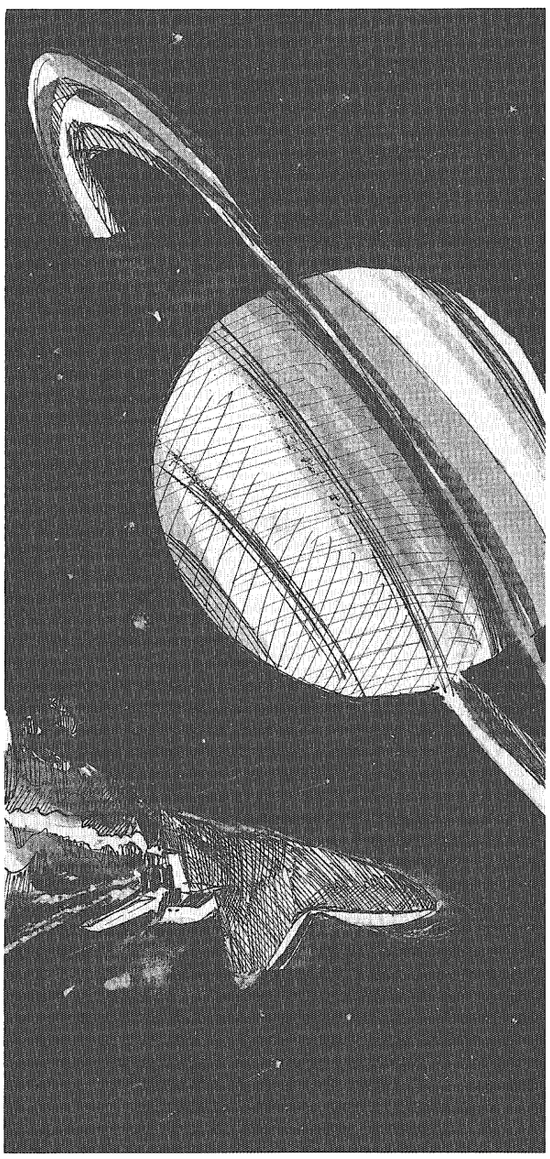
After she completed her studies at the Academy, attending a university seemed like the next logical step. Her programming skills certainly shouldn't go to waste. At the university, her studies were more challenging, and she found a few friends who spoke her language (computerese). But she also began to experience an overwhelming restlessness. Everything indoors seemed to oppress her, the walls, the air from ventilation systems, the perfectly modulated light, even the indoor botanical or zoological gardens were no relief. She felt like a trapped whale, swimming around and around in a transparent tank. Running into the same trapped companions day after day. Scooping up fish dropped by humans to feed her.

Sometimes she would become so annoyed with the predictability of everything, the metropolises, the University, the conversations she had with people, that she would withdraw into her room for days at a time. Her friends were accustomed to these withdrawals and didn't bother her.

She spent most of her time reading century-old data files—stories of Earth before the 21st century. She read of a time when Europeans thought the world was flat and they would fall off the edge if they sailed far enough. Stories of a time when the

Americas, or Africa, or Asia were covered with vast, unexplored forests. Of humans exploring polar caps (with dogs!) or rain forests or discovering primitive cultures on lost islands in the Pacific. She had learned about the rehabilitation of the deserts in school of course, and the early colonies on the Moon and Mars, and SEE, the complete mapping of the solar system.

Liz rarely mentioned these database searches to her friends. It was an obscure topic, at best. They would agree that the Earth was overinhabited, and polluted. So they made plans to move to the Moon and start families in a cleaner, safer environment. The more altruistic among them wanted to improve the productivity of desert agriculture, or move to the deepest marine colonies to have wild marine fauna outside their habitation unit windows.



Liz visited Taun at Marine Colony 35, off the coast of Australia. He showed her around. "Isn't the reef incredible? Two hundred years ago this area was completely killed by pollution. We've been able to reconstruct a complete ecosystem."

"Where did you get the organisms?"

"Some of them we culled from colonies in the Pacific, others were lab synthesized."

"A synthesized coral reef. Beautiful."

"Sometimes I think there's nothing we can't do," Taun said enthusiastically, missing her sarcasm. He outlined the ecological foundations of the reef.

Liz watched as brilliant fish darted and brushed off the clear walls of the habitation module. "I wish I had seen the real reef."

"Well, we did the best we could."

"I know. It's just that I wish there were some place in this solar system not reconstructed by humans."

"So go colonize Venus," he said nastily.

It was not a successful visit.

The moon colonies were even more artificial. Liz didn't bother to insult her hosts. She returned to Earth, carelessly accepted a job at the Biocosmology Institute and moved to the metropolis of California. She found an apartment within walking distance of the Institute.

"Is there any way to open the windows?" she asked.

The manager glared at her. "We just remodelled last year. Our ventilation system is top of the line."

"Might you have missed any units?"

"Yeah, I might have something down on third." The manager waited, fiddling with his communication unit. But Liz couldn't bring herself to live further down. Even on twelfth she could feel vibrations from students living in the shabby lower units. When she finally descended to the first floor and stepped outside, the noise overwhelmed her. Bouncing around in the soundbox between habitation towers, it was amplified into a raucous cacophony.

Something like the crackle of electromagnetic radiation on her instruments, Liz thought now, running her hand over the useless controls of the shuttle. The solar system was amazingly loud if you had the right ears.

Even in the shadows of the habitation towers, the heat that summer was unbearable. The sun baked the dusty streets as it burned down through the golden haze of dirt that filled the air. The air was thick with heat and dust. The occasional winds that roused eddies of sand, or stirred the sluggish currents of trash that flowed along the streets, scorched her skin. Liz gasped and sweated her way to work, and occasionally spotted a vintage piece of trash or a scavenging bird. She rarely saw another person outside.

Evenings, especially in the winter when she could watch the sunset, she gave in and took the monorail home. She always felt lazy when she did this, as if the sunset that bloomed on the horizon through a thick layer of atmospheric dust was a luxury. She had it to herself since most commuters were busy watching the public telecom or punching last minute transactions into their communicators. Around her was the comforting hum of muted voices, as she watched the sun sink between the habitation towers into a fierce pool of red light.

Liz gasped and sweated her way to work, and occasionally spotted a vintage piece of trash or a scavenging bird. She rarely saw another person outside.

Cliantha had left the Institute by the time Liz started working there. She was passing a crabby and unproductive senescence in a retirement colony. Even Liz called her infrequently, unable to stand more than a half hour of Clia's acerbic tongue.

"What's this I hear about you walking outdoors to the Institute."

"I like the fresh air."

"Like hell you do. You think I'm going to leave you money for a lung transplant? Well think again. All my money's going to the Institute."

"I don't want your money, Clia. My salary at the Institute is adequate."

"I don't know what they pay you for. Those last programs you sent me were trash. Pure trash. I'd rewrite them, but they won't let me have anything to work with here. I could be writing books, finishing my life's work, but they won't even let me access my own files." Tears were streaming down her pale face. "They won't even permit me to transfer them to you, Elizabeth. By the time I die the software will be a century old."

"I'll talk to you next week, Grandma, OK?"

"I'll probably be dead by then!" Clia shrieked.

In the darkness of the shuttle, Liz now missed Clia's voice. She had managed to reconstruct the tapes after Clia died. It was the only extra data she had brought on the trip, aside from a handful of books. She had convinced herself that the tapes, old logs of Clia's Solar System Expedition, were necessary for her own voyage, but she knew it was Clia's presence that she really wanted. The composed voice of a brilliant scientist at the height of her career, on the most renowned interplanetary voyage ever attempted by humans, the mapping of the solar system.

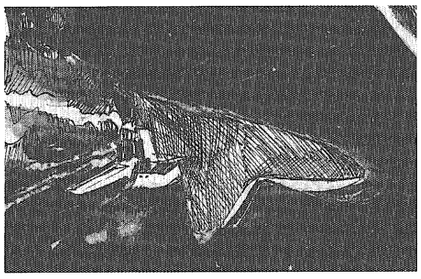
The logs had also inspired her own voyage. Work at the Biocosmology Institute was futile. After five decades of investigation, using the most advanced techniques available on Earth, no one had been able to prove the existence of extraterrestrial life. The researchers split into several battling factions, each demanding the maximum funding for their particular research. She spent more energy trying to justify her esoteric research than doing it. Clia's private files dropped from Central Records into this vacuum of activity.

The Expedition logs were already public domain by this time, of course. Reruns of the SEE Transmissions were still shown regularly on the telecom. Clia's analyses of organic compounds on Jupiter and Titan had inspired the founding of the Institute. Within this research were holes, silences. Pe-

riods of months spent following wild unscientific speculations, later abandoned.

Buried in a mass of notes and journals, Liz found fragments of what was missing. One was an untransmitted log entry from the Solar System Expedition. It began without introduction.

"2623.09.15.08:30:12. Left the ship in an escape shuttle 09.14.04:13:00. Flew to Phoebe (Saturn 16). Time coordinates approximate. Now on return course. Have just come out of a computer blackout and one of the most extraordinary encounters in my life. As we approached Phoebe a fortnight ago, the ship computer detected traces of gamma radiation in the vicinity of Phoebe. A flyby with the shuttle detected nothing, and the ground sample remains to be evaluated. Too minuscule to detect anything worthwhile anyway. I began analyzing the gamma emissions, comparing them to central databases, as well as certain mathematical constants, and seemed to detect a pattern. Periodic bursts from this sector. The emissions were so faint that they were easily encompassed in the error margin of the instruments, as Svensen, the team manager, pointed out. As we were preparing to leave the system, the computer registered another faint fluctuation. I felt that we were overlooking something significant. Svensen wouldn't authorize another flyby, so I appropriated an escape shuttle. He has always had a limited mind."



Intelligent life had still not been discovered in the universe, although humans had spent several centuries searching. (The response from the universe was a consistent silence).

"As I approached the moon, sensors registered a sudden burst of radiation that sent the shuttle reeling into orbit. I scanned the surface, attempting to identify the source. Another large fluctuation of the gamma meter and my control panel was incapacitated. The shuttle drifted around the moon. As the orbit slid around to the dark side of the planet, I saw the radiation source. A spot of intense white light glowed on the horizon, and above it, fantastic streaks of light shifted in the sky. Radiation, emanating from the bright spot, was bouncing off the planet's puzzling ionosphere, filling the sky with ghostly blue and green specters. I was thrown back to a moment of my adolescence, sixty years previously. My father and I had travelled to the Arctic Circle, to see the last terrestrial wildlife area, before it was sold to an interplanetary corporation. Night after night the sky burst into a ghostly display too bright to sleep by."

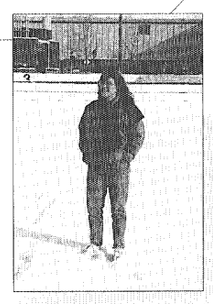
"Later, people said that the sun was in a very active cycle that year. I always remembered it as some sort of retribution of the heavens. The last wrathful howl of a planet sterilized by human inhabitants."

"I watched the electromagnetic display for over an hour. At the aphelion to the source, I observed a circle of white light, 5 km in diameter. The control panel lit up wildly as I orbited back around to the light side of the moon. Sensors had recorded nothing. Oxygen levels too low for another orbit, and possibly too low to reach the ship."

Cliantha had been rescued, of course. Svensen apparently respected her enough to maintain a judicious silence about the trip, or perhaps Cliantha had not bothered to justify herself. Her work, when she returned to Earth, was rational and brilliant. In later years, however, it became more and more erratic. She tried to push the Institute's research into new areas, like silicon biology and abstract radiology. Eventually her colleagues fired her as director of the Institute on the grounds of mental illness. She was permanently confined to a retirement colony for the last eight years of her life.

When Liz finished reading the records, she did not leave her apartment for two days. She could remember that time now. How the communicator rang and rang, and she ignored it. The floor vibrated from the students below, but she barely felt it. Her parakeet fought outrageous squawking battles with his mirrors, while she watched blankly. Inside of her was a profound ache. The unfinished work of her grandmother was something she could not even blindly approach.

After a while, Liz pulled herself back up to the habitation module. She could lie there, suspended in a zero-g stasis, as the shuttle drifted towards the silent planet that encompassed her view. ❐



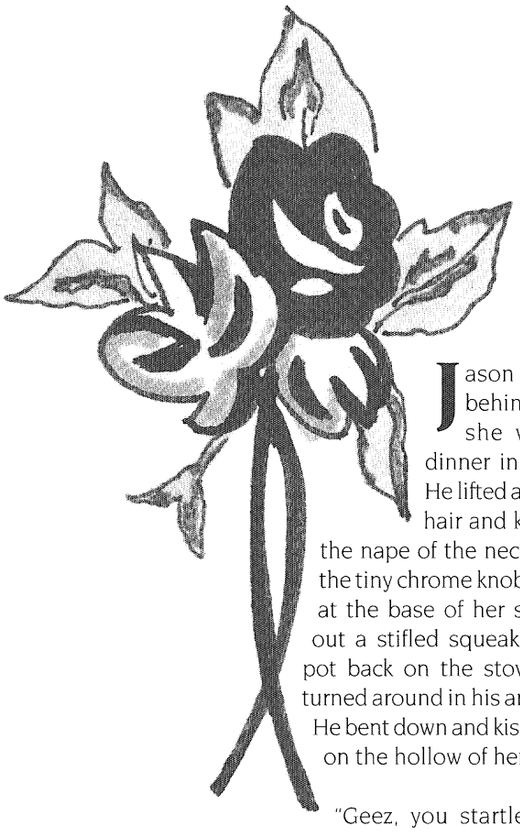
Author Bio: Trisha Collopy

Trisha is a Chinese major and says that her story was inspired by society's "silencing" of literature by women and minority writers. She also harbors a secret love for reruns of "Dr. Who" and cheesy science fiction movies. Her favorites feature large, rubbery monsters reigning death and destruction on crowded, metropolitan areas.

Editor's Choice

Analog Anniversary

by Pegg Kerr



Jason sneaked up behind Selena as she was making dinner in the kitchen. He lifted a strand of her hair and kissed her on the nape of the neck, just below the tiny chrome knob that nestled at the base of her skull. She let out a stifled squeak, dropping a pot back on the stove, and then turned around in his arms, giggling. He bent down and kissed her again on the hollow of her throat.

"Geez, you startled me!" she said, throwing her arms around him, her earrings bouncing wildly. She gave him a big kiss.

"Mmm." He smiled. "What was that for?"

"That was for keeping my life interesting, you big lug. I never know when I'm going to be ambushed. Whoops." She stepped to one side to grab another pot that was boiling over. Removing the lid, she tapped a command into the range console to lower the temperature and then activated the Auto-Stir. Jason kept his arms around her, limiting her mobility a bit.

"Now you're going to have to let me go," she said, laughing. "How do you expect me to get this feast on the table otherwise?"

"Look, I'm sure it's delicious..."

"You better believe it, buster." She reached for the Garn-O-Matic and began shoving radishes into the top. As the machine hummed, perfect radish roses rolled out of the bottom slot.

"But wouldn't we really rather go to a restaurant for our anniversary? We could shove all this stuff in the refrigerator and eat it later as exotic midnight snacks. It only takes fifteen minutes to drive to Rupert's, and then we could go dancing afterwards."

"Too late." She waved a spoon, causing a dollop of cheese sauce to fly off and land on the floor. The At-Your-Service robotic butler quickly scuttled under their feet to mop it up off the tile. "Besides, I'm too selfish to share you with a crowd tonight. I want you all alone when I work my nefarious charms."

"Promises, promises." He let her go with another kiss on the ear and headed towards the hall, sidestepping the butler. "I'm going to check the mail."

After he had tossed the circulars advertising hardware and ski sales into the Exacto-Trash-Pactor, the only thing left was a letter from the bank. He opened it and had to read it twice before the contents registered.

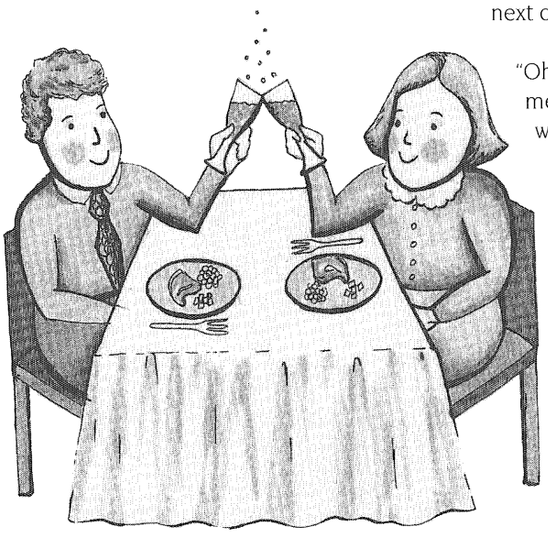
"Selena?" he said, stepping back into the kitchen. "What's this about the mortgage check bouncing?"

She looked up from the roast which she had just opened the oven to check. "Why, I don't know." The oven door banged shut, and she came over to his side, plucking the letter from his hand. He read it for a third time over her shoulder.

"I just can't understand it," Selena muttered. She went to her purse, hanging on the back of one of the chairs at the kitchen table, and pulled out her hand comp.

"What does the check register say?"

Selena punched in some access commands and studied the tiny screen with a puzzled expression. "Let's see... I mailed that check on Thursday. I've written two checks since then and..." Her expression suddenly froze. She scrolled through the register rapidly.



"What is it?"

"It's not here." Selena pulled out one of the chairs at the table and sat down weakly. "I forgot. I bought a new Rice-Noodle-Extruder at Calumet's and... and didn't enter the check."

"How much did it cost?"

"Uh... three hundred dollars."

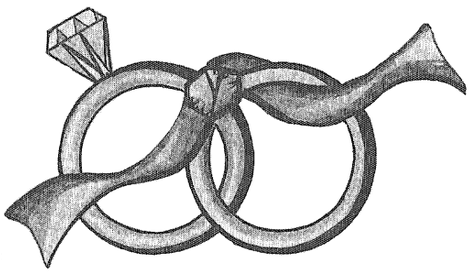
"What?"

She stood up, pulling the chrome knob at the back of her neck away from the magnet inset just underneath her skin.

"But it was on sale!" she cried. "I just had to have it! I had the money for it, from the bonus we were going to get at work the next day. I was going to enter it in the check register when I deposited the bonus, but they didn't give us the bonus the next day like they promised..."

"Oh wonderful, Selena! You never ever mentioned this! I can't believe you would do anything this stu..."

"Wait a min-ute." She stood up, pulling the chrome knob at the back of her neck away from the magnet inset just underneath her skin. A tiny dimple of metal showed in the space where the knob had been. She turned off the stove. "Give me your analog node, too. If we're going to argue, let's do this right."



Slowly he reached around his neck, just above his collar, and removed his own knob. Silently they both went into the den where they kept the analog generator, right next to the stack of old *Time* magazines. Selena turned the machine on, plugged the nodes into their respective slots, and stepped back.

The two holo lenses on the front of the squat box began glowing. With a sudden flash that made the dust motes in the air sparkle, a life-size holo-projected analog of Jason appeared, followed a split second later by an analog of Selena. Both were naked. The analogs rotated to face each other, hovering about an inch over the brown carpet.

Selena tapped a command into the control keyboard on the box. "Um, let's start it from three sentences back. I'll set it for two hours." She looked at the floating figures.

Jason's voice sounded from the speaker on the side of the box.

"Oh wonderful, Selena." Jason's analog waved a hand, exactly as Jason himself had waved it a moment before. "You never even mentioned this! I can't believe you would do anything that stupid!"

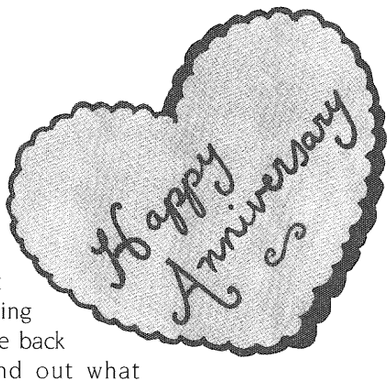
"Stupid!" Selena's analog tossed her hair back. "You should talk! Anybody can make a mistake!"

"Anyone with three hundred dollars to throw around, you mean. We don't."

"Oh, so now I'm a spendthrift! What do you care, as long as I'm buying it with my own money?"

Jason's analog ran his fingers through his hair. "If you had a windfall like that, we should have decided together what to spend it on."

Illustrations by Kristine Jagers



"Oh, yeah? And what about the thousand bucks you blew on a car security system, for God's sake? Did you ask me first about that?"

As Jason's analog considered several possible stinging replies, Selena reached over and turned the volume down slightly. "It sounds like they're going to be at it for a while," she said. "Let's go ahead and eat dinner, darling."

❤

The roast was delicious. They toasted six years of marriage with champagne, and Jason raved over the chocolate mousse that Selena served for dessert.

He bent down to kiss her again, and sparks flew. "Happy anniversary, darling."

"Do you want more coffee, sweetheart?" Selena asked after the robotic butler had cleared away the plates.

As he paused to think it over, they both heard Jason's analog shouting, "Bitch! Leave my mother out of this!" and Selena's screaming, "Who are you calling a bitch, you asshole!"

"Yeah, I think I will," he answered finally. "And some cream, if we have it."

"For a special night like tonight, of course we have cream." Selena smiled, kissed him gently. Then she went to the kitchen to pour the coffee.

❤

They snuggled on the living room floor in front of a fire for half an hour, sipping their coffee. "I didn't realize when we bought this house how much we were going to appreciate the fireplace," Selena said.

"Yeah, but there are still a bunch of things we can do to fix up this living room. What do you think of putting in a skylight?"

"Well, I don't know about that. I have been thinking about redecorating, too, though. I think we need a whole new color scheme."

"Like what?"

"Oh..." Selena cocked her head. "New couch, of course. I picture something like repainting the walls a sort of salmon color and putting in a new carpet. Mauve, maybe."

"Mauve?" Jason sat up and looked at her in horror. "Mauve?!"

❤

"Aren't they going to come back and find out what we've decided?" said Selena's analog as Jason's bent to nuzzle her ear.

The two analogs floated horizontally, limbs entwined, about an inch above the carpet. Jason's analog raised his head and listened.

From the living room came the sound of raised voices. "Oh, yeah? That's just the kind of asinine remark I should have expected from a tasteless fathead like you!"

"Tasteless! You wouldn't know style if it came up and kicked you in the ass, you stupid jerk!"

Jason's analog smiled down at Selena's. "It sounds like they're going to be at it for a while. Let's ignore them." He bent down to kiss her again, and sparks flew. "Happy anniversary, darling."

"Mmm," she giggled, "Happy anniversary." ❐

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Writer Profile: Peg Kerr

Peg is a graduate student in the English department and is a bonafide published science fiction writer. She began her career five years ago in a class called "Writing Science-Fiction and Fantasy for Publication" here at the U. Her first story from the class sold for $500 and she met her husband there. As you might imagine, she gave the class high marks. "Analog Anniversary" was written as an anniversary present for her husband.

Editor's Choice

An Hour and a Half From Now

by Dennis VanDenBerg

Enter the vast video wasteland of the future where Jimmy Brogan is about to experience GAME OVER *for the last time.*

Jim Brogan jumped off the lowest step of the bus and started crunching through the snow towards home. Ordinarily, the sky to the west was a deep orange by the time he got home, but today they had all been sent home early, and an unusually warm sun glinted off the slush puddles in the street. He walked up to the second level of the building and over to his family's door. Like most of the small buildings on the densely packed street, this one was a fourplex.

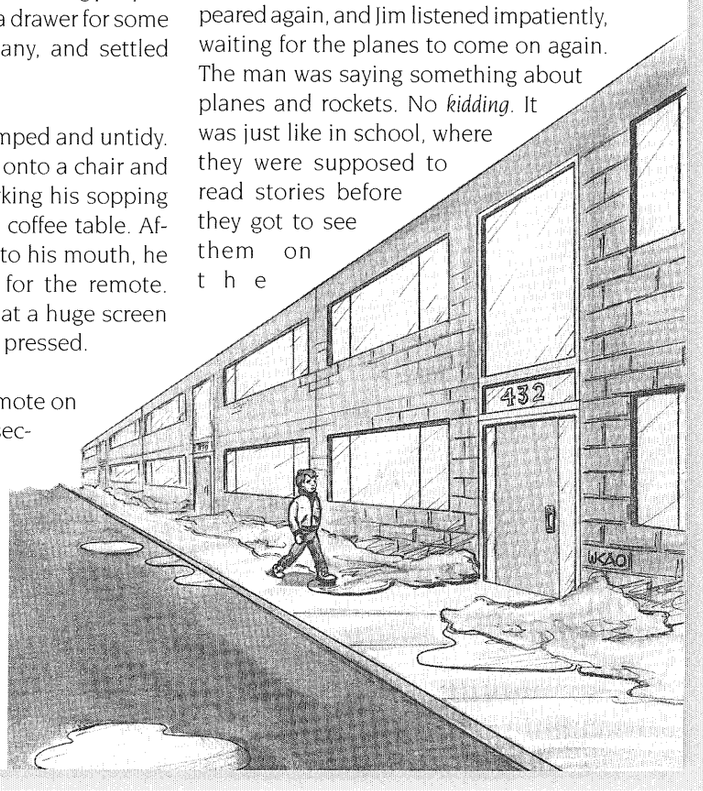
He walked in the unlocked door. His father was always home sleeping during the late afternoon, until he had to get up and go to work. His mother wouldn't be home from work until late. Funny they didn't let the grownups off early, too, he thought. He supposed that what their school learning supervisor had called the "inc'dent" wasn't important for big people. In the kitchen, he dug in a drawer for some Twinkies, couldn't find any, and settled for a Ho-Ho.

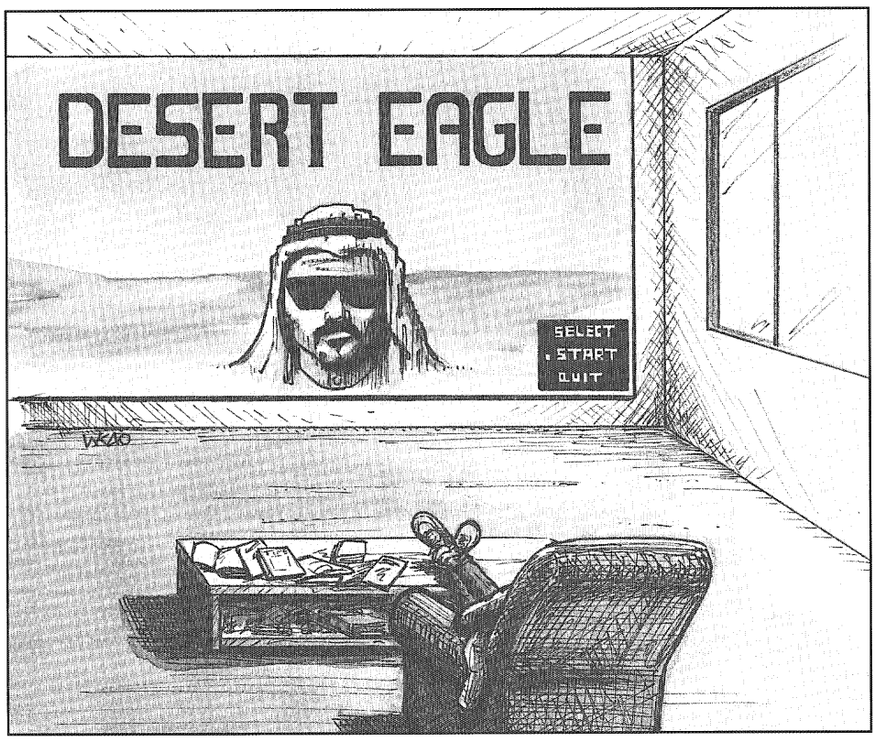
The living room was cramped and untidy. Jim tossed his ski jacket onto a chair and flopped on top of it, parking his sopping basketball shoes on the coffee table. After getting the Ho-Ho into his mouth, he fished under the chair for the remote. Finding it, he pointed it at a huge screen hanging on the wall and pressed.

"Oh, god." Jim set the remote on scan, watched for a few seconds, and groaned again. No cartoons. No horror movies. Just a whole bunch of news on every channel except for a few, and he wasn't gonna watch the cooking channel or those dopey old low-resolution *Wonder Years* reruns. And the *Hustler* channel was scrambled.

He sat watching some suit-man talk about some strange place, a map of it behind his head, until the Ho-Ho was gone. Then, bored, he got up and began sorting through the dusty collection of wires and black boxes clustered under the coffee table. He found the one marked BALLY-MIDWAY and was about to press the "on" switch when a loud, stereo explosion jerked his eyes back to the TV screen. The scene had shifted and now sleek, angular aircraft darted up from airfields and soared across the wall. Rockets burst upwards on expanding cones of light. A lit-up city appeared, with more lights flashing in the clouds above it.

This was more like it! Then the man appeared again, and Jim listened impatiently, waiting for the planes to come on again. The man was saying something about planes and rockets. No *kidding*. It was just like in school, where they were supposed to read stories before they got to see them on the





video. Why didn't the suit-man just show the story, instead of telling it?

Bored, but not wanting to miss anything good, Jim plopped back with the BALLY-MIDWAY box on his lap and fiddled with the remote. A small window appeared in the bottom half of the TV picture. He turned on the box, and the window became a computer's menu screen. Jim had just positioned the pointer at SELECT GAME when a huge ship filled the wall and started shooting rockets. He stopped to watch. A disembodied voice off to the right somewhere said something about "commencement of hostilities in the area", and said the ship had blown up some other ship. Jim waited for them to show the other ship exploding, but they just showed the suit-man again, this time to introduce a wrinkled-looking army man.

The army man began to talk about the ship and its missiles. "...fifty-four total air defense units on board, and with it's escorts, I think it can do a pretty good job of protecting itself. I don't think..." His momentary distraction over, Jim picked *Desert Eagle* from the SELECT GAME menu.

The words DESERT EAGLE and a pixilated image appeared of a mustached Arab with crosshairs centered on his nose. After adjusting the volume, he clicked the cursor in the START box.

The starting music tinkled over the now barely-audible murmur of the news broadcast. A cartoonish profile of an old F-15 fighter plane appeared, sand dunes scrolling below. Jim tensed as he waited for the first of the enemy missiles to begin zig-zagging towards him.

They came, and Jim avoided them with some simple maneuvering. The first level was easy. Soon the tiny tanks and AA emplacements began appearing and things got more difficult. By the time he had blown up all of the missile launchers at the end of the first level, he had already lost two lives. He wanted to swear, but his dad might be awake and hear him. "Damn", he whispered under his breath.

At last, smart bombs! "Die, sucka!" he yelled as the tiny dots disengaged from his plane and chased their targets across the wall.

While the intermediate screen was displaying his point total, Jim selected WINDOW-MUTE on the remote's tiny LCD screen. The news broadcast rose automatically in volume as the video game was silenced. "There have been reports from the front that tactical nuclear warheads have been deployed by the enemy on a small area of the battlefield. Now, keep in mind that this is only a rumor. At this time, no one is sure of what is really happening. The Pentagon, by the way, is officially denying the reports. Again, to remind you: there have been no..."

Jim selected START and began the second level. Suddenly, the wall-scene shifted again, and Jim pressed PAUSE to watch it. More planes took off; the shot cut to a long aerial view of a hillside suddenly bursting into flame. The images came faster and Jim watched with mild interest. A blurry color shot of a building appeared, coming closer and closer until the screen blanked out. A map with big animated arrows moving in different directions. Soldiers in gas masks, struggling to pull a tarpaulin off a truck with a large rocket perched on top. "America's own forces are equipped with ...". Bored, Jim resumed his game.

More planes and explosions appeared, but Jim didn't stop to watch them again. He was too busy with his game. The tiny parody of a warplane dove and strafed tiny bunkers below, and they exploded into animated bits with cheerful-sounding explosions. Behind the window, talking heads traded places with bigger explosions. Jim dimly heard the muffled sound of the newscasters as he concentrated on the game play. Someone said something about "3rd generation smart bombs." They'd been saying it all day, for crying out loud. He liked smart bombs. He wished he had some, but you didn't get any until the fourth level in this game. He needed them now. He cursed again as his plane exploded and crashed into the bottom of the screen. He'd never get to the last level! He wished they'd shut up and put some cartoons on, so he'd have something to do if he quit. The game was becoming aggravating.

After a snack and a show about taking care of pet lizards, that he had found slightly interesting because nothing else was on but the news, Jim was ready to try

it again. This time, the videogame took up the whole screen and the news was tucked away in a small window in the lower right corner of the screen. Jim hoped the regular TV would come back on soon. It was almost time for his favorite show.

He lay intent upon the screen, eyes fixed, hand moving in small, precise movements as if performing some strange ritual, while the strangely realistic sounds of computerized battle mixed with the somehow less realistic sounds from the newscast. He caught a few words here and there, "...no reason for alarm..." That was easy for the suit-man to say. Jim pulled on the joystick and tilted it unnecessarily as he fought to keep his on screen self ahead of rapidly gaining Migs. "No reason for alarm", he mocked the suit-man aloud. "I'm only sittin' here gettin' wiped."

He played on and on, miraculously getting to the fourth level. At last, smart bombs! "Die, sucka!" he yelled (quietly), as the tiny dots disengaged from his plane and chased their targets across the wall. Suddenly, a flash of color appeared in the small window by the bottom of the screen, and he heard something about North Dakota. North Dakota? They had named lots of places today, but he actually knew where this one was. Sort of, anyways. His family had taken him to the city of Black Hillsville to see Mount Rushmore once, and that was in South Dakota. North Dakota must be close to there. He paused his game and fumbled with the remote, hurriedly selecting WINDOW-SWITCH . The displays traded places in an instant, and now the wall was filled with rockets rising above a barren, grassy plain. The picture was out of focus and shot from a long way off, and soon disappeared. The suit-man came back on. "That footage was sent to us by satellite a few minutes ago by an affiliate in North Dakota. It shows what appear to be ICBM's being launched. Now, I caution people to remember that this is not documented footage, and military sources are denying that any missiles have been launched. Meanwhile, back at the front ..." More news. Jim went back to his game, but played it on the small screen this time.

He had gotten near the end of the fourth level; incredible, for him, although his friend Justin could do it with ease. He paused the game again, partly to check on the news, but mostly to take a breather before attempting the last level. Another army guy was on. The suit-man was talking very sharply to him, Jim thought. He should show more respect to a soldier.

His elation, suddenly gone, was replaced by a sinking feeling in his stomach.

"So you're saying that we can expect at least ten percent penetration, if in fact war does break out? As a best-case scenario?"

"Well, it's hard to estimate the efficiency of our defenses, and we certainly can't be sure of the capabilities of the enemy...it's impossible to know just what will happen. Again, we really don't know what's happening now, and it will be impossible to know for some time."

The suit-man was angry for some reason. Probably because the army man didn't know the answer. Just like school! Well, excuse *him*, Jim thought.

"Can you tell us what the most likely targets would be for an attack?"

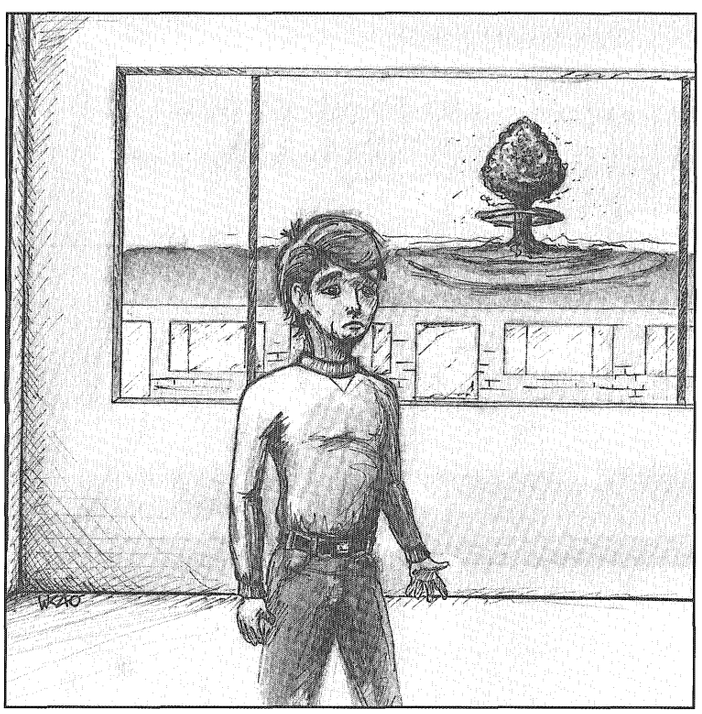
"Oh, that's not too hard to figure out. Los Angeles, of course. The whole Western seaboard. San Francisco. San Diego. All of that. And of course..."

San Diego? One of Jim's grandparents lived in San Diego.

Was San Diego going to be bombed?

Jim paid real attention to what was being said on screen for the first time, but they were talking about other cities he'd never heard of now. He wondered if he should wake up his dad. He turned, walked over towards the hallway, but stopped. He heard the newscaster again: "There is, I repeat, no cause for panic as of yet. There are a lot of unsubstantiated rumors coming in from all over, but none of them are verified. The best thing to do is remain calm." However, the man glanced off screen after he said that and didn't look calm at all. Still, Jim hesitated. His father would be mad if he woke him up for nothing. And the newsman said that nothing was probably really going on. Besides, if his dad came in he'd probably want to watch the news, which meant he would shut off his videogame, and Jim had gotten farther in *Desert Eagle* than he'd ever been. It *had* to be nothing. He couldn't imagine the alternative.

He settled back down and relegated the news to the window again, telling himself determinedly that it was nothing. To show how unconcerned he was, he made himself concentrate on the



game. It paid off. He advanced rapidly, destroying what were now buildings instead of vehicles on sand dunes, as he advanced towards the game's final objective. This was getting difficult. Planes swooped after his dodging F-15 constantly, and he couldn't fly for five seconds without one or two guided missiles coming up after him. One hit his plane, and he kicked the coffee table in frustration, but it didn't matter. He had two lives left, and the end was almost near. The next plane appeared, and Jim tried extra hard to make it through. He was so intent on making it through the gauntlet of electronic enemies that he failed to notice the window in the lower right hand corner of the screen had gone blank.

Finally, after breaking through a particularly ferocious fighter squadron, the main target appeared. Hussein's Bunker. Missiles flew up from it thick and fast, and Jim lost a life in the process, but after a few minutes, at last, he dropped one of his bombs in just the right spot. The entire screen resounded with flashes of light and one long, continuous explosion, while his plane flashed victoriously.

"Yeeeah! Alriiiight!" Jim cheered softly. He threw down his joystick, rose, and jumped around with his arms upraised in a victory dance, while the video screen celebrated his victory with flashing lights and the triumphant electronic music Jim thought he'd never get to hear. He had done it!

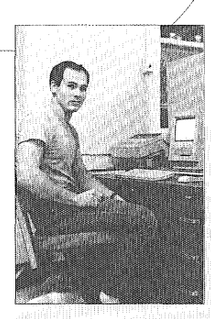
However, the music had a strange whine to it. At first, he thought it was mixed-in noise from the news show, but then he noticed the news wasn't on anymore. He turned off the small window. The sound persisted.

Maybe, Jim thought, the sound is on too loud, and that's making it do that. He lowered the volume. The sound grew *louder* as the videogame's music faded.

Jim stared dumbly at the flashing screen, his elation suddenly gone and replaced by a sinking feeling in his stomach.

He switched off the TV. The image popped and faded to grayness.

The civil defense sirens continued to scream. ❐



Writer Profile: Dennis VanDenBerg

Dennis graduated from the Journalism school here at the University of Minnesota last year. A year of pounding the barren pavement of the job market has given his work a cynical edge that the *Technolog* staff has really come to enjoy. Did we mention that he draws great cartoons?

"There won't be any tree crop this millenium! Like I told you, these stupid ape-things mutated and...oh, hell, just get me the exterminator already!"

Cartoon by Dennis VanDenBerg

IT Week Slogans That Didn't Quite Make IT

Every year, Plumb Bob sits around, drinks diet root beer, and comes up with a slogan that conveys the theme of IT Week. Through a morally-questionable bit of insider trading, the *Technolog* acquired a list of slogans that didn't have the right stuff.

IT Sucks

I Hate IT When That Happens

IT's Your Own Fault

Have IT Your Way

I Just Can't Stand IT

Shove IT

IT Doesn't Get Any Better Than This

IT's the Cows

IT's the Pits

IT Hurts So Good

IT's Not My Problem

[bleep] IT!!!

IT Week Antics

Forestry icon defiled by out-of-control Plumb Bob members.

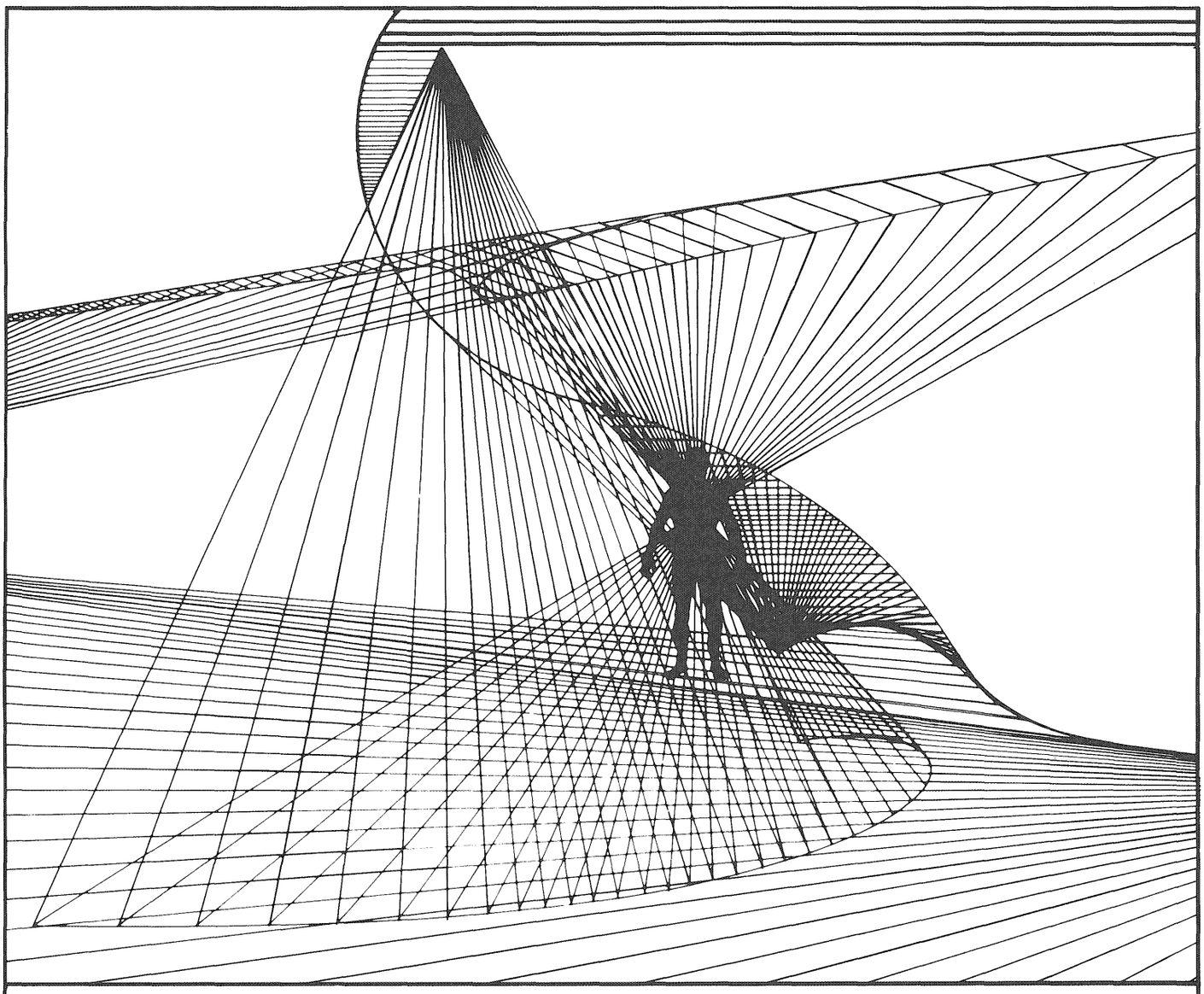
Students from Plumb Bob have apparently defiled the Forestry school's beloved statue of Paul Bunyan. As we hear it, these desperate students are holding the mighty man's noggin hostage in a last-ditch effort to recover the Blarney Stone.

The students say that they will return the head if and when students from the Forestry department return the Blarney Stone. The Blarney Stone disappeared some time back and Plumb Bob members are eager to recover it.

The Blarney Stone is a large and extremely heavy rock that was discovered missing several years ago. Plumb Bob members cherished the massive stone as a carrier of good fortune, among other things (hard-luck IT Olympic competitors used to kiss it for luck).

Unconfirmed rumors and dubious sources have it that Forestry students are rioting in the streets and burning Plumb Bob logos in effigy.

Unnamed Plumb Bob commandos proudly display the head of Paul Bunyan, taken from the Forestry Department's beloved statue.



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Type A appointments are available to University of Minnesota undergraduates to participate part-time in the internship program while they take courses. The standard Type A appointment will be 15 hours per week for one to three quarters. The stipend will be $175 per week. Appointments at the 12 or 20 hour level will also be available upon special request, with stipend levels of $145 and $225, respectively. Type A appointments will be available beginning Fall quarter, 1991.

Fall Quarter Application Deadline: May 10, 1991

All student interns will work closely under the direction of their project supervisors. In most cases, these supervisors will be University faculty members.

A document describing available projects and opportunities is available and is updated frequently. Contact Cathy Duvall to receive a copy of this document and an application form.

Direct applications to:

Cathy See Duvall, Executive Secretary
Undergraduate Internship Program in Scientific Computing and Graphics
Minnesota Supercomputer Institute

U.S. Mail: 1200 Washington Avenue South
Minneapolis, Minnesota 55415

Campus Mail: 2048 Supercomputer Center
University of Minnesota
Minneapolis campus

Phone: 624-8859

Or contact: Professor Tayfun Tezduyar, MSI Director of Interns at 624-0850

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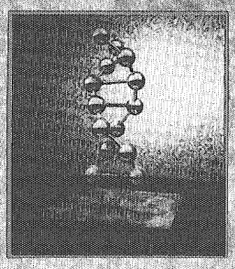
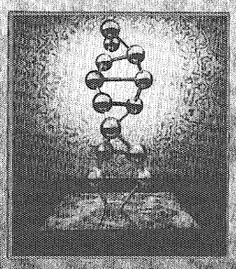
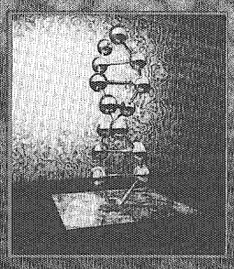
TECHNOLOG

Volume 1991







Virtual Reality:

Exploring the high technology of computer-generated worlds

Inside

- Babylon Revisited:
  Is the sky the limit?
- A closer look at HDTV

Also

- Ethics in engineering?
- The flip side of science
- Larry Hasnone cashes in on current bargins

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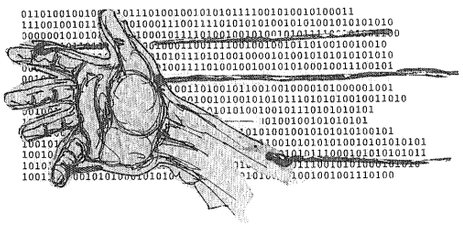
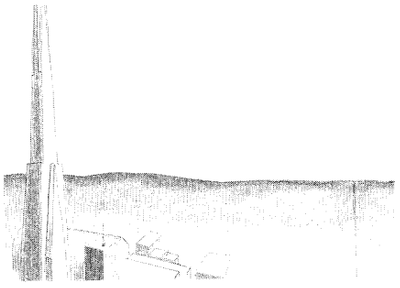


16 Virtual Reality

by Darrin P. Johnson

Computer models are old hat, right? How about a computer model of *reality*? Take an up–close look at the fascinating world of virtual reality.



20 Babel Revisited

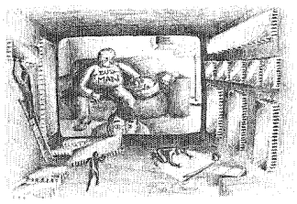
by Iyad Alsamsam

Going up? The sky's the limit as our writer takes you on a trip to the top of tall buildings of the future.

26 A Walk on the Wild Side

by Pat Kellogg and Lee Klancher

Step right up for a look at life on the flip side of science in a journey through the netherworld of alternative thought.



34 High Definition Television

by Chris Klassen

Couch potatoes, rejoice! The world of traditional television is about to get turned on its ear and chucked in the trash as the mind-blowing sound and resolution of High Definition TV comes to home viewers everywhere.

About the Cover...

The sculpture, ***The Garden of Life I,*** *is the first in a series of images being created in a "virtual museum" by Darrin Johnson. The image was created in Rayshade, compiled on a Silicon Graphics Iris 4D/240S, and displayed on a 4D/80 monitor at the Molecular Biology Computing Center here at the University. Photography and layout by Robert Schroeder.*

Departments

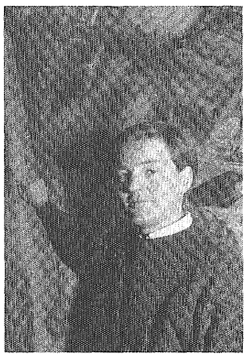
Editorial

Welcome to the Meat Grinder

Step right up for five years of agony, miles of red tape, $16,000 of debt, and (maybe) a degree.

The mighty steel wheels of this University grind out students like crudely crafted billets of pig iron. The progression from your first-year to graduation is long and painful, filled with endless hours of waiting in line and mountains of paperwork.

The student, buried in the bowels of the machine, feels insignificant and unimportant. There is no room for exception or individuality—the University way is the *only* way. How can the student, a mere cog, effect this mighty machine?



This "cog effect" creates student apathy. This lack of power or control turns students off. Granted, this doesn't apply to everyone, but it is safe to say that a large percentage of University students would rather have rabies than spend their spare time on campus.

The real tragedy is that students suffer the greatest loss. Studies have shown that students who aren't somehow connected with their school are more likely to drop out or fail. University studies show that students here drop out in large numbers and that very few students graduate in less than five years, if at all.

Administrators are aware of these studies, but claim that they can do nothing, citing everything from the student body's high average age, large percentage of commuters, and general lack of interest as reasons for the widespread apathy. They seem to think they are not at fault.

Administrators, counselors, and policy-makers can make a difference. They cannot blame student apathy on demographics, a high average age, or general disinterest.

Student apathy cannot be written off as a feature of any large university. Berkeley is one of the largest institutions in the country and students there are very involved. I recently took a walk around their campus and the experience was an eye-opener.

Campus elections were in progress and the place was a madhouse—candidates giving speeches, picketing, and stopping passing students. Apparently, a good percentage of Berkeley students actually vote for student governors. The only way I ever end up voting here at the University is when they give out free cookies—I never can tell who's even running!

University students are apathetic for a reason. As long as students are treated as stamped pieces of tin to be processed by the University's bureaucratic machine, they are going to feel insignificant and powerless.

Better advising and access to information are two ways that things could be improved. Students, like anyone else, need to be informed before they can act. Rather than students having to seek out an organization, the University should be beating down the students' doors to recruit them for organizations.

As students become more involved with the University, the University will become a more important part of their lives. Campus elections will be relevant if student government effected your life.

Students, a word of warning. Don't wait around for the administration to make something happen for you. Especially not at this school.

Take things into your own hands and become a part of this University.

I know—you have seven jobs and 22 credits and don't have time. Drop a class. Quit a job. Make some time and make the University yours.

The best part of the University is that you can find anything you want here. Join the fencing club. Get involved in MSA. Take part in IEEE. Learn how to play underwater hockey (no kidding). You can do or be whatever you want at the University. I guarantee it.

You will not only make valuable contacts and improve the quality of your life, but you will also increase your chances of graduating. Statistics show that students who are involved—in a sport, a club, just about anything—are more likely to succeed in college. Look at it as improving your odds.

If you don't have ties to the campus, the cold, steel machine of the University will grind you up and spit you out.

Being involved doesn't mean wearing black, being obnoxious, and spilling red paint on oil company reps. (Although, if that's what you're looking for, go for it.) Take up a sport or hobby. Do something just for fun—you might be surprised how much connection can change your image of the University.

Or maybe you prefer to go through life lonely and bored. You don't really want to meet new people. You like feeling like an outsider at your own school. Well, that's your business, not mine.

The University can be a good place to get an education, but only if you go out and make your place here. If you don't have ties to the campus, the cold, steel machine of the University will grind you up and spit you out.

Don't let the machine turn out another slug. Go out and take what is yours. You put too much money and time into this school to miss out on the best part.

TECHNOLOG

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Letters

Dear Editor,

Your editorial *Hammered* in the February/March issue of the *Technolog* was very good. Much better than your uninformed rhetoric about the Hubble Space Telescope.

I wanted very badly to get into IT but my six years of Naval experience in electronics didn't seem to matter at all. Never mind that my rate in the Navy (Electronics Technician) is one of the most difficult and desired positions for an enlisted person. Never mind that I was advanced (promoted) four times in six years. I was very hard-charging and my command was very sad to see me go.

So, I apply to the IT. "Sorry," they say, "Your grades in high school really suck." "OK," I say, I'll re-apply to the CLA. No problem there, I'm immediately accepted—bad grades and all.

All along, I'm figuring I'll re-apply to IT later. Problem is, I don't do very well in these CLA courses. If I could just get into some EE courses, some of which I could probably teach, I could someday become an electrical engineer and a happy member of society.

Are you listening, Mr. Ben Sharpe (Director of IT Admissions)? I want into IT. If I can't get in, I'll take my tuition elsewhere. Meanwhile, I'll sweat bullets in Calculus because if I can't get through this, Mr. Sharpe, I am sure I could never be an Electrical Engineer. Now I have to take Physics and pass with a decent grade. Fat chance.

Basing admissions on GPA is discrimination. You are discriminating against people who do not take tests well. In the real world, will I be asked to solve a problem in 10 minutes? As Mr. David Ellis wrote in *Becoming a Master Student*, "Grades are not a measure of intelligence. Grades do not measure creativity. They are not a measure of your ability to contribute to society. Grades are simply a measure of how well you did on a test one particular day."

But what other ways are there? I don't know. But I do know that I want to be an Electrical Engineer, Mr. Sharpe. And I could be a damn good one. If I could only "get in..." (If you'll excuse me now, I have to solve a 4th degree polynomial in five variables...in five minutes.)

Jim Muehlberg
CLA Sophomore, forever

Dear Editor,

Your magazine sucks. I hear that you're all a bunch of goobs that like numbers. Your artists can't draw and your writers can't spell. Get a life and quit sucking me out of my money each quarter.

Disgruntled IT Student

Eye ca'nt speke fore tha artists, butt wee riters spel jest fign, thanc u vary mutch.—Ed.

An Open Letter to Our Readers:

Dear Readers,

As you may or may not know, a part of our funding comes out of your student service fees. Each IT student pays about $1 for each issue of the *Technolog*.

We do our best to serve the IT student body but there are certainly things we could do better. Your feedback can be extremely helpful in this matter. In fact, we surveyed about 70 randomly-picked IT students by phone in order to find out what you, our readers, want.

My point is that the letters page is your opportunity to voice your concerns about your magazine—the *Minnesota Technolog*. So, if you have something to say about the magazine, drop us a line and let us know. I'm quite certain that we don't do everything right and you may be able to alert us to a problem.—Ed.

P.S. The letters that are not signed with a real name—like the one at the left signed, "Disgruntled IT Student"—are supposed to be jokes. As we understand it, though, some of you take these letters seriously. Please don't—real letters are signed by real people.

The Room Five Gang

The 1991 IT Board of Publications

Back row, left to right: Lee Klancher, Jackie Duley, Rick Sanchez, Jim Hou, Advisor Herb Harmisson.
Middle row, left to right: Jonathan Wong, Laura Sokol, Kathy Podolske, Tola Marts.
Seated, left to right: Khanh Nguyen, Kale Hedstrom, Jeff Conrad.
Not Pictured: Karen Schlangen, Doug Sutton, Darin Warling, Christos Zachariades

The 1991 Minnesota Technolog Staff

From left to right: Khạnh Nguyen, Robert Schroeder, Brian Neurauter, Teresa Kimler, Tim Hartley, Lee Klancher, Doug Sutton, Chris Klassen.
Not Pictured: Too numerous to list.

Perspectives

The Riches of the Recession

by Brian Jensen

Our friend Larry Hasnone, now an established junior engineer and responsible manager of his money, is out shopping for a new home. He is tired of apartment life, paying rent, and his neighbor's complaints about Hairball, his cat.

Larry found several places that he liked and that were in his price range (dirt cheap), although his favorite needed a few renovations. Larry was dubious about buying due to the recession and called on his favorite uncle, Carl Cashola, for advice.

Like many of us, Larry tends to spend less when times are looking tough. Carl, on the other hand, believes that economic lulls can be the perfect time to make large purchases. Carl explained to Larry that in times of uncertainty and economic hardship, many goods are over-supplied due to reduced consumer spending. Consequently, retailers and manufacturers are forced to lower prices to move their merchandise. For those with a little money, hard times can provide a bonanza of bargains.

Consider the current U.S. situation. Many economists say that the U.S. is in a recession and that tougher times are on the way. Add in the conflict in the Persian Gulf and the ballooning federal budget deficit and you can see that consumers are faced with a very gloomy economic picture. This gloomy picture induces consumers to delay or abandon their purchase decisions. These consumer actions dampen economic activity. When the downturn begins, it feeds upon itself and ends up in a vicious circle.

The downturn is reflected in big discounts for consumers. For instance, Larry was tired of spending his Sunday afternoons at laundromats and decided to check out prices on a new washing machine. He got quotes from two large electronics stores. For simplicity, we'll refer to them as store A and store B.

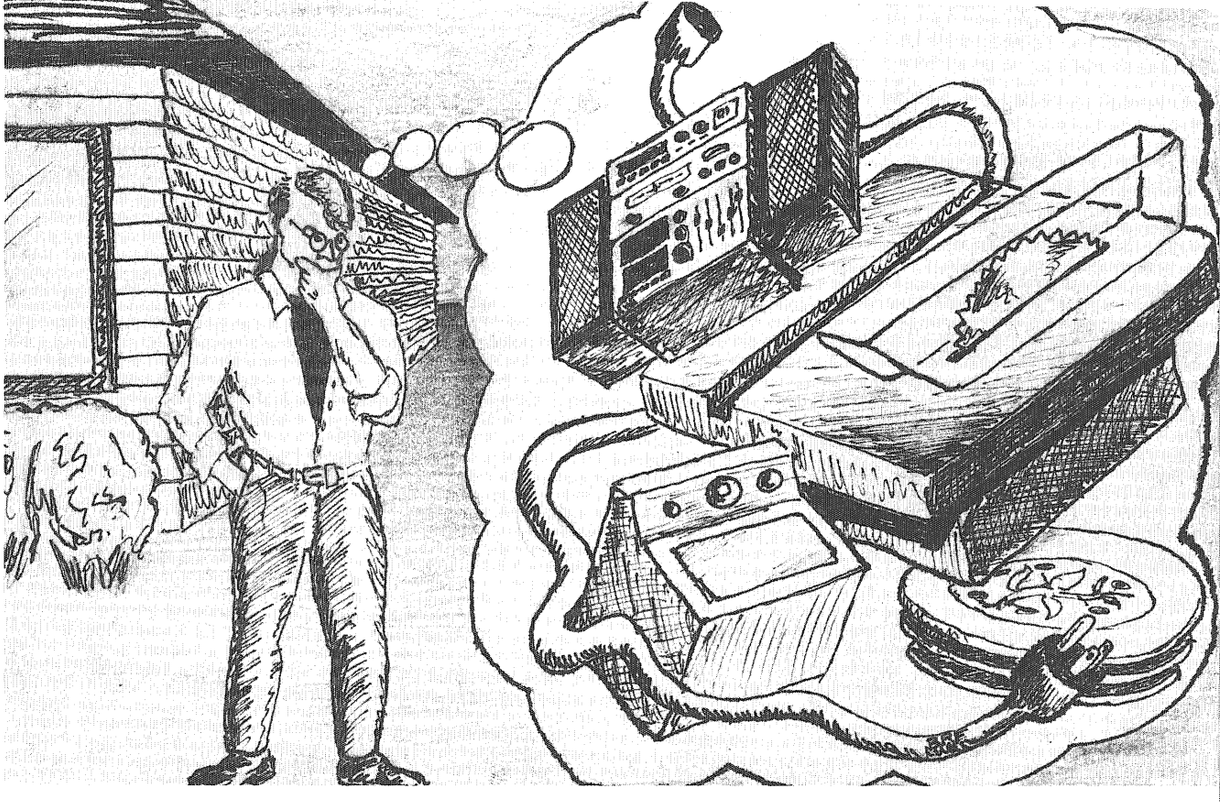
Store A had a sale on a GE washer for $350. In addition, the store was offering a year of interest-free financing. Store B was willing to match store A's price and, when pressed, cut the price another $20 if Larry was willing to buy that day (which he was).

Elated at his success, Larry decided to check out the home stereo market. At store B, Larry found a complete stereo rack system marked down from $1189 to $899. Larry was impressed with the sound and the price, but considering the economic conditions, was able to haggle the salesman into throwing in five compact discs.

In times of uncertainty and economic hardship, many goods are over-supplied due to reduced consumer spending. Consequently, retailers and manufacturers are forced to lower prices to move their merchandise.

Next, Larry headed over to Sears to check out prices on power tools. He was particularly interested in a table saw for future home improvements. He liked everything about the top-end model except for the price. While talking with the salesman, however, Larry was informed that a similar model would be going on sale next month. The salesman went on to offer the top end model to Larry at the sale price of next month's special. Larry hemmed and hawed and

Illustration by Brian Fournier



the salesman offered to throw in a carbide-tipped blade for no extra charge. Larry ended up receiving a 20% discount on the table saw and a free extra blade.

Larry was able to benefit from the poor economy by timing his purchases. He was able to save a considerable amount of money by making his purchases when no one else was buying.

There is a definite cycle to the availability of discounted products. As we have seen, Larry Hasnone was able to benefit from retailers' and producers' willingness to deal.

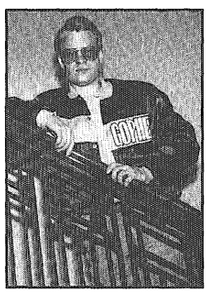
Larry had less luck with his tax preparer. Unlike retailers of hard products, his accountant was unwilling to discuss any type of price discount.

However, there are some classes of goods that are more susceptible to economic downturns than others. Large durable goods, such as appliances, automobiles, housing, and implements are more affected by the state of the economy than most other goods. Smaller, non-durable goods such as foodstuffs, household supplies, gasoline, movie theater tickets, and service industries are usually not affected much by economic cycles. The reason is that most people still have to purchase smaller items, whether they want to or not.

Generally, economic events may be bonanzas for those who are prepared. Our current economy is a little stagnant, but it is full of bargains for those who have waited for the right moment to make their purchases. Look at Larry Hasnone; he was able to find some bargains that most likely would not have been available during better times.

However, you should be careful when considering major purchases during uncertain times. Don't drive yourself into dire economic straits!

Larry Hasnone has been through a lot of troubles in the past few months. He had troubles with his credit cards, budget and financial security. One thing, however, can be said about Larry—he learns his lesson the first time. He is now a very competitive and knowledgeable consumer, and should do very well for himself. ❐



Brian Jensen is a business major and recently took his own advice and bought a house in (ahem) Minnetonka. As we hear it, he intends to invest the rest of his capital in high-end stereo equipment, obnoxious outdoor lighting, and a large, fierce dog. He says he wants to "wake up those damn yuppies." We wish the worst on the pork-barrel yuppies and the best for Brian. Go get 'em, Jensen!

Henry David Thoreau Was My High School Adviser

by Brian Neurauter

As a rule, children learn to hate work at a very young age. Not wanting to be the exception to the rule, I hated it as well, especially working in the family garden.

I spent long weekend mornings and afternoons pulling weeds, tying tomatoes, watering broccoli, and picking beans. No matter how fast I worked, there were always two more things which "needed to be done," and as anyone knows, two things lead to four others, and four things lead to...

It was hopeless. I worked day after day under the bright sun, knowing the whole time that just a block away my friends were playing matchbox cars.

There was one thing that saved me from the garden, however, and that was school. It seemed that the only thing that could get me out of gardening was homework, and believe me, I loved it.

The garden wasn't the only influence that pushed me into liking school, though. For example, imagine if you had an "imaginary friend," someone who could relate to you and strengthen your sense of wonder in the world. What would it be like? Imagine, if you will...

° ° °

I stand in the parking lot of O'Brian State Park and look at the note which mysteriously appeared in my mailbox. It simply says, "Brian, please meet me this Saturday at O'Brian State Park. Sincerely, H.D.T."

I look at my watch. Noon. Looking up, I notice a man approaching from the distance. A few minutes later, he reaches me.

"Hello, Brian. I'm Henry David Thoreau. Nice to meet you."

"Hi. Nice to meet you," I would say, masking my confusion.

"Would you like to go for a walk through the park?"

"Ah...sure. Why not?"

° ° °

What's wrong with the picture above? Is it crazy to think that Henry Thoreau, dead for years, would rise again and give someone guidance? Or is it crazy only because science has so closed our minds to the possibilities of something like that happening that it has become too absurd to think about?

° ° °

Thoreau stops by a small grove of birch trees. He stands silent, staring out over the river valley. I pause and stand beside him.

I stand in the parking lot of O'Brian State Park *and look at the note which mysteriously appeared in my mailbox. It simply says, "Brian, please meet me this* Saturday *at* O'Brian State Park. *Sincerely,* H.D.T."

"I've heard you want to be a writer," he says, not looking at me, but still studying the trees beyond.

"Yes, I would love to be a writer, if only for a part time job." As an afterthought, I add, "Of course, if my books are successful, I would write more often."

"You said writing would be part time. What else would you do?" he asks.

"I also want to be an astronomer. I'm in college now, working on my degree."

"You said you love writing. Do you love astronomy as well?" he asks.

° ° °

Where did my love of astronomy first come from? In childhood, we were all subjected to certain ideas and situations that molded us into what we are today, and my mold was my family. My father loved looking at stars, and pointing them out to me, and my oldest brother, a high school physics and astronomy teacher, would show me planets and galaxies through his telescopes.

As a kid, I also watched the Cosmos series with a passion. Each week, Carl Sagan would travel in his "ship of the imagination" to the far reaches of the galaxy, exploring strange and beautiful things. I wanted his ship of the imagination to be my ship. I wanted to sail amid the stars.

I can only wonder what happened.

° ° °

"You said you love writing. Do you love astronomy as well?" Thoreau had asked.

"Well, of course! I wouldn't be spending all my time and money on it if I didn't."

"But," he would say, "I gather that from what you said earlier, that you would give up your love of studying stars just to write more, if you were successful at it?"

"Well, I guess that's what I said. It's not like I'd give up science totally. Besides, in this world, everyone wants to be as successful as they can."

"You're saying you want money, right?" asks Thoreau.

I dodge the question. "In these times, you need money to get by."

"That's what people said back when I was alive, too." He pauses, then adds, "What is success to you?"

"Well, success to me will be when people read the books I intend to write, or watch my weekly show on PBS about the universe."

"If that is success to you, then why do you need money?"

"I need money to live. I can't give my ideas away and not get anything in return."

"I didn't say you had to," Thoreau would say. "I just don't want you to get bogged down. You see, with money, you can buy too many things, become wasteful; in essence, you become a slave to that which you want."

"Hey," I exclaim, "you wrote that in your book, *Walden*!"

"I know. It seems as if you didn't pay much attention, though, doesn't it?"

I would stand in silence, pondering what he had said. Finally, he would speak again.

Illustration by Wayne Kao

"There are many rocks on a beach, Brian. Some are covered with sand, while others are covered with mud. Those in the mud have no hope of getting out into the light again. But those covered only in sand can be washed clean by a single wave. Watch closely for that wave."

° ° °

Somewhere, in the befuddlement of my high school years, that wave hit me. I realized that I wanted to study science and write stories. This was fine, because at that age, I could do what I wanted, and no one tried to place limits on me or my imagination.

By the time senior high rolled around, a funny thought had occurred to me. In our society, it seemed as if choices were limited. Money became important, and to make money, one had to focus on a single field of study. I had to choose: science or writing.

° ° °

"Mr. Thoreau," I ask, "Do you think I would make a good writer, or should I stick to science? It's kind of a dumb question, but..."

"No, it's not a dumb question. Writers are special people, and there are few left in these times." His thoughts appear to wander, and he says, "My favorite visitors were..."

"Were poets. Yes, I remember from your book. But I'm wondering what I should do?"

"That's why I came here to talk to you. You are on the verge of making a choice, between science and writing."

"I suppose you want me to be a writer, huh?"

"Not necessarily. Who am I to say what you should or should not be? That's for you to decide. What I don't want is for you to be like me, for as you know, I might change. Just be yourself. Find the right life for you, and then do your best in it."

° ° °

This is what Henry David Thoreau said in *Walden*, probably the most influential book I've ever read. It gave me a different perspective on life, and after reading it, I began making up conversations with him. Eventually, through a sort of self-analysis process, I decided that I'd pursue science.

Why did I make that choice? Well, I was good at science. I understood it, and it let me use my imagination. I also figured it would be easier to come back to writing than to relearn science later.

By 12th grade, I was accepted into IT in astrophysics. However, in English class, I learned about the Renaissance period in history, and about the Renaissance man, a person who studied many fields and didn't limit himself. Yes, I thought. This is me. I can be both a scientist and a writer.

Wrong!

For the first two years of my college life, every class except one had been planned for me. Four quarters of physics, two quarters of chemistry, six quarters of math, four more quarters of higher level physics, plus numerous physics and chemistry labs. There was no end to it! The only elective I had time for was one creative writing class, and I treasured every minute of it. It was a class where I could express myself, where I could be an individual. And science?

Science was just the opposite. I listened to lectures, took notes, worked on problems, took tests, and when it was over, began the process again. But after only a few cycles into that process, I encountered my own barrier. Things suddenly didn't come to me as easily as they used to, and as if waking from a dream, I suddenly found myself struggling just to keep from going under. My acquisition of knowledge, which had generally been on a linear scale before, now looked like an exponential curve, with no limits in sight. What was worse was that the others around me were keeping up and understanding perfectly while I was floundering.

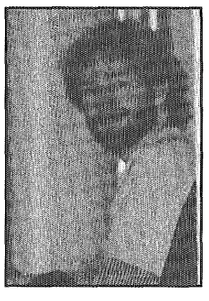
Luckily, I'm not the kind of person who gives up. I stuck with it, but I felt as if science had become obscure to me, like an elitist group that was slowly pushing me out, and I began feeling like the perennial football water boy, permanently stuck on the sidelines.

Even now, I feel as if I'm still on the sidelines. Somewhere along the way, most likely as a sophomore, the wonders of astronomy, of really looking at the stars, were lost, and now those billions of winking suns have become just a group of equations that make little sense to me.

Luckily, I've held on to my love of writing, and recently, my love of music has grown, too. In a way, it's the Renaissance man in me coming out, allowing me to move on and do something else, and in a way, it's like my old friend Thoreau. When he was done living one life, he moved on, and did something else to take its place.

Recently, I realized that I was well on my way to finishing college in four years. Knowing this fact really made me happy, because like Thoreau, I will finally be able to move on.

I will always love school. Learning is and always will be important to me. And even now, when I don't feel like doing my physics, I simply think of pulling weeds in my dad's garden, and suddenly Taylor Series expansions don't seem all that bad. ❐



Brian Neurauter is our Associate Editor and has managed to conceal his writing talent from us for only so long. Now that we know, we will hound him for copy at every opportunity. Brian is a junior in Astrophysics. He aspires to be the first *Technolog* staff member in space—we think he's already achieved his goal.

Ethics in Engineering?

by Darin Warling

"Concern for man himself and his fate must always form the chief interest of all technical endeavors, concern for the great unsolved problems of the organization of labor and the distribution of goods—in order that the creations of our mind shall be a blessing and not a curse to mankind. Never forget this in the midst of your diagrams and equations."

—Albert Einstein, to the students of the California Institute of Technology, 1931.

Until a few years ago the idea of engineering ethics was addressed only rarely. Early treatises on the subject were little more than professional codes of courtesy. In other words, "Don't compete for commissions on the basis of price only." "Don't advertise." "Don't review a fellow engineer's work without his or her permission." In the early years, a breach of ethics was most often a simple breach of professional decorum. Recently, however, an increasing number of books, papers, and articles have been devoted to the subject, often presented alongside the notion that technology is beginning to hurt us more than help us.

Technology is the miracle worker of the modern age, bringing with it Progress and The Easing of Humanity's Burden. Take communications for example. Modern communications really began with Gutenberg's press in the 1400s, followed by telegraph in the late 1800s. Then came telephones and film in the early 1900s and radio in the 1920s. Television in the 1950s. Xerography in the 60s. Computers in the 70s. *Personal* computers in the 80s. Fax machines. Satellites. Desktop publishing. Overnight delivery. Fiber optics and on and on and on. Because technology has eased humanity's burden, technological progress is obviously good.

For every benefit the technology gods have brought us, I can produce at least one detriment. As old evils are slain, new ones are created.

Yes, technological progress is good. Communications, however, is only one example, and a rather benign one at that—there are few ill effects of good communication. But what about Chernobyl? That too is the result of technological progress. The greenhouse effect? Again, progress. Thalidomide? Challenger? Star Wars? Valdez? Acid rain? DDT? *Et cetera, ad nauseam*. For every benefit the technology gods have brought us, I can produce at least one detriment. As old evils are slain, new ones are created.

People often blame engineers for the problems caused by technology, and rightly so in many cases. But while the engineer may be the creator of the technology, he or she is not necessarily the person who decides how it will be used. For example, here are the fathers of the Bomb—they may have built it, but they didn't drop it:

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"I am become death, the destroyer of worlds."—J. Robert Oppenheimer, *quoting* Vishnu *from the* Bhagavad-Gita, *upon witnessing the explosion of the first atomic bomb.*

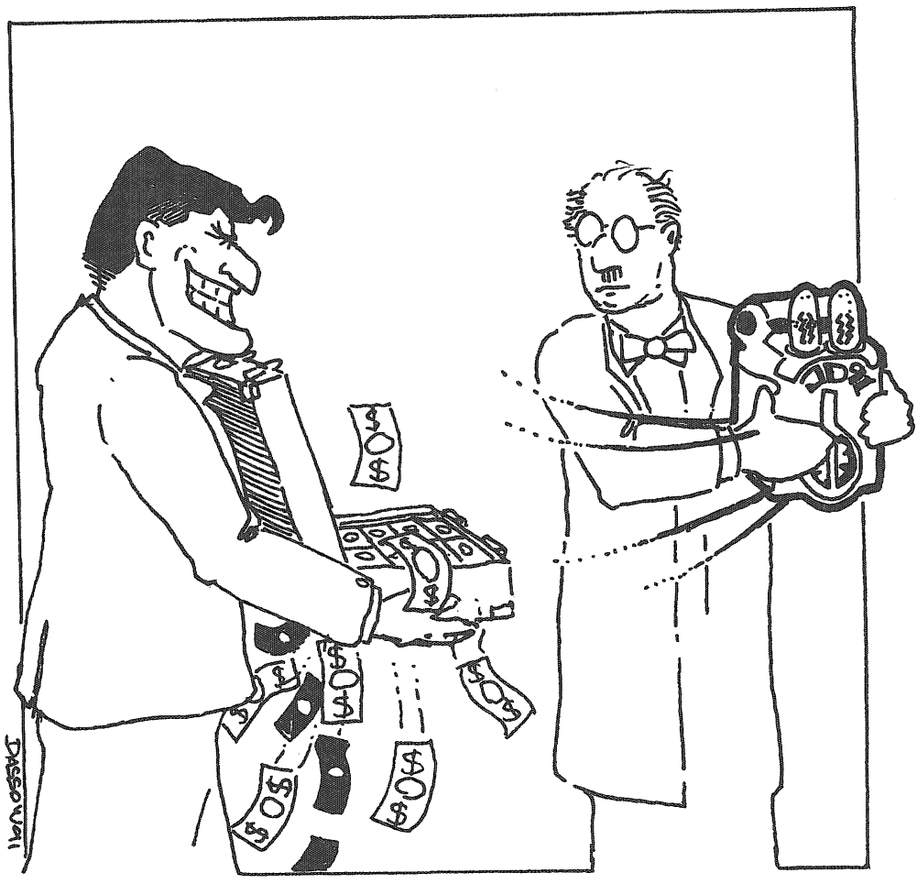
"If only I had known, I would have been a cobbler."—Einstein.

"Our defense is not in armaments, nor in science, nor in going underground. Our defense is in law and order."—Einstein, *revisited.*

◆

Einstein was right. Our defense is in law and order. This is especially true in engineering, since much of it is now regulated by the government. *Caveat emptor*—let the buyer beware—no longer applies

as it did in our wild and wooly frontier days, when snake oil salesmen and shysters abounded. Our standards are defined by the law and the law is defined by society; that is how it should be. Thus society needs to define for the engineer how safe is safe enough. What is the public's expectation of safety? What is acceptable risk? Everything has risk associated with it, even something so mundane as waking up in the morning—a slip and fall in the shower and whammo, permanent brain damage. Who's to blame? You? The owners of the tub company? The salespeople? The people working the assembly line? The engineers who designed it? Just *who* is responsible?



The engineers I know are not philosophers; they tend to be very conservative, practical people. And, according to Mike Martin and Roland Schinzinger, two authors heavily involved in engineering ethics, this is their downfall. Engineers are shortsighted because they are goal-oriented. In the heat of a project they often lose track of the implications of their work, striving for expediency above all other things. However, this does not necessarily make us unsavory weasels. People, after all, are generally capable of making ethical decisions without formal training, and engineers are no exception. However, due to our profession's lack of formal training in ethics, the full implications of our work are often overlooked simply because we have never been shown *where* to look. And therefore, what we feel to be a correct decision may actually turn out to be a very poor decision, simply because the full scope of its effects went unseen.

Management generally lacks the knowledge to make an informed decision concerning the use and application of new technology. Therefore, it is up to the engineer to insure that his or her work is used in an ethical manner. But what is this so-called "ethical manner?" The traditional view of ethics, the view ethics classes generally teach, attempts to determine the rightness or wrongness of an action (or inaction). Unfortunately, this is useful only as a thought exercise—it has very little practical applicability to real-world decisions because it is too vague. What, after all, constitutes absolute right or wrong? People have different views on the subject—no one code or credo or definition is acceptable to everyone. And while a code of ethics, such as those set forth by most professional engineering societies, can occasionally serve as a useful guideline, codes with real meaning and real teeth are a practical impossibility. Most are little more than noble proclamations along the lines of "Do not break the law!" There exists no shortage of unrealistic and unworkable ideas and it's easy to mouth well-meaning clichés, but ethical action often comes down to very difficult decisions where no clear right or wrong answer exists. Instead, it is more often a tradeoff between the lesser of two evils.

There exists no shortage of unrealistic and unworkable ideas and it's easy to mouth well-meaning clichés, but ethical action often comes down to very difficult decisions where no clear right or wrong answer exists.

Because no concrete answers can be found in subjects like ethics and philosophy, most engineers consider them "breezy," believing they play no part in the hard reality of day-to-day life. They feel these are subjects best left to those concerned with solving problems relating to the greater good of all

Illustration by John Dassow

humankind, not those concerned with solving flow rates through a combustion chamber. However, ethics *cannot* be left to others—they must be practiced by *everyone* who has an effect on society, including engineers, or else things like the neutron bomb will be the result. Samuel Florman, in his book *The Civilized Engineer*, has proposed a more concrete—meaning usable—definition of ethics for the engineer. According to Florman, few of our engineering failures are the result of behavior that is unethical in the standard sense of the word; most are the result of human error—miscalculation, poor research, sloppy workmanship, basic ineptitude. As Florman states, "Possibly the greatest danger to humanity is that our destruction may come about by way of a technical error—not by evil intent, but by miscalculation." His basic premise is that in order to be ethical, engineers need to be *conscientious*.

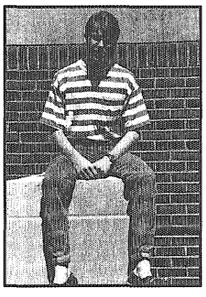
However, due to our profession's lack of formal training in ethics, the full implications of our work are often overlooked simply because we have never been shown where *to look.*

According to Florman, being conscientious includes being alert, aware, dedicated, self-disciplined, creative, and innovative. In this manner, a competent engineer is an ethical engineer because "a conscientious engineer, by definition, cannot falsify test reports or intentionally overlook questionable data, cannot in any way avoid the facts." An incompetent engineer, on the other hand, is unethical because "no matter how saintly or kind-hearted an engineer is, if he or she is incompetent, he or she is 'bad.'"

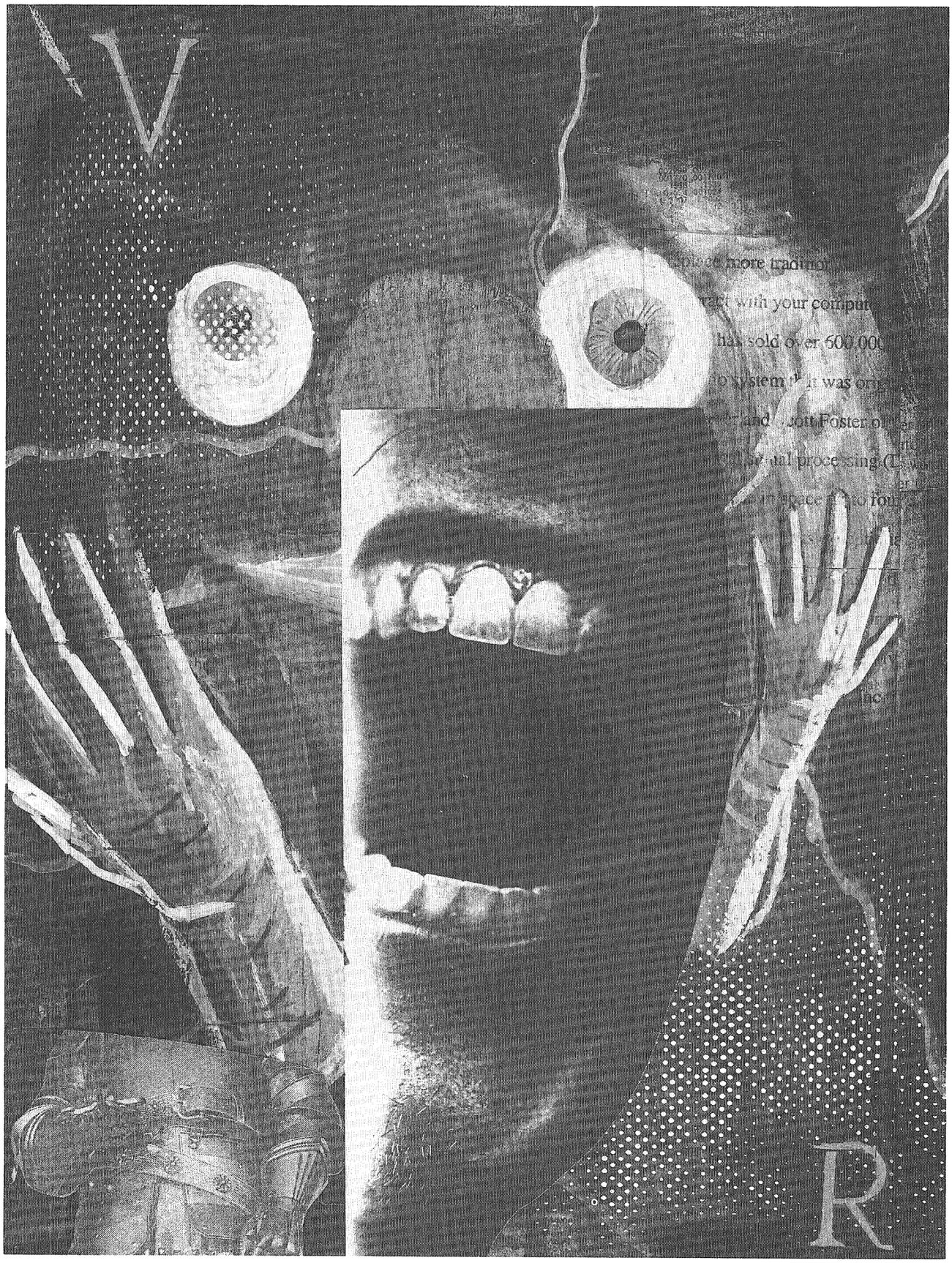
I'm not here to preach on what is and what isn't ethical. I'm merely saying this is something engineers need to think about, and I've presented Florman's definition as a useful starting point. Engineers should not be neutral slaves to their technology; it is perfectly proper for an engineer to take a stand on one side of the political fence or the other. And since the question of ethics in engineering is falling further and further into the limelight, the engineer will no longer be able to hide behind the decisions of his or her non-technical managers and say simply, "I'm only doing my job."

You, as an engineer, wield more power than you probably realize; the public has placed its faith and trust in your work. The public relies on you, and this is why the subject is important. Jim Holte, an electrical engineering professor here at the University and long-time student of ethics, summarized it very well:

"The bottom line comes down to ethical engineers making every effort to anticipate misapplication and proper application of their engineering efforts. We must insure that others know the implications of the technology we are developing. You can't hide behind saying, 'I was just working in the lab.' The buck stops in the engineer's lap. I contributed to the technology. A part of my continuing life is to make sure, insofar as I am able, that I continue to make known the limitations and the positive aspects of the technology I have created. You stand behind it. You are responsible. Maybe you don't feel you should be, but the alternative is that nobody is responsible. And that would get us nowhere fast." ❐



Darin Warling is double majoring in Mechanical Engineering and Computer Science and intends to graduate sometime in this century. He is a member of the IT Board of Publications and dreams of one day writing a best-selling Harlequin romance novel. Rumor has it that he is currently doing in-depth research on the subject. We wish him the best in all of his endeavors, however morally questionable they may be.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Virtual Reality

Science Fiction or Science Fact?

By Darrin P. Johnson

I am walking through a damp cavernous tunnel with tapestries and metal-bound doors along each wall. The smell of mold and rotting cloth indicates that this place had been unused for awhile. Suddenly, I spot a bright light shining through the hinges of one of the metal doors at the end of the tunnel. With my blade drawn, I cautiously step towards the door...

"Johnny, time to eat!!"

"Aw, mother you ruined my game again," Johnny says as the scene fades when he pulls off the headset from his new SimStim (Simulation Stimulator; ©2010).

Virtual reality, the creation of a computer-generated graphical world, has been popularized by the television series *Star Trek: The Next Generation*. The Enterprise's holodeck creates an pre-programmed artificial environment which allows the user to interact with their created reality. Although current technology cannot turn energy into matter to create the bridge of the Enterprise or another environment, it does allow us to begin to experience the brave new world of virtual reality (VR), where one can be anybody or anything—given the right hardware and software.

The origin of the term "virtual reality" is in some dispute, but in 1972 the term "Artificial Reality"—used to describe computer and video environments—was coined by author-inventor-engineer Myron Krueger. Krueger's vision of artificial reality, published a decade later in a book of the same name, has been a guide for all of today's investigations of virtual reality.

More recently in the 1984 novel *Neuromancer*, William Gibson describes the ultimate interface as "cyberspace"—his term for virtual reality. He describes using the human nerves to link a machine to the brain which allows direct stimulus to be sent to the brain. Gibson's characters can be "jacked into" a computer-generated visual matrix of information or into the living or recorded senses of another person. Gibson's vision, like Krueger's, is taken very seriously by researchers in the development and consequences of virtual reality. Gibson's idea of direct interface is being used with damaged hearing where experiments are being done to connect microphones directly to auditory nerves. Currently, VR technology is not as direct as a neural interface, but it does attempt to make the human-computer interface transparent (perceived as direct). The ultimate effect of VR is to put a person into an artificial world that one can actually move through and interact with.

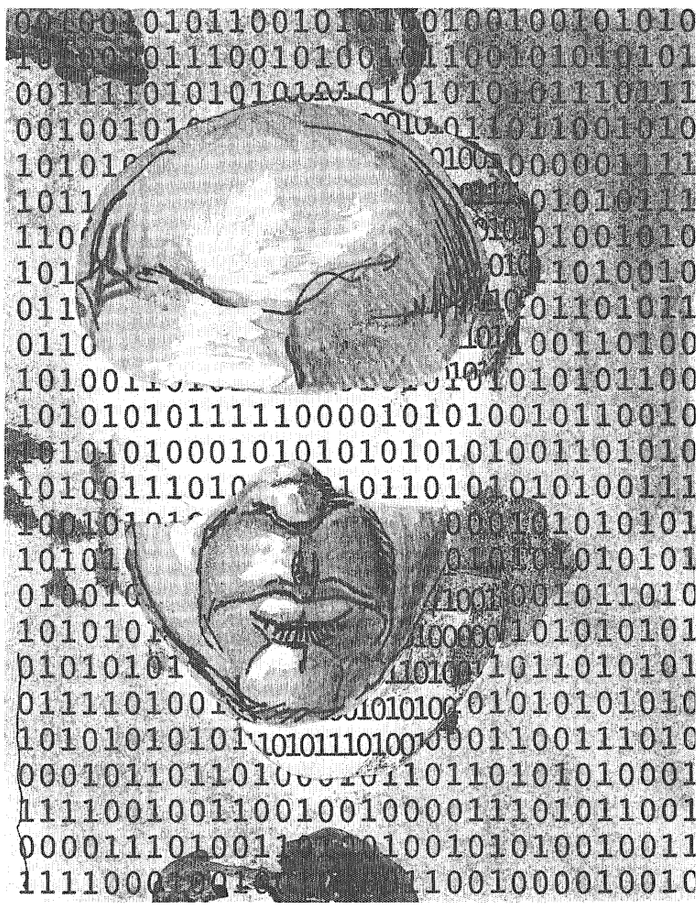
The psychedelic effects of VR, even in its present primitive form, creates the possibilities of psychological addiction.

Sensing Virtual Reality

Virtual reality is hardware and software that allows you to explore the inside a computer-generated world. The illusion of interacting with the virtual world can already be done to a limited extent with

hardware developed by several companies and academic institutions. Current research uses two of the five senses (seeing and hearing) and three-dimensional movement in VR.

To enter the world of virtual reality and experience an artificial environment, you put on a pair of goggles that contain two liquid crystal displays (LCDs) which serve as view screens. The stereo EyePhone, developed by VPL Research, of Redwood City, California, has optics mounted on the LCDs which present a wide-angle stereoscopic color images of the real world or imaginary ones generated by a computer linked to a display via a cable. The headset has a sensor on the goggle that tracks head position and orientation, allowing the computer to shift the image in correlation with your head movement. The stereo eyephones allows the viewing of scene with 360° of freedom through the X, Y and Z axis. Currently the eyephones are connected to two Silicon Graphics IRIS workstations—one for each eye—that allow the creation of up to 30 high resolution color images per second. The VPL EyePhone includes a built-in headphones that provide stereo sound.



VPL has also developed the DataGlove as a part of its virtual reality hardware package, called the Virtual Workstation. Optic fibers sewn onto the fingers of the glove that detect flexing and extension of the fingers, and a Polhemus magnetic tracking device has been added to the glove to determine the hand's position and orientation. A microprocessor control unit transmits the data to the host computer. The glove replaces more traditional control units—joystick and mouse—providing a more intuitive way to interact with your computer. Mattel, Inc. has introduced a plastic glove based on VPL's technology, and has sold over 600,000 units.

VPL is developing a virtual audio system that was originally developed by Dr. Elizabeth Wenzel of NASA's Ames Research Center and Scott Foster of Crystal River Engineering (CRE) Inc. Called the Convolvotron, it is a digital signal processing (DSP) system that enables the listener, using standard headphones, to locate in space up to four independent and simultaneous sound sources. The power of the Convolvotron is its exceptional processing capacity—128 parallel processors make the system more than 20 times faster than conventional DSPs. CRE has developed an advanced prototype system with four times Convolvotron's throughput.

Most current head-mounted VR systems are to expensive ($200,000) for widespread use, because they rely on customized workstations. Autodesk, Inc. is developing a PC-based VR software package called Cyberspace that will reduce the cost of creating virtual worlds and will be generic enough to be applied to any type of graphics or design work. Ultimately, the cost of VR will be reduced to a level where it can be used for any application.

Applications of Virtual Reality

Virtual Reality creates a new medium for human communication by allowing large amounts of digital information to create a foundation on which our brain can perceive "reality." VR is a new medium because it is a is realm of information that is encountered as experience. The content of the telephone medium is speech; the content of the television is movies and news and heavy-metal videos, but with the telephone and TV, you are aware of the inside and outside and of the limits of the real world that surrounds it. The "experience" of VR leads to some marketable real-world applications.

The first future mass-market application of VR will likely be entertainment. Many people believe that VR will be carried through an intermediate development phase applications in adult entertainment (as was the case with the VCR less than fifteen years ago). More mundane entertainment applications will follow including VR arcade games, simulations and movies. Think about "experiencing" a favorite movie through the eyes, ears, etc. of one of the characters. Or, imagine having tea with a favorite companion (real or not) on the top of Everest, or in the jungles of the Amazon.

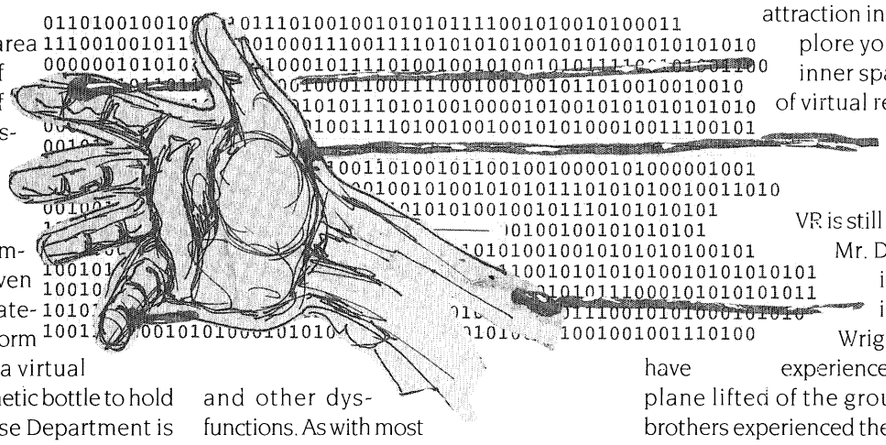
Illustrations by Tom Nynas

The value of VR extends beyond its entertainment applications into the commercial market. VR could allow company to sell a product (e.g., a new building, or a new car) before it needed to be produced. The customer could experience the feel of the product, and even make changes to it before it went into production, saving the company and customer a great deal of time and money. VR could be used to simulate (experience) a nuclear plant operation or allow you to try to terra-form Mars.

Education is another area in which VR would be of great value. Instead of sitting in a lecture hall listening to a dull professor describe a historical battle, you could experience it from any number of positions, and even explore alternative strategies. You could also perform open heart surgery on a virtual human, or shape a magnetic bottle to hold anti-matter. The Defense Department is currently using the most sophisticated VR hardware available for training fighter-pilots. The key importance of VR in education is the ability to not only learn by memorizing, but also to experience and hopefully enjoy the learning process.

The Future of a New Reality

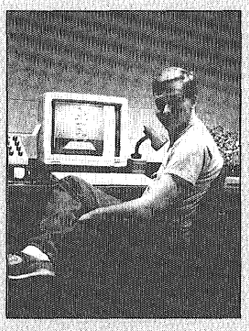
Virtual reality raises a number of interesting social and moral questions including how VR will affect those who use it heavily. Timothy Leary, a proponent of VR and a former Harvard researcher who popularized LSD in the 1960s, has visions of a whole new generation of people tripping electronically. The psychedelic effects of VR, even in its present primitive form, creates the possibilities of psychological addiction and other dysfunctions. As with most technologies, VR has its benefits and shortcomings, and must be explored with a watchful eye.



Phillip Elmer-Dewitt, in the September 3 issue *Time* (1990), realized the power of VR first-hand, and gave the following testimony:

I had my first realization of the potential power of the technology. I was sitting in a room crowded with strangers, but within the space of my virtual reality, I was totally alone. So deeply immersed was I in the illusionary world projected in front of my eyeballs that I assumed everyone else was experiencing the same panic and frustration I was. In fact they were oblivious. Perhaps that s the secret attraction in being able to explore your own personal inner space. In the world of virtual reality, your anxiety is all your own.

VR is still in its infancy with Mr. Dewitt experiencing the same feelings that the Wright brothers must have experienced when their first plane lifted of the ground. The Wright brothers experienced the first exploration of the air, and now with VR the exploration will be of one s own personal inner space. The only question now is how far and how fast virtual reality will advance❐



TECHNOLOG

Writer Profile: Darrin Johnson

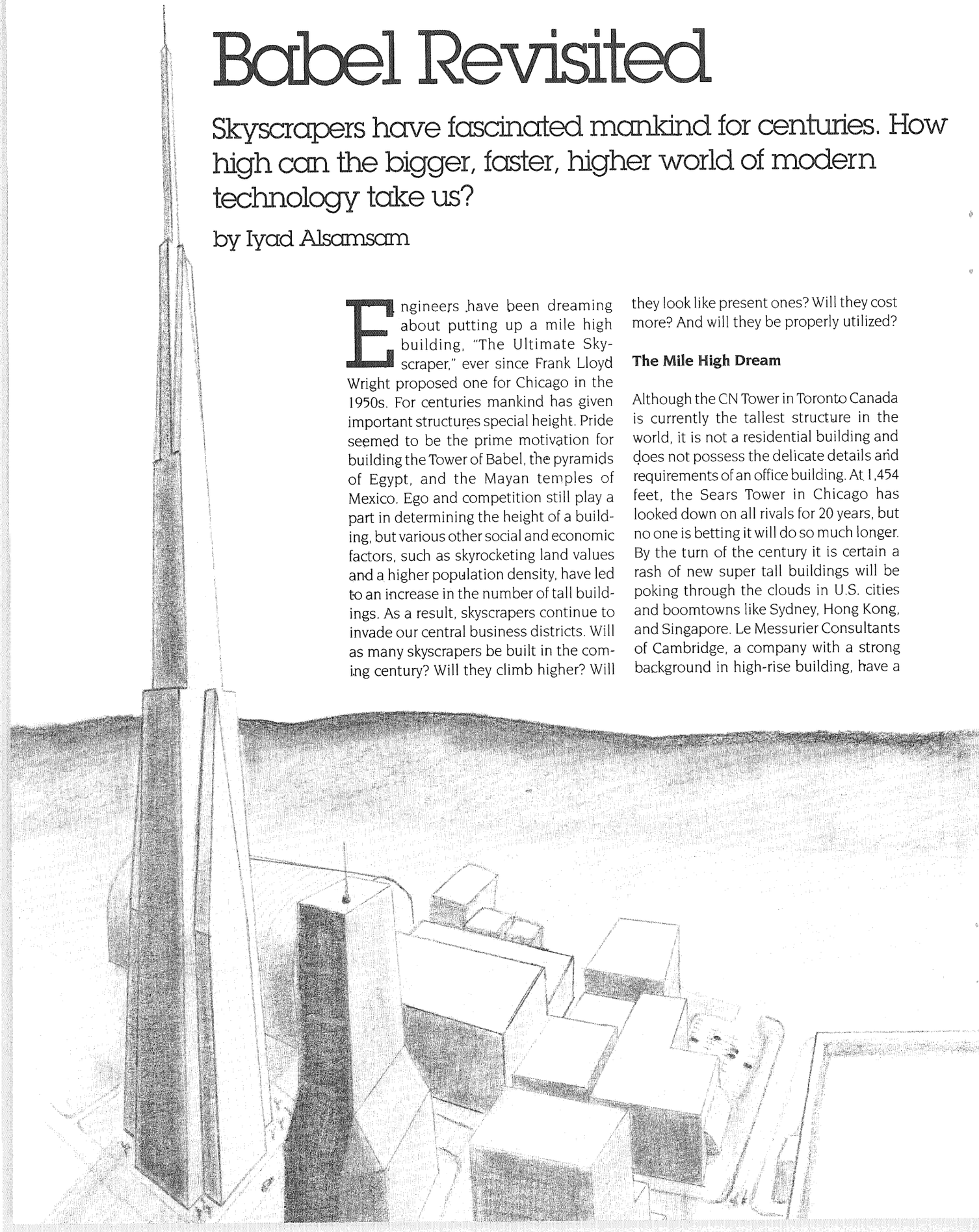
Darrin will finish a double-major in Biochemistry and Genetics next Fall and will start on another major in Computer Science. He spends what little spare time he has rummaging through computer networks and creating three dimensional computer art—check out the cover for an example. Lucky for us that he found a little extra time to write!

Babel Revisited

Skyscrapers have fascinated mankind for centuries. How high can the bigger, faster, higher world of modern technology take us?

by Iyad Alsamsam

Engineers have been dreaming about putting up a mile high building, "The Ultimate Skyscraper," ever since Frank Lloyd Wright proposed one for Chicago in the 1950s. For centuries mankind has given important structures special height. Pride seemed to be the prime motivation for building the Tower of Babel, the pyramids of Egypt, and the Mayan temples of Mexico. Ego and competition still play a part in determining the height of a building, but various other social and economic factors, such as skyrocketing land values and a higher population density, have led to an increase in the number of tall buildings. As a result, skyscrapers continue to invade our central business districts. Will as many skyscrapers be built in the coming century? Will they climb higher? Will they look like present ones? Will they cost more? And will they be properly utilized?



The Mile High Dream

Although the CN Tower in Toronto Canada is currently the tallest structure in the world, it is not a residential building and does not possess the delicate details and requirements of an office building. At 1,454 feet, the Sears Tower in Chicago has looked down on all rivals for 20 years, but no one is betting it will do so much longer. By the turn of the century it is certain a rash of new super tall buildings will be poking through the clouds in U.S. cities and boomtowns like Sydney, Hong Kong, and Singapore. Le Messurier Consultants of Cambridge, a company with a strong background in high-rise building, have a

scaled down model of a half mile high building nearly 15 feet tall but only a foot and a half wide at the base. Even though they are confident of their ability to construct the tower, there is no likelihood it will ever be built, because there is no imaginable site where the tower would make sense. Several other engineers around the country have their own plans for the world's tallest building. Skidmore, Owings, and Merrill, who designed the Sears Tower, believe the technology for building 150 stories and perhaps higher is comfortably available.

A number of technological advances are responsible for this confidence. Wind tunnel testing has become a routine tool for better understanding a building's behavior and its reaction to several loading schemes. Computer Aided Engineering (CAE) has significantly reduced the time required to perform sophisticated modeling procedures, and provided additional incentive to consider alternatives, make changes, and come up with refined designs. High strength materials and optimum state-of-the-art composite construction methods allow the owners to go tall without the penalty of extra material and time and thus extra cost. From a structural engineering standpoint, erecting super tall buildings poses no insurmountable challenges. Technical problems will not limit the height of new buildings. However, efficiency and economics, regulations and zoning, safety and human response will temper interest in building taller than 100 stories. However, when all of these factors are in balance we can expect, and plan for, super-tall buildings advancing toward the mile-high dream.

It took around fifty years for the Sears Tower to climb 200 feet higher than the Empire State Building.

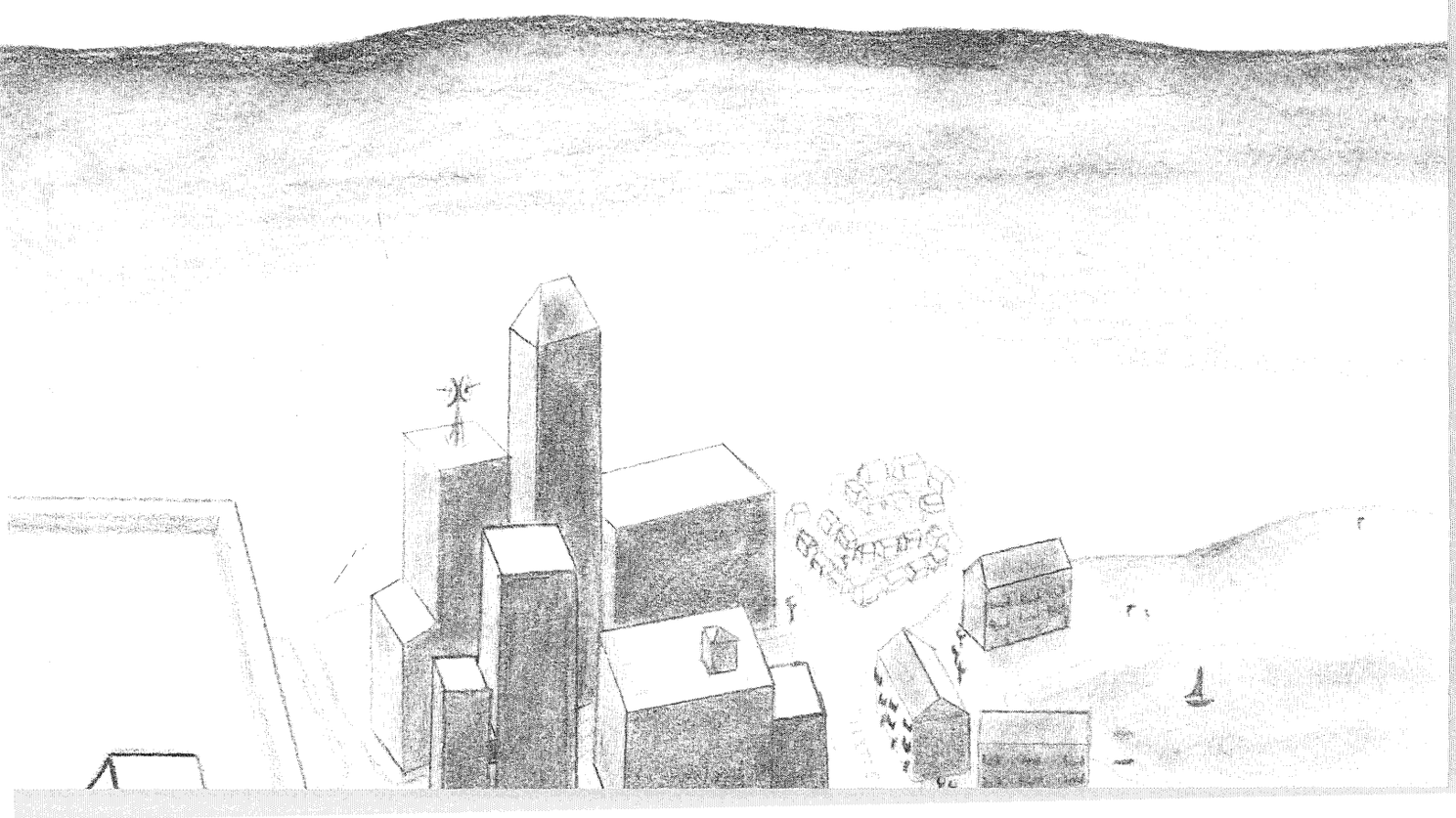
What Makes Tall Buildings Tall?

The lateral forces of earthquakes and winds must be accounted for in the design of tall buildings. Unfortunately, a skyscraper's vulnerability to winds and seismic loading grows dramatically with height. To ensure a skyscraper's stability, it has to resist lateral loads while satisfying all other strength and serviceability criteria. As a result, proper wind and seismic design creates most of the premium for added height in a tall building. An optimal design of a structural system would provide inherent stiffness and strength, such that the distribution of the building weight can automatically account for wind and earthquake resistance without any added premium.

Wind Loading

All buildings sway during windstorms, but motion in older tall buildings, with locked-in gravity loads from their enormous weight, is usually imperceptible and certainly has not been a cause for concern. Structural innovations and light weight construction technology have freed the modern high-rise buildings from stiffness. Wind action has become a major problem for the designer of high-rise buildings. When a building sways and twists under wind action, the movement makes the building produce inertia loads, causing fluctuating stresses. At any given instant, the amplitude of twisting and swaying motion is not only a function of the magnitude of wind load at that instant, but also of the integrated effect of the wind over the several previous minutes.

Keeping the movements in the upper levels of the building to acceptable hu-



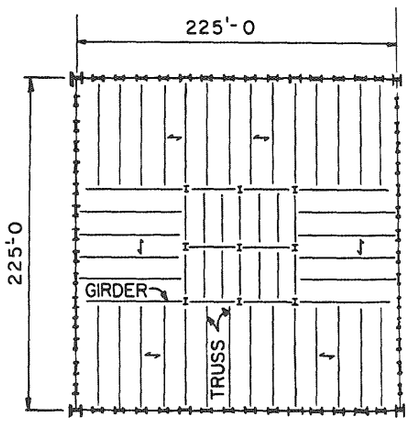


Fig. 1. Exterior frame "Tube"

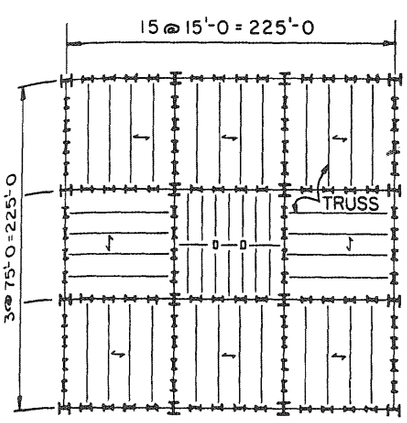


Fig. 2. Bundled framed "Tube"

Graphics Courtesy of American Institute of Steel Contruction

man tolerances is the goal of the structural engineer. Exactly what this tolerance is has been difficult to assess. Engineers today try to design structures that have inherent stiffness through engineering techniques rather than depending on dead weight to stabilize the structure. Aeroelastic models are then tested to predict the building's dynamic response and characteristics, and in turn, provide guidelines for necessary design modifications.

Despite all of the modeling techniques possible with computers, wind has managed to dodge complete quantitative analysis for two major reasons. First, unlike dead and live loads, wind loads change in magnitude and direction rapidly and even abruptly, creating effects much larger than if the same loads were applied gradually. The other reason is the problem of providing comfort to the occupants, and determining acceptable human tolerances.

Earthquake and Seismic Loading

The seismic ground motions during an earthquake do not damage a building by impact as does a wrecker's ball, or by externally applied pressure such as wind, but rather by internally generated forces caused by vibration of the building's mass. An increase in the mass has two undesirable effects on the earthquake resistant design. First, it results in an increase in the force. A second possible effect is buckling of columns and walls when the mass pushing down exerts its force on a member which was bent or moved out of plumb by the lateral forces. This phenomenon is known as P-Delta effect. The greater the vertical force, the greater the movement due to the P-Delta effect. Although codes require buildings to have larger vertical load carrying capacity as a factor of safety, the P-Delta problem is not eliminated. It is always the vertical load that causes the building to collapse. Simply put, buildings don't fall over, they fall down.

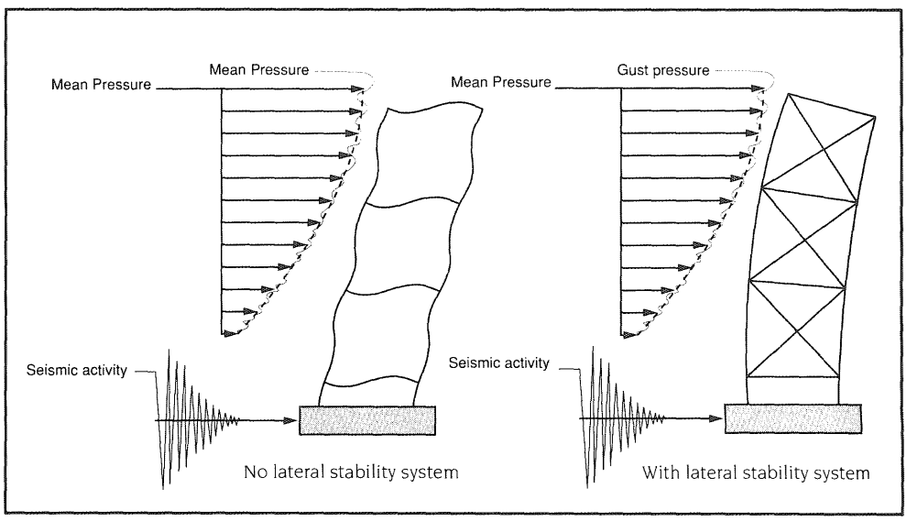
During an earthquake, the structure is compelled to conform to ground motions. Thus, the design criterion is the ability to absorb imposed deformations rather than resist applied forces. Increased earthquake safety can be achieved using lightweight materials with higher ductility and damping characteristics, providing structural symmetry and having adequate bracing and foundation. Shaking table testing on scaled models of buildings has been taking a larger role in assessing seismic response and optimizing earthquake design.

State of the Art High Rise Construction

Up until the 1960s, engineers were trained to think of tall buildings as either steel or concrete. Fazlur Khan broke this barrier in 1969 by blending steel and concrete into a single system for a 20 story building. The frame used structural steel with exterior columns and beams encased in concrete to provide lateral resistance for the building. Structural steel was used for its strength, speed of construction, and flexibility in interior planning, whereas reinforced concrete was used on the exterior for its characteristics of fireproofing, moldability, and stiffness.

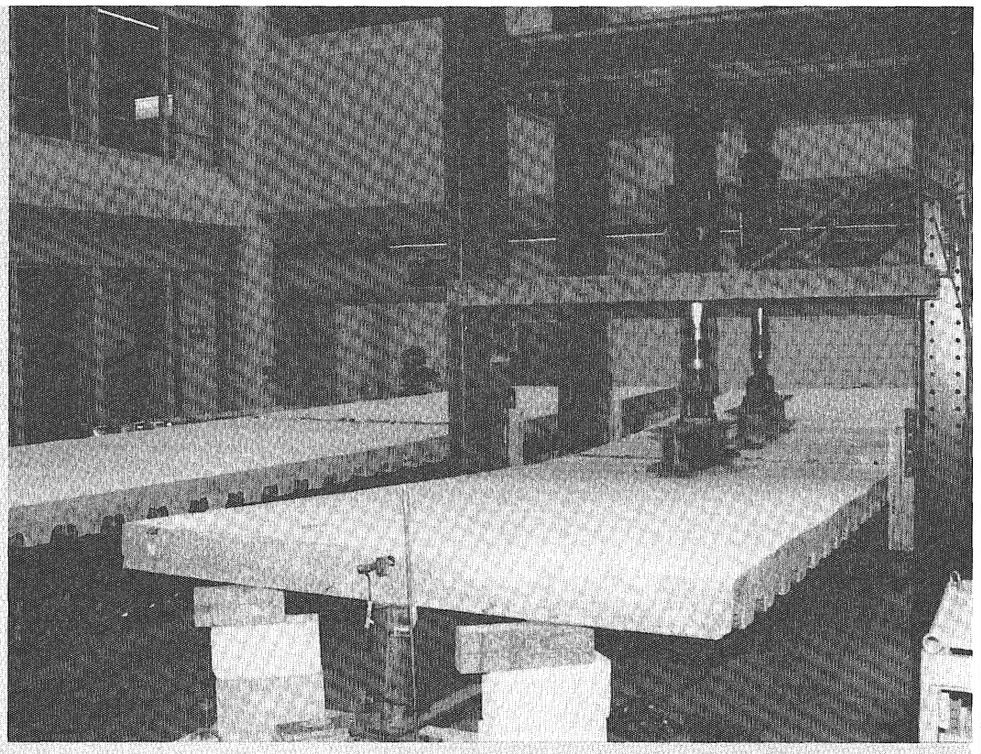
The understanding of the relative economics of composite construction resulted in the growing use of combinations of these materials. Designers overcame the steel versus concrete hangup and have since come up with many innovative combinations for lateral and gravity load resistance. These combinations frequently result in building systems that are more economical than either steel or concrete systems.

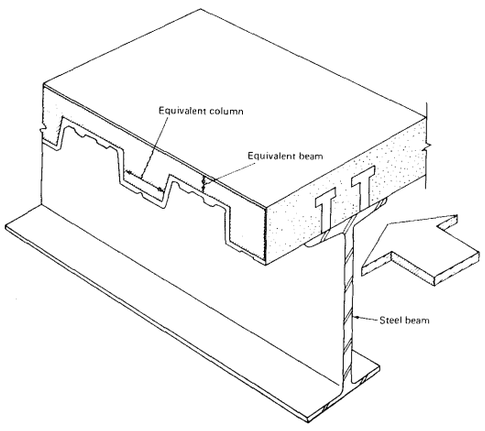
Among the systems currently in vogue for high-rise construction, the "Tube System" is the most common for buildings 50–100



Computer Illustrations by Robert Schroeder

Aiming Higher at the University of Minnesota

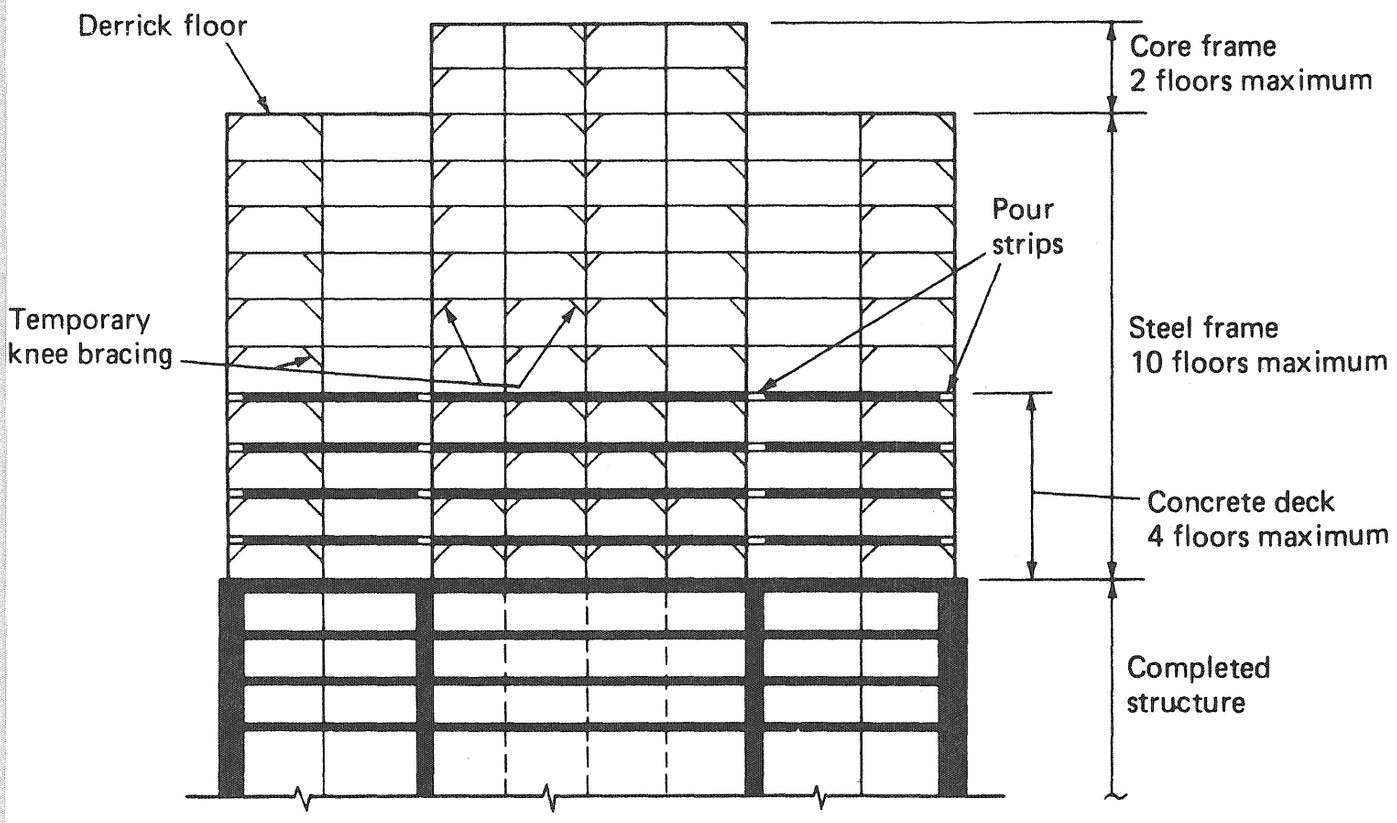




Research at the University of Minnesota has been very active in the area of composite systems and construction methods. Current research focuses on the different elements lending themselves to composite floor systems. The author has recently completed an experimental project involving construction, instrumentation, and testing to failure of six composite beams and trusses. The sizes and materials used were similar to those used in buildings currently in service. The tests included investigations of the compression member stability, time dependant response, effect of support conditions, and different construction techniques. Several other tests were also conducted in the structures laboratory to study the various connections available for composite frames and to assess their strength and serviceability when employed in lateral load resisting and frames. A study on a composite column, made using a steel section encased in concrete, was conducted during the construction of the Norwest Tower. One of the 14×14 foot megacolumns was instrumented to assess the effects of construction sequencing and time dependant behavior.

During the last 20 years, steel beams acting compositely with floor slabs have been extensively used for floor systems in high rise construction. The system uses corrugated metal decks which are used as permanent forms and have virtually replaced wood formed systems. The reduced labor costs and faster construction resulting from the elimination of form-work, combined with the facility to weld shear studs onto the beam flanges through the metal deck, have been the basic elements in its universal adaptation. It has been established that concrete slabs and steel beams act as one unit when joined together to resist horizontal shear.

In high rise construction, the slab usually takes the form of the corrugated metal deck with reinforced concrete topping, and the beams are usually rolled steel sections. The required interaction between the two is achieved by welding shear connectors to the beam top flange. Such a combination of two distinctly different materials results in significant increases in the strength and stiffness of the member in bending. Composite beams can carry larger loads or similar loads with appreciably smaller deflections, are less prone to transient vibration with respect to their steel counterparts. Composite action results in overall reduction of floor depth, long column free spans, and a good deal of savings on curtain walls, electrical wiring, and HVAC ductwork.



Fazlur Khan's design for a 20 story building, constructed from steel and concrete.

stories high. The theory governing the Tube System is to bring all or most of the gravity loads to the perimeter of the building using long span beams (50–80 ft), and then to transmit those loads smoothly through the exterior columns to the foundations. The perimeter columns and bracing system resist lateral loads by creating cantilever action. The cantilever action efficiency of Tube Systems is greatly enhanced if more than one tube is used to form a "Bundled Tube" as in the Sear's Tower, or by concentrating a large part of the total column area at the corners of the tube, forming "megacolumns," as in the Norwest Tower in Minneapolis.

The basic idea of composite construction is letting the construction of the steel frame advance to a predetermined number of stories first. The installation of permanent metal decking follows closely behind steel erection. Desired interaction between the steel beams and the concrete slab is established by welding the metal deck beams to the beam flange using shear stud connectors. Concrete topping is then placed on the deck and the column and shear walls are poured or enveloped with concrete. With proper sequencing of different trades, the construction can proceed at a pace equal to that of buildings made with only steel.

Looking up at the Future

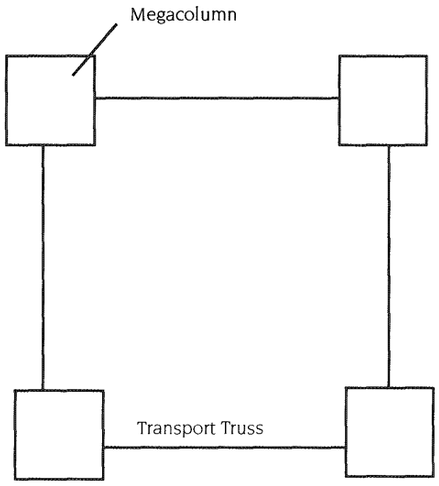
The buildings of the future will be "Intelligent Buildings," accommodating changing communications, computer, and other electronic systems. They will be more energy efficient. Walls will be solar energy collectors, putting spandrels and windows to work with photvoltaic systems incorporated into these enclosing components. There will be a need for faster (up to 80 mph) and larger elevators that

A mile-high building seems farfetched even for the next few decades.

can move horizontally to an unused shaft if necessary. Buildings will be lighter in weight, more accurately engineered and more efficient, and therefore more economical. Composite structures will be more common. Higher strength steel, concrete, aluminum, and other materials will combine into more rational and efficient factory made parts.

Someone once said you can never plan the future by the past. Even though predictions can be off,

there are some guidelines. Compared to advances in other engineering disciplines, the increase in height of buildings brought by structural innovations and computer technology is modest. The Empire State building was built in 1931 and it took around fifty years for the Sears Tower to climb 200 feet higher. A mile-high building seems far fetched even within the next few decades. Some believe the skyscraper has reached the end of the line, but as long as the cost of land continues to soar and there is a demand for an improved standard of living, there will be a demand for high rise buildings. The question we should ask is "are those megastructures necessary for the betterment of life and urban city scape or just the greed and ego of the builder?"



Megacoloumn floorplan for tall buildings of the future. As buildings get bigger, the design becomes simpler.

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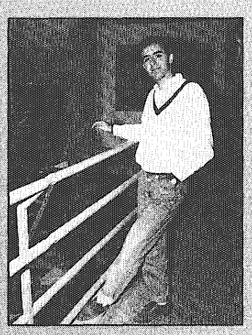


TECHNOLOG

Writer Profile: Iyad Alamsam

Iyad is a graduate student in some sort of engineering and spends a lot of his time running through building accident scenarios that would make even hard-core Hollywood disaster film veterans wince.

A Walk on the Wild Side...

Here in the carefully cloistered world of academia, we tend to view the world through the ever-so-rational eyes of science, considering concepts such as evolution as hard facts. Most of us are so accustomed to the hard rules of science that we believe there can be no truths other than our own.

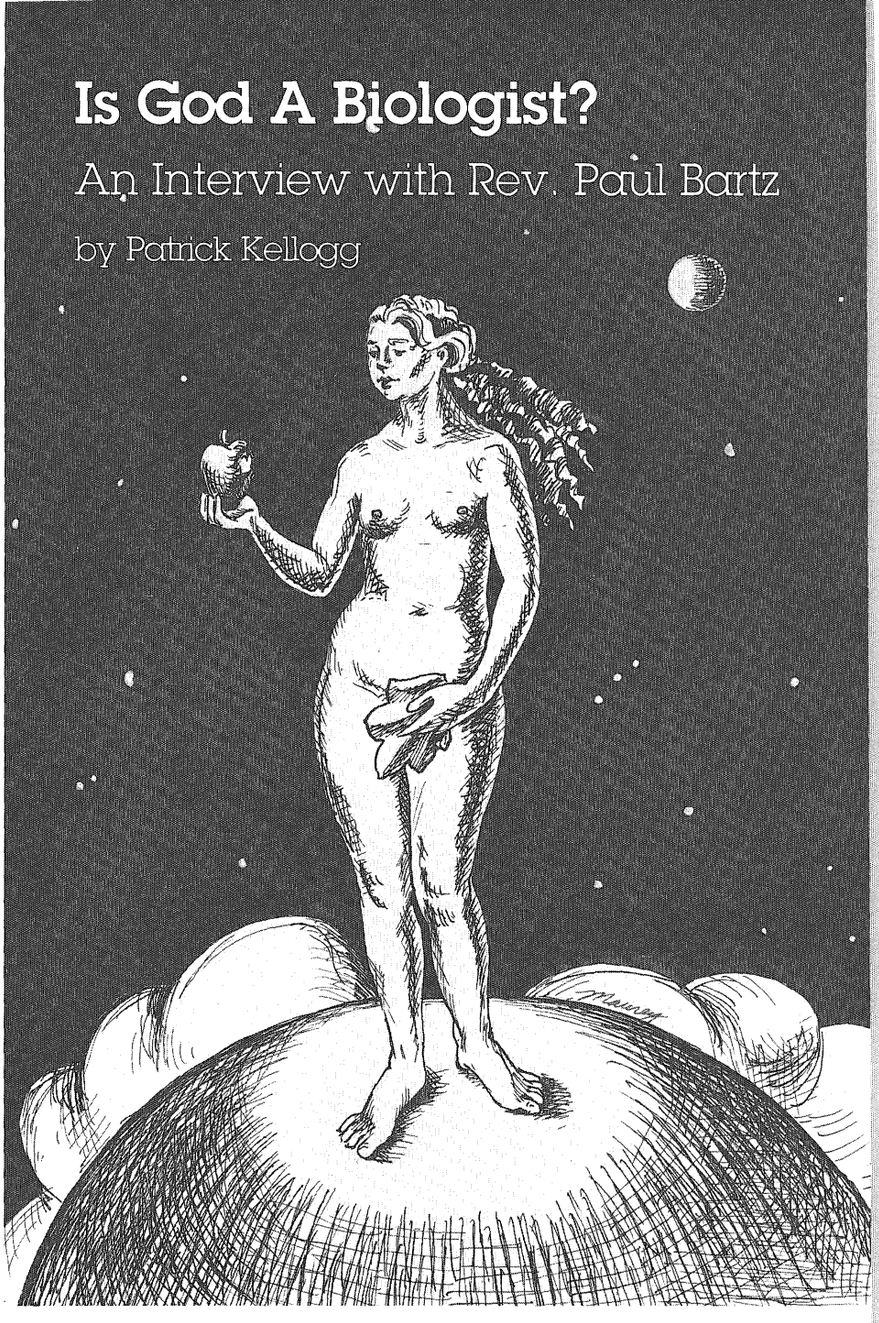
There are a good number of folks who take issue with the hard facts of science and stray wildly from the beaten path of traditional beliefs. The *Technolog* decided to venture off the well-traveled road of mainstream society and see what's out there.

The journey was a fascinating one and we hope that you will enjoy the trip as much as we did.

Is God A Biologist?

An Interview with Rev. Paul Bartz

by Patrick Kellogg



How was the earth created, and when? Biology, paleontology, and physics all have theories explaining the origin of the planet and the evolution of man. However, many religious fundamentalists disagree with those theories. They believe in a literal interpretation of the Bible—one that is irreconcilable with current scientific opinion. Or is it?

The Reverend Paul Bartz is a leading proponent of creationism. As the communications director for the Bible-Science Association (BSA), he is trying to offer scientific proof for the stories in the Bible. The BSA distributes a world-wide radio program on science that is translated into twelve languages, including Arabic and Russian. They also publish a monthly newsletter boasting over five thousand subscribers, including many scientists and engineers. The *Technolog* met with Reverend Bartz at the BSA headquarters in Coon Rapids, to hear what he had to say about science.

†

Technolog: In your newsletter, you compared the world to an "information system"; why is that?

Reverend Bartz: In biology, we're not talking about some duplicated chemical structure like you might have in a crystal, but an information system—the genetic code. And in fact, it's an information system so sophisticated that it makes our best computer storage look like writing on stone.

T: You're talking about the Genome Project? The group of scientists working right now to map the human DNA?

Bartz: Yes. If you were to store information in a DNA structure, a teaspoon would not only contain all the information needed to make human beings and everything else that is alive, but all the books ever written, and all the information man has ever recorded. We're not talking about something that is haphazard. And you don't get that kind of information system without a source of information or a designer.

T: That much information wouldn't come about randomly.

Bartz: That's right. So that's a good starting point when we're talking about biology. Then there are specifics, like the lack of transitional fossils. Now, I know that some textbooks say "here's one," but in final scrutiny, there aren't any, period.

We've had fewer hassles since Colin Peterson of the British Museum admitted that there were none, or he would have put them in his book. Now, since he's the paleontologist in charge of the Museum of Natural History, I suspect that's a good source of information!

T: And it's the important fossils that are missing?

Bartz: Yes, the important ones are missing; they're all missing when you're talking about divisions from one kind to another. And "kinds" do not equate with "species." If you look at all the different kinds of creatures, there must be over eighty million, and yet in all of the fossil records, not one of the links has ever been seen.

"Kinds" remain "kinds." The genetic process is a conservative one, where if errors creep in, they are usually corrected. If not, the animal dies.

T: So the large variety of animals on this planet have been here all along? Like the dinosaurs?

Bartz: Well, there is an excavation in North Dakota where there are dinosaur footprints and human footprints side-by-side. This

leads us to believe that, yes, they were created to live together. Then the dinosaurs died out.

T: Then at one time there were probably more species on the planet than there are today?

Bartz: Oh yes, it's like the opposite of evolution—there were more kinds of creatures back then compared to now, and many were bigger and stronger than those found today. Man, as God created him and meant him to be, was vastly superior to what he is today. We know that we use only a small part of our brain. I suspect that when man was created, he used a much greater portion.

The Reverend Paul Bartz

T: Why would his thinking decline? Why is there a "de-evolution" of man?

Bartz: Again, here we look at the consequences of man breaking fellowship with God. When man basically withdrew his love from God, at that point, the Bible said, "There will be thorns and thistles...death and sickness" (Genesis 3:18).

So, in the fossil record, you see more types of animals the earlier you go, but today there are fewer. There was a pleiosaur caught in fishermen's nets off the coast of Japan in 1977. That's a rather famous incident. It's interesting that in Japan, if you study biology or paleontology, the pleiosaur is not considered extinct; they recognize that it's alive. But in the United States, they are extinct.

T: Are biologists lying to themselves? Are they hiding something?

Bartz: We all try to interpret the world according to what we expect to find. When something contrary comes along, the first thing we try to do is fit it into the world as we understand it. And then if we can't, we set it aside.

So, both the creationists and evolutionists interpret the world according to their expectations. We're not arguing over the data; we're not going to argue that there's a creature caught in a net. What we are arguing is how we understand this creature, how we interpret the data. That means the whole issue is not a "Bible versus the science" question, it's the interpretation, which is something that goes beyond the strict scientific method. That's not to say it's bad—the scientific method simply is meant for certain things. There are other methods for other parts of life. Take history as an example. You can't study history using an empirical method. There are rules for studying history.

T: So you're saying that you really shouldn't study creation using data analysis?

Bartz: Well, pure data analysis is pure science, which will just lead you to a series of boring facts. Now, what do those facts mean? Another example, we look out into space and see that the starlight is shifted a tad to the red. That's the scientific fact. Why is it shifted to the red? Most evolutionists say that it's due to the Doppler effect. That it's due to an expanding universe that originated from a single point and that all the galaxies are moving away from each other.

But many creationists are saying that there are other things at work: gravity, dust in space. More and more, that interpretation is beginning to spread. But people and textbooks assume that the Doppler red shift expanding universe is a scientific fact. No it's not; it's an interpretation. The *red shift* is the scientific fact.

T: What are your opinions on how the earth fits into the universe?

Bartz: From what we know, when God gave man the command to subdue the earth, to utilize it for his own good and for the good of the other creatures, I believe it included everything that God placed in man's hand. So that should man reach the moon or Mars in person, those things would also be included.

As a Christian looking at it, we have an interesting situation. The Bible tells us that when man sinned, the consequences of that sin affected the entire universe. Now it seems to me, if God had made some sentient beings, and put them on a planet where they were following God's word, and all of a sudden, their world went to pieces along with ours, it just doesn't seem terribly fair!

TECHNOLOG

Writer Profile: Pat Kellogg

Pat Kellogg is a veteran writer for our little rag and enjoyed immersing himself in the alternative worlds of New Age and Creationist thought.

So as much as I like science fiction and Star Trek, which are fun stories, theologically I have to say that the Bible hints that there isn't life elsewhere.

T: That there's not sentient, intelligent life in our space; life with a soul?

Bartz: Right. And many of your readers will probably laugh at taking all these things seriously out of the scriptures, but it's important to understand that these stories aren't just in the Bible.

T: They are also in other folklores, other traditions?

Bartz: That's right. The idea that man lived for vast ages before a worldwide flood, that man fell into sin, these are ideas that can't be ignored outright. ❐

Sources

The Bible-Science Association can be reached by writing to:

P.O. Box 322457
Minneapolis MN, 55432-0457

In addition to their newsletter and radio broadcast, they do public lecture for various groups. Also, they have an extensive bookstore at their headquarters with many BSA-published books.

Doin' That Funky New Age Thing

by Patrick Kellogg

We probe the wild and wooly world of New Age culture and find goofy gadgets, good food, and our "natural energy pathways."

Hey! You there! Right now you're probably munching on a candy bar, or drinking a can of carbonated sludge and wondering why you've been feeling lazy and out-of-sorts lately. Well, mine eyes have seen the glory of the New Age. This spring, I went on a journey of discovery, trying to get back to my spiritual center, or to at least lose my beer gut. What I found was an amazing parade of quacks, frauds, and cosmic nuts. I also found a lot of wonderful people, who just might be right.

My journey began, as all good journeys should, with lunch. I decided to skip my usual meal of cold Spaghettios for something a bit more sustaining. The New Riverside Cafe—call it the "New Riv" if you want to be trendy—located on the West Bank at 329 Cedar, has a tasty assortment of vegetarian dishes. After ordering a slice of broccoli lasagna I found out there are many types of vegetarians, some following a stricter diet than others. Some vegetarians will eat chicken and others won't even eat eggs. I'm not sure which type came first. In any case, vegetar-

ian food is not only ethically pure, but healthy too.

After lunch, I walked down the street to the Evenstar bookstore. Evenstar was filled with hundreds of great books on topics I had never heard of and didn't understand. So, I drank a FREE cup of orange-flavored tea and read the business cards posted on the wall. I was starting to worry self-discovery was going to be a lot of work, until I saw an ad for spiritual massage. Now here was something I could take lying down!

Steve Sonmore is a practitioner of Shiatsu, a Japanese method of massage invented in the seventh century. He uses finger pressure, as well as stretching, rocking, and joint rotation to re-orient the body, and remove tension. Steve told me Shiatsu uses a "meridian" system to access the internal organs below the surface of the body by using the body's natural energy pathways. It sounded impressive, if not a little bit painful.

However, after five minutes, with the Machine vibrating at the "exact same frequency" as alpha-brain waves, I felt like I had a Pink Floyd laser show embedded in my nose. I had trouble driving home.

Another massage method, from China, called Tui-Na (pronounced "Twee-Na") uses acupuncture points to cut off energy channels, instead of stimulate them. Or, there's an offshoot of Zen meditation called Reiki, which sounded as inscrutable as Zen itself. In contrast, several Western methods exist, like "rolfing" which concentrates on the muscle fascia and physically smooshes the body into place. Perhaps massage wasn't going to be as gentle as I expected.

I was starting to feel a bit queasy, so it was good that I found Dr. Andrew Lucking. Dr. Lucking studied pharmacology and chiropractology for ten years, but found Western therapy to be "pretty limited." He started using natural therapies in his practice, including herbs, acupuncture, and homeopathy. Homeopathy was started in 1860 in Europe by a chemist named Samuel Hann, who studied the effects of salt, mercury, and arsenic on the human body. Hann claimed a trace amount of a chemical, an amount too small to be detectable, will have the same effect as a normal dose. Recently this claim has been ridiculed by many physicians. However, think of the advantages if homeopathy does work: "With homeopathy, the wrong prescription has no effect," Dr. Lucking states, "but with traditional medicine, the patient would develop toxicity and die." Plus, think of all the money saved on pills.

I decided Bonnie Yarger practices the best medicine of all—laughter. She is a public speaker who lectures on the power of humor. She says, "Everyone has the ability to laugh, but often don't think it should be an important part of their existence." Bonnie gives patients a questionnaire on their "laugh-lives," asking why they laugh, what makes them laugh, and who they laugh with. She then works with her patients to help them add laughter to their lives. After talking to Bonnie, I felt like laughing with the New Age, not at it.

However, it wasn't until I met Ali Wolf that I truly found the meaning of the New Age. For a brief, shining instant, I felt the power cosmic, witnessing with my "inner child" the rapture of having an expanding consciousness fill the universe at the speed of light. Trust me, it was fun. Ali Wolf, and her partner Darrell Countryman market a device called the "Paradise Machine," which sounded like a computer science student's erotic dream. It was actually a sound generator hooked up to a pair of Oakley sunglasses with a white light bulb in each lens. When I finally placed the Paradise Machine on my head, I saw...well, I saw blinking lights. I didn't expect much else. However, after five minutes, with the Machine vibrating at the "exact same frequency" as alpha-brain waves, I felt like I had a Pink Floyd laser show embedded in my nose. I had trouble driving home.

While on my journey to higher consciousness, I also met some indescribable people. There's Martin Bulgerin, who, by feeding astrology charts into his Apple IIe, developed something he calls the "A5 spectrum." I never thought an Apple IIe could provide enlightenment, but I guess it can. Then there's Paul Micheal Davies, who channels a spirit guide called "Plautus." Davies uses the Akashic method, with Plautus' help of course, to connect with a client's eternal aspect of being. Davies told me, "Plautus doesn't tell anybody anything they don't already know. He just says it louder." I asked Davies if it bothered him that a lot of people scoff at channelling. He replied nonchalantly, "Well, perhaps they'll believe in another lifetime." I liked that answer.

Well, my journey to spiritual discovery has just begun, and I don't think it's going to end soon. I just started learning about flower essences and herbs, and how they can help you live longer. And I didn't even mention the crystals and tarot deck I bought recently. Strangely enough, the most important message I've learned on my psychic journey so far is the simplest: "Wherever you go, there you are." Unless, of course, you're having an out-of-body experience, in which case you're somewhere else entirely.

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Minneapolis, MN

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The Ortho-Scientific World of Dee David Smith

by Lee Klancher

Join us for a journey into the realm of the Taksonometric Function, a multi-faceted world that exists and originated in the fertile mind of Dee David Smith.

A wooden sign hangs in the second-story window of a rambling three-story house, reading, "Fundamental Concepts Research, Dee David Smith." The lettering is painted in capital letters with a phone number underneath. A woman greets me at the front door and leads me through a cluttered entry way and into a pell-mell living room. As I wait for Dee David Smith to come down, I take in my surroundings. Musty hardcover books fill the wooden shelves lining the walls of the living room, and piles of magazines—*Scientific American*, *National Geographic*, U.S. *Catholic*, and *Nature*—and more books are stacked in an enclave next to the coat closet. The living room connects to a kitchen adorned with deeply-oiled oak furniture, blued-glass vases, and silver serving sets.

Smith comes down the stairs, ducking the ceiling. He is tall and rangy, and the simply-cut black suits he favors hang on his frame in a manner reminiscent of textbook portraits of Abe Lincoln. In contrast to Lincoln's dark curls, Smith's gray hair is short and unruly. A long, wispy, grey goatee sprouts from his chin. Silver wire-rim glasses frame his slate-blue eyes and set off the silver western-style slide tie he wears over his starched white shirt.

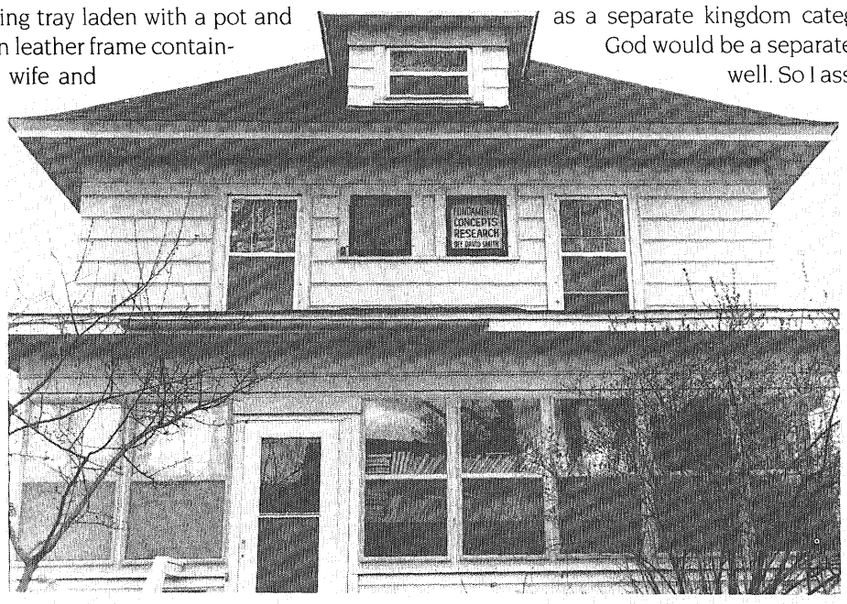
He greets me, takes my coat, and beckons me to follow him up the twisting stairwell. The walls and ceiling of the stairwell are completely covered with maps. As I wind up the stairs towards Dee David Smith's attic office, I pass a classic brown-tone map of the world, several bright blue and yellow state maps, and glossy maps cut from *National Geographic*, all smoothly pasted to the irregularly-angled wall and ceiling.

The stairwell narrows past the second floor landing and then emerges into Smith's attic office. The room is broken into several little nooks which extrude out to small windows. The largest

nook is filled with a seven-foot oak desk covered with a long row of multi-colored three-ring binders and a battered electric typewriter. A long wooden shelf is mounted on the wall behind the desk and lined with Bibles of all kinds, *Gray's Anatomy*, and an assortment of thick, unidentifiable books. Near the window hangs a slide rule case, a multi-colored assortment of foreign currency, a banner reading, "By Peace Shall Destroy Many," a photo of Oliver North, a yellowed poster reading, "Stenvig for Mayor," and an American flag.

A copy machine and a jumble of filing cabinets and bookcases are jam-packed near the desk. On one of the bookcases lies a silver serving tray laden with a pot and two teacups and a worn leather frame containing photos of Smith's wife and daughter.

Smith bases his studies in the office and has spent much of the past 44 years here, writing *The Taksonometric Function*, a book that introduces a system of categorizing all things into a precise code. This system, like Smith's home and attic office, is a complex tapestry of science, religion the paranormal, philosophy, and the occult.



The Smith Home, where it all began.

His book is actually a book of lists, breaking anything and everything imaginable into "Orthogonic categories" which are referenced with a code of digits and letters. This system does not originate from the hallowed halls of academia nor from the profit-minded research of industry. *The Taksonometric Function* outlines a unique system that classifies everything you can imagine and then some into Orthogonic categories.

The Orthogonic categories divide all things into five different "Kingdom" categories. Current popular theory classifies all things in the world into only three Kingdom categories: animals, vegetation, and inorganic matter. The categories then break down into phylum, class, order, family, genus, and species. Smith proposes that there are two other categories: humankind and God. In addition, *The Taksonometric Function* would reorder the categories into a system of digits and letters that would precisely describe each thing and its place in the universe.

Smith believes that he began formulating this theory at the tender age of three. "When I was three years old, I was almost burned to death by scalding water. Very much pain, you know. And my mother says try to think, because that will help you to not have so much pain, you know. And I said, 'What things are there? What should I think about?' She said, 'Well, there's the kingdom categories, they taught me in high school: Inorganic matter, vegetation, and animal.' So, immediately, I said, 'Well, there would be two more. Humans think, animals don't. Humans would be a separate kingdom category.' There's a great difference between humans and animals. I mean, we have a much more complex civilization than animals do. So, I have that as a separate kingdom category. God creates, so God would be a separate kingdom category as well. So I assumed that there were five kingdom categories."

While Smith's system of categorization of the Universe seems a little far out, some of his other theories stray much further from the beaten track. He claims to have proven the existence of God by statistical analysis of Genesis 1:1. He claims to have been assisted in this endeavor by seven rabbis, none of which he ever met in person. They helped him, he says, by telepathy.

"When I was first here in the Twin Cities, I got caught up with seven rabbis. I went to see a rabbi and I didn't get any help from him. But after that, I did get help, from seven rabbis by telepathy. And they helped me work out seventeen tables of statistical data proving that Genesis 1.1 is so intricate that it couldn't possibly be designed by humans," Smith said.

Smith claims that the FBI has developed technology that can detect thinking waves and that Hitler was able to produce mob violence by emitting raw animal/nature waves.

The proof is compiled in a nicely arranged booklet that shows that the occurrences of combinations of Hebrew characters in Genesis 1.1 are statistically improbable. This method of valuating letters is called *gematria* and was originally developed by a group of rabbis who formed an occult religious philosophy called the *cabala*. The booklet shows long lists of occurrences of each character and the "probable" occurrence of each character. In the cases where the actual strays from the probable, the type of character partially determines the meaning ascribed

to the difference. In any case, Smith states that the fact that the actual differs from the probable several times is proof that God exists.

Then there are the seven rabbis who communed with Smith telepathically. Smith is an unabashed believer in telepathy and explained that the brain is an electro-chemical organ and, like any machine that uses electricity, gives off electromagnetic waves. The waves given off by the brain, he says, can be divided into three different types: thinking waves, telepathy waves, and animal/nature (emotion) waves. Smith claims that the FBI has developed technology that can detect thinking waves and that Hitler was able to produce mob violence by emitting raw animal/nature waves. Telepathy, he said, is somewhere between the two types of brain waves.

"I don't know if you are able to hear people thinking or not. Well, you may get to get it. A thought will come to you and it's in a voice and you will think, 'Boy, nobody's talking to me and I'm hearing.' That's what's called telepathy,"

"I don't know if you are able to hear people thinking or not. Well, you may get to get it. A thought will come to you and it's in a voice and you will think, 'Boy, nobody's talking to me and I'm hearing.' That's what's called telepathy," Smith said. He cautions, though, that telepathy is not particularly reliable, mainly because you never know whose thoughts you're picking up and how their thoughts pertain to your life.

Smith juxtaposes these stellar concepts with some very down-to-earth beliefs. He is a strong believer that man has to think for himself and cannot be led by a leader who stresses only obedience. He also strongly advocates voting, saying that too many Christians view the world of politics as of no concern to them and thereby refuse to vote. In relating the larger meaning of his system, he explained that a person's ideological outlook on life would fit into his system of categories. "The pure materialist would say that life is just a chemical phenomena. He would have a one-dimensional system. In other words, his code, his life would be real simple." The crux of his system is bringing mathematics, chemistry—all the trappings of science—in as a part of the meaning of our existence.

Smith's views may not appease the masses and they certainly aren't for everyone, but he is aware of that and expresses his thoughts without apology. "If it's logical, I'll use it. If you think I'm insane, that's tough," he said. Whatever else he may be, Dee David Smith is most certainly an original thinker. Only time will tell what he will come up with in the years to come. ❐

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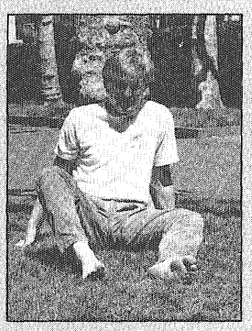


TECHNOLOG

Writer Profile: Lee Klancher

Lee Klancher, the current Editor-in-Chief, recently returned from Berkeley where he and other *Technolog* staffers attended the annual ECMA convention. Seen here on the last day of the trip, Lee is waking up in a public park after a hard night of celebration. No socks? No shoes? What happened, Lee? It's obvious that the rest of us missed quite a party! We're all going to miss Lee, as well—this is his final issue as Editor.

High Definition Television

by Chris Klassen

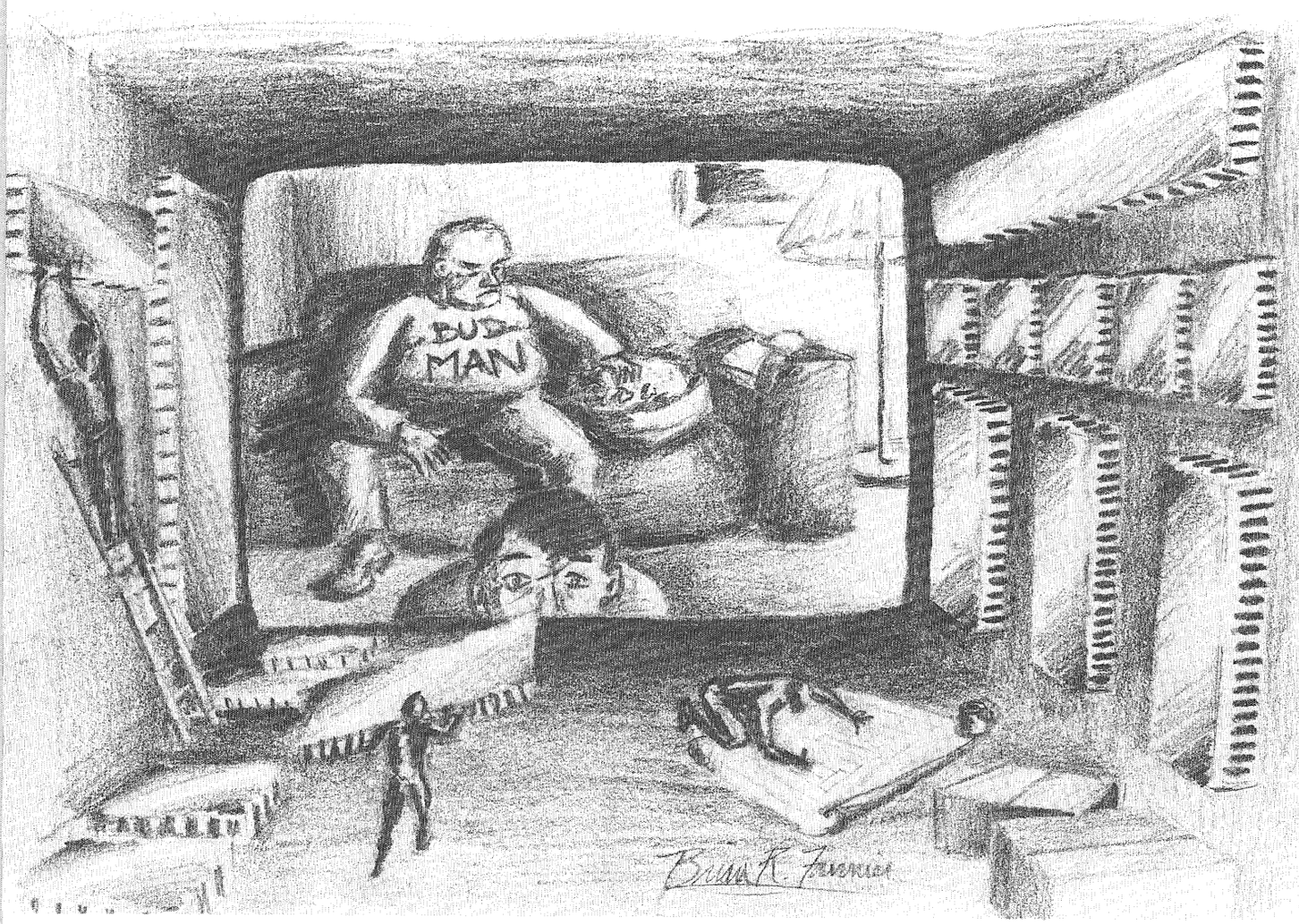
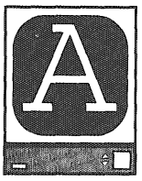


Illustration by Brian Fournier



new technology is in the works. It's called High Definition Television (HDTV), and it could have widespread implications and applications. In 1953, the National Television System Committee (NTSC) established standards for a color television system. Since then, HDTV has revolutionized television technology. HDTV has been spotlighted at consumer electronic shows and soon will be accessible to the public. The NTSC will set HDTV standards in 1993 that will pave the way for HDTV to come to your living room. Meanwhile, a virtual economic and technological war is being waged to capture the HDTV market and the profits.

High Definition Television is all that the name implies, producing an image equivalent to that of 35 mm film and sound comparable to that of a compact disk. It does this by integrating several new technologies and strategies, with improvements in the current television system, and new digital techniques and displays. Transmission of the signal must be compatible with existing receivers and may use fiber optic technology. There are several forces driving this technology, including economic and defense concerns that have prompted nations to develop and research HDTV to differing degrees.

HDTV's "Black Box"

The current system operating in America, Japan, and a number of other countries is commonly referred to as the NTSC system. The standard system was established by the National Television System Committee (NTSC) in 1941. The NTSC standard broadcast consists of three signals: one luminance or black and white signal, and two chrominance or color signals that provide information to approximately 336,000 pixels, or dots of the screen. The signals are broadcast simultaneously, in an interwoven pattern, and as a result interfere with one another, disrupting the picture (television engineers call them artifacts). Additional disruptions arise due to the nature of the scanning. NTSC receivers consist of a cathode ray tube (CRT) that scans an electron beam horizontally across 525 lines of a phosphorous–coated screen. The light emitted by the phosphorous passes through red, green, and blue filters at each pixel, collectively producing the image on the screen. The electron beam first scans over 262.5 lines of the frame alternating every other one. It then returns to scan the remaining blank 262.5 lines. Several defects arise due to this type of scanning which in television engineering is called interlaced scanning.

When designers set out to find a new television technology, one of the most important objective was to eliminate the defects inherent in the NTSC system and to increase the fine detail of the image. Resolution increases by a factor of two when the signal interference and scanning method of the NTSC are improved. Comb filters are used to effectively separate the chrominance and luminance signals, while scanning is modified to what is called progressive scanning. In this mode, all of the lines are scanned sequentially, rather than scanning every other line. Resolution also depends on the total number of pixels of the display. HDTV systems increases the number of pixels to approximately 2 million. For comparison, conventional NTSC receivers contain only 336,000 pixels.

HDTV is superior to NTSC in analog to digital conversion. The three "p's" of signal technology (processing, protection, and preservation) use digital processing. Digital processing eases the transition from interlaced to progressive scanning. Digital operation also decreases the amount of noise and errors in recording and transmission. Digital signals stored in memory preserve the signal for a still-frame, picture–in–picture displays, or storage on tape and disk.

Although increased resolution is an advantage over a standard television, HDTV will take advantage of the way we view the world by using a wider screen. By taking advantage of more of our peripheral vision, HDTV will appear roomier than the cramped width of current television sets. Proposed aspect ratios (width to height ratios) of 1.78 give HDTV sets rectangular screens.

High Definition Television is all that the name implies, producing an image equivalent to that of 35 mm film and sound comparable to that of a compact disk.

To take full advantage of HDTV, the screen's dimensions will be larger than cathode ray tubes (CRT) allow. CRTs are limited to a screen diagonal of 40 inches, beyond which unacceptable increases in receiver depth, width and voltage requirements exist. Researchers are currently developing several new flat panel displays that would allow the screen to surpass a 40 inch diagonal. Although flat panel display systems have not exceeded CRT image quality, they would allow the construction of a flat television set which could be mounted on your wall like a picture frame.

These new screen technologies include liquid crystal displays (LCDs), electroluminescence (EL) and plasma. LCDs use crystals that alter their orientation in the presence of an applied voltage. This changes their refractive index and subsequently the amount of light passing through the color filters. One obstacle to LCD operation is the large numbers of transistors required. If even one transistor is defective, the screen is useless. Another technology, electroluminescence (EL), induces the screen's phosphorous to glow by directing an electric current to each pixel, or dot on the screen. Plasma displays use electric currents to cause a gas at each pixel to emit light, which in turn causes the phosphorous to glow. EL and Plasma displays both possess limited gray scales and require high power levels.

One of the problems with HDTV is producing a broadcast that is compatible with the existing 162 million NTSC receivers. In 1988, the FCC ruled that the HDTV standards, to be established in 1993, must use only the current NTSC standard VHF and UHF channels. The presence of HDTV in this region places additional demand on spectrum space that already is burdened with the NTSC. The solution in some cases may be to allow broadcast on so called "taboo channels," or those channels restricted for broadcast, to decrease channel to channel interference.

There is a problem broadcasting HDTV over standard local channels. HDTV sends more information and requires a wider bandwidth than standard television broadcasts. A number of scenarios have been proposed to send the additional information without immediately shutting out owners of standard television sets.

One such scenario would be to broadcast both an HDTV signal and a separate NTSC signal for both types of receivers. This procedure, called simulcasting, avoids any compatibility requirements with NTSC. Proponents of this strategy expect a quick phase out of NTSC receivers in favor of HDTV. Another scenario combines the NTSC signal with the HDTV signal.

Local broadcasting is problematic, but cable and satellite can better accommodate HDTV broadcast. Cable possesses more channels and is shielded against outside interference. The cable industry is in the process of converting their lines to fiber optics. The advantages include nearly unlimited channel capacity, low cost, and immunity to electrical and magnetic phenomena. The phone companies also have legislation pending to grant them permission to broadcast HDTV signals over their fiber optics networks and compete with the cable industry. Satellite is another avenue that can be used to broadcast HDTV signals to the public, and has been used in Japan since 1989.

HDTV Implications

There are certain economic forces at work in HDTV, driving nations to research and develop this technology in the hopes of capturing the market. These forces include the projected market, the ripple effect, and HDTV's potential applications.

The projected market is estimated to be worth billions of dollars a year. One estimate, made by the American Electronics Association, places the cumulative market at $500 billion. Initial costs for HDTV receivers are predicted to be $4,300 with costs tapering to $2,300 after five years and down to $1,600 ten years after their introduction.

With the aid of a robotically controlled microscope, HDTV is already being used by pathologists to diagnose diseases in samples hundreds of miles away.

HDTV is expected to cause a ripple effect in the electronics industry because it requires a large array of electrical components. As research progresses, new techniques in electronics will be invented, creating broad "spin-off" effects as components such as transistors, integrated circuits, and fiber optic technology are manufactured and eventually applied to other technologies. Don Ritter (R–PA) has stated, "To miss out on HDTV is to miss out on the 21st century."

The potential applications range far beyond the consumer electronic market to printing and publishing, teleconferencing, medicine, monitoring of manufacturing operations, and computers. The computer industry will enjoy enhanced graphics, computer memory, and increased efficiency of chip manufacturing as a direct result of HDTV. With the aid of a robotically controlled microscope, HDTV is already being used by pathologists to diagnose diseases in samples hundreds of miles away.

This technology has further applications in the area of national defense, for use in cockpit displays, satellite imaging, and training and simulation. This raises an interesting question. To what degree does the United States pursue this and related technologies in the interest of national defense? The answer seems to be provided by the United States Department of Defense which has "taken the position that national security requires an assured

domestic supply of the highest performance and highest quality technology in our industrial base." Dr. Craig Fields, director of the Pentagon's Defense Advance Research Project Agency (DARPA) offers three reasons for this position. "One is mobilization. Stockpiling of high technology items is impractical because of the rapidity of change. In high technology, it is impossible to assure alternative sources of foreign supply for any but the most common items. A second and more compelling reason is that the defense industrial base cannot be separate from the much larger volume commercial and consumer industrial bases, and as the civilian industrial base moves off shore the risk for defense sharply increases. In other words, it is hard to separate national security and economic strength. Third and most troublesome, if our military adversaries turn to the companies in foreign countries for their weapon systems technology, and if that technology is more advanced or available earlier than in the US, we will be in serious trouble."

HDTV Responses

These implications have prompted nations to respond in varying degrees and manners. Japan's government invested $500 million to develop an HDTV studio system and adapted it direct broadcast by satellite to provide the first HDTV operation available to the public. The European Economic Community has cooperated in a joint venture with 11 countries and spent $200 million in research and development of their Eureka HDTV system. Meanwhile, United States efforts have been through DARPA, with $30 million going to small innovative companies for display technology research and development.

This could be the United States' opportunity to invigorate its ailing electronics industry. Fully "one third of our electronics trade deficit with Japan—around $7 billion is due to lack of U.S. presence in consumer electronics." In 1993, the FCC will establish HDTV standards and with it the extent of United States involvement and subsequent electronic invigoration. Five proposals are on the table, three American, one Japanese, and one European. Tests of these systems will begin in April and proceed for one year, after which one system will be chosen as the standard. It appears the FCC will be generous to American interests but Japan maintains a powerful Washington lobby.

HDTV, in contrast with the NTSC system, will be like putting on new glasses for the first time. The resolution will be sharper, the image brighter, and the color enhanced because of technological advances in television engineering. The national economy, defense industry, and numerous other fields provide compelling reasons for America to invest in this and related technologies. It must do so to retain its leading role as technological innovator of the world.

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AUTHOR BIO
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TECHNOLOG

Writer Profile: Chris Klassen

Chris is a junior in Chemical Engineering and this is his first full-length article for the *Technolog*. For the HDTV article, we had him conduct extensive research about television. Consequently, he spent several long nights watching old episodes of the *Twilight Zone* and Mr. *Ed* re-runs. As we hear it, he'll never be the same.

News

Earth: Just a Weird Accident?

Observing new planets may give us answers

by Pat Hefner

Planetary researchers have an interest in finding out if Earth's life-supporting characteristics are in fact a common occurrence in the Universe or if they are a rarity. But a significant obstacle to doing this is the lack of planets to study.

If we are the result of a common, recurring pattern in the universe, there is quite possibly life similar to Earth's on other planets

According to University of Minnesota Professor Robert O. Pepin, we understand planets by observation, but as of yet, "we have only one example...we need lots of examples."

Well, we just might have some more. This January a report was released by the National Research Council's Committee on Planetary and Lunar Exploration, which says that in the next 10–30 years yet unknown planets may be pinpointed by us and used for observation. Evidence of a planet orbiting the star Van Biesbroeck 8 and a disc of particles associated with planet formation near the star Beta Pictoris gave incentive to start the report in 1984 (*Science News*, Jan. 1991).

The committee has urged NASA to start a project that will consist of monitoring 100 or more stars to see if there are planets orbiting them. One of two methods will be used to do this. The first is the use of an astrometric telescope, which searches for any wobbling motion in the normally straight-moving stars. A planet circling one of the stars can be the cause of this wobbling. The second method is the Radial Velocity Approach, which looks for a "Doppler shift," also associated with an orbiting planet, and which changes the frequency of the light emitted from the star.

So what is the importance of all this? So there are a few more planets out there—why should we go to all the trouble and expense of finding and observing them? According to Pepin, who is former chairman of the committee, there is a strong philosophical aspect of this research. In our universe, are there many opportunities for life to develop? Are the factors that resulted in living organisms on Earth common elsewhere? Or is it that, as Pepin states, "We could be the end result of a weird accident." The underlying theme is to conclude whether life exists in other places. This goal is at the heart of research involved in planetary observation.

It could be that planets yet to be found and observed are sterile, uninhabitable masses of matter completely devoid of life. But, if we are the result of a common, recurring pattern in the universe, there is quite possibly life similar to Earth's on other planets. If this is the case, maybe some of the life forms are similar to us. Perhaps we're not alone. And if the committee gets NASA's full cooperation in getting the project underway, time will tell.

Don't Have a Cow, Man

Nuclear industry gets up in arms over cynical *Simpsons* episode

Members of the American Nuclear Society (ANS) are not enchanted with *The Simpsons*, the extraordinarily popular prime-time television cartoon show featuring the family of a nuclear reactor employee. Last year ANS and the U.S. Council for Energy Awareness (USCEA) mounted a membership letter-writing campaign protesting the program's unflattering portrayal of the nuclear industry—one of this season's episodes featured a radioactive, three-eyed fish.

In responding to the protests, Fox Broadcasting Company executives agreed to take a USCEA-guided tour of a California nuclear power plant. Sam Simon, executive producer of *The Simpsons* said the tour "had changed a lot of minds."

By January, ANS felt victory in its grasp. The February issue of ANS *News* announced that the program's producers had agreed to stop taking "cheap shots" at the industry, and solemnly concluded: "Evidence shows that making the mass media representatives aware of lapses in

The February issue of ANS News *announced that the program's producers had agreed to stop taking "cheap shots" at the industry.*

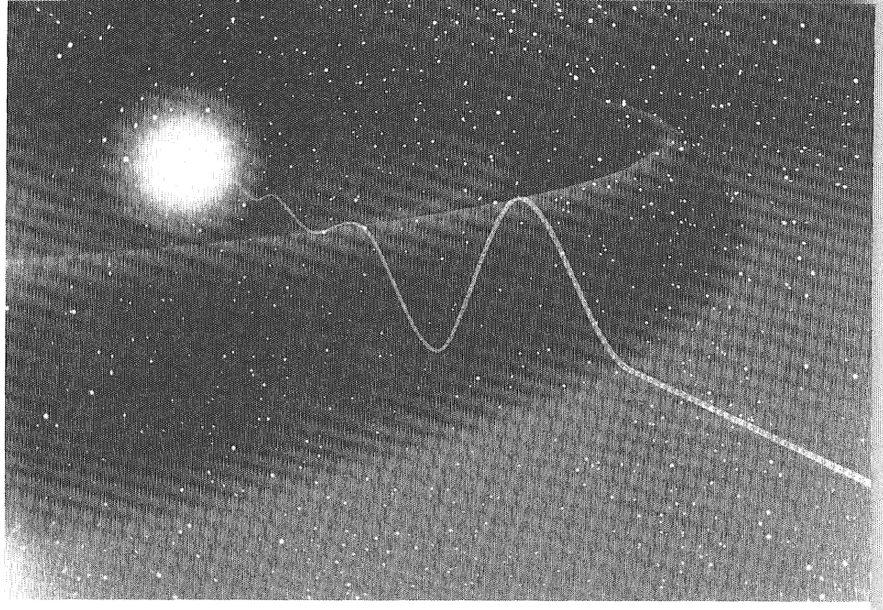
responsible programming makes a difference." But an editorial note admitted that on January 3, just as the industry was declaring victory, the episode with the three-eyed fish was rerun. "The fight continues," vows ANS.

This story courtesy of *The Bulletin of the Atomic Scientists*.

The Astronomers

Spectacular television series highlights the heavens

by Kim Harris



Gravity waves, as yet undetected but predicted by Albert Einstein, are the topic of the May 6 episode, *Waves of the Future*.

"The Universe is a raisin pudding." Perhaps you've heard this analogy of the expansion of the Universe, perhaps not. Its origin is even more unlikely; a young monk who was kicked out of the Rama Krishna Buddhist sect in San Fransisco in 1967. You might ask, "Why would a monk be thrown out on the street?" Simple. He was obsessed with making telescopes and showing the heavens to people on the street.

John Dobson, the inventor of the revolutionary Dobsonian telescope, is just one of the people featured in the multi-million dollar series *The Astronomers* presented by KCET/Los Angeles. The six-part series, narrated by actor Richard Chamberlain, was made possible by a $5.3-million grant from the W.M. Keck Foundation and began airing locally Monday, April 15, at 8:00 pm on KTCA channel 2.

In conjunction with the series, St. Martin's Press has published *The Astronomers*, an illustrated companion book written by award-winning editor, writer, and teacher Donald Goldsmith. The book and the series provide a behind-the-scenes look at the men and women who have shaped our understanding of the universe. "The Astronomers" National Science Education Outreach, also made possible by the generous grant from the W.M. Keck Foundation, was launched in February and is designed to motivate students to consider careers in scientific fields.

The upcoming shows include:

Waves of the Future	May 6
Stardust	May 13
Prospecting for Planets	May 20

Waves of the Future airs May 6 at 8:00 pm and discusses the important new investigations of a phenomenon that has yet to be detected—gravity waves. Predicted by Albert Einstein in 1915 in his theory of general relativity, these waves may hold the key to many of the secrets of the universe. Described as ripples in four dimensions (space-time), gravity waves cause no destruction as they pass through matter, and are weak on all but the largest scales.

Long-time friends and collaborators, Kip Thorne of the California Institute of Technology and Leonid Grishchuk of Moscow's Sternberg Astronomical Institute are featured. The professional and private lives of the two scientists are shown in scenes varying from Grishchuk's country "dacha" and a Soviet neutrino observatory to Thorne's retreat in Oregon and his laboratory at Cal Tech. The scientists discuss their plans for detecting the elusive gravity waves and display a prototype of LIGO (Laser Interferometer Gravitational-Wave Observatory), which they hope will soon be funded by the United States. The theorists are joined in the final minutes of the episode by another scientist who sees with a "telescope of the mind," the famous Cambridge theorist Stephen Hawking.

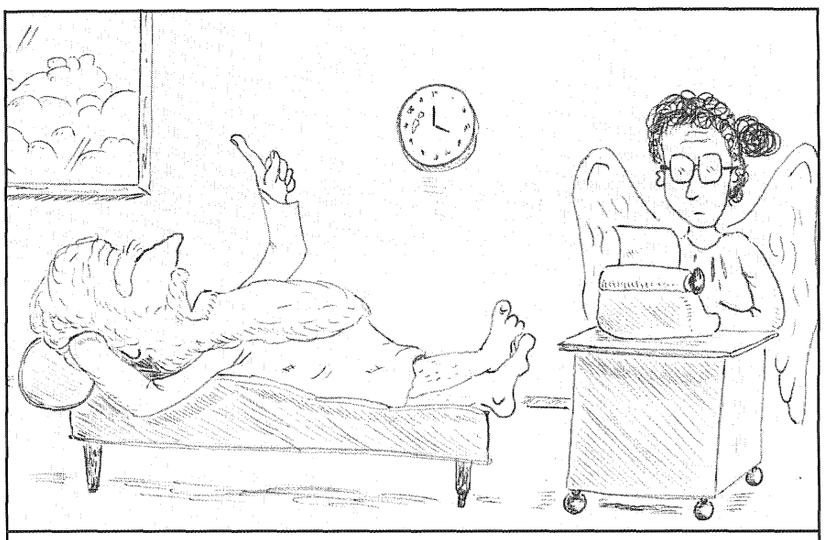
Stardust airs May 13 and follows the men and women who investigate how stars are born, when we can actually see a "newborn" star, what makes them burn, and why they either die quietly or explode violently as supernovae.

Prospecting for Planets airs May 20 and focuses on the astronomers who are developing new methods of searching for planetary systems around other stars. Also featured are the researchers who followed the Voyager missions to examine the planets of our own system more closely.

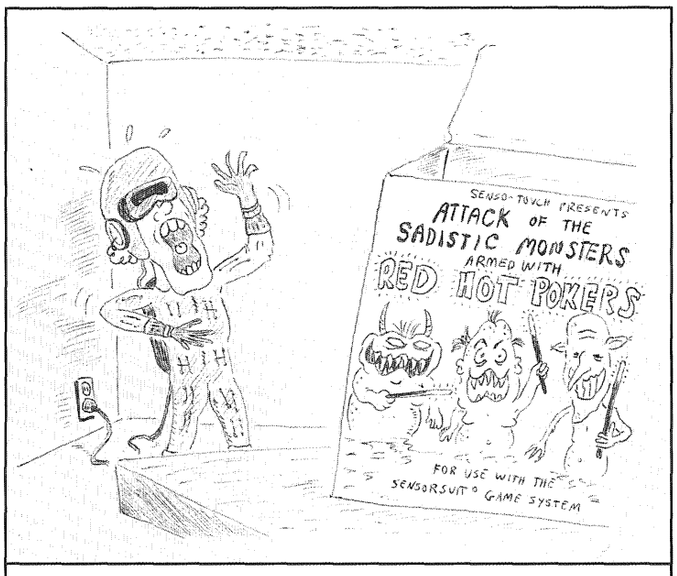
The complex cosmic phenomena and scientific concepts discussed in *The Astronomers* were illustrated using ground-breaking computer imagery. The extraordinary effects were created by the Kleiser-Walczak Construction Company, Sidley Wright and Associates, and Digital Animation Laboratory, three Los Angeles-based computer graphics companies. "We are attempting to make the invisible visible," explained Blain Baggett, the executive producer for the series. "Many of the animations involve the creation of new computer software reflecting both art and mathematics."

John Dobson loves to quote New Zealand astronomer Graham Loftus: "What we need is a big telescope in every village and hamlet, and some bloke there with that fire in his eye who can show something of the glory the world sails in." *The Astronomers* gives us a personal look at those blokes.

Diversions



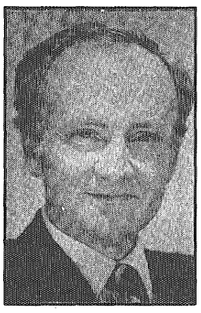
OK, so far I've got light, the Heavens and the Earth, blah, blah, blah...and this is good. So to even things out, let there be disease, earthquakes, cellulite, woodticks, and The New Kids on the Block.



Bob loses again.

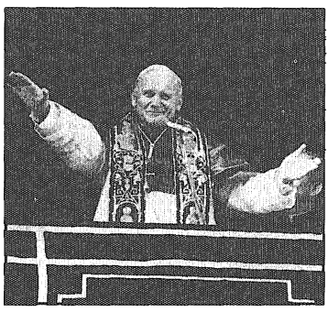
Separated At Birth?

We noticed some startling resemblances in the following people and thought we would share them with you. Frankly, we think these improbable relationships could explain a lot, if you really think about.



"U" President Nils Hasselmo

and



Pope John Paul II?

IT Dean Ettore Infante

and

Inet the Ewok?

Senator Paul Wellstone

and

Larry of the Three Stooges?

Governor Arne Carlson

and

Stalin?

A Session With Destiny

by Frank McQuarry

I looked across the room at the leather sofa. "These days will soon be gone," I thought. The doctor was already leaning back in the chair next to the sofa, packing his pipe.

"Lie down. Relax. How are you feeling today?" he asked.

"Oh, not too bad," I replied.

"I understand that you are graduating soon..."

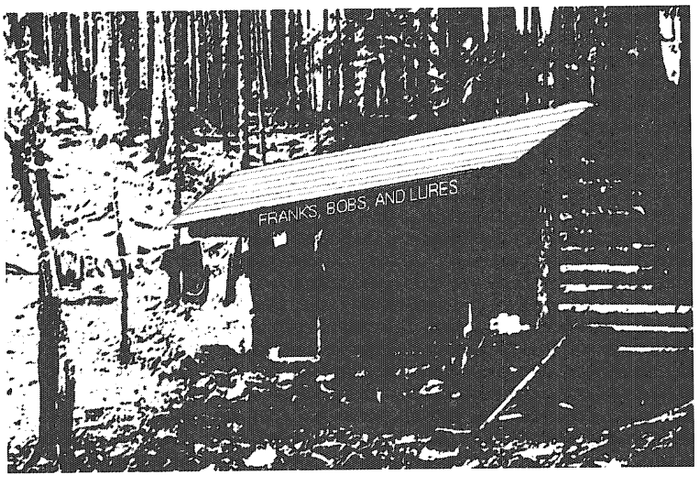
That was enough. The mere suggestion of graduation is impetus for heaving and sobbing. The good doctor waited for the last tear and handed me some Kleenex.

"Thank (sob) you," I said.

"Tell me what's so terrible about graduating."

"Well, it's nothing really," I said, "It's just that I was raised as a Catholic."

"What does Catholicism have to do with graduating?"



"When I first started college, graduation seemed so far away. I had this vision of having a pair of wings issued to me with my diploma. I would put the wings on and, while clutching my diploma, would go fluttering off into the private sector."

"Well, now I know that this is not going to happen. I feel cheated. I have an overwhelming desire to go out and buy a 'There Is No Free Lunch' T-shirt."

"What kind of entry-level job is waiting for me when I get out? Will I have to open a store called, 'Frank's Bobs and Lures' in some town like Ogilivie, Minnesota because the recruiters are just not coming to campus this year?"

"And the job search is out to get me. I could apply for the job as Water Boy for the villagers and I'd probably get a response like, 'Although we find your qualifications interesting we feel that they do not quite meet the requirements needed to fetch water for our town... sincerely... the villagers.' "

"Last night, I had a nightmare about the power elite in the U.S. It was kind of a graphing dream in 3-D so bear with me."

"At the bottom of the graph was the generic rich and powerful person. One level up were all the people the rich and powerful person did favors for—the secondary rich and powerful. One level above the secondary powerful were placed the people the secondary rich did favors for; the tertiary people. The graph stretched upwards into all the little people. It looked like some kind of parabaloid."

"Then I imagined all the other primary rich and powerful people having similiar graphs. The whole thing looked like a set of cow utters."

"I woke up panting, shivering, in a cold sweat. I wondered which utter I was on, and who was doing the milking. The whole thing was so scary, I couldn't get back to sleep."

"I lay awake in bed all night worrying about things. Before long, I was thinking of my brothers Alan, Richard, and Tom. It occured to me that if you put together the first letters of our names it would spell F.A.R.T. Did Mom and Dad plan it this way? What did they have in mind when they did that?"

"What if people find out about it? Imagine making dinner reservations for quality time with my brothers and having the Maitre D' say something like, 'Dinner at 7:30 pm for FART. We'll see you then.' "

"It was not long before my mind turned to even larger worries. What if some big foreign power learned how to produce smegma and armed a warhead with it?"

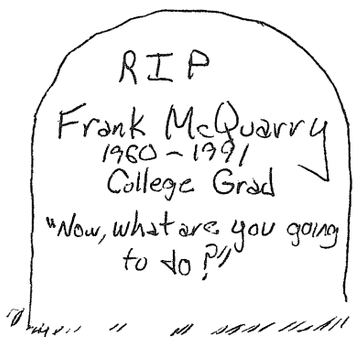
"Have you ever looked that word up in the dictionary? The definition is 'a thick, foul–smelling cheese–like sebacious secretion.' Who's job is it to sit around and think up phrases like that?"

"What a frightening thought. You can throw nuclear bombs out the..."

He slapped me. The doctor didn't seem to be quite satisfied, so he slapped me a couple more times. His hand reached out and crushed my lips closed. "Frank," he said, "Shut up. Shut up or I will have to kill you."

I nodded my head in agreement and he let go. "Get out. Get out now, while you still can." He started opening his desk drawer and reaching in. I started backing out of the room slowly.

I hoped the doctor would wait until after I graduate before he killed me. The image of my tombstone lurked in my mind. It looked like this:



Frank McQuarry is a twisted and bitter man (in other words, he is a Senior) and is graduating with a degree in Math and an attitude. Once again, Frank has eluded our team of photographers and our readers are left to wonder what the quick-witted McQuarry actually looks like.

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