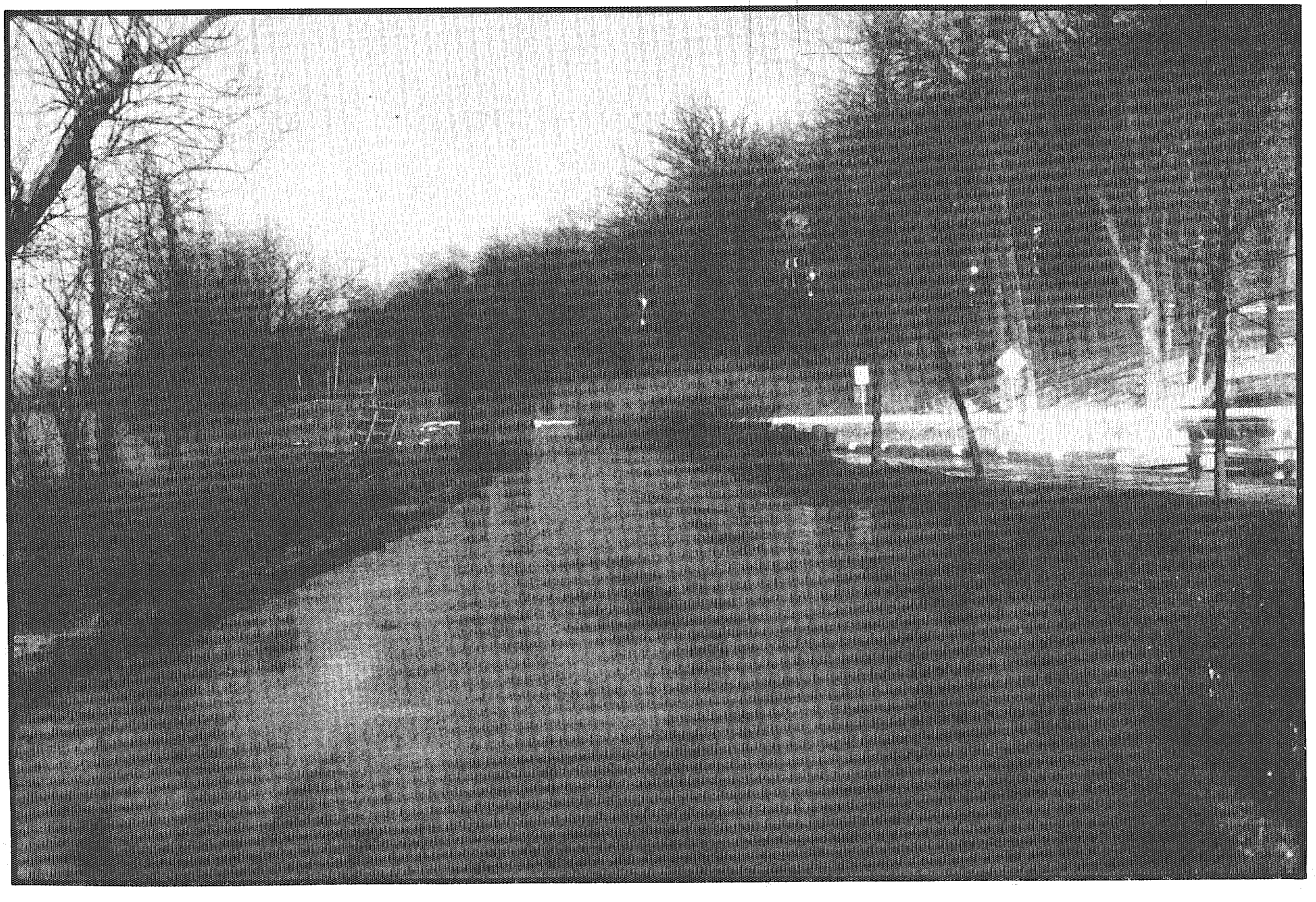
minnesota **Technolog** fall1 1977

Job Outlook
Space Shuttle
Captain Phlegm Phlagm



Our business is aircraft, aerospace, electronics, automation, hospital services, etc...

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Sure, we're into fast, exciting fields, but at McDonnell Douglas we realize that our industry growth and our company growth depend on how fast our people grow.

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B. J. Waller, Professional Employment, McDonnell Douglas Astronautics Co., 5301 Bolsa Ave., Huntington Beach, CA 92447,

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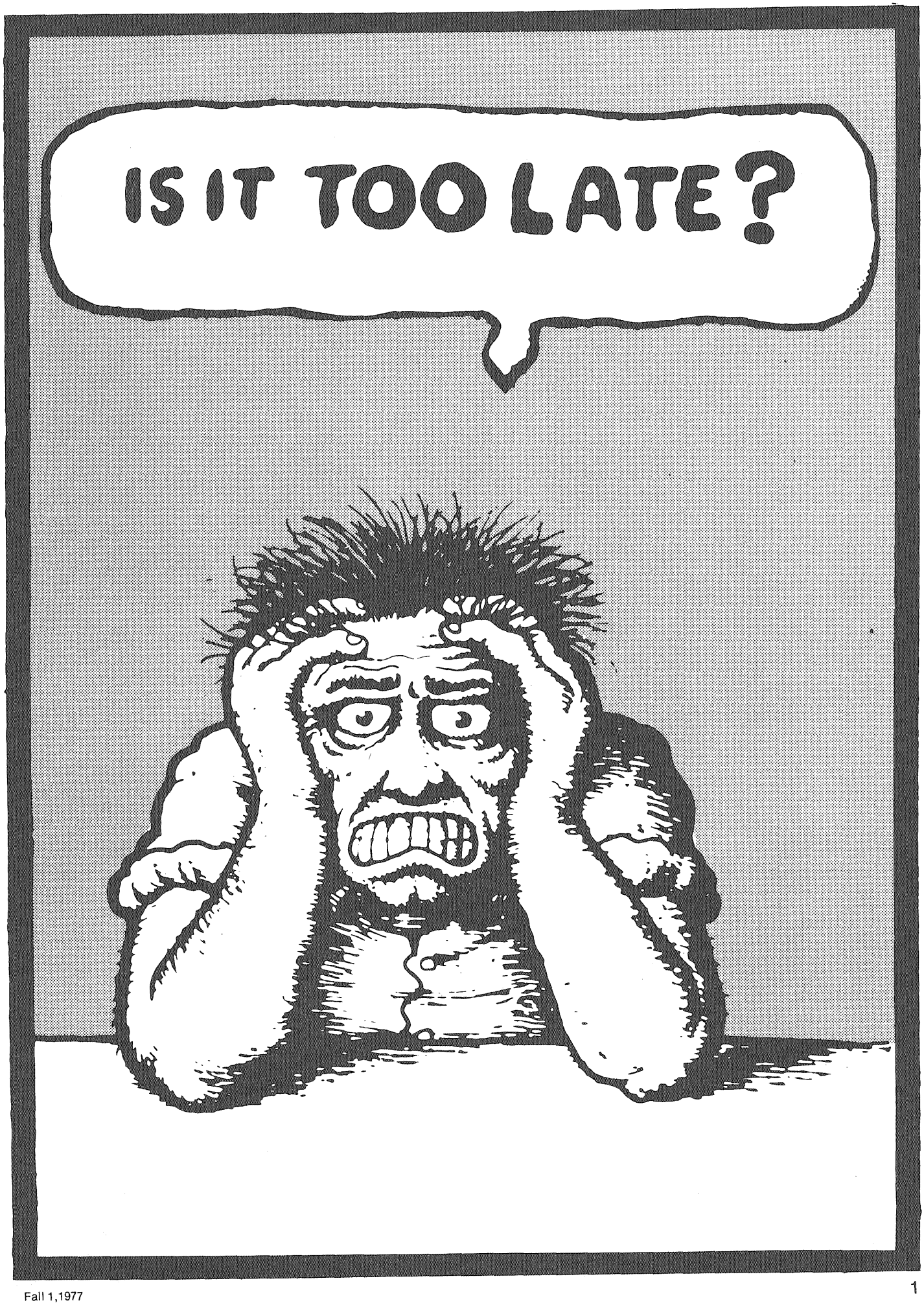
IS IT TOO LATE?

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 Vol. 58 No. 1

EDITOR'S PAGE

Support Your Local Magazine

The oldest continuing University of Minnesota student publication is in trouble.

We don't mean the **Daily**. The Minnesota **Technolog**, the official undergraduate magazine of the Institute of Technology over 55 years old, is the publication we are referring to.

You are now reading a magazine, that while devoted to matters of interest to student engineers, scientists and architects, is mainly staffed by journalism, business and other liberal arts students. This magazine also faces the possibility of having its $1 per quarter per student subsidy reduced or eliminated, if two opinion polls being taken this quarter among IT students show that the **Technolog** has little support of readership from the IT student body.

Many technical students obviously do not see the need for a technical magazine. It does seem somewhat paradoxical that a technical and scientific college is the only one at the University to put out its own magazine. After all, IT students are not known for their writing ability. And how in the world would they ever find time to put out such a magazine? They are too busy with math problems, exams and chemistry experiments to find time for working on a magazine, aren't they?

Ever since high school, most students considering enrollment in IT have concentrated on science and math to the exclusion of most other important academic subjects. Getting A's in analysis, chemistry and physics was all-important. "We don't need to know history or how to write well, we're bound for IT and all we need to communicate with are numbers and formulas," was often heard.

Here at the U, when forced to take freshman composition, ITers gritted their teeth, took the course S-N and made sure everyone in the class knew how much they hated writing, and how engineering students shouldn't be required to take irrelevant courses like freshman comp.

This is a gross stereotype of course, but like most stereotypes there is a grain of truth to it. Those who think that the need to write well, that is, to **communicate** with others in technical fields, is unnecessary, are dead wrong.

The fact that there is an association of engineering magazines from colleges all over the country (many also 30-50 years old) underscores the fact that engineers (as opposed to engineering students) obviously feel and felt that communication is necessary in their field. The **Technolog** is not a unique publication.

As the editor of the **Engineering and Science Review**, from Case Western Reserve University in Cleveland wrote in the May, 1977 issue, "The engineer will need to communicate in and across his specialty in order to grow, innovate and progress. If there are no engineers who have learned the techniques of communication, there will be no cross-fertilization of ideas, which is a unique feature to technological revolution."

the **Technolog** represents an excellent opportunity to learn here at the U. Journalism students, who do not have company recruiters coming to them for placement and who need more than a 4.0 to get a job after graduation, have realized it and have come to work on the **Technolog** to gain valuable experience in putting out a magazine. These journalism students and other non-IT students have a very easy time getting jobs on the **Technolog** because IT students are not applying for these jobs.

We at the **Technolog** feel the attitude that many IT students seem to take is totally short-sighted. The **Technolog** should be a vital, relevant part of the Institute of Technology, yet now it is ignored and scorned by most ITers.

A viscious cycle has begun. IT students seem dissatisfied with the content of the magazine as evidenced by recent polls done by Student Activities Center on readership. ITers are critical of the **'log** obviously, yet the non-IT staff who work hard to produce a magazine they think IT students will enjoy, get almost no input or feedback from IT students.

(Continued on page 5)

Help Yourself.

You might not have seen our ads in the classified sections of the newspapers. So we put one here where you would see it. Because we think new graduates are vital to Boeing's future.

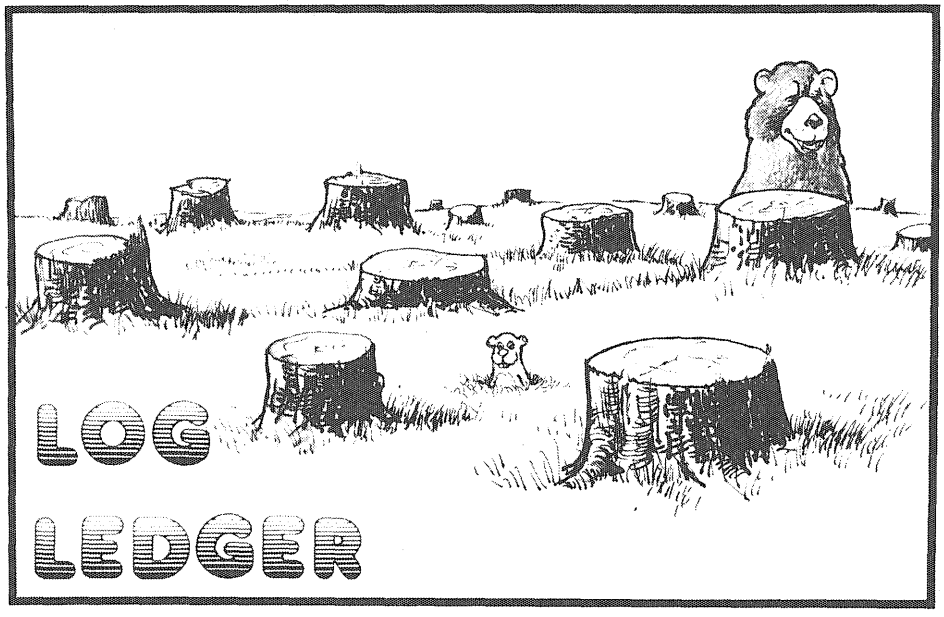
We're offering you a challenging career with a dynamic company. And an opportunity to live in the unspoiled beauty of the Pacific Northwest.

This is your chance to help yourself to the best of both worlds.

(Continued from page 3)

The advice consumer advocate Ralph Nadar gave at his speech here Oct. 7 has relevance to our problems at the **Technolog**. "Broaden your horizons. Students should get their noses out of their books and insist on courses more applicable to the outside world," he was quoted by the **Daily**. He urged the audience to take advantage of its college years to fight waste, pollution and corruption. He also mentioned that students can communicate easily with one another and have an enormous repository of information stored at universities which is an advantage in effecting change. IT students, with their knowledge and interest in technology and science have the power to make changes, and the **Technolog** should be their means of communication.

The time has come to rejuvinate the **Technolog**. And we do not mean by throwing out all the non-IT students on the staff and starting over. Their contribution has been invaluable and will always be necessary. However, IT students are desperately needed to stop by the office with ideas for articles, to write letters to the editor and especially to be writers. We challenge the students of IT to get out of the laboratories and libraries and become more than student drones. We challenge you to do something that will teach you what you cannot learn in the IT classroom, that will give you some spending money, that will sharpen your invaluable communication skills and make you a better engineer, scientist or architect.



Technolog's Art Director, Jeff Osborne will be leaving us after this issue. Thanks, Osborne, for the contribution you have made to the quality of the magazine.

Another staff member, Assistant Editor Bruce Kvam has sold a science fiction story to **Galaxy** magazine. Well done, Bruce old boy! Check out his SF review column on page 6.

While we're on the subject of SF, notice our ad for the SF contest—we've already begun receiving entries, so start cranking out those stories.

* * *

We need a new Art Director! If you're interested, apply to the editor by stopping in at Room 2, Mechanical Engineering or calling 373-3298.

* * *

Richard A. Swalin, of the Institute of Technology, has been named vice president for technology of the Electra Corporation in New York City effective Nov. 1. Swalin, 48, joined the University faculty in 1955 as an assistant professor in the department of metallurgy and was named dean of IT in 1971. A committee will be named to find a successor to Swalin, according to Henry Koffler, vice president for academic affairs.

* * *

Professor James Stageberg, of the School or Architecture and of Hodne-Stageberg Partners, was awarded the fellowship of the American Institute of Architects in June, at the American Institute of Architects national convention held in San Diego. This is the highest award an architect can receive.

* * *

John Mehaffey, a University of Minnesota senior, was named the recipient last summer of the second annual engineering scholarship of the Consulting Engineers Council of Minnesota (CEC/M).

Mehaffey was awarded $500 based on information supplied on his application form, responses from references he supplied on the form, and personal interviews with the scholarship committee.

This scholarship competition is open to any student currently in the sophomore or junior year in an accredited engineering course, preparatory to a possible position as a consulting engineer, according to scholarship committee chairman, Lawrence Grubbe.

If interested in further details, call or write Consulting Engineers Council of Minnesota, Earl Oseley, Director, 5009 Excelsior Blvd., telephone: 922-9696.

* * *

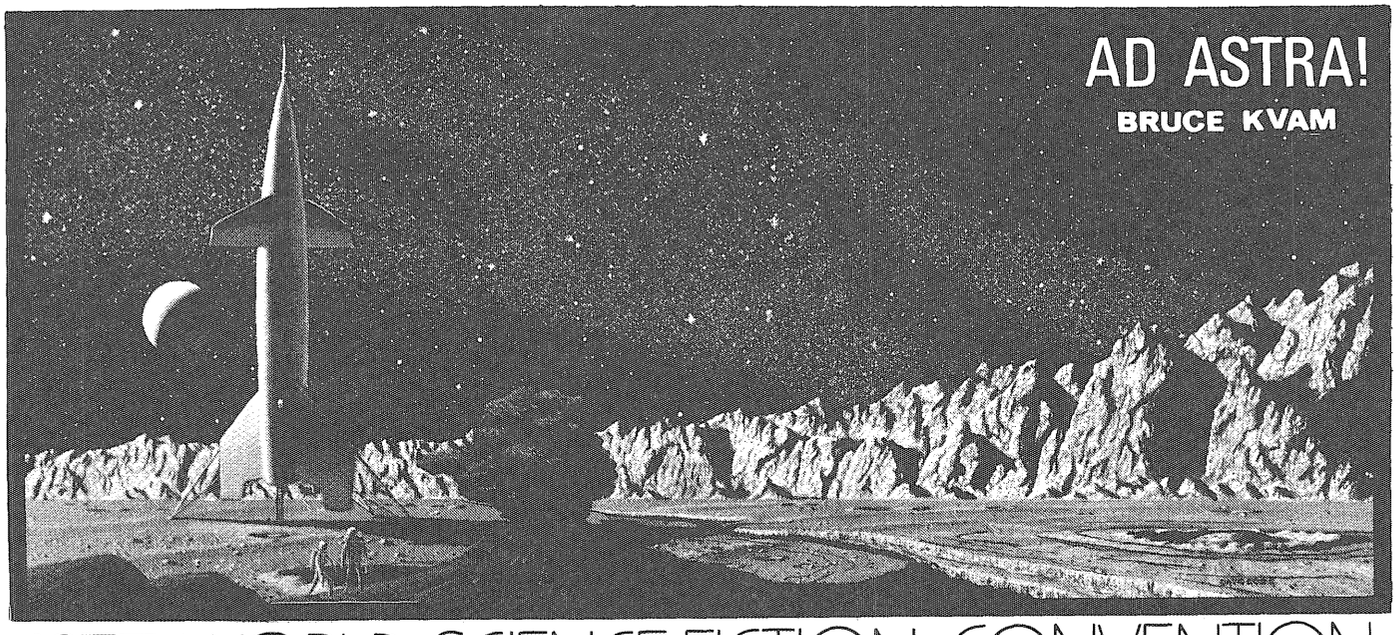
Student Employment has moved. The new office is at 6 Morrill Hall, but employment listings are still located in the basement of Wulling Hall.

* * *

NASA and industry have developed an impoved, surgically implanted prosthetic sphincter for patients who have lost muscular control of their bladder functions. The prosthetic urinary sphincter with external controls, uses a miniaturized valve originally developed for spacecraft such as Viking. This model will eliminate the need for external collection devices and will simplify operation for those who use it.

* * *

(Continued on page 27)



1977 WORLD SCIENCE FICTION CONVENTION

Worldcon, wow! This past Labor Day a group of friends and I drove down to Miami Beach in a van to attend the Thirty-fifth World Science Fiction Convention. It was fantastic: all-night parties, dozens of movies to see, scores of new people to meet, hundreds of books to buy; I really liked it.

Science fiction is unique in that its writers and its readers are so close. At a Worldcon authors like Robert Heinlein talk with you, drink with you, listen to your criticisms and thereafter tell you where to stick it. But it's all in great fun.

The Fontainebleau Hotel, located right on the Atlantic with 1000+ rooms, was the guest hotel of Suncon. Each Worldcon also has its own special name, the 35th being called Suncon, because the sun allegedly shines a lot in Florida. Three out of the five days of the convention it rained, entrapping us in the hotel, whose coffee shop sold *the most expensive* hamburgers in the solar system ($2.95! Can you believe that?).

One of the functions of a Worldcon is that of presenting the Hugo awards, which are given out annually to the best SF published during the previous year. Attendees of the convention decide on the winners, and of course the losers. I would have been able to vote too, except that they never sent me a ballot! Well, someone else would have just cancelled my vote anyway . . .

Kate Wilhelm is only the second woman to win a Hugo in the Novel category. (Ursula K. LeGuin won it in 1975 for her book *The Dispossessed.*) Her novel, **Where Late the Sweet Birds Sang**, is out from Pocket for $1.75, and is probably worth buying, even at today's exorbitant paperback prices. It's basically an end-of-the-world novel that tells what happened *after* the end. Pollution and over-exertion of the earth's resources bring civilization to a collapse. There is starvation, plague, even atomic war. People can no longer reproduce. To keep the human race alive it is necessary to clone children That is, to take a cell from a living person and cause it to develop into a separate, yet physically identical human being, though many years younger.

The clones have a completely diffferent psychology. They disdain solitude, individuality and sexual reproduction. But in this ravaged world it is impossible to clone indefinitely, for the cloning process requires high technology, and that technology is rusting away . . .

My major criticism of the book is that I couldn't get fully involved with her characters or the action.

Lack of reader involvement is the result of expanding a short story into an entire novel. With the transition from story to novel, she dropped fully developed characters twice. Although I can see the necessity, it was disturbing nonetheless. I still have mixed feelings about the book, but by all means at least go into your public library and check out a copy of it.

What goes on at a Worldcon?

AUTHOR PANELS

Author panels give you a chance to hear your favorite writers talk about their works, kick around ideas, or if you're part hound, just to get autographs. I listened to two of my favorite authors at such a panel: Larry Niven and Jerry Pournelle.

Niven has won three Hugos, one for his *Ringworld.* Pournelle is most renowned for his work with Larry, though he did win the John Campbell award in 1973. They have collaborated on three novels so far: *The Mote in God's Eye, Inferno and* **Lucifer's**

1977 HUGO WINNERS

Best Novel: Kate Wilhelm, **Where Late the Sweet Birds Sang**
Best Novella: Tie between Spider Robinson for "By Any Other Name' and James Tiptree, Jr. for "Houston, Houston, Do You Read?"
Best Novelette: Issac Asimov, "The Bicentennial Man"
Best short story: Joe Haldeman, "Tricentennial"
Gandalf Award: Andre Norton
Best professional editor: Ben Bova, **Analog**
Best professional artist Rick Sternbach
Best new writer (The John Campbell Award): C.J. Cherryh (A woman!)

There are fan categories for the last three awards that I leave out here.

Hammer

Lucifer's Hammer came out a few months ago from Playboy Press at $10 per copy. I, the fool that I am, bought a copy of the thing and had them sign it. Then I got back home and found that the library already had it.

Lucifer's Hammer takes place right now. It's so relevant that it's hardly science fiction. The hammer is a comet that hits the earth and causes mass destruction. In other words, *Lucifer's Hammer* is the epitome of a disaster-novel-soon-to-become-movie.

If someone had told me that before Worldcon, I'd have never bought the book. But Larry and Jerry did write it, so I read ahead.

Tim Hamner is a rich amateur astronomer who finds a comet and is proud of it. Hamner-Brown is the comet's name now, and it's going to outdo Kohoutek by a thousandfold, perhaps rivaling Halley's comet, because of its close approach. How close? Will it hit? At first the odds of a strike are vanishingly small, but as the data on Hamner-Brown's orbit are refined the odds climb from millions- to hundreds-to-one. And . . .

Niven and Pournelle are hard science fiction writers, which means they don't play around with their science. They use current theories and accurate information. Their depiction of a comet strike is, therefore, especially vivid and logical. Most of the comets fragments fall into the ocean, vaporizing cubic miles of water and causing fantastic tidal waves.The whole earth is shrouded by a thick deck of clouds and it rains for weeks. The clouds increase the reflectivity of the earth: the temperature drops. All coastal areas are wiped out, the inlands drowned by incessant rains. The USSR and China have it out in one last battle before Armageddon. And a new ice age is on the way.

The novel is marred by a profusion of characters and episodic transitions between them. A cast of characters is given in the front, but it's a pain to flip back to it every three pages to find out exactly who Harry is.

Jerry Pournelle's opinions stand out very loudly in the work, especially his feelings (pro) on nuclear power. His writing echoes his style of speech: loud and opinionated. But still, he's no fool.

The weakest part about *Lucifer's Hammer*, however, is its plot. There are 60,000 hackneyed stories about the end of the world. Some are even identical in a few details to *Lucifer's Hammer.* I was disappointed in Niven and Pournelle. I think they can do better stuff. It is readable, but not outstanding. I definitely think it is *not* Hugo material. Here I stop. Pournelle may read this and charge me with libel. And win.

PARTIES

Everything at Worldcon is scheduled around parties. They usually run from nine at night anywhere up to seven (bah, usually only six) the next morning. And the weird thing is, nobody gets roaring drunk. Slightly tipsy, yes; into the giggly stage, sometimes. But never really drunk. Maybe it's because the parties last so long.

On the last night of the con (slang for convention) we held a party in our room. It was four in the morning and I wanted to get sleep but bad. After several hints ('Get out of here, damn you!') everyone cleared out and we collapsed into our sleeping bags. That's right, sleeping bags. SF fans are very cheap and rooms in Miami Beach are very expensive. But with ten in a room the price goes down quickly.

And the hotel never suspected a thing . . .

* * *

Robert Heinlein is a nice guy.

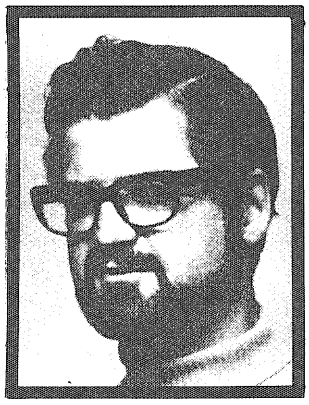
At the convention two of my co-travelers met with unfortunate accidents. While Martin Schaefer was carrying Renée Valois out of the hotel's theater (yes, *Logan's Run* was that bad) Martin tripped, a)spraining his own ankle, and b) breaking Renée's. But was has this to do with Robert Heinlein? Well, when he heard poor Renèe was sitting alone in her room all day, the Big Name Pro rode that elevator right up to her room and signed her autograph book, in French, yet.

As Grandmaster of Science Fiction, Heinlein has won his share of Hugos. His last was in 1967 with *The Moon is A Harsh Mistress*, in paperback from Berkley at $1.75. The story is about a lunar penal colony that must ship its life-blood in grain from the moon to the earth, and it's one book that really deserves its Hugo. In this book Heinlein originated, I believe, the term TANSTAAFL (There Ain't No Such Thing As A Free Lunch), which is the battle cry of the Libertarian Party.

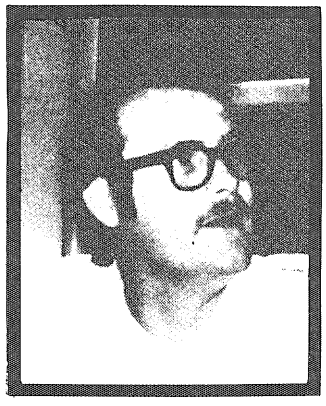
The two main characters in the novel are Manny, one of the few competent computer specialists on the moon; and Mike, the huge computer that runs all of Luna. No one except Manny realizes that Mike is almost human. Only he understands that the computer's errors are really jokes. They team up with a beautiful blonde and an old professor to plot a revolution.

Their revolution is a success and many wrongly accused inmates and their descendants are freed—but for how long? Earth is rather peeved at Luna for rendering their warden senile and begins making unveiled threats. Heinlein shows how ridiculous nuclear proliferation talks are for frictionless space, where a ten-pound rock has the explosive force of a largish TNT bomb, *if* you throw it

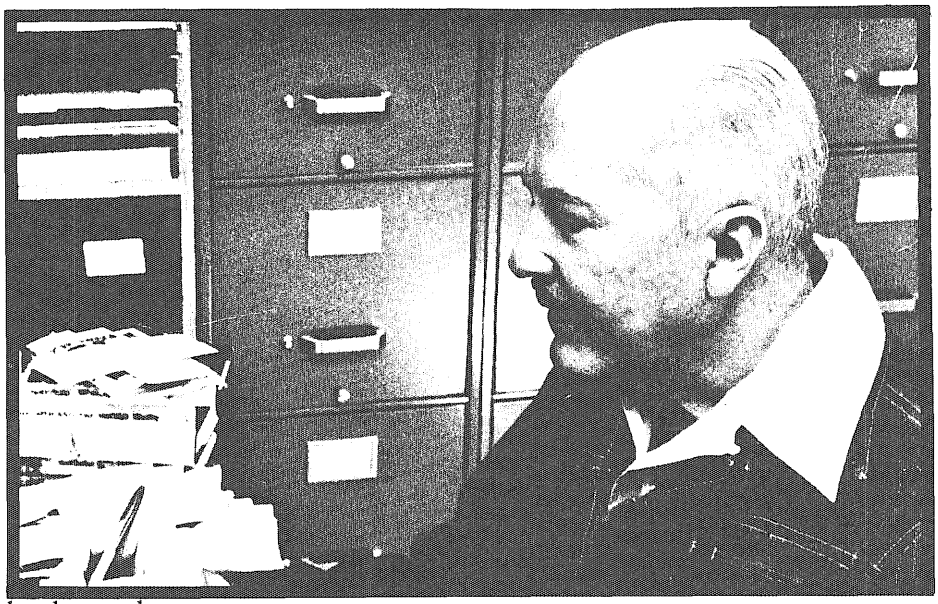
Kate Wilhelm



Larry Niven



Jerry Pournelle



Robert Heinlein

hard enough.

The book is always technically accurate and includes the same ideas that Gerard O'Neill now proposes for colonizing space. At first the book seems very strange because of the Russian structure imposed on the English language. This kind of language may sound childish,as it lacks articles and pronouns, but in this style Heinlein says some pretty deep things.

Attendance at Suncon was 1975, counting fans, writers, hucksters and staff. One writer I kept seeing at Suncon was Fred Pohl, whose new book, **Gateway**, was published serially in *Galaxy* and will soon be out in paperback from Ballantine/del Rey for $1.95.

Fred Pohl

Gateway is a strange hollowed-out asteroid in an orbit perpendicular to the rest of the planets' orbits. In the book, Venus has been colonized and all Wyoming works in petrochemical food mines. On Venus mankind has found the remains of a super-civilization, dead perhaps half a million years. Gateway is full of this same race's artifacts and spacecraft—and they still work. But no one knows how.

You board a ship, set a course that was predetermined half a million years ago and wind up hundreds of light years away, in just a few days. Nobody knows what the destination will be like; what riches it may hold, what quick death waits there. It's a huge gamble to go out on a mission. Robinette Broadhead wins a trip to Gateway. Problem is, he's scared to death of going out on a mission.

So he and his new-found female friend Klara cower in the tunnels of Gateway, having sex every few pages. Intermittently, Robinette works up enough courage to go out. On his last mission he hits it big, but at a tremendous cost.

The book is laced througout with a running interview between Broadhead and his psychologist-computer, Sigfrid von Shrink. This technique of treating the whole story as a series of flashbacks didn't turn me on. Just when I'm getting interested in the story line, Broadhead has to talk to the computer again.

Pohl also used 'sidebars,' little blurbs on the side of the page set in a different type to convey incidental information: classified ads, sections of popular physics lectures, contracts Broadhead has signed, mission reports, all kinds of jazz. This technique allowed Pohl to inject information into the story without actually having the characters tell it to each other. Useful, but sometimes it took my attention away from the story when I didn't want it to.

The ending'll really grab you.

At Suncon science fiction films, from the silent *Metropolis* to X-rated *Flesh Gordon*, were shown twenty-four hours a day. This made some films hard to catch, especially those scheduled at 10 a.m., the time when everyone in the hotel (staff included) was recuperating from the previous night's parties.

Bob Silverberg has been in science fiction since the fifties, starting out at the same time as Harlan Ellison, and in the same apartment building to boot. He left SF for a few years and returned with a completely different style. His novel *Shadrach in the Furnace*, was one of the nominees this year. I wouldn't have minded his winning.

Oh yes. There is another Hugo category that I failed to mention, that for 'best dramatic presentation', which usually means movie. The Toastmaster is rewarded for his valiant efforts of speechifying with the privilege of presenting the Hugos. Bob carried forth quite well in his presentations, as I will have you witness.

(An excerpt from the unofficial transcript of Suncon Hugo awards banquet follows)

"And the four nominees are," Silverberg read in the microphone, *"Carrie,"* boos and hisses from the audience, *"Futureworld,"* hisses and boos from the audience, *"Logan's Run,"* catcalls and boos and hisses, *"The Man Who Fell To Earth,"* ditto, "and No Award." Cheers rose from the audience.

Bob took the envelope sealed by 'an independent accounting firm' and ripped it open. "And the winner is—No Award!" The doors of the room bulged as the sound level peaked at 117.3 decibels.

No you silly fool, **Star Wars** was released in 1977, so it'll be up for the Hugo at the '78 Worldcon where you can vote for *Star Wars* like everyone else is going to. At this awards banquet Gary Kurtz, the producer of *Star Wars*, accepted a special Hugo for the film's contribution to science fiction.(Plug: Worldcon '78, Iguanacon, Phoenix, Arizona, Labor Day weekend, registration $15 till Jan. 1, 1978).

Ah well. This closes my very first column, so getting input from you, the reader, would be **very** welcome. Just address your comments, wishes and curses, to: Bruce Kvam, **Technolog** Mech Eng. Rm. 2; and drop them in the campus mail.

You Can Develop Yourself

By Fred Harding

The medium of photography is the most pervasive art form in American culture today. Thousands look at photographic art, hundreds of thousands see it in magazines and newspapers and millions see it in the form of T.V. and movies. Although the processes involved in making a finished print look complicated, they are rather simple upon further investigation.

The vast majority of photographs produced in the United States are done by the people who brought us Foto-Foto-Fun-Fun, in other words, machine processing. While dropping your film off at the drugstore is definitely an easy out, the satisfaction of photography is enhanced if you process the materials yourself.

The first step in making a photo is choosing a film. There are a myriad of choices on the market, both color and black and white. Almost all films have ASA numbers. The ASA number is simply an indicator of the film's light sensitivity. The lower the number is, the more light is required to "correctly" expose the film. The ASA numbers can be used to gauge one film against another For example, Kodachrome 25 requires approximately twice the light that Kodachrome 64 requires and 64 requires twice the light (again approximately) of Plus-X film, at 125.

One other indication that the ASA gives the purchaser is the grain size of the film. Grain, the non-farm type, is the tiny dots that make up the finished print—you can see it in any picture with a magnifying glass. Anyhow, the higher the ASA number the larger the grain size and the greater the sensitivity to light.

One final note on ASA: the world will not end if you expose the film contrary to what the ASA suggests, by altering the film development time you can compensate for exposure changes.

After a film has been chosen and exposed, comes processing. With color film it's best to have a lab develop your shots, at least until you've mastered the black and white procedures. Color films require incredible accuracy in time and temperature. The colors will alter if the requirements are not met. Black and white is also cheaper to process, so start with that.

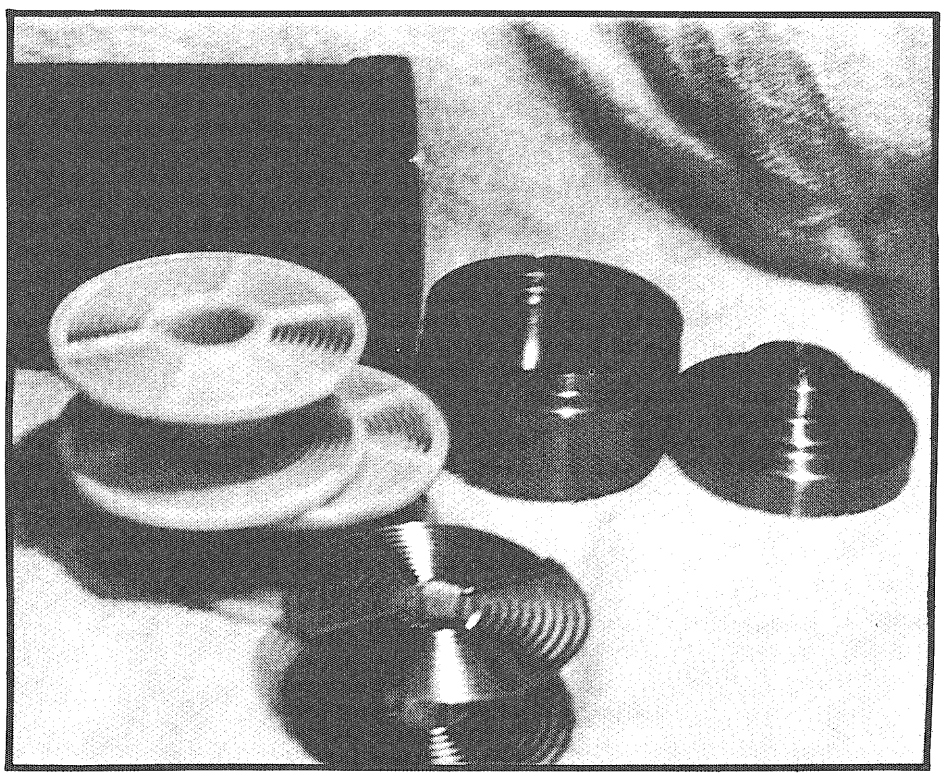
Some of the basic materials needed for developing black and white film include:

- Exposed film
- Water
- A light-free environment
- A developing tank and film holding reel
- Photochemicals (developer, fixer, wash agent
- A thermometer
- Time
- Discipline

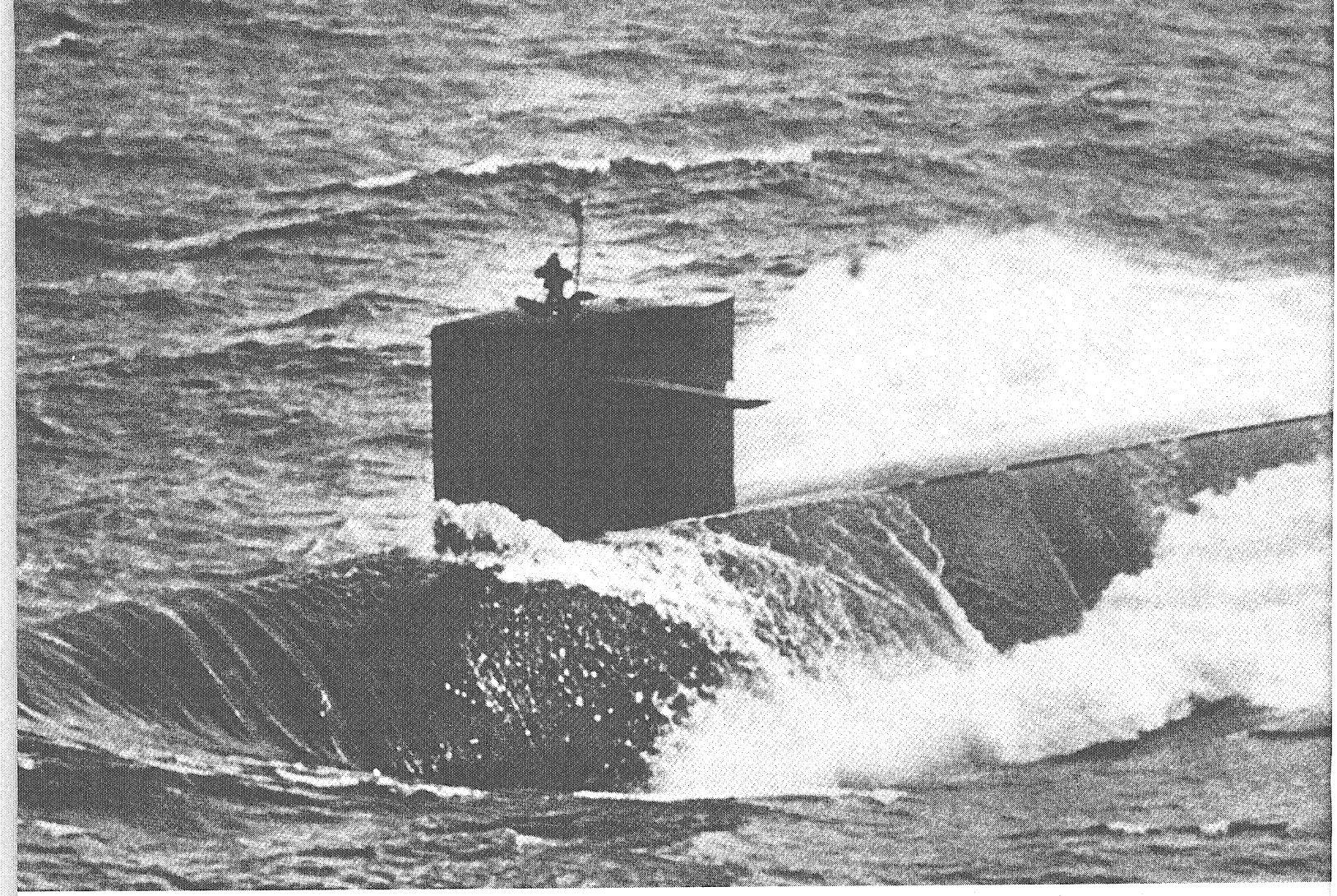
You will have to purchase some of these items. Others you'll (hopefully) aquire.

To begin with, get a developing tank. A variety of brands and styles are on the market today, with varying price tags. Kodak has a nifty tank reel for cheap that's eay to use. I use an Omega stainless steel model myself.

Practice loading your reel. With a practice roll of film. Do not use your exposed roll for this purpose. When you are satisfied with your competence



Developing tank and film holding reel



HERE'S ONE ENGINEERING OPPORTUNITY YOU WON'T GET IN PRIVATE INDUSTRY.

If you're thinking about a technical position after graduation, think about this.

How many companies can offer you a nuclear submarine to operate? The answer is none. Equipment like this is available only in one place – the Navy.

The Navy operates over half the nuclear reactors in America. So our training is the broadest and most comprehensive. We start by giving you a year of advanced technical education. In graduate school, this would cost you thousands, but in the Navy, we pay you.

Once you're a commissioned Nuclear Propulsion Officer, you'll earn a top salary. Over $24,000 a year after four years. And you'll be responsible for some of the most advanced equipment developed by man.

The Navy also has other opportunities in surface ships and aviation assignments. If you are majoring in engineering, math or the physical sciences, contact your placement office to find out when a Navy representative will be on campus. Or send your resume to: Navy Officer Programs, Code 312-B379, 4015 Wilson Blvd., Arlington, VA 22203.

The Navy. When it comes to nuclear training, no one can give you a better start.

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try it once in your light-free area—still competent? Now load your "good" film, with light still out, onto the reel and place it in the developing tank. Put the lid on it, make sure it's on, and then proceed to where your chemicals are.

The chemicals are all self-explanatory, or at least the labels are. Follow them closely, particularly the temperature requirements for mixing. Some developers remain in a colloidian suspension without sufficient heat. Store your chemicals in air-tight containers, out of harm's and light's way. (Some things react adversely to light.)

With the chemicals and loaded tank ready, pour in the developer. Different films do different things with developers; a general purpose developer is a good kind to start with. You will keep the developer in the tank for a varying period of time, depending on brands, films, and temperature.

At occasional intervals, agitate the film tank. Do this by moving the tank in some manner of form; do it to keep fresh developer in contact with the film. I shake my tank 12 times per minute.

When the developing is completed, pour out the old developer and pour in water. This stops the development. Agitate for 15 seconds and pour out the water, still with light-tight seal.

Now add the fixer. The fixer desensitizes the light-absorbing elements in the film and alters them into stable compounds. Agitate the fix along similar lines as the developer. When the recommended time is up, (see fixer package) discard the fixer. You can now open the film tank to light. Fill the tank with water and agitate for 15 seconds.

Now add the washing agent. This will reduce the time spent on the final wash. Agitate this as per instructions. discard when used, and immerse the film and reel in running water. Wash the film for 10 minutes and then hang it to dry in a dust-free room. Tiptoe out, keep everyone else out and wait anywhere from 20 minutes to an hour for the film to dry. It's dry when the film curls.

Some important factors in developing film are temperature control and discipline. The best way to control temperature is with a *good* thermometer. The type the chemistry department has are good. Check them out and you'll know the type needed. Once you have a thermometer, care and feeding of same is relatively simple. Keep it clean, check it with another from time to time, don't open beers with it, and it'll serve you well.

The important point is, though, that the chemicals, including water, should be at or near the same temperature. 68 F has been declared a good temperature by the moguls of photography so use 68 F.

Discipline is required to keep the temperatures at 68 F, the times accurate and the work area clean. Dust is an insidious enemy that will mess up prints if your guard is down. The times must be kept accurate in order to keep a standard, or control in the process. The agitation should be uniform too, for similar reasons.

With time, developer and agitation variables established, you can be certain that if something messes up, it's not the process. In addition, the maintenance of these variables gives you a control and allows uniform excellence with each roll or film.

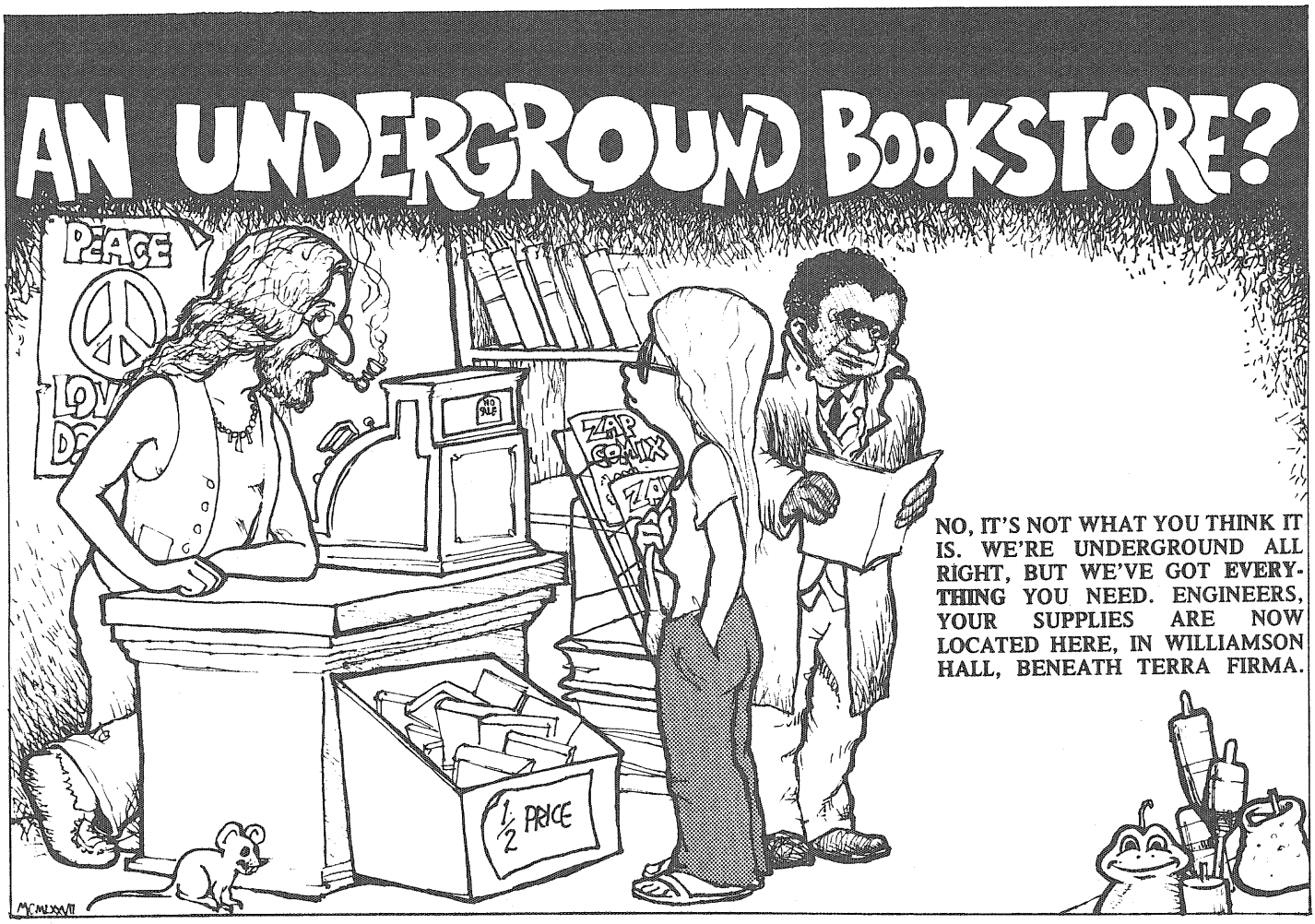
Storing negatives should be done with care too—not only to protect the darlings, but in order to find them next year. Different companies offer different styles of holders. Some are really grim. Included on the grim list are hard plastic or acetate holders. These scratch negatives.

Another style, glassine paper envelopes, was used by almost every photographer for years. The trouble is, they get brittle and the glue in them tends to travel onto your negatives. Currently I'm using plastine negative folders which hold an entire roll of film.

Whichever kind you chose, plan on storing them in a cool, dry place with an easy system of identification.

One final note: once your routine is established, which includes being comfortable with developers, films, and time/temperature combinations, stick with it for awhile. Your pictures will be much better for it.

Now that you have your own negatives, you can either take them to the drugstore or print them yourself.



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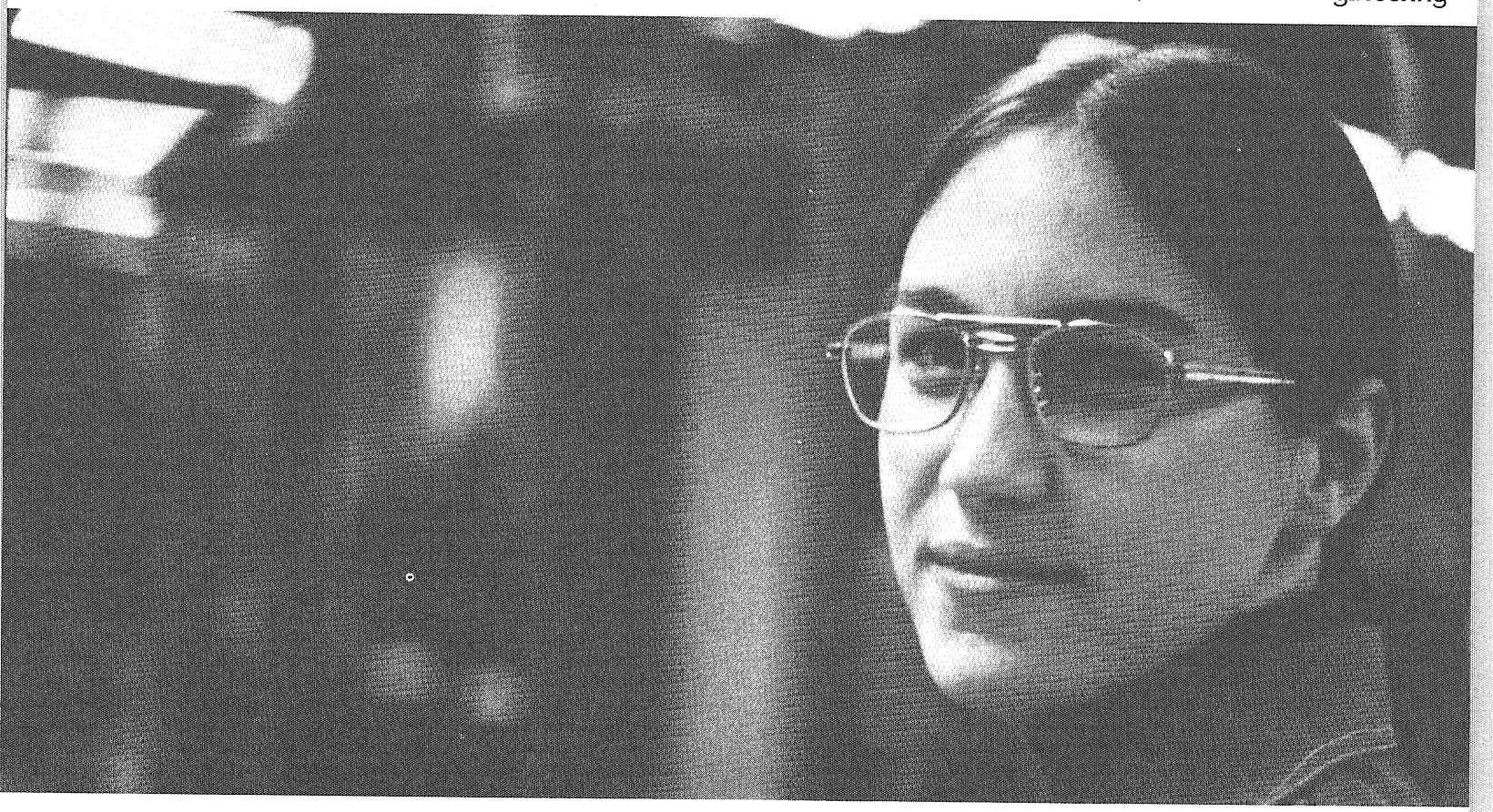
At a diversified company like Du Pont, an engineer can change careers without changing companies.

—Linda Land BS, Mechanical Engineering



"My job gives me the chance to change assignments every couple of years. This has two advantages: I get variety, yet I am in one place long enough to make a contribution.

"Du Pont has many opportunities for engineers to learn, develop and establish their own kinds of careers—whether in research or practical applications, in specialized or broad fields, in supervision or technical work."

Linda was recruited by Du Pont from the Mississippi State campus in 1973. She interviewed about 30 companies.

Linda's story is typical of many Chemical, Mechanical and Electrical Engineers who've chosen careers at Du Pont.

We place no limits on the progress our engineers can make. And we place no limits on the contributions they can make to themselves, the Company or to society.

If this sounds like your kind of company, do what Linda Land did: talk to the Du Pont representative who visits your campus. Or write: Du Pont Company, Room 25241, Wilmington, DE 19898.

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PLAN AHEAD TO GET BEST JOB PICK

By Jon Kavanaugh

Students can best prepare themselves for the recruiters by developing something in themselves personally...

—Lee Ponto, I.T. Placement Director

Some of the old, all-too-often-used expressions like "Don't put off until tomorrow what you can do today" or "A stitch in time...", seem appropriate warnings, especially to IT seniors who haven't begun thinking about the job they'll find after graduation. No need to worry; there are plenty of jobs available this year, but the time to look for them, according to IT Placement Director Lee Ponto, is before graduation because it takes a long time to work through the interviewing process. To research a company's background, complete first on-campus interviews, visit the facilities of promising prospects—all of this takes "about two-three months to complete." So, says Ponto, students would serve themselves well to begin thinking about their professional objectives long before graduation.

That means as juniors or earlier, most students should begin to develop a good idea of which positions they desire most and then narrow the list down to one or two possible positions. "A student can't really go grocery shopping for positions," warns Ponto. During recruiting interviews, conducted through the Placement Service, company representatives often ask the prospective employee which area of the particular industry the student is most interested in. Only then, does the interviewer reveal which jobs are actually available.

Other aspects of the interview require the student to exercise good public speaking in explaining his personal interests, academic preferences, career objectives, extracurricular activities and more.

The students who communicate well, who express themselves most effectively have the best chances for good positions. Explains Ponto, "Companies aren't hiring engineers to sit off in the corner to design something." Rather, today's professionally-trained company representatives look for the prospect who can display top communicative skills. "Someone who can sell his ideas to management," says Ponto.

Students who make favorable impressions in their preliminary interviews at the Placement Office are often asked to visit company facilities. To schedule a trip to see a company plant takes more planning and more time, sometimes adding weeks to the job hunting task. But, if students begin their interviewing early in the senior year, plenty of time is left through the year to follow up with trips to companies. A student who waits until a few weeks before graduation in the spring to schedule interviews "is out of luck," warns Ponto.

Early planning also means registering with the Placement Office. Registration is required in order to participate in the interviewing. To register, students fill out personal data sheets, resumes and scholastic record forms (to avoid delays in requesting transcripts). Among the information included is work experience, membership in professional societies, references and other personal data. The information is then compiled into a modest package for examination by companies prior to their appearance on campus. Often companies will contact students registered with the Placement Office, encouraging the students to sign up for an interview with that company on its recruiting day.

Once registered, students can take advantage of the Placement Library, containing volumes of descriptive

information about the companies that visit campus each quarter. Annual reports, job descriptions, product lines, facilities brochures—all are available in varying quantities to help students "know" their companies before meeting representatives in an interviewing situation.

Since only a limited number of interviews can be conducted each day at the Placement Office it is necessary to sign up for them in advance. Schedules of visiting companies and their representatives are posted Fridays with interviews to be held the second week later. Anyone registered with the service may sign up for any number of interviews. The Placement Service operates on a first-come, first-serve basis.

Through years of experience, the Placement Service has developed a smooth system of interviewing, designed, simply, to match graduates with industry. But the interviewing itself doesn't always come easy for many of the potential employes. Again Ponto explains: It takes several interviews for many students to feel comfortable. Those students who are most qualified for the positions they are seeking may interview just a few times and find the right match. Students bearing lower grade point averages or who have difficulty communicating their ideas, or a combination of many factors, might have to interview 20, 30 or more times to find the right match. Grade point averages do not necessarily determine the success of the interviewee.

To help identify problems of communication and personality, the recruiter is required to file a form which contains, along with other vital information, comments about the student's performance in the interview. Ponto gathers all of the forms daily and discusses the problems with students when they need special guidance. All comments are kept confidential; students read the comments but don't know which company representative made the remarks. "We can tell the student things from the comments... to help him improve for the next interview," says Ponto.

Prior to any interviewing, even months or years in advance, Ponto offers the most valuable advice. "Students can best prepare themselves for the recruiters by developing something in themselves personally," he suggests. "Companies are looking at students who have done more than just go to school for four years. They're looking for students who have gotten involved in some extra curricular activities." He suggests the work-study program as one of the most effective variations because it can affirm or reject the impression a student has of a particular kind of job before the student accepts a full time professional position at the same job. Recruiters look with favor on students, especially, who display a certain amount of leadership quality in extra curricular activities—athletics, communications media like the Technolog, or part-time work. There are problems with these demands, though, too. Ponto cites heavy class loads and student needs to work for self support in nearly half of the IT students. These factors tend to work against the diversity prospective employers are after. "A student gets a few class periods or even a week behind in a math course or some other technical course and he may as well drop it," says Ponto.

Perhaps all of this discussion about job seeking is much too much premature for some. For others it may be too late. There's comfort for all, though in noting the success of the Placement Service recently. Strong recruiting is being reported by the office this fall, surpassing last year's pace when over 250 companies were represented on campus, a substantial increase from the previous year when about 210 companies sent representatives to do recruiting.

The total number of placement interviews conducted by the Placement Service *did* increase, too, from 4,577 to 5,700 from the previous year. As a result of the jump in volume of interviews, only 25 of 555 June, 1977 graduates remain, looking for work. Of the larger group, 73% obtained work through the placement office, a level slightly above a relatively normal high placement figure around 65-70%. A normal 14% of the 1977 graduates went on to graduate school while smaller percentages of students joined the armed forces or pursued alternate activities like traveling.

Those students worried about their academic area filling up with job applicants, relax. There is a relatively equal number of jobs available in all academic/professional areas. Salaries, too, have remained relatively stable with no one academic/professional area dominating the pay scales.

Good and varied job selections are available this fall but those who plan ahead will continue to benefit from their foresight in the quality of job choices.

. The students who communicate well, who express themselves most effectively have the best chances for good positions... "Companies aren't hiring engineers to sit off in the corner to design something"...today's professionally-trained company representatives look for the prospect who can display top communicative skills..."Someone who can sell his ideas to management"...

—Lee Ponto

See interview schedule on next page.

Fall Quarter Interviews

The following companies have announced that they will be interviewing at the I.T. Placement Service during fall quarter on the dates listed below. This schedule is tentative and subject to change. For more complete and up-to-date information regarding exact hours and sign ups, please contact the I.T. Placement Office.

Wednesday, October 26
American Cyanamid Company
General Electric Company
Kimberly-Clark Corp.
Mare Island Naval Shipyard
Phillips Petroleum Company
Shell Companies

Thursday, October 27
Allis-Chalmers Corp.
IBM Corporation
Kimberly-Clark Corp.
Pickands-Mather & Company
Shell Companies
Shell Development Company

Friday, October 28
Allis-Chalmers Corporation
American Cast Iron Pipe Company
Babcock & Wilcox Company
Donaldson Company Inc.
Micro Control Company
National Security Agency
Procter & Gamble Company

Monday, October 31
Air Products and Chemicals Inc.
FMC Corp./Northern Ordinance Div.
3M Company
Procter & Gamble Company
A.O. Smith Corporation
United States Navy
Wisconsin Natural Gas Company

Tuesday, November 1
Air Products & Chemicals, Inc.
Burlington Northern Inc.
Consolidation Coal Company
Continental Oil Company
General Dynamics Corp./Convair Div.
Oscar Meyer & Company
3M Company
Nalco Chemical Company
Union Carbide Corporation

Wednesday, November 2
Burlington Northern, Inc.
Hercules Incorporated (Research Center)
3M Company
Nekoosa Papers Incorporated
Polaroid Corp./Sesame Div.
Standard Oil Company of Indiana

Thursday, November 3
Chevron Companies
3M Company
Polaroid Corporation/Sesame Div.
Sandia Laboratories
Standard Oil Company of California
Standard Oil Company of Indiana

Friday, November 4
Cargill Inc.
Chevron Companies
Granite Construction Company
3M Company
Sandia Laboratories
Standard Oil Company of California
Wisconsin Power and Light Company

Monday, November 7
ADC Products
Duval Corporation
Sigma Chemical Company

Tuesday, November 8
Archer Daniels Midland Company
BASF Wyandotte Corp.
Control Data Corp.
Eastman Kodak Company
Wisconsin Public Service Corp.

Wednesday, November 9
Analytic Sciences Corporation
Burroughs Corp.
Control Data Corp.
Gulf Oil Corp.
Eastman Kodak
Union Carbide Corp.

Thursday, November 10
Boeing Company
Dow Corning Corp.
Northern Natural Gas Company
Union Carbide Corp.
United States Steel Corp.

Friday, November 11
Boeing Company
CEA Carter-Day Company
Dow Corning Corp.
Menasha Corp.
RTE Corp.

Monday, November 14
Amoco Production Research
Pratt & Whitney Aircraft Group
Square D Company

Tuesday, November 15
Eaton Corporation
Ford Motor Company
Harris Mechanical Contracting Company
Pratt & Whitney Aircraft Group
Sperry Univac Defense Systems
Standard Oil Company (Ohio)

Wednesday, November 16
Owens-Corning Fiberglas Corp.
Sperry Univac Defense Systems
Standard Oil Company
Whirlpool Corp.

Thursday, November 17
A.T.&T. Long Lines
Fisher Controls Company
Fruin-Colnon Corp.
Motorola Inc.
Northwestern University Graduate School
Sperry Univac Defense Systems
Western Gear Corp.

Friday, November 18
A.T.&T. Long Lines
Fisher Controls Company
Fruin-Colnon Corp.
Motorola Inc.
Stanley Consultants Inc.

Monday, November 21
Monsanto Company
Union Carbide Corporation

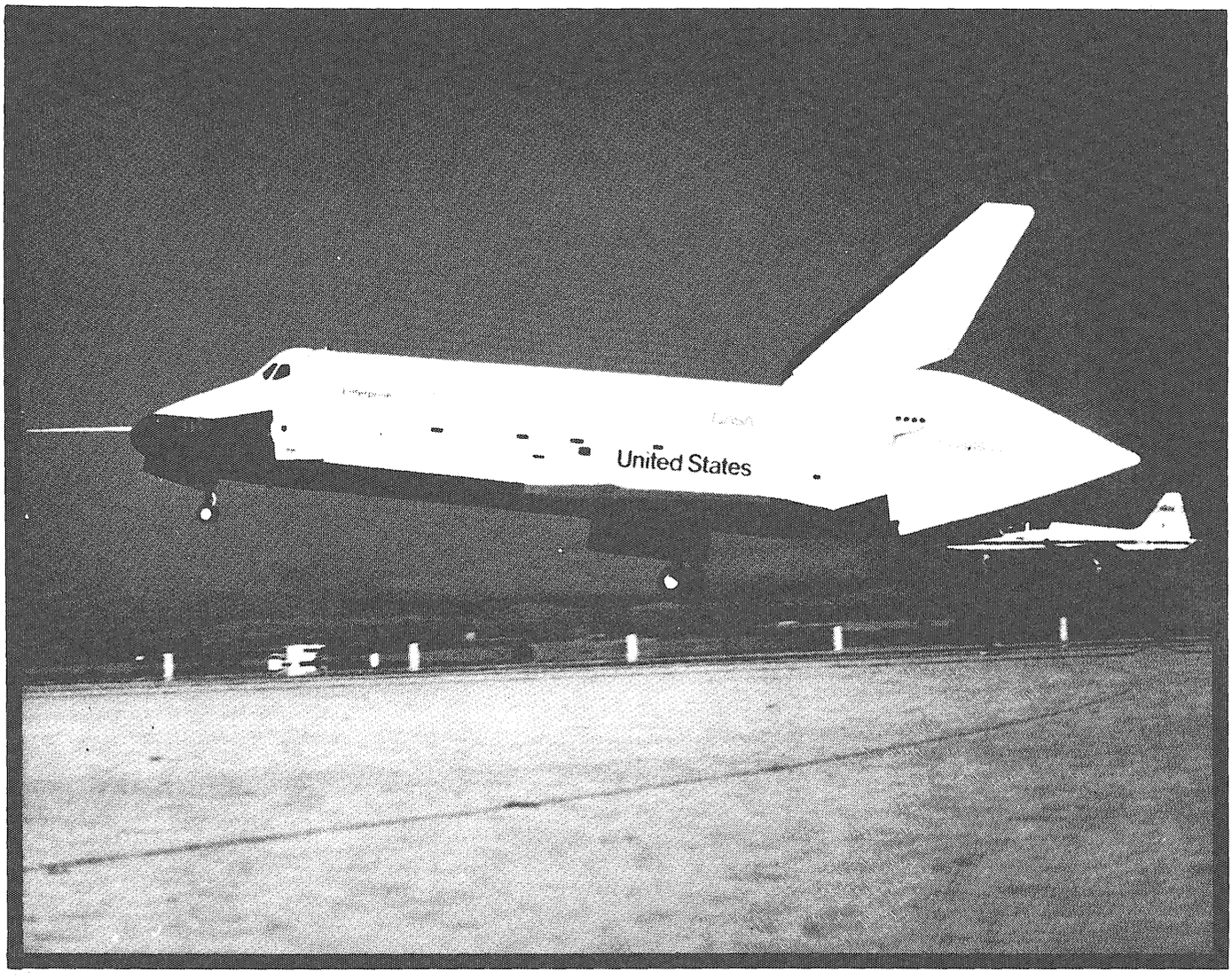
Tuesday, November 22
Monsanto Company
Olin Corp.

Monday, November 28
E.I. du Pont
United States Navy

Tuesday, November 29
E.I. du Pont

Wednesday, November 30
E.I. du Pont
Illinois Department of Transportation
MIT Lincoln Laboratory

Friday, December 2
Argonne National Laboratory



AMERICA'S SPACE SHUTTLE

By Karl Jorgenson

Photos courtesy of NASA

Space may be the final frontier, but the time when only pioneers like Yuri Gagarin and Neil Armstrong can traverse it is almost past. With the advent of the Space Shuttle, NASA's multi-billion dollar program to open space to mankind, space travel will become economically feasible, desirable and eventually indispensable. And **you** may get to go there.

The first space shuttle orbiter, named **Enterprise** in honor of the fictional spaceship from **Star Trek**, made its first landing in August. Since then it has landed three more times, though it has yet to make its first launch.

This may seem odd, landing without taking off, but actually, the landings, done by launching the orbiter from its position atop a 747 airliner at more than 400 kilometers per hour were necessary to test the orbiter's flight characteristics and ability to land. The landings also provided practical experience for the pilots, who until August had performed orbiter landings only in a flight simulator.

The landings went perfectly. In each case the orbiter popped free from its special 747 and coasted down to a long, fast deadstick landing.

The orbiter, as the title implies, is the component of the Space Shuttle System that will be put into orbit when all the various tests of engines, subsystems, and the orbiter itself have been completed.

The orbiter is a streamlined space and atmosphere vehicle that will be boosted into space with external components and then return to Earth without benefit of power. The prime contractor is Rockwell International, the same company that designed and developed the X-15.

The orbiter is 37 meters long and can be divided for purposes of examination into three sections: the forward-most section that is pressurized and sealed for orbiter's pilot and operators; the mid and longest section, called the cargo bay, which can accomodate a wide range of cargos; and the engines and related equipment in the aft section.

The forward section of the orbiter

will provide the greatest, or perhaps the only comfort in space that man has yet experienced. It is divided into three decks, the top two of which are normally occupied during the course of a mission.

The topmost deck is the flight deck. On it are all the controls, displays and gizmos necessary to operate the orbiter in space and land it again. A typical mission crew includes the mission commander, the pilot and the mission specialist, who is a universal expert on the operation of the Shuttle.

The crew has at its fingertips four banks of controls and displays, organized and simplified according to related function.

The first and most important console is the forward flight control console, which closely resembles the cockpit of a jet airliner.

There are duplicate controls for pilot and copilot that activate the orbital maneuvering subsystem (OMS) which slows the orbiter to re-entry speed.

Immediately behind the pilot and copilot seats at the back of the flight deck is the payload control station. Here one of the crew members or a special technical passenger will operate the mechanical components of the cargo bay area.

This station controls the operation of the cargo bay doors. Satellites can be inserted or captured in orbit with the massive mechanical arm. Two closed circuit monitors will keep an eye on the procedures.

On the port side of the Shuttle orbiter is the rendevous and docking station. Included here are the radar displays, the crosspointer display for the orbiter's pitch and roll angles and rates and the hand manipulated attitude controls.

I suspect watching the crosspointer and radar would be similar to that of flying an electronic game, although I choose to believe that the game was modeled after the orbiter, and not vice-versa.

The fourth station is called the mission station and it contains a smorgasbord of control subsystems, communciations and a wide assortment of warning lights and safety checks that monitor the vital parts of the ship. Should some critical part in the vessel fail, perhaps an essential element in the life support system, one of the crewmen would notice a warning on the mission station and take emergency action.

The designers of the orbiter provides a maximum of utility and simplicity while using a minimum of valuable space. There is room to walk and stretch, or, when in orbit, to float.

The middle or living deck is just below the flight deck. Its purpose is to provide living space for both crew and passengers and storage for food and other items.

A typical mission will include seven or eight acceleration chairs installed on the middle deck to provide seats for the passengers, plus a safety hedge.

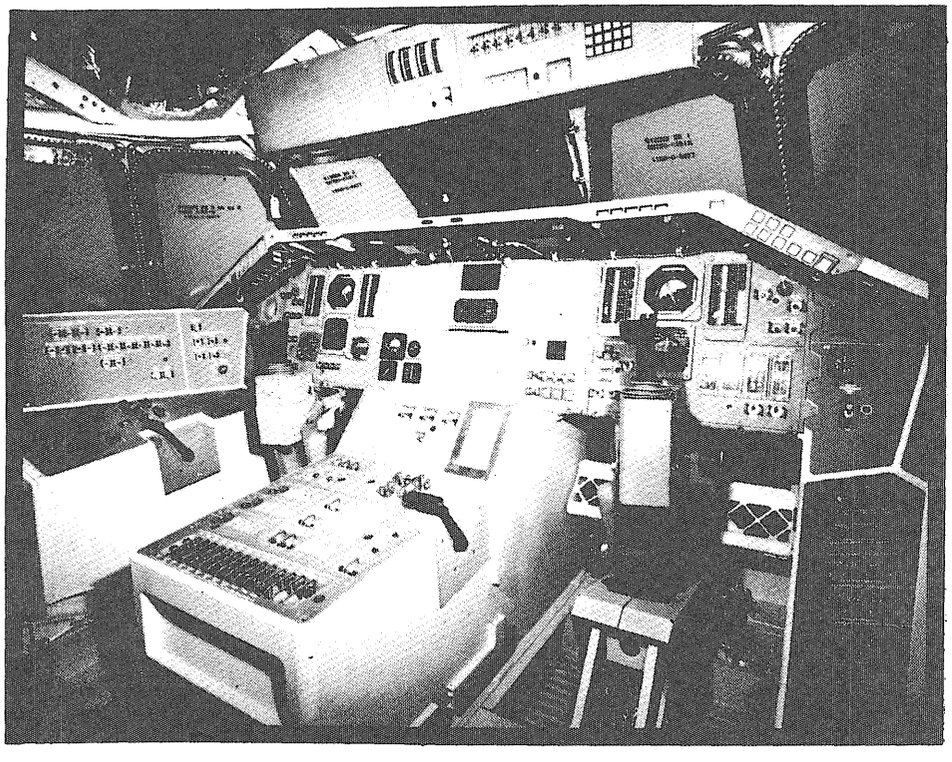
In the event that an orbiter should become disabled in space, a standby shuttle can be launched within 24 hours to bring down all the people aboard the other shuttle.

The center of the living area contains the galley and storage for the necessary foodstuffs and miscellaneous items. Around the living area of the second level are avionics cabinets, which conceal and protect and the electronic and mechanical wizardry necessary to launch a vehicle into space and land it again. The cabinets form an interior wall around the second level making it possible to find, if not fix, virtually anything that malfunctions.

A minimum of two spacesuits for extravehicular activity (EVA) are stored in the avionics cabinets. These suits are of a new type developed for the Space Shuttle Program by the Lyndon Johnson Space Center. Unlike their predecessors, these suits are not tailor-made for the wearer. The new suits come in three sizes: small medium and large; and can be adjusted to fit both men and women.

They are two-piece outfits: top and bottom halves just snap together at the waist. This is a vast improvement over the old suits, which required another person to help with the zippers, boots, gloves, etc. One can don the new suit alone, in zero-g, in much less time than was needed for the old suits.

The elbow, knee, and other joints on the new suits are made of a special new fabric that permits more freedom of movement than the old neoprene rubber joints did. It also costs and weighs less. The new suit has an; integral life support system for the average passenger of the Space Shuttle. The personal rescue enclosure, as it is called, is designed for a single person and consists of a tough inflatable plastic ball 86 centimeters in diameter. It comes complete with its own life support system and communications potential.



Shuttle cockpit

In the event of an emergency, like the failing of the orbital maneuvering subsystem, (which would prevent the orbiter from slowing down and dropping out of orbit) the people on board would be forced to escape to another vehicle.

The pilot and the mission specialist of the disabled orbiter would climb into their spacesuits for the trip across the vacuum of space to the other Shuttle.

The rest of the personnel on board, including the mission commander and the payload specialists, would enter personal rescue enclosures. The two men in spacesuits would then employ one of three ways to maneuver the plastic eggs across space. They could be clotheslined across, lifted with the mechanical arm, or simply carried.

To leave the orbiter, in a spacesuit or a personal rescue enclosure, one uses the airlock that opens onto the rear of the middle level. Through the airlock, crewmen make delicate repairs on a payload or the orbiter's external antennas and equipment.

Typically, the airlock will have two exits, one straight back into the cargo bay and the second straight above, behind the flight deck, so that seen from above it resembles the top turret in a WW II bomber.

Below the middle or living level is a bottom level that is not normally occupied. On this level, easily accessible from above, is the life support system. These three levels, tiny when compared to Earth-bound standards, but extremely spacious when compared to previous space vehicles, compose the pressurized and occupied portions of the orbiter. Directly behind this section is the large cargo bay.

The cargo bay is shaped like a cylinder with double doors that are the top half of the bay. The bay is 18 meters long and five meters in diameter, making room for a variety of payloads. Of course space isn't everything; the orbiter is designed to carry up to 29,500 kilograms in its cargo bay. The third section of the 85,000 kg orbiter consists of the three main engines, whose maximum thrust is 2.1 million newtons The fuel for the engines is stored in the largest single part of the Shuttle System, the external tank.

The tank is a monster, 47 meters long and 8.5 meters in diameter and when strapped to the orbiter they resemble an ICBM strapped to a Piper Cub.

The tank is actually a shell around two tanks. The forward third of the external tank is taken up by a tank containing some 600,000 kilograms of liquid oxygen while the rear two-thirds contains the actual fuel, 100,000 kilograms of liquid hydrogen.

The external tank, which weighs 35,000 kilograms, provides the rigid backbone on which the orbiter is mounted. Aside from that function, the tank is nothing more than a container; all of the fluid controls and valves necessary for operation of the main engines are located in the orbiter, behind the cargo bay, because the external tank is the only part of the Shuttle System that is designed to be lost at each launch.

the last two parts of the Shuttle System, a matched set, are the solid rocket boosters. These sit on the backbone of the external tank, slightly to either side of the orbiter.

Each booster weighs 80,000 kilograms including engine, hull and recovery system. When ready for firing, each will contain half a million kilograms of solid rocket propellant, providing an initial thrust of 12 million Newtons.

The boosters are recoverable and reuseable. When they have exhausted their fuel, explosive bolts will fire and the tow boosters will fall away. Parachutes will pop from the noses and the boosters will drift to an ocean

recovery.

These four components, the orbiter, the external tank, and the two solid rocket boosters, comprise the entire Shuttle System. When all of the tests currently underway at various laboratories around the United States are completed, a series of test orbits will be launched.

The external tank and the solid rocket boosters will be mounted on the launch platform first. The refurbished orbiter is then fastened to the tank and boosters and the system is ready for the launch.

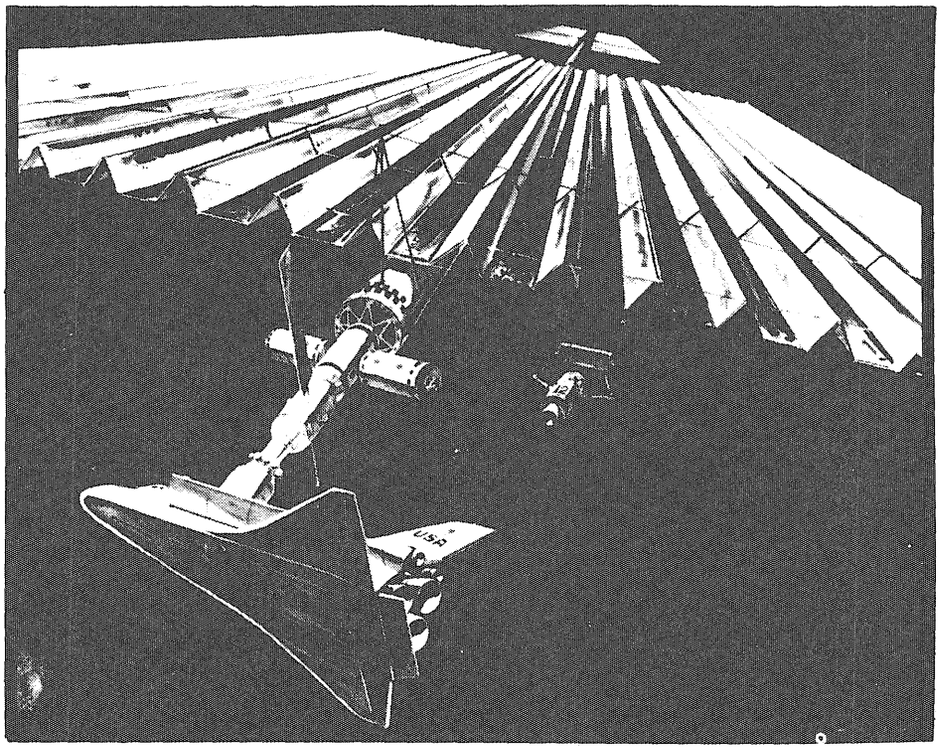
Unlike previous space shots, the launch tower does not swing away just before ignition. It is completely fixed for the Shuttle shots and, having been strengthened and partially redesigned, can withstand the exhaust blast with a need for only refurbishment.

At liftoff all five engines are firing full thrust, the three main engines burning the liquid fuel from the external tank and the two solid fuel boosters adding their thrust to get the shuttle moving.

The solid boosters reduce their thrust once, and at a height of 45.6 kilometers they burn out and drop off. At that point, the Shuttle is moving at 1391 meters per second and needs only its main engines to attain orbit. The solid boosters, out of fuel, fall from that point and land approximately 300 kilometers downrange from the launch site.

The main engines on the orbiter continue to burn for another six minutes, almost exhausting the fuel in the external tank. Then, at a height somewhere between 185 kilometers and 1110 kilometers, the external tank drops off and the main engines fall silent.

The external tank re-enters the atmosphere and is scheduled to break up over a remote section of the ocean. Or, if NASA gets the go-ahead, the tanks will be put into orbit and used as basic units in a space station. The orbiter will stay in orbit for 7-30 days with a typical mission lasting somewhere around 10 days.



Shuttle docked with solar power station

With the Shuttle, one-satellite rockets can be eliminated. The cargo bay can carry as many as seven satellites into orbit, where they can literally be dumped into space.

The orbiter can actually grab a passing satellite, pull it into the cargo bay with the remote manipulator arm and work on it from remote control or by EVA. Should it be necessary or desirable, one can close up the bay and land with the satellite for more extensive servicing, removal of spy film, etc.

The Space Shuttle can also carry up a satellite intended for orbit around the moon, or even another planet, if the satellite is equipped with its own propulsion system. The Department of Defense has already developed an engine-fuel stage called an interim upper stage for this purpose.

The Shuttle would boost a craft of this type into orbit and when properly positioned, release it. The payload would then fire its own engines to escape orbit and head for its destination.

The NASA Goddard Space Flight Center is studying a family of modular satellites that could be used in conjunction with the Shuttle. Aside from the advantage of low-cost standard hardware, the modularity would permit many more repairs and routine servicing to be done in space. NASA and the European Space Agency (ESA) have cooperated with the Spacelab program, one of the Shuttle's major missions. Spacelab is a complete scientific laboratory developed by the ESA to operate in zero-g with full facilities for working, eating and sleeping in ordinary clothes.

A Spacelab would occupy the entire cargo bay, and connect with the airlock on the middle deck. A maximum of four scientific personnel could live and work in Spacelab, conducting experiments in medicine, manufacturing, astronomy and pharmaceuticals.

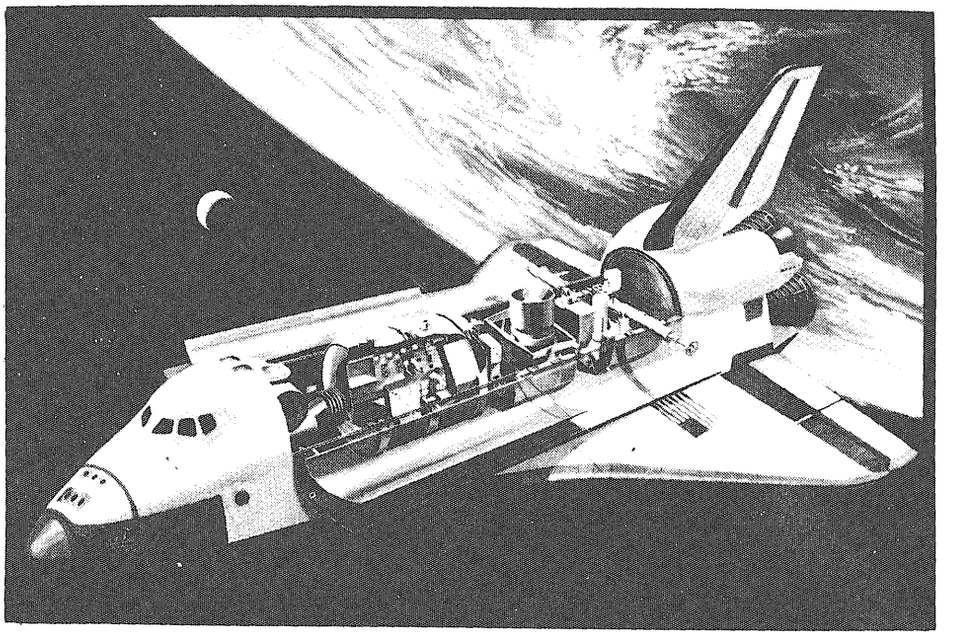
Once a Shuttle orbiter with a Spacelab orbiter with a Spacelab on board is in orbit, it can open its cargo bay doors, exposing the lab to space. It can then assume any attitude with respect to the Earth, including upside down, so that the scientists on board can observe the stars, the planets, the weather, our own planet or anything to which space offers a superior vantage point.

Spacelab personnel from ESA member nations and the U.S.A. will be experts in their fields. Scientists selected to fly aboard a Spacelab need only undergo a few weeks of space-flight training.

Members of the ESA, sponsors of Spacelab are Belgium, Denmark, France, Italy, the Netherlands, Spain, Switzerland, the United Kingdom, West Germany and Austria.

Two special missions scheduled for Shuttle flights are the Space Telescope and the Long Duration Exposure Facility (LDEF). The Space Telescope is an international undertaking sponsored by the George C. Marshall Space Flight Center in Huntsville, Alabama and the Goddard

Shuttle with Spacelab in bay



Space Flight Center in Greenbelt, Maryland. Once dropped in space it will be controlled and monitored from the ground.

The Space Telescope will spend several years in space before returning to earth. While it's up there, the Shuttle will change its film, replace lenses or faulty electronics.

The LDEF is an orbiting, unmanned laboratory that will contain various passive experiments that will record the effects of long exposure to space. When the LDEF has been in orbit for a number of years, it will be brought down again and the results will be studied by its creating institution, the NASA Langley Research Center.

A more exotic shuttle mission would be the construction of solar power stations in orbit. Such a station would convert solar power into microwaves and beam them to earth, where they would be converted into electricity. The Shuttle, of course, would be responsible for maintaining it.

Another drawing board mission for the Shuttle is the building of a permanent colony in space from modular units, or perhaps the used fuel tanks. The weightlessness of space makes the manufacture of some drugs cheaper, and the forging of some special alloys possible. Drugs and lenses of unusual purity can be produced, and crystals can grow to sizes impossible on Earth.

One of the main objectives of the Space Shuttle Program is to get non-astronaut scientific personnel into space. The less-than-perfect physical specimen can indeed ride the Shuttle because everything has been designed to increase comfort.

The atmosphere, except for a lack of a few pollutants you might find on Earth, is indistinguishable from that at sea level. Most importantly, the acceleration at launch is only three times Earth surface gravity and the acceleration on re-entry is one and one half times that of Earth. By comparison, previous manned flights experienced three times these rates, necessitating a much tougher physique.

****

When the orbiter has complted its mission it will fire its orbital manuevering subsystem to slow it to re-entry speed. The OMS fuel is monomethyl hydrazine with nitrogen tetroxide as an oxidizer. Since these two substances ignite on contact, there is no need for any ignition system in the OMS.

At a height of 121.9 kilometers the orbiter will begin its re-entry into the Earth's atmosphere at a speed of 7434 meters per second.

A new type of heat shield that does not burn away has been developed for the Shuttle.The shield is so effective that one side could be held in a bare hand, while the other side is red hot. The shield will withstand heat to 1260 C for 100 flights with little or no refurbishment. Previous heat shields relied on self-erosion to dissipate the heat generated by re-entry.

The landing, from the point where the orbiter enters the Earth's atmosphere to the time it touches down on its desert landing strip, will cover 1850 kilometers. In contrast to earlier flights, the pilot will have a wide range over which to steer his craft, with a maximum crossrange of 2000 kilometers.

Over the landing distance the orbiter will average 112 meters per second. It will make its final, one-shot approach to the runway at 90 meters per second, approximately the landing speed of current high-speed jet fighters.

As soon as the orbiter has stopped rolling, work will begin on it. First the explosive-bolt connections to the external tank and boosters will be removed. The payload will be removed, if one is aboard, and the technicians will replace, service and test the various systems and components of the orbiter, to ready it for another launch.

Special equipment for its new mission will be installed and the orbiter will be transported to the launch pad where the new external tank and the old boosters which have been refueled are already waiting.

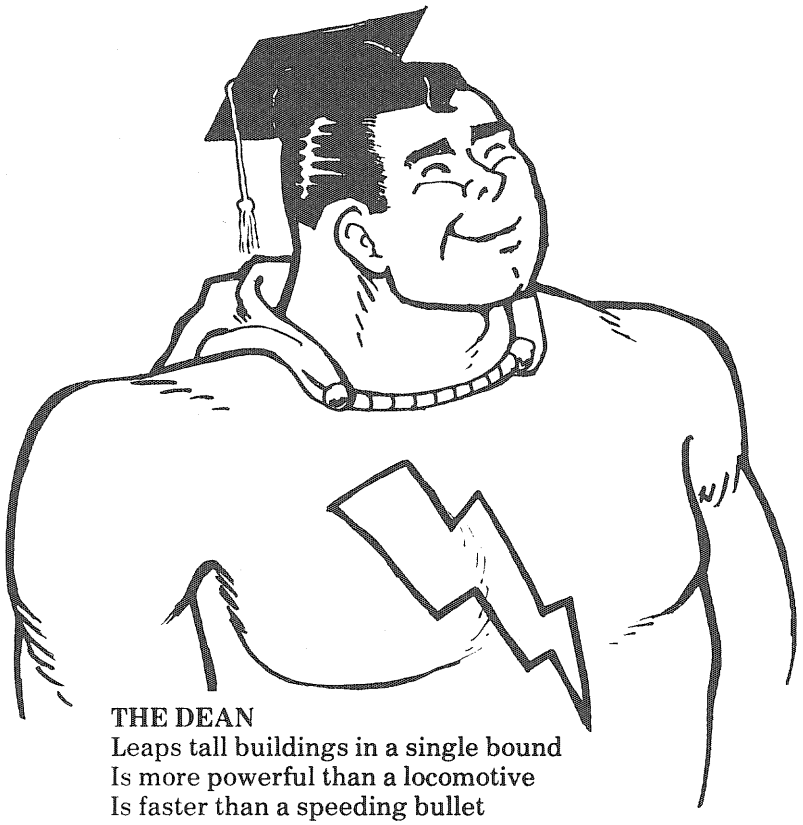
Shuttles will be launched from two places. To the east, at NASA's John F. Kennedy Space Center in Florida and to the west at Vandenburg Air Force Base in California.

Each orbiter will be flown about 50 times over a 10-year period with a life expectancy of 100 flights. The life of a Spacelab is estimated at 50 flights. The ground turn around, which is the time it takes a newly landed orbiter to be ready for a new mission, is about two weeks. The orbiter requires about 160 hours of actual work.

NASA has scheduled the Shuttle to begin regular flights in 1980 on the basis of about 56 shots per year for at least 10 years.

The objectives for the Space Shuttle, according to NASA, are two-fold: First, to substantially reduce the cost of space operations; Second, to provide a broad capacity for scientific, defense, commercial and international users.

At any rate, if you would like to ride up on the Shuttle, plant your own satellite or just see how much snow there is in Colorado, then you better hurry—NASA has already sold out the first year of scheduled flights.

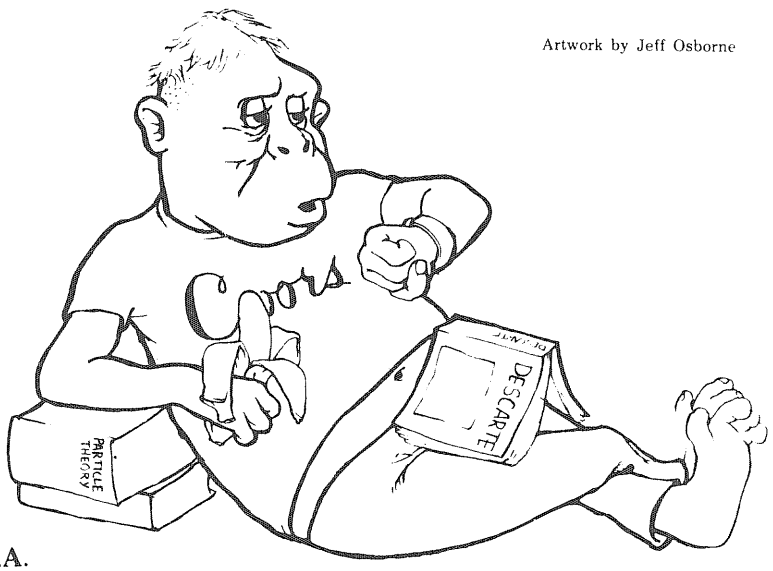


THE DEAN
Leaps tall buildings in a single bound
Is more powerful than a locomotive
Is faster than a speeding bullet
Walks on water
Gives policy to God

PROFESSOR
Leaps short buildings in a single bound
Is more powerful than a switch engine
Is just as fast as a speeding bullet
Walks on water if the sea is calm
Talks with God

THE SYSTEM REVEALED

Artwork by Jeff Osborne

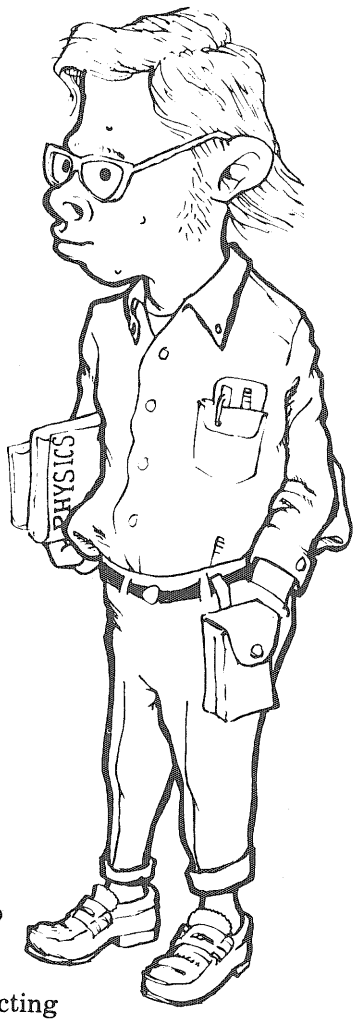


T.A.
Runs into buildings
Recognizes locomotives two out of three times
Has trouble deciding which end of a gun is dangerous
Can stay afloat with a life jacket
Thinks he is God

UNDERGRADUATE STUDENT
Falls over doorstep when trying to enter buildings
Says "look at the choo-choo"
Wets himself with a water pistol
Plays in mud puddles
Mumbles to himself

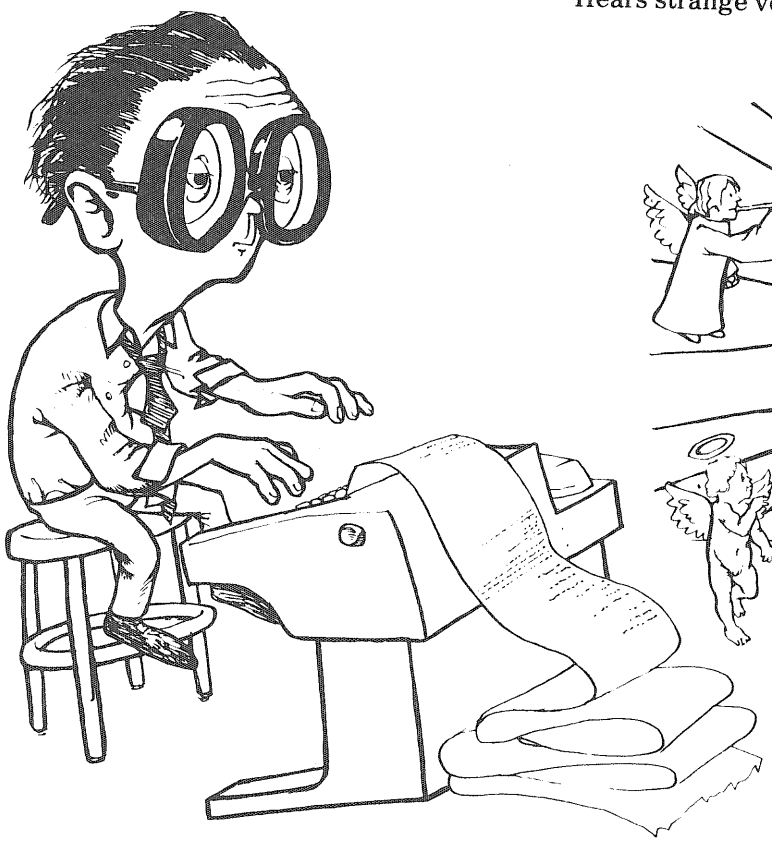
ASSOCIATE PROFESSOR
Leaps short buildings with a running start and favorable winds
Is almost as powerful as a switch engine
Is faster than a speeding BB
Walks on water in an indoor swimming pool
Talks with God if special request is approved

ASSISTANT PROFESSOR
Barely clears a quonset hut
Loses tug of war with a locomotive
Can fire a speeding bullet
Swims well
Is occasionally addressed by God



COMPUTER PROGRAMMER
Does not recognize buildings
Trips on tracks, then is run over by locomotive
Gets a kick out of hearing a cap pistol shot
Recognizes "water" as a real variable
Prays to God in Fortran

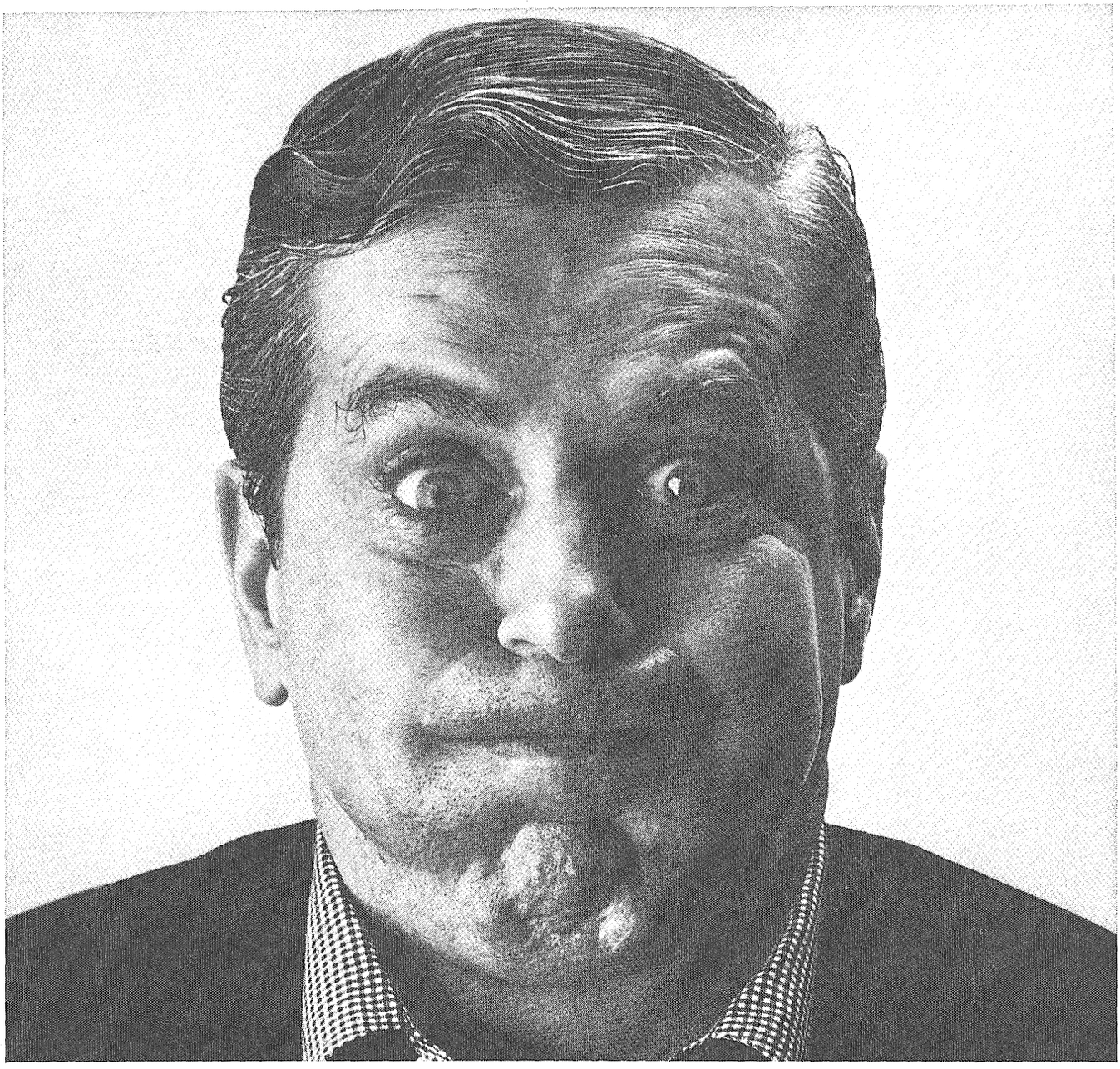
GRADUATE STUDENT
Makes high stains on walls when trying to leap tall buildings
Is run over by locomotives
Can sometimes handle a gun without inflicting self-injury
Can usually keep his head above the water
Hears strange voices in the night



DEPARTMENT SECRETARY
Lifts buildings and walks under then
Kicks locomotives off the tracks
Catches speeding bullets in her teeth and eats them
Freezes water with a single glance
She is God


INTRODUCING THE WHACKY MISADVENTURES OF OUR HERO
CAPTAIN PHLEGM PHLAGM!
©Technolog MCMLXXVII
TAKING CARE OF BUSINESS AT HIS DEEP SPACE ROLLER RINK, CAPTAIN PHLEGM PHLAGM IS INTERRUPTED BY A CALL....
SIX BAZONGAS, PLEASE...
!!BZZZZZZZ
RIGHT CHIEF! GOT IT! BE RIGHT OVER!
C.P.PH.PH. HURTLES THRU SPACE....
BURMA SHAVE
AND LANDS ON THE PLANET ZYXV...
SO! AS I SUSPECTED...
....THE EVIL EMPEROR PHALANGER IS UP TO HIS OLD TRICKS...
SENDING HIS GOONS OUT ROUNDING UP NAIADS TO WORK IN HIS TACKYNITE MINES...
I'M GONNA NEED HELP ON THIS ONE...
CALLING STAR PATROL HEADQUARTERS! THIS HERE'S CAPTAIN PHLEGM PHLAGM! SEND THE BOYS! 10-4!


YOU SEE SON? SOON WE'LL CORNER THE INTER-GALACTIC MARKET ON TACKYNITE! WITH FREE NAIAD LABOR, WE CAN UNDER BID ANYONE AND NAIL THE FAT ARTILLERY CONTRACTS....
WE ONLY HAVE TO KEEP A SHARP EYE PEELED FOR THAT NO GOOD MEDDLER, CAPTAIN PHLEGM PHLAGM!
AUTHORIZED PERSONNEL ONLY
MEANWHILE....
NOT A BAD LIFE, EH KID? KETCHIN' NAIADS FOR PHALANGER'S SWEAT FACTORIES!
NOT WIT'OUT IT'S BRIGHTER SIDE...
SUDDENLY...
GET EM GUYS!
POW
BLAM
SKWUTCH!
WHAT THE....!
OUR INTREPID HEROS FIGHT VALIANTLY, BUT ARE HOPELESSLY OUTNUMBERED! SOON THEY ARE CAPTURED AND...
BIF
SOK
BROUGHT TO EMPORER PHALANGER!
THROW THEM IN THE PIT WITH THE HIDEOUS BURSAR MONSTER!
IS THIS IT?...
WILL OUR FEARLESS IDOLS END UP AS HORS D'EOUVRES FOR THE BURSAR? CONTINUED NEXT ISSUE!



Hold your breath for 60 seconds.

Try this little experiment and chances are you'll find the last few seconds unbearable.

That desperate, terrifying sensation is caused by a lack of oxygen and an excess of carbon dioxide.

People with emphysema or other lung diseases know the feeling well. They live with it 24 hours a day.

Oxygen therapy can help many of them. But it can also sentence them to a bleak existence—living in fear, bound to heavy, bulky oxygen tanks.

Union Carbide has developed a portable oxygen system.

We call it the Oxygen Walker.

It's small enough to be carried on a shoulder strap and weighs only 11 pounds full. Yet, incredibly, this handy pack can supply over 1000 liters of oxygen gas—enough for 8 hours or more, depending on individual flow rates.

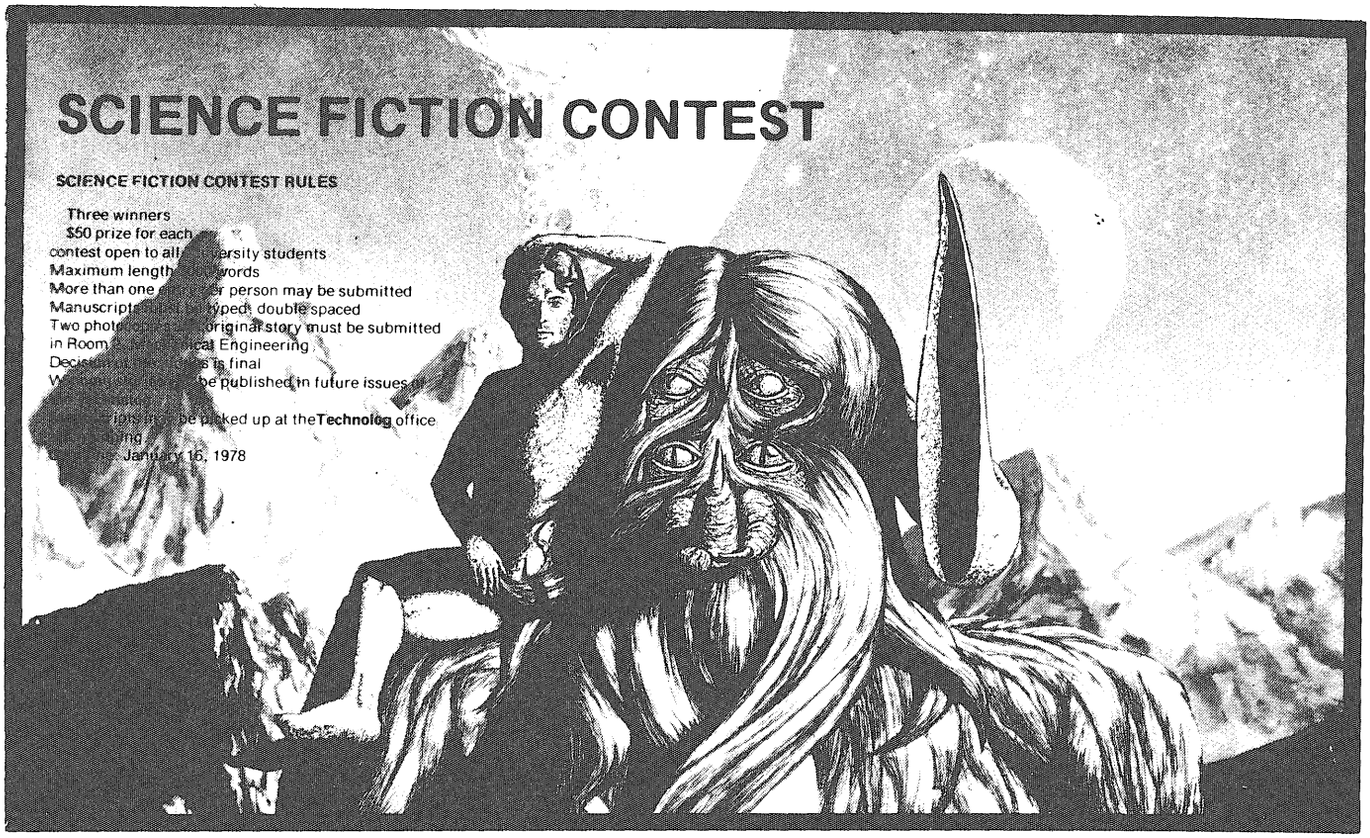
Taking the Oxygen Walker with them, patients are free to leave their homes. Free to go walking, shopping, fishing... many have even returned to work.

The Oxygen Walker is only one of the things we're doing with oxygen. We supply more of it than anyone else in the country. For steelmaking, hospitals, wastewater treatment and the chemical industry.

But, in a way, the Walker is the most important use of our oxygen. Because to the people who use it, it is the breath of life.

UNION CARBIDE

An Equal Opportunity Employer M/F



(Continued from page 5)

The deadline for submission of applications for the National Science Foundation Graduate Fellowships for 1978-79 is Dec. 1, 1977. Applicants will be required to take the Graduate Record Examinations, designed to test aptitude and scientific achievement, which will be given on Dec. 10, 1977 at designated centers throughout the United States. For further information and application materials, write to: Fellowship Office, National Research Council, 2101 Constitution Ave., Washington, D.C. 20418.

The National Science Foundation will also award approximately 140 postdoctoral fellowships. The deadline date for these fellowships is Dec. 15, 1977, and information may be obtained by writing to the address above.

* * *

The Science Museum of Minnesota, Future Studies Department, is conducting a conference series on understanding Minnesota's resources. The series will examine some of Minnesota's resources in order to increase public awareness and understanding of issues and alternatives regarding our resources.

The format of the conference will vary, but all will include formal presentations, panel discussions, opportunities for audience participation and some meals. Some will also include exhibits, small group workshops, multi-media and a Dudley Riggs Brave New Workshop presentation. All of the conferences are open to the public, but pre-registration is required.

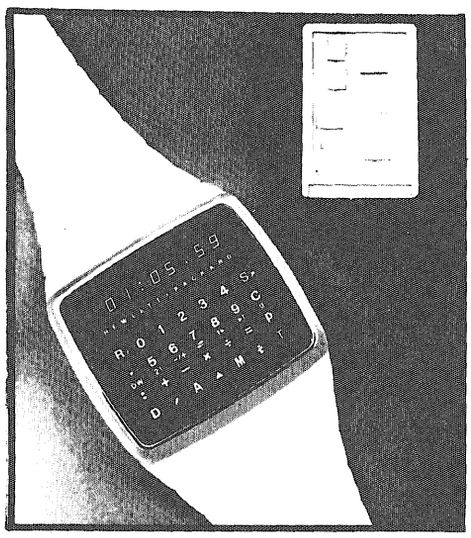
On Nov. 4 and 5, 1977, a conference, "Robotics: Is There a Robot In Your Future?" will be held at the Holiday Inn in Downtown Minneapolis. There is a registration fee of $22. On Dec. 8, 9 and 10, the topic will be "Water: Our Delicate Life Membrane," and the conference will be held at the Radisson South, Bloomington. Registration fee is $30. Feb.17, 18 and 19, 1978, are the scheduled dates for a series on "Future Directions in Health and Healing." The location will be announced, and the registration fee is $32. "The Future of Education" is the topic of the June 19-30, 1978 conference. The location for this conference will also be announced at a later time and the registration fee has not yet been determined.

For further information and registration materials write: The Science Museum of Minnesota, Future Studies Department, 30 East 10th Street, St. Paul, Minnesota, 55101.

* * *

Introducing HP-01, a new wrist instrument to integrate both timekeeping and computation operations in a single, interactive system! This instrument, introduced by Hewlett Packard, which resembles a digital watch, performs more than three dozen functions, weighs only six ounces, and costs $650 in stainless steel and $750 in gold.

* * *

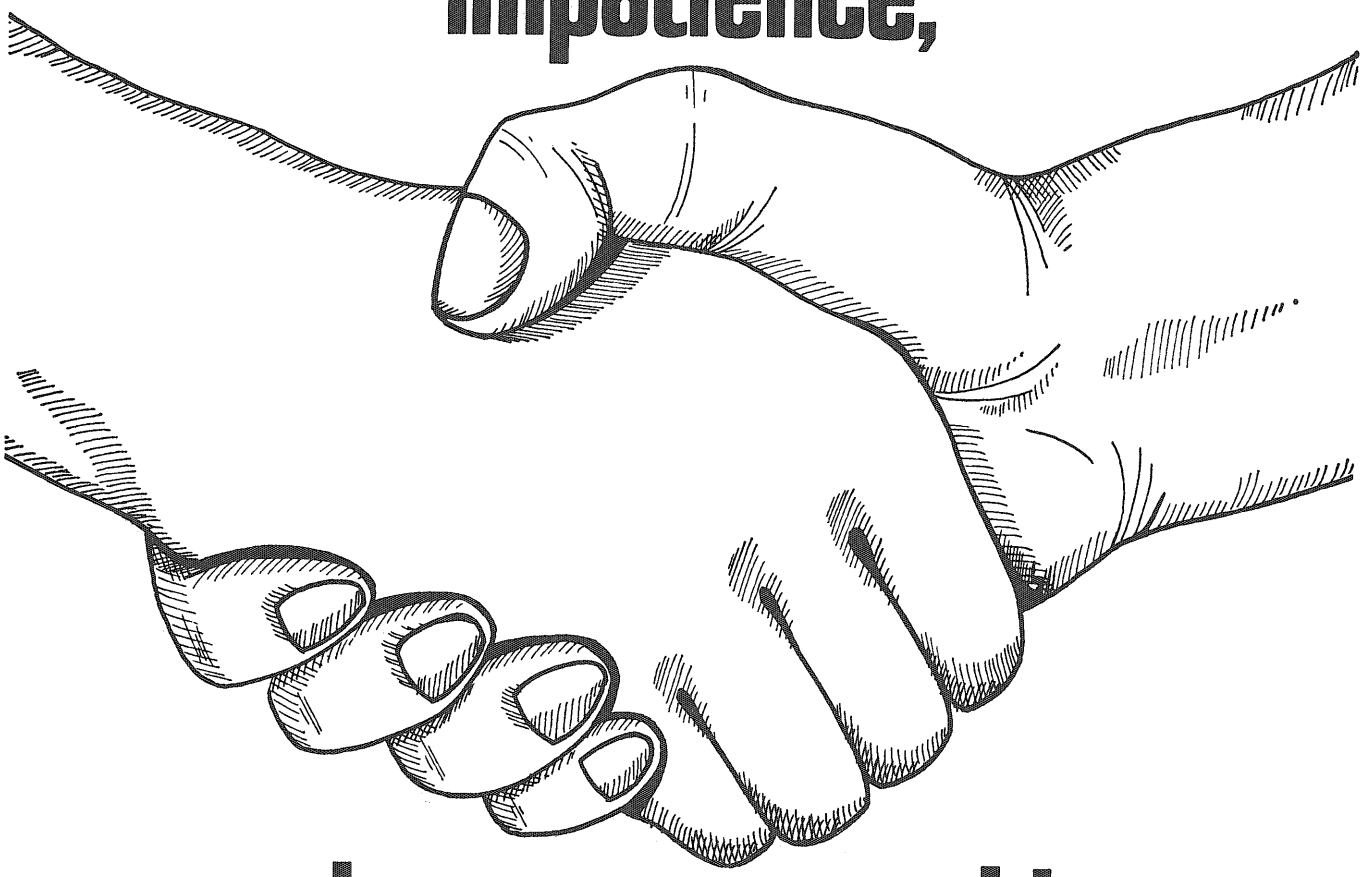


Editor's Note: We would be happy to include information about student club meetings or events or other announcements in the Log Ledger. Please submit information to us in Room 2, Mechanical Engineering. If the door is locked, slip the information under the door, addressed to Log Ledger.

AND NOW, LIVE FROM THE U OF M, THE Technolog!

Hi! We're on the **Technolog** staff and you're not! But you can be! We need artists, photographers and writers. Stop by Rm. 2, Mech E and offer to help. We'll be looking for you!

If your middle name is impatience,



maybe we can put things on a first name basis.

At Celanese, we don't think patience is much of a virtue when it comes to creativity or careers. We became a 2 billion dollar company by responding quickly and creatively to changing markets and technologies. By giving our people the opportunity—and responsibility—to respond to change, to develop, to take initiatives.

That's why you won't find any lengthy training programs at Celanese. Our management philosophy is to give our engineers and chemists significant projects and responsibilities as soon as possible. Give them as much to handle as their skills and dedication are up to in an unusually open working environment which fosters creative decision-making at all levels.

It works for you because it gives you the opportunity to grow rapidly. It works for us because it's what has made us a leader in man-made fibers, with a solid position in chemicals, polymer specialties and engineering resins. Without an impatient responsiveness, we wouldn't have pioneered triacetate, developed Fortrel® polyester or become a world leader in formaldehyde and methanol production.

If you think you'd like working in this kind of an atmosphere, let's get to know each other better. If you have a degree in engineering or chemistry, ask your placement officer to set up an interview with us. Or write John D. Grupe, Celanese Building, 1211 Avenue of the Americas, New York, N.Y. 10036.

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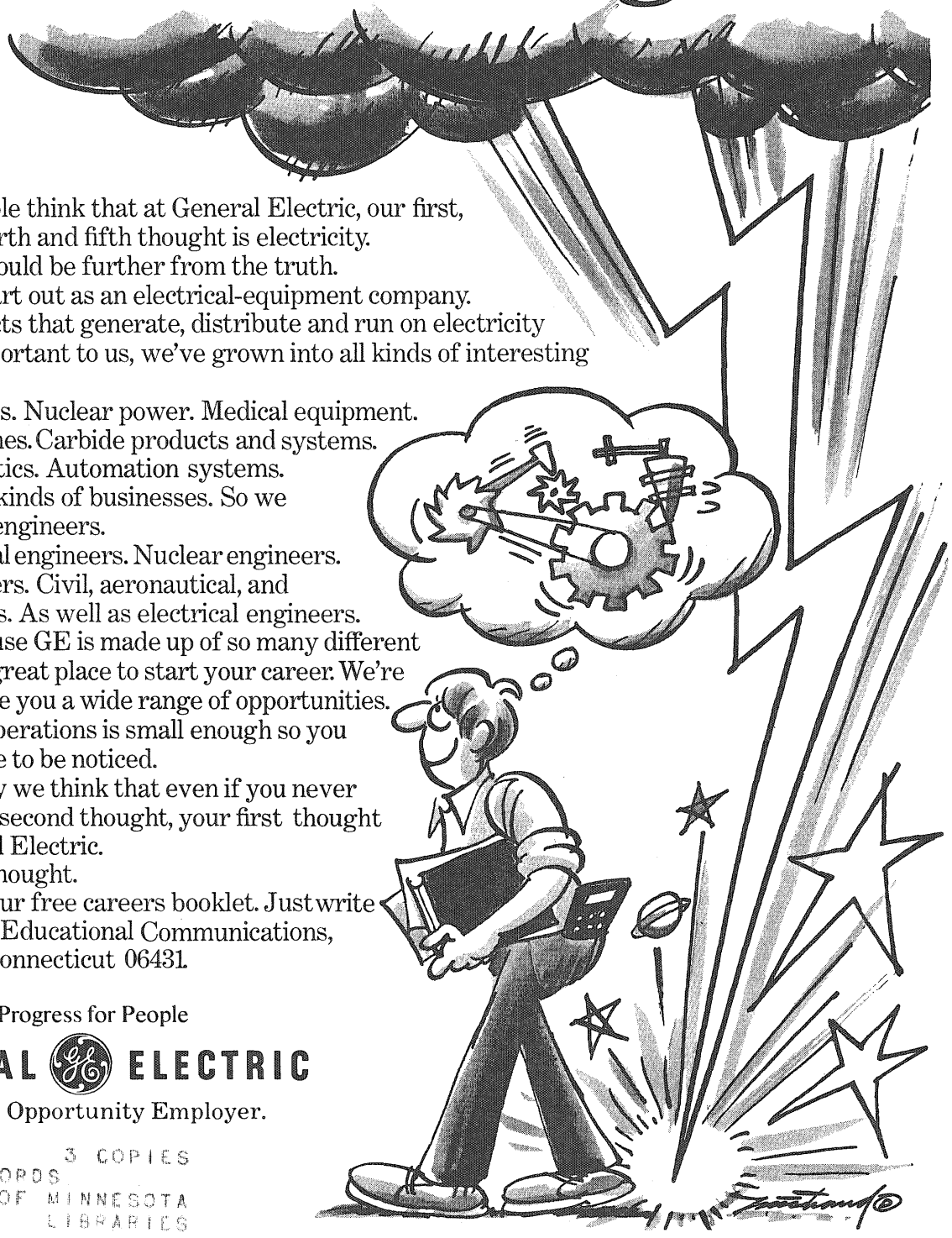
CELANESE®

An equal opportunity employer m/f

We're looking for engineers who never gave electricity a second thought.



Most people think that at General Electric, our first, second, third, fourth and fifth thought is electricity.

Nothing could be further from the truth.

We did start out as an electrical-equipment company. And while products that generate, distribute and run on electricity are still very important to us, we've grown into all kinds of interesting business areas.

Jet engines. Nuclear power. Medical equipment. Aerospace. Silicones. Carbide products and systems. Engineering plastics. Automation systems. Mass transit. All kinds of businesses. So we need all kinds of engineers.

Mechanical engineers. Nuclear engineers. Chemical engineers. Civil, aeronautical, and ceramic engineers. As well as electrical engineers.

And because GE is made up of so many different businesses, it's a great place to start your career. We're big enough to give you a wide range of opportunities. But each of our operations is small enough so you have a real chance to be noticed.

That's why we think that even if you never gave electricity a second thought, your first thought should be General Electric.

Give it a thought.

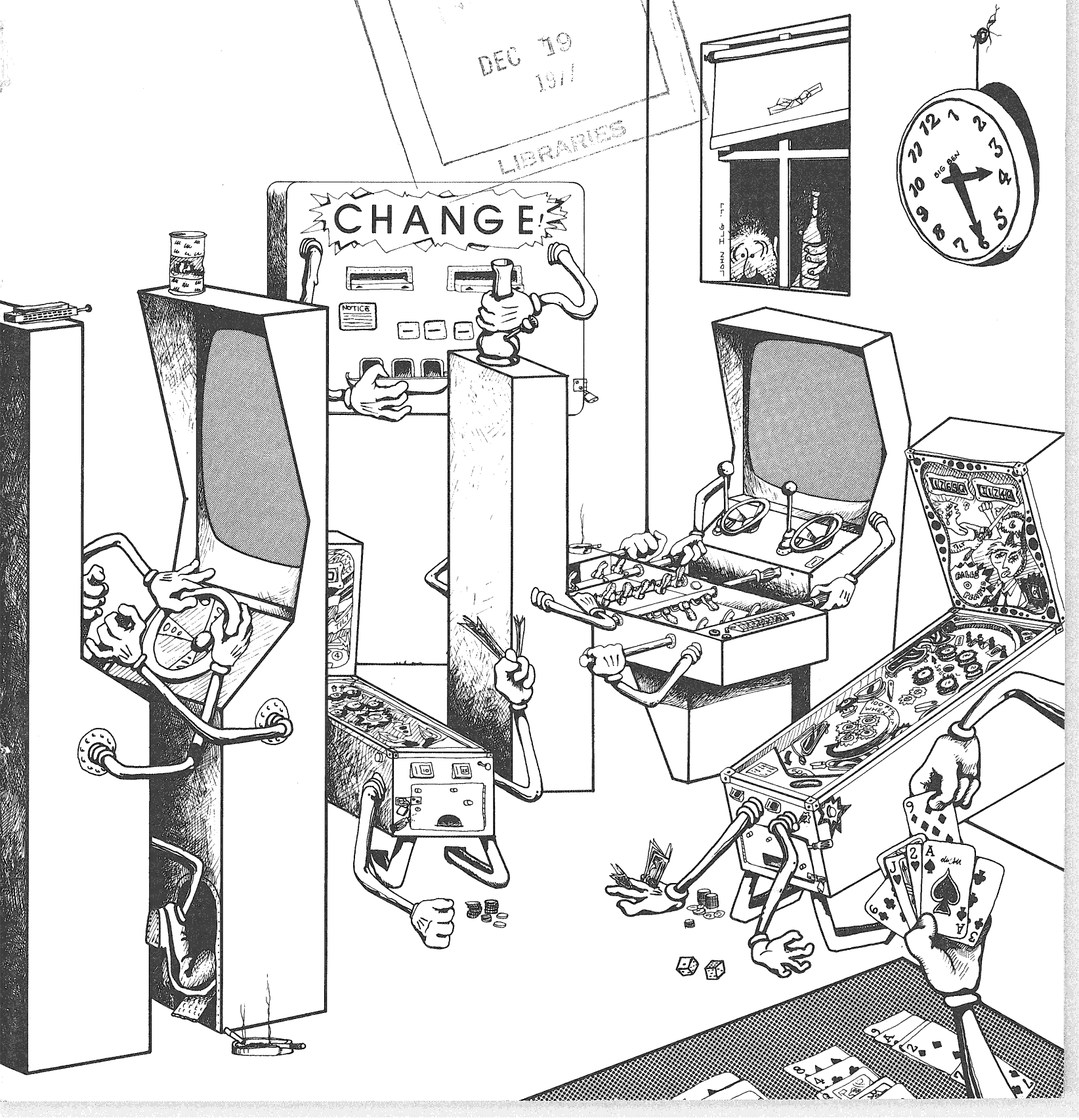
Send for our free careers booklet. Just write General Electric, Educational Communications, W1D, Fairfield, Connecticut 06431.

Progress for People

GENERAL ELECTRIC

An Equal Opportunity Employer.

minnesota Technolog fall 2 1977



It pays to enroll in AFROTC

The Air Force needs commissioned officers in the science and engineering areas. Many will enter active duty through Air Force ROTC.

And you don't have to wait for graduation to receive financial help. You can be paid as you earn your college degree.

Check the list of college majors. If yours is on the list, you could qualify for either a 2 or 3-year AFROTC scholarship that includes full tuition, books, all lab fees and $100 a month, tax free. Even without the scholarship you can get excellent Air Force ROTC training and the $100 a month tax-free allowance during the last two years of college.

Full Tuition
Lab Fees
$100 a month

Upon graduation, you will be commissioned as an Air Force Reserve Officer and may be selected for extended active duty. As an active duty officer you will have the opportunity for a challenging, technical, responsible job. There is also a chance for advanced education in your chosen field. And the pay and related benefits are excellent. You'll start with good pay and allowances; academic and technical training opportunities; 30 days of paid vacation each year; free medical and dental care; recreational facilities; low cost insurance; commissary and exchange privileges; and more advantages.

In return for the AFROTC scholarship or training, you are expected to maintain a high level of scholastic excellence and agree to remain on active duty with the Air Force for a minimum of four years.

A limited active-duty opportunity is also there for highly qualified non-Air Force ROTC graduates. Graduates whose degree appears on the list may apply for officer training. Successful applicants will attend a 12-week Officer Training School located in San Antonio, Texas. Graduates of the school receive an Air Force commission and are on the way to challenging jobs as Air Force officers.

Check the list again and for more information visit your campus Air Force ROTC representative or your nearest Air Force recruiter. For more information or the name of an ROTC representative or Air Force recruiter send in the coupon or call toll free: 800-447-4700 (in Illinois: 800-322-4400). When calling please specify your interest either in Air Force ROTC or Officer Training School.

If your major is listed here, it could be worth a lot to you.

Aeronautical Engineering
Aerospace Engineering
Architecture
Architectural Engineering
Astronautical Engineering
Chemical Engineering
Chemistry
Civil Engineering
Computer Technology/Science
Electrical Engineering
General Engineering
Industrial Engineering
Mathematics
Mechanical Engineering
Meteorology
Nuclear Engineering
Physics
Space Physics Engineering

AIR FORCE OPPORTUNITIES CENTER **2-EC-117**
P.O. BOX AF
PEORIA, IL 61614

I would like more information on opportunities for Science and Engineering students and graduates. I am interested in (check one) Air Force ROTC_____. Air Force Officer Training School _____.

Name_____ **Sex ☐ M ☐ F**
(Please Print)
Address_____
City_____ **State**_____ **ZIP**_____
Date of Birth_____ **Phone number**_____
(Furnish college or high school information.)
College_____ **Major**_____ **Graduation date**_____
High School_____ **Graduation date**_____

Air Force ROTC–Gateway to a great way of life

"At Du Pont you don't get lost in a big company atmosphere. It's very personal."

—George D. Peterson BS, Chemical Engineering

"Du Pont is a big company but it's broken down into satellites. So you don't get lost in a big-company atmosphere. It's very personal, and I think the people are top-notch.

"I started in technical here at the Belle Plant in West Virginia. Now I'm a production supervisor. Production is solving problems on a day-to-day basis. I like working under that kind of pressure. When things work out, it's very rewarding. So is working with people. I'm responsible for helping 22 people do their jobs."

George was recruited by Du Pont from the Michigan Technological University campus in 1973. He interviewed about 25 companies.

George's story is typical of many Chemical, Mechanical and Electrical Engineers who've chosen careers at Du Pont.

We place no limits on the progress our engineers can make. And we place no limits on the contribution they can make—to themselves, the Company or to society.

If this sounds like your kind of company, do what George Peterson did. Talk to the Du Pont representative who visits your campus. Or write: Du Pont Company, Room 35972, Wilmington, DE 19898.

At Du Pont...there's a world of things YOU can do something about.

DU PONT

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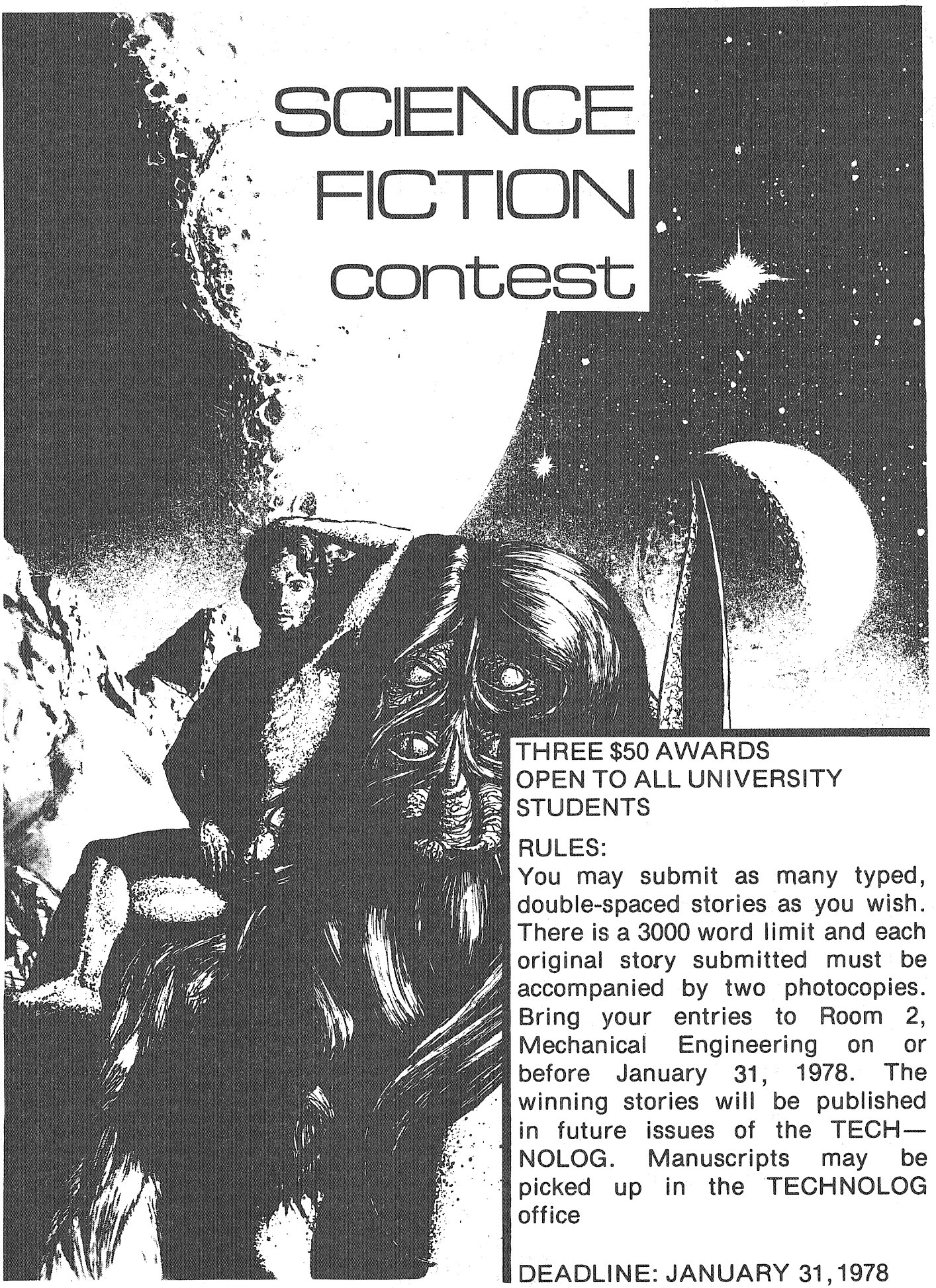
An Equal Opportunity Employer, M/F

SCIENCE FICTION contest



THREE $50 AWARDS
OPEN TO ALL UNIVERSITY STUDENTS

RULES:
You may submit as many typed, double-spaced stories as you wish. There is a 3000 word limit and each original story submitted must be accompanied by two photocopies. Bring your entries to Room 2, Mechanical Engineering on or before January 31, 1978. The winning stories will be published in future issues of the TECH—NOLOG. Manuscripts may be picked up in the TECHNOLOG office

DEADLINE: JANUARY 31, 1978

minnesota **Technolog** fall 2 1977

Official Student Publication of the Institute of Technology, University of Minnesota

Vol. 58 No. 2

Cover art by John Ilg

MEMBER OF ECMA

The Minnesota Technolog is published six times yearly: two times each during the periods from October through December, January through March, and April through June. Second class postage paid at Minneapolis, Minnesota 55455. Telephone: 373-3298. Is anyone reading this? Printer: Greenhaven Printing, Minneapolis. Publisher's national representative: Littel-Murray-Barnhill, 60 West 42nd Street, New York, NY. Subscription rate: 70 cents per issue. Advertising rates available on request.

editor's page

TECHNOLOG SURVEY

Please number the following articles from this issue in order of preference, from 1-9.
Check as many as apply

Log Ledger_____

The Myth of the IT Nerd_____

Video Games_____

Ask Uncle Dave_____

Farewell, Dean Swalin_____

Interstellar Spaceflight_____

Contraception Comes of age_____

Captain Phlegm Phlagm_____

Wildlife Portrait_____

Please list three topics which you would like to see covered in future issues.

1.

2.

3.

Do you think **Technolog** supplies relavant information to you as a student and job-seeker?

How many issues of **Technolog** do you pick up each year?

none some most all

What do you think of the content of **Technolog**?

A good mix of technical / non-technical_____

Not technical enough_____

Entertaining_____

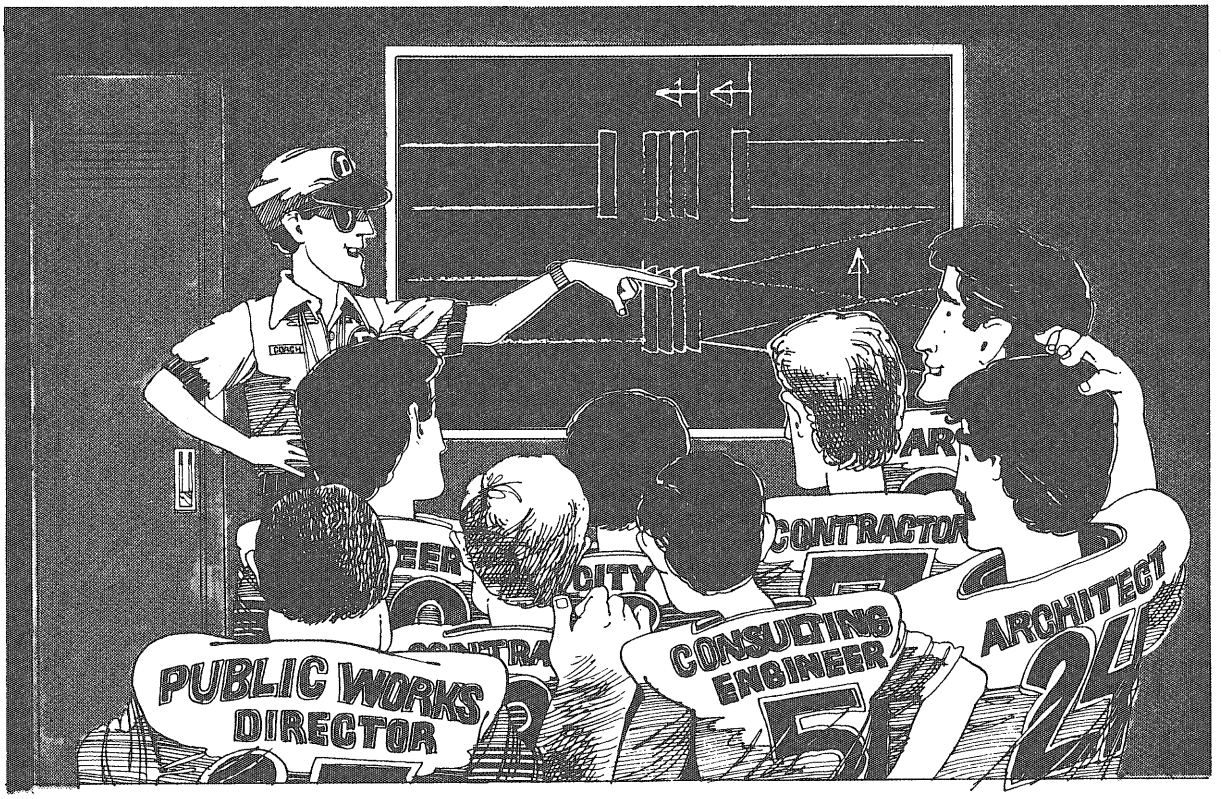
Interesting_____

Boring_____

Informative_____

In the space provided, please write any questions, comments, criticisms or praise you have concerning **Technolog**.

After answering the survey, tear it out and drop it in the suggestion box located outside the Technolog office, Room 2, Mechanical Engineering.
Thank you for your cooperation.
The editor.

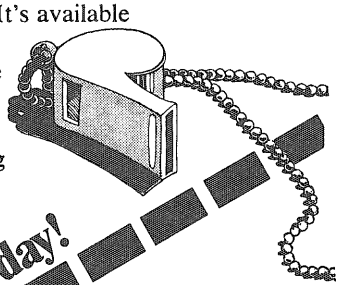


It's time for a PEP talk

We've developed, tested, and thoroughly proven a new coupling technique for Dickey clay pipe that is so improved and effective that you'd probably challenge our claim if all were presented here.

We call our new coupling system PEP, for Plain End Pipe. The ends are plain. No bells. And the joints set new standards for the industry. It's available in sizes to fit six through twelve inch pipe.

Users, in unsolicited testimony, already report impressive results and economies from Dickey PEP and we know you'll want to use it when available in your area. So, arrange now for a PEP talk. We'll pit our best men against your toughest questions. They're waiting to bring you the full Plain End Pipe story.



DICKEY™ COMPANY

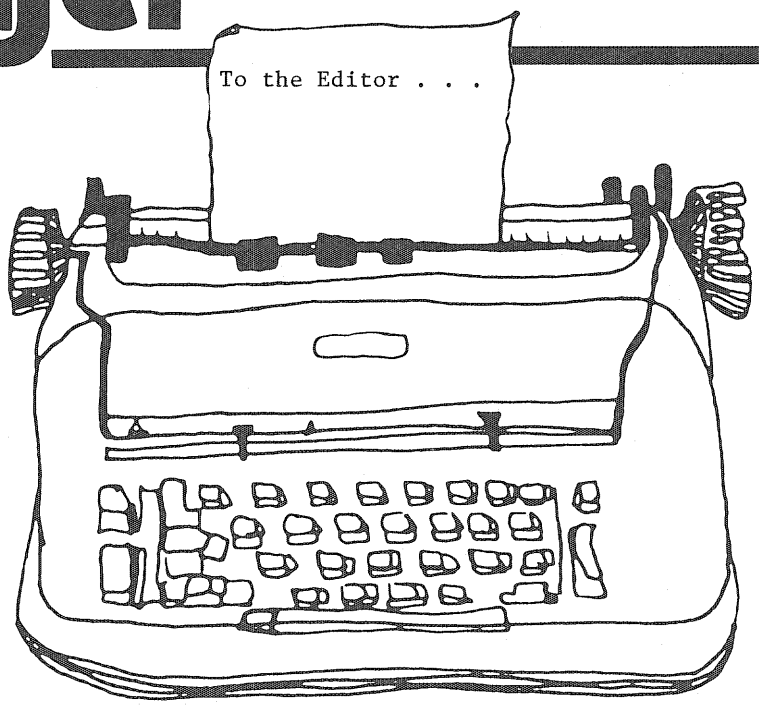
Call or mail this handy coupon, today!

W. S. Dickey Clay Manufacturing Company
P.O. Box 6, Pittsburg, Kansas 66762
Telephone: (316) 231-1400

Name *Title* *Address*

4-2710B

'log ledger



Belated credit for **Technolog**'s Fall I cover photograph goes to Fred Harding. Sorry about the omission, Fred.

Last issue, our editorial gave the impression that the continued publication of **Technolog** was uncertain at best. Since then, we have received the following, which reads in part, "RESOLUTION 77,10. 27:01; The following points have been agreed upon by the membership of the Institute of Technology Board concerning the **Minnesota Technolog**:

1. In recognition of the strong tradition exhibited in the over 55 years of publication and because the magazine provides desired services to IT students, the Institute of Technology Board endorses the continued publication of the **Technolog**.
2. The Institute of Technology Board endorses the continued funding of the **Minnesota Technolog** through student fees . . ."

This should help answer the dozens of questions we've received in the **'log** office about whether or not we will continue to publish.

Technolog has a new art director. Her name is Sharon Gale. The **Technolog** staff warmly welcomes you, Sharon!

Longer Hours for IT Libraries

In response to the request for more hours, the IT libraries are open during the following additional hours:

Architecture Library
Monday-Thursday until 10 p.m.
Sundays 1-6 p.m.

Engineering Library
Saturdays 11 a.m.-5:45 p.m.
Sundays 6 p.m.-9:45 p.m.

Geology Library
Wednesday until 9 p.m.
Saturdays 12-4 p.m.

Math Library
Wednesdays until 9 p.m.
Saturdays 12-4 p.m.

Mines Library
Wednesday until 9 p.m.
Saturdays 9 a.m.-4 p.m.

Physics Library
Wednesdays until 9 p.m.
Saturdays 12-4 p.m.

FLASH! IDAHO SPUDS INVADE THE U OF M CAMPUS. Do you know what they are?

Here's some more information about the Consulting Engineers Council of Minnesota's scholarships. Tom Ceterski, a U of M student also received a $500 scholarship.

According to scholarship committee chairman, Lawrence Grubbe, two scholarships will be awarded this year. One award will be based on merit and one on need. For more information, call Grubbe at 926-9696.

In its November, 1977 issue, **Money** magazine rated the best and worst careers for the 1980's. Ranked in declining order, these

are **Money**'s selections of the ten most promising professions, followed by their estimated percentage growth in the next eight years: Doctors, 37.8%; Veternarians, 27.0%; Systems Analysts, 32.9%, Dentists, 20.8%; Geologists, 38.1%; Actuaries, 26.7%; Personnel administrators, 34.9%; City Managers, 28.3%; Engineers, 25.0%; and Pharmacists, 16.4%.

Engineering, the second largest profession (teaching is the first), "offers the classic example of a cyclical job market," **Money** notes. Right now, there's a shortage of engineers, but in a few years, you can count on a surplus. Despite the highs and lows, engineering shows steady growth and pays good starting salaries, according to **Money**.

Among the professions with the worst prospects over the next eight years, **Money** lists schoolteachers, librarians, Protestant clergymen, foresters (!!), newspaper reporters, hotel managers, college professors, military officers, biologists and lawyers.

A delegation of 10 Institute of Electrical and Electronics Engineers (IEEE) traveled to Mainland China for three weeks this fall. Dr. Robert Saunders, president of IEEE reports that the People's Republic of China has set a goal of being on a par with the engineering of the western developed world by the end of this century.

Dr. Saunders found many technical areas not as advanced as in the U.S., but says that the rate of progress is extremely high, and that it would not be impossible for China to equal the West, technologically, by 2000.

Engineering Registration Studies has some home study courses available to help you prepare for the April, 1978 exams. Further information may be obtained by writing or calling: Engineering Registration Studies, P.O. Box 24550, Los Angeles, CA 90024.

AIAA fly-in picnic.

For engineering students seeking jobs: The Engineering Firms Index is a listing of major companies throughout the United States which employ engineers. The Index provides addresses. If interested, write to Engineering Firms Index, P.O. Box 2163, Clinton, New Jersey 07015.

This is AIAA!

The American Institute of Aeronautics and Astronautics (AIAA) is a national organization of professional engineers involved in all aspects of aerospace. The student branch, while associated with the national organization is something more. One is as likely to find us playing football or having a few beers as attending some techincal symposium or other. Recently, we have organized such activities as tours of the Northwest Orient Airlines flight simulators, and the FluiDyne Engineering Labs (a wind-tunnel test facility.) We also had a fly-in picnic and we'll be doing a lot more in the coming months.

The big event of the year though, is the AIAA Regional Student Conference, to be held this year in Colorado Springs. As in the past, spring will find us flying off to the conference to present papers and party a bit too. This year, we're also organizing a ski party.

Our membership is not limited to aero students; all that's required is an interest in aerospace. Stop by Aero 205 for more...

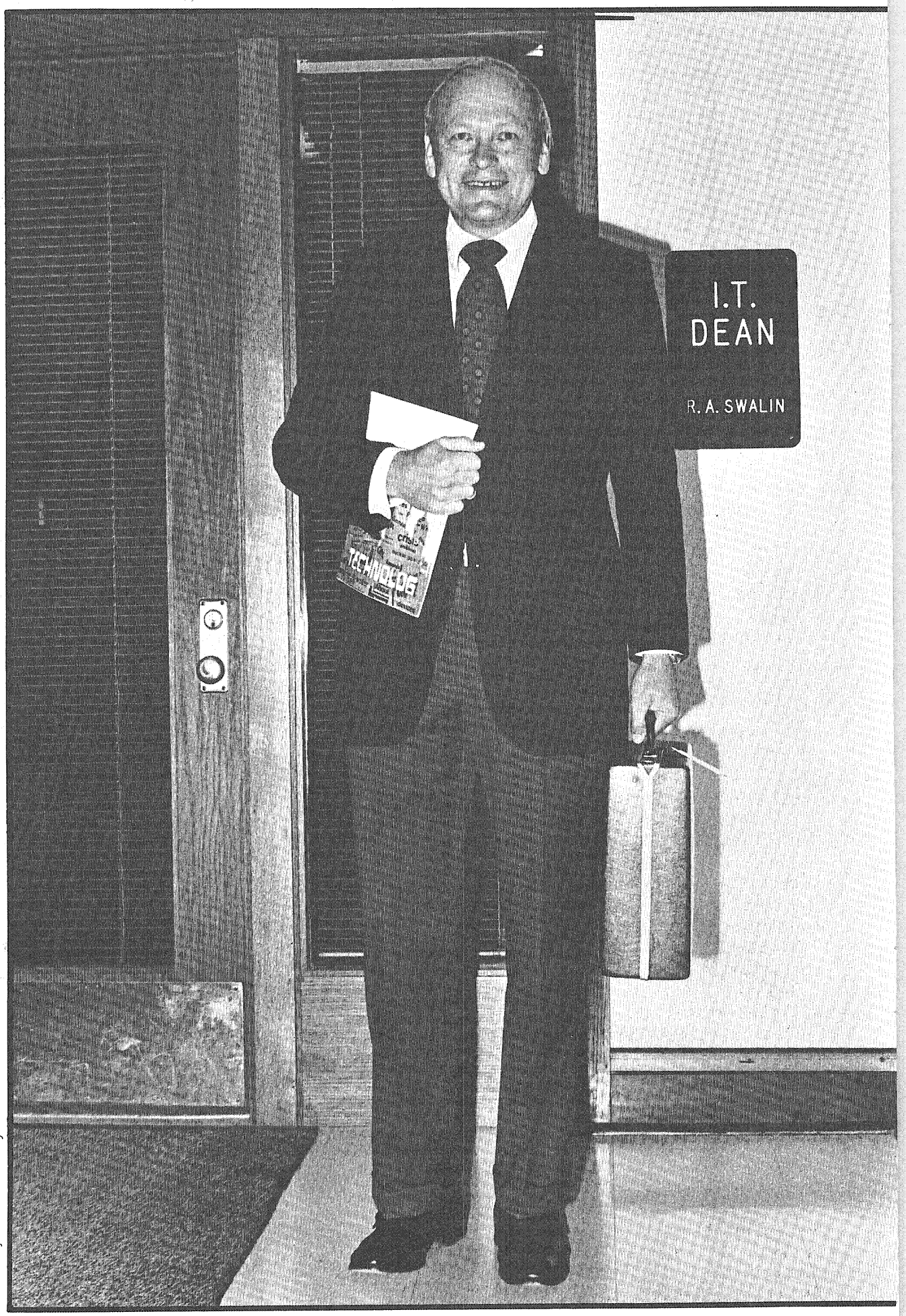


Photo by David Parry

Farewell, Dean Swalin

By Jon Kavanaugh

The University, especially IT, lost a first-rate administrator last month when Richard Swalin stepped down as Dean of IT. Winding up 22 years of service to Minnesota, six years as Dean of IT, Swalin left for New York to become Vice President for Technology at Electra Corporation.

And Swalin is excited about the change. A month after his move, he feels he has interesting, challenging work ahead. He will be involved with shaping the direction and scope of technology at Electra, including working with new product development, scientific innovations for existing products and more.

Swalin joined the University in 1955 as an associate professor in Metallurgy, later working his way to professor. And in 1963 he was named head of the School of Mines and Metallurgy. From there Swalin was appointed Associate Dean of IT in 1968 and later Dean in 1971 after Dean Warren Cheston became Chancellor to the University of Chicago-Circle Campus.

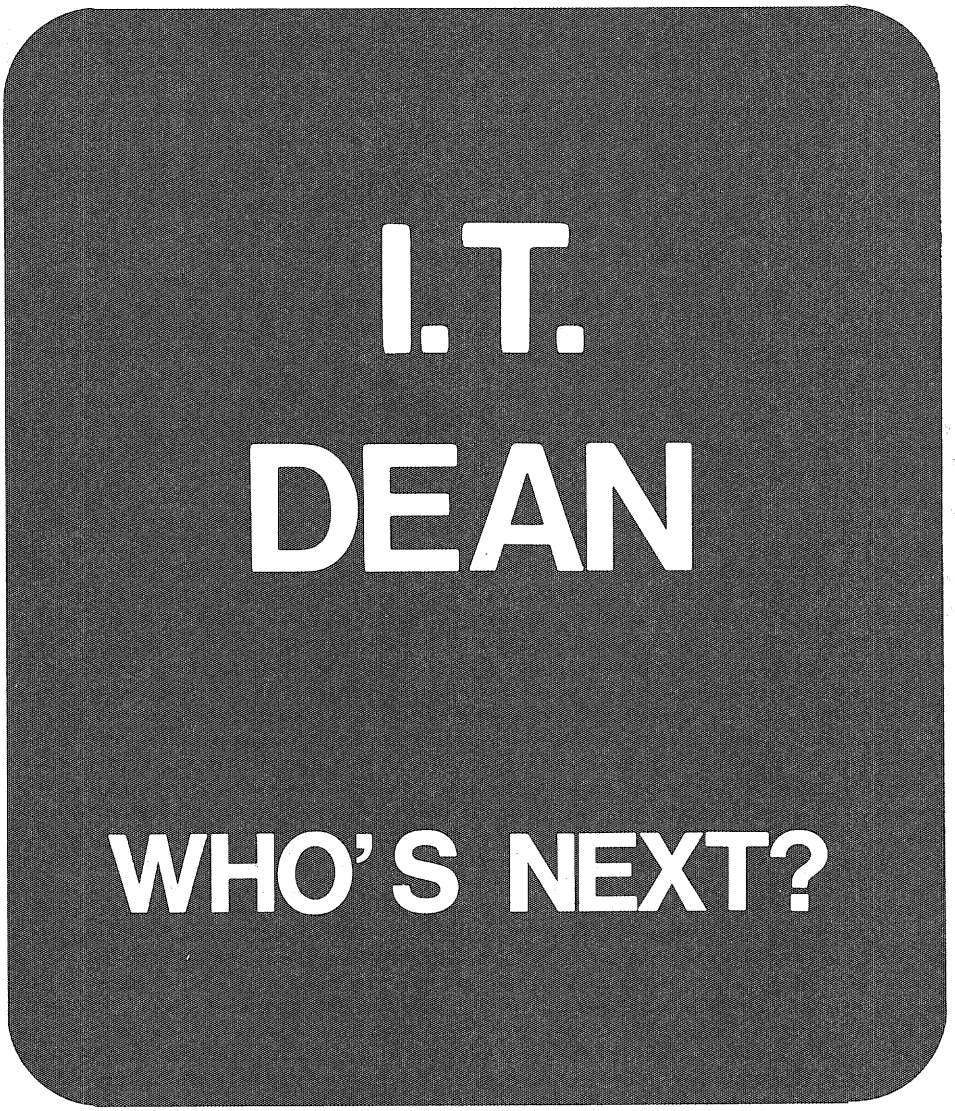
Swalin received his undergraduate and graduate education at Minnesota as well.

A 22-year career with any firm or university is difficult to leave behind, especially considering the many personal working relationships built through years of work. Dean Swalin is no exception, regretting leaving "a superb office staff" and good working relationships with other departments in IT. Staff members who worked closely with Swalin praised him as a good man to work for, "a fair man," one said.

But Swalin's move to New York and into industry need not be eulogized as if IT had suffered an administrative death. Rather, IT has gained a valuable friend in industry whose influence, hopefully, will transcend geographical borders and remain active with the University.

A friend in industry. This is the most important aspect of Swalin's career at Minnesota as he spent a great deal of effort, working closely with representatives of various industries throughout Minnesota. Recognizing the need to gain industry support of education in technology, Swalin encouraged efforts in the state legislature, across industry as a whole and with private groups, to try to gain better financial and facilities support in the face of perrennial federal budget cutting. Also by working closely with industry leaders in technology, better understanding is achieved in determining precisely what the educational needs of various industries are and how the University and IT can meet those needs through its various degree programs. Through communication, educational programs can be better tailored to suit the needs of industry as they change through time.

But Swalin's move to New York and into industry need not be eulogized as if IT had suffered an administrative death. Rather, IT has gained a valuable friend in industry whose influence, hopefully, will transcend geographical borders and remain active with the University.



Another important aspect of Swalin's career as dean involved spending time working closely with the internal relationships in IT, the result of which is improved quality of teaching over the years, according to Swalin. He stressed the attempt to cement strong working relationships between departments, faculty and administration and students as vital to IT's smooth functioning. "There's nothing political here," he commented, as if to emphasize a strong priority towards productive educational activities and a good working attitude among all IT faculty and administration. Swalin summed it up as excellence in teaching, one of his major intents proclaimed at the beginning of his term as dean. Swalin is quick to point out that credit for these strong relationships goes to a qualified and diverse staff of deans and faculty, not only for his own effort.

While much of Swalin's career as dean was marked by significant development and securing of a good working environment, friendship with industry and more, a very localized challenge proved mostly fruitless and frustrating for Swalin. His and others' efforts to get students more involved in extra-curricular activities and broader educational courses have not been very successful. He blames a lack of interest and motivation in students & faculty for the apathetic view towards extra-curricular participation. While Swalin realizes that IT students have big class loads as it is, he and the other deans are still disappointed that they couldn't be more effective in promoting other activities more. Faculty members haven't been very helpful either, he explains. Faculty advisers, when given the task of recommending courses for engineers will most often give them science electives rather suggesting broader liberal arts courses which would diversify students' interests and perhaps influence them to become involved in more activities outside of class.

Swalin hopes the succeeding dean would attempt to continue this influence to help motivate students better but suggested that such efforts are often frustrating, a "going against the grain," so to speak.

And what about the next dean? From what background will he or she be selected? When will the selection take place? As this issue of **Technolog** went to press, a committee had not been formed yet to expediate the appointment of a new dean, so many questions remain unanswered. Nominations for a selection committee were due to President Magrath November 4 but no committee has been formed as yet.

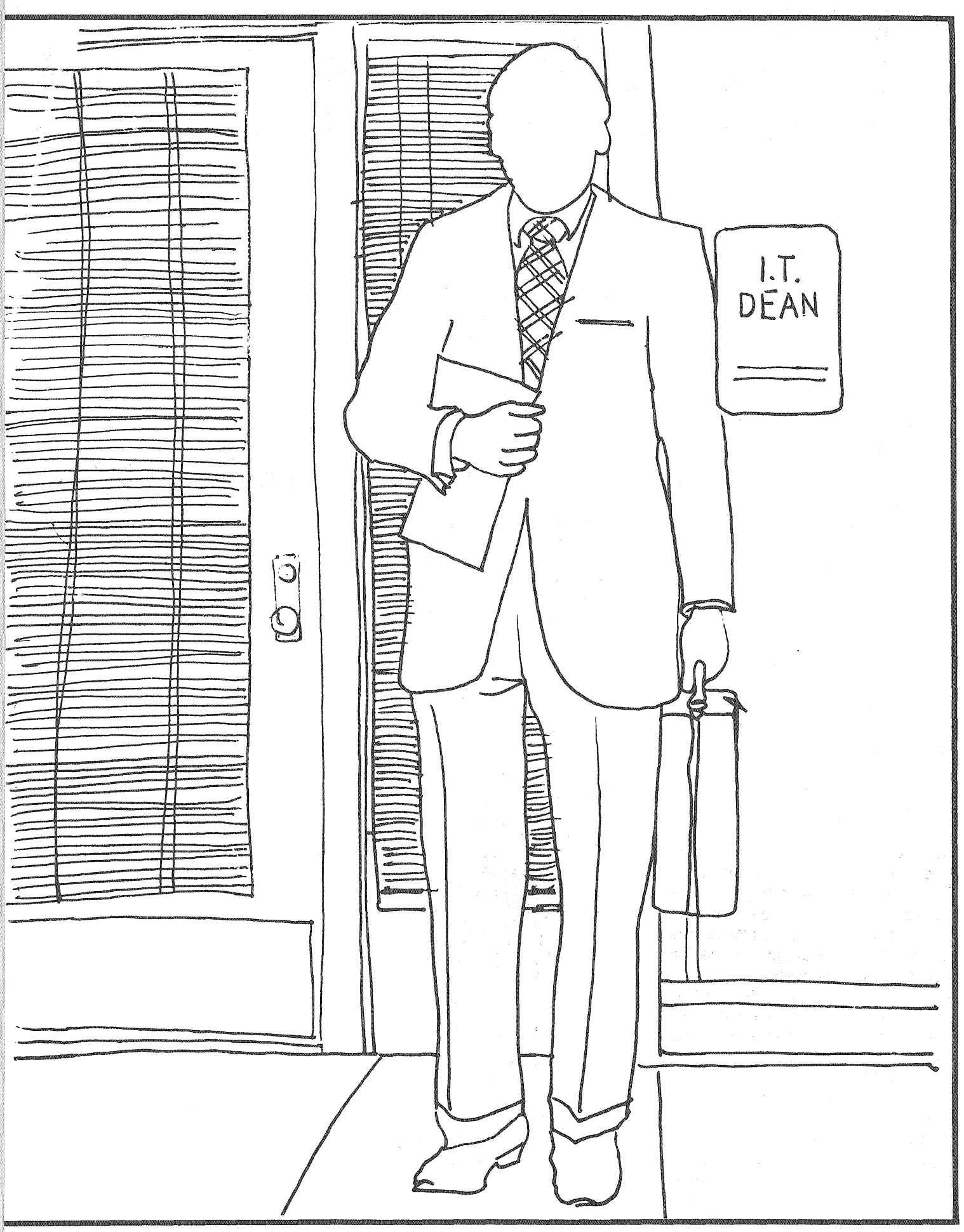
Dean Johnson, described as very capable by staff and Swalin, is acting dean until the selection committee has their choice approved.

The criterion to be used to select the next dean can only be speculated upon as well but Swalin suggests the new dean should have a strong interst and sensitivity toward the relationship between IT and Minnesota industries as well as a keen understanding of faculty and student roles throughout IT. He added that he thought the selection could be made adequately from within the University.

History shows that the selection of new deans does not always happen quickly as was the case with retiring Dean Spilhaus in 1968. Dean Cheston wasn't appointed until two years after Spilhaus had left the University.

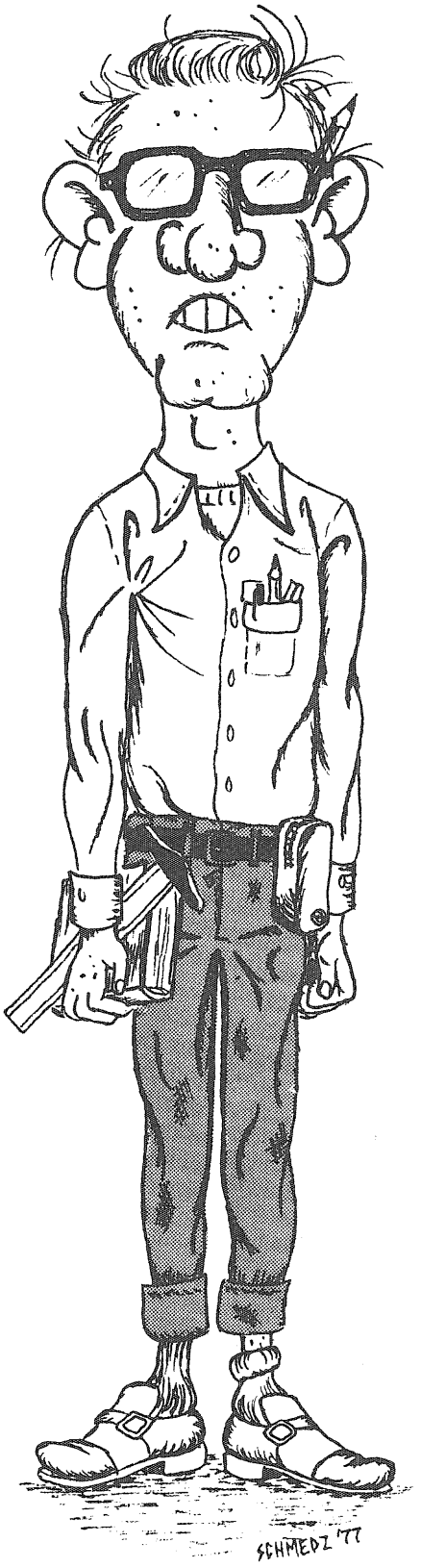
But this gap isn't so important according to some staff members and Swalin. Because the other deans in IT are competent and well organized, Swalin doesn't think the day to day operation of IT will suffer in the short run. However, an acting dean isn't likely to be very progressive or innovative because he or she doesn't know the duration of the position, forcing IT into a holding pattern until a new dean takes charge.

Electra Corporation has gained an enthusiastic, perceptive technologist in Richard Swalin whose influence will have impact on Electra's directions in technology just as IT has been influenced by Swalin's leadership. Until a new dean has been appointed, other administrators, collectively, will need to accept the leadership challenge left in Swalin's absence.


I.T.
DEAN

The Myth of before

By Laura Weber



Art by Steve Smith

He wears J.C. Penney button-down shirts, perma-creased cuffed pants, a calculator on his belt and a plastic pocket protector for his pens. He spends hours in the library, lab and classroom. He barely knows what's going on in the "real-world" outside the U of M and his only idea of fun is playing "Star Trek" with the computer or calculator games.

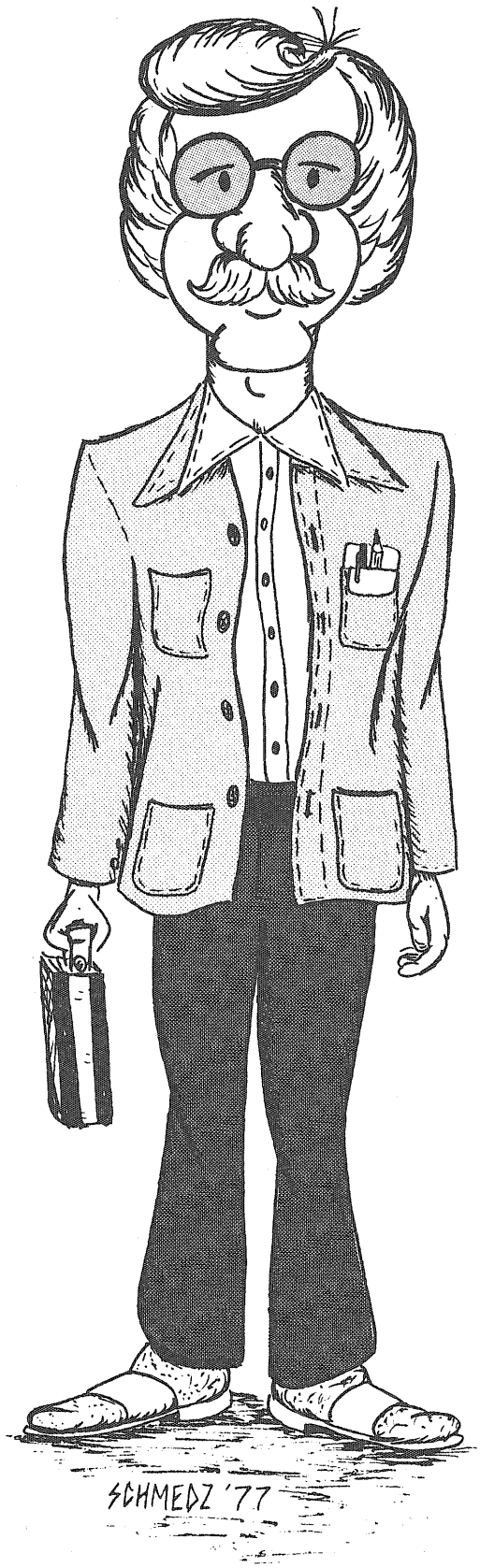
Do you know this person? Actually, he isn't one specific person at all, but a composite of stereotyped views on what an IT student is like. You who are reading this are probably nothing like the description at all, yet when the phrase "IT" is spoken by some students, the word "nerd" often follows.

The "nerd" stereotype couldn't have begun without some concrete evidence to support it, though. One day while working on this article in the **Technolog** office, I walked out into the halls of the engineering buildings to get a look at students walking around. Just as I rounded the corner in Mech. Eng., I spotted one. One who fit the above physical description of "nerd", even down to the pocket protector.

In the past, perhaps, many more IT students could have been described similarly. But then engineering and science were under the "Sputnik scare" when everyone thought the Soviet Union would surpass the US in the

the IT Nerd

after



space race and other technical fields. Engineering was almost totally a male field, and reflected the general conservatism of the rest of society. Things are now different, including the appearance of engineering students.

The stereotyped exception proves the rule as far as IT students go. IT students are "she's" as well as "he's", are from rural areas and urban areas, look about as alike as any group of 3000 people would be expected to (that is, not at all) and are interested in fields and specialties as diverse as any group of 3000 liberal arts students.

The technical, scientific and mathamatical programs that are demanded of IT students are usually more time-consuming for those of less-than-genius status than many other majors. The great amount of time necessary, may lead others to look upon the IT student as a drone. IT admissions standards are higher than CLA, General College and Business School, for example. All in all, the IT student's workload is greater in many ways than most other undergraduates'.

Along with the notion that IT students study all the time, goes its corollary; IT students are apathetic, uninvolved and not too well informed on non-scholarly matters. This attitude particularly bothers IT students who are active outside of the classroom.

Mark Jarvis, president of the IT Board is one of those students. IT Board is one of those students.

"Of course, the rigor of the IT curriculum necessitates that a large portion of an individual's time be spent studying, but this time should not be a measure of apathy. I am not saying I.T. has no apathetic students. All of us are apathetic in one way or another. Some students couldn't care less about student government, yet these same students might be among those most politically aware and concerned about national government," Jarvis said.

Paul Rollof, another board member, agreed with the idea that IT students are interested in more than studies. As an illustration, he noted that his dormitory's team—the 'Puds' of Territorial I East (which consists of over 90% IT students)—won the resident hall championship in the extramural sports program last year, 76-77.

While participation in sports may not totally "prove" that all IT students are active, Jose E. Lopez, IT Board Unclassified Representative, said that the mere fact that IT students are studying science and technology shows their concern and involvement in the world around them. "By virtue of the fact that someday these same IT students will be actively involved in devising solutions for various social problems such as pollution, depletion of natural resources, increasing energy demands, etc. one would have to conclude that IT students are deeply involved with the society around them.

"But their involvement is on a much higher level because it demands that they commit a specified portion of their lives to the study of the sciences and present technologies in order to help and improve the world in which they live. How many people are willing to make such a commitment? So, in terms of the average IT student, what appears to be apathy on the surface is really an overwhelming sense of latent involvement," Lopez said.

Energy shortages, pollution and all the other problems that uncontrolled demand for food, fuel and other resources bring means the role of the engineer and scientist will become more politicized and activist than ever. Old ways and ideas that have served the engineering profesion for decades are being changed and challenged due to the crises of modern life. The perception of engineers and their jobs will change with this increased activism. A 'nerd' will have to have more going for him than a 4.0 to be a good engineer.

"It must be remembered that the Institute of Technology is an artificial environment. What one observes is hundreds of students punching calculators and sweating through finals. A closer look will reveal a person. And people care," Jarvis said. The people who comprise the Institue of Technology are all unique, of course. Stereotypes that are proved false every day will fade away soon enough.

WILDLIFE PORTRAIT

Studentia forestus

A sub-species of the Studentia universitus minnesoteum known to inhabit the Twin Cities area. This sub-species, commonly known as the forestry student, is becoming quite rare, possibly due to extreme harassment by another sub-species, the Studentia engineericus. The Studentia f. is undoubtedly the most primitive sub-species of Studentia u. m. and can frequently be seen in the St. Paul area, where bicyclists and buses claim a heavy toll.

INTERSTELLAR SPACEFLIGHT

By Bruce Kvam

Land on Mars all bought up? Every asteroid staked out? When the solar system's all filled up, head for the stars...

...the problem is getting there. At a respectable speed, say the escape velocity of the sun at Earth's orbit, traveling to the nearest star system would take about 30,000 years. That's a bit more than the three score and ten years of the average human life span.

Hmm, not so great. But let's say we take a rocket along, something like a Saturn V, the booster used in the Apollo moon program.

First, some basic mechanics. From Newton's second law,

$$F = ma, \text{ or } F = \frac{dp}{dt},$$

we can derive the equation

$$\Delta v = u \ln R ,$$

where

Δv = the total change in velocity (delta-v)

u = the speed of the fuel as it leaves the rocket (nozzle velocity)

$$R = \frac{s + f}{s} ,$$

the mass ratio,

s = ship mass,

f = fuel mass.

This formula can be used for any kind of rocket, be it chemical, electric, or nuclear. For my purposes, I will rearrange it thusly:

$$R = e^{\Delta v/u} .$$

If we're going to go anywhere fast, we should approach the ultimate speed limit: the velocity of light (c) 3.0E8 (3x108) m/sec. Let's be conservative and set the delta-v equal to 1% c. For the Saturn V, u = 3500 m/sec. With these values, R = exp(857). Even my SR50 balks at that number. In fact, the fuel needed to accelerate a chemically-powered ship to 1% c would have a mass greater than that of the universe!

The maximum practical delta-v we could ever get out of a chemical system is about 35,000 m/sec, 0.01% c. We could cross the 4.3 light-year (ly) distance to Alpha Centauri in 20,000 years.

Other rocket systems are possible. One with a much higher delta-v is the nuclear ionic. We ionize some material, say a metal like cesium, in the core of a nuclear reactor. Then we take the plasma and accelerate the ions in a linear accelerator and squirt them out the back. The nuclear ionic system could have a delta-v of 175,000 m/sec, 0.06% c. Trip to α Cen: 6500 years.

We're getting closer, but we're not there yet. Some theoretical work has been done on nuclear drives, both fission and fusion. A good guess at a nozzle velocity is 1.0E7 m/sec. With a reasonable mass ratio, say that of a Saturn V (228), the delta-v is 5.4E7 m/sec, or 18% c. If we use up half the delta-v on acceleration and half on deceleration that gives us a top velocity of 9% c. We'll make it to Alpha Centauri in just 50 years, a period of time that a single person can actually comprehend.

To sum up, our main problems are just plain physics and engineering: u can never be greater than c and R can never get too large. I'll return to nuclear rockets, as they seem the most promising, but I'd like to take a look at a few other possibilities first.

When you come right down to it, the main villain is Einstein's impassable speed of light. If there was some way to go faster than light, without using rockets, the stars would be ours. But no matter how hard we try, we'll never reach Alpha Centauri in less than 4.3 ly, measured from the galactic reference frame.

But is that necessarily so? Maybe not. Einstein's equations don't really forbid particles that travel faster than light, just particles that travel at the speed of light, excluding, of course, massless particles which travel at nothing but the speed of light.

The Lorentz transformation for mass s

$$m = m_o/(1 - v^2/c^2)^{1/2}$$

Note that at v = c the mass becomes infinite and the universe collapses. But what happens when v is greater than c? We take the square root of a negative number, which is an imaginary number. Well, they use those in electrical engineering all the time. Do imaginary numbers have a real meaning in relation to mass? We don't know. These faster-than-light particles have been called tachyons, as opposed to slower-than-light tardyons, of which our material universe is composed. Maybe the tachyon universe is adjacent to ours, and all we need is a little push to reach it. Who knows?

Another weird possibility is derived from Einstein's General Theory of Relativity. When applied to black holes, stars that have collapsed down to a point mass from which not even light can escape, the theory predicts some pretty strange happenings. A rotating singularity may be a link to every point in the universe, allowing almost instantaneous travel to everywhere. We would probably never survive the tidal effects of falling through a black hole, but the prospect is damned exciting. Another problem is that we wouldn't find a black hole just anywhere: if there were no singularity near our destination we'd never get back.

Those two possibilities may be mere figments of a mathematician's imagination. So let's look harder at our best bet: the nuclear rocket.

Alan Bond and his team at the British Interplanetary Society have been working on a nuclear starship for several years now. The study is called Project Daedalus and the result is the design of a ship that could travel to Barnard's star, 5.9 ly away, in 50 years.

According to the study, the unmanned ship will be assembled in lunar orbit, or perhaps in Jupiter orbit, depending on where the fuel comes from. A fusion pulse engine is postulated, using the reaction

$$^2H + {}^3He \rightarrow {}^4He + p + \gamma .$$

The helium 3 will either be bred on the moon or mined from Jupiter's atmosphere. A bundle of deuterium-helium 3 will be inserted at the focus of the engine chamber and zapped by electron beams, causing the deuterium and the helium 3 to fuse. This is repeated 250 times a second. The acceleration phase of the journey will last 3.8 years. The project hopes for a 1.0E7 m/sec nozzle velocity.

The latest version of the Daedalus has two stages. When the second stage shuts down after a 1.76 year burn, the ship will be traveling at 12.8% c.

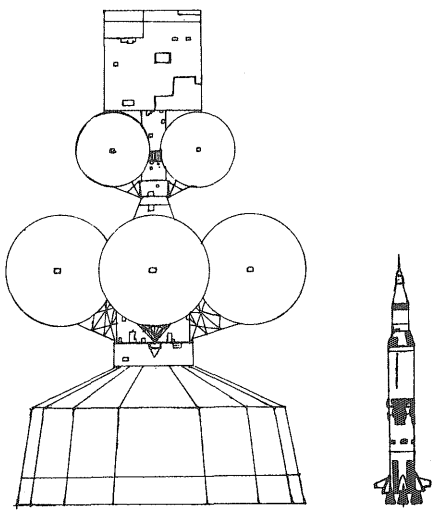
En route to Barnard's star the ship will observe the interstellar medium and make stellar parallax measurements. This baseline of six lightyears would give us the distances to some pretty distant stars.

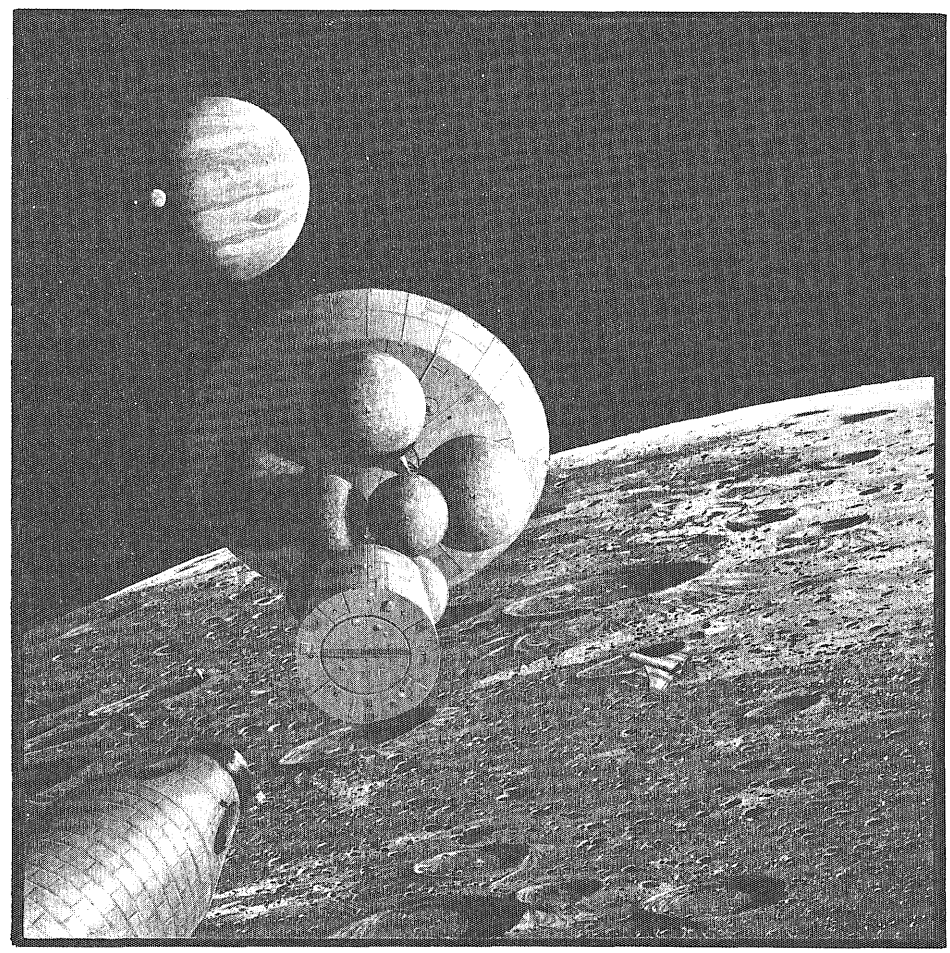
Two five-meter telescopes will detect the jovian planets of the system and course corrections will be made to optimize the flyby.

The Daedalus will streak through the Barnard system without decelerating, dispatching as many as 20 probes that will approach the planets. The entire encounter will last about ten hours.

Barnard's star was chosen by the Project Daedalus team for several reasons. The most important one is the result of Peter van de Kamp's work at Sproul Observatory. He has found perturbations in the proper motion of Barnard's star that indicate the presence of two planets, 1.1 and 0.8 Jupiter masses. Other analyses of the data have been published, giving as many as three planets and as few as one. Another reason is that Barnard's star

Right: Daedalus fueling up in orbit around Callisto, Jupiter's fourth moon. The fuel, helium 3 and deuterium, was mined from the atmosphere of Jupiter and the ice fields of Callisto
Below: The Daelus compared with the Saturn V





Art by Dave Egge

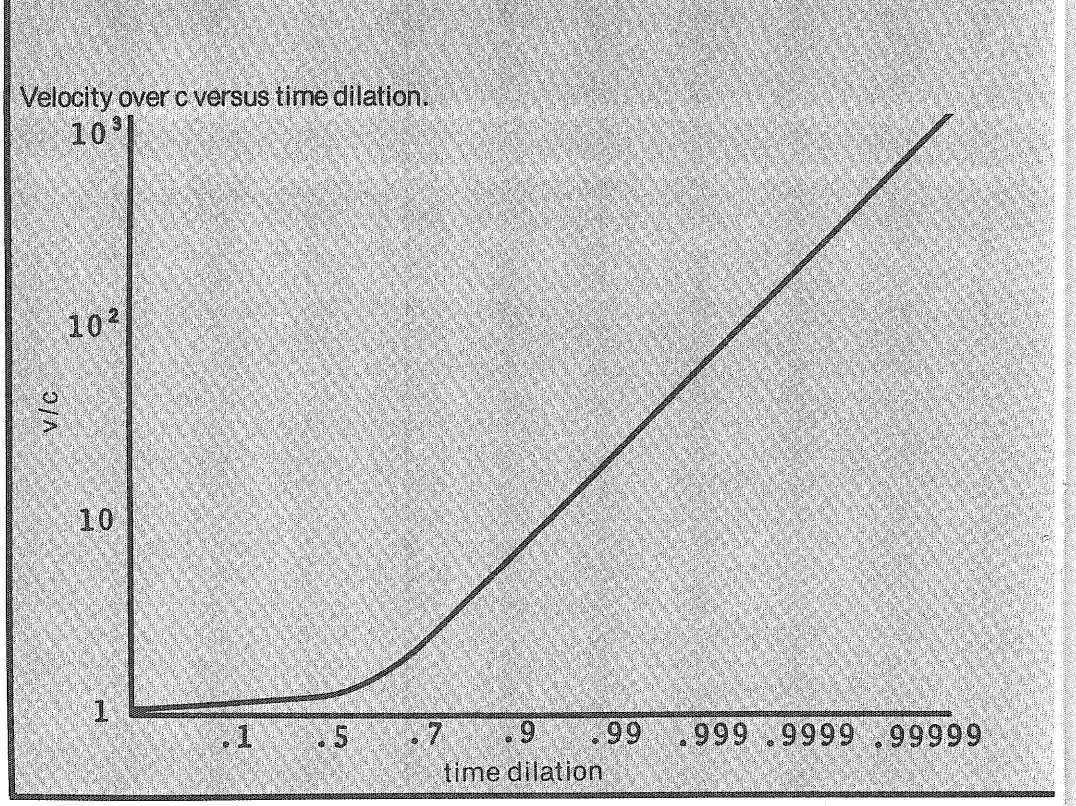
is an intermediate goal. A Daedalus ship could easily fly to Alpha Centauri or be stretched to a ten-ly mission.

The project is nowhere near the actual implementation stage. Development of the fusion pulse engines hasn't even started. A good, lightweight way to shield the Daedalus from cosmic rays and high-velocity dust particles is also needed. But the biggest problem is the construction of a computer that can run the whole mission.

From Barnard's star it would take twelve years to receive a reply to a message sent to Earth. The computer will not be able to rely on the designers back on Earth. Its program would have to be heuristic enough to think up new experiments, in essence, to have imagination. Can a computer replace a man? I don't think so.

In that case, suppose we adapt a Daedalus-type ship for humans. We supply an entire ecology, a completely enclosed system. How can we make sure we have a sane, non-senile person to make decisions fifty years into the mission? What ways are there to protect the human mind and body from the ravages of time?

Suspended animation has long been considered, but we still have no leads. Water has the peculiar habit of forming crystals that expand and contract as the temperature passes 0 degrees C. Freezing a body turns it into raw meat.



If our missions last fifty years we can send an entire colony to the stars. The crew would live, reproduce, and die aboard ship. When they reached their destination, there would be someone aboard who would be rational enough to make decisions, even though he would have never seen the green hills of Earth.

The multi-generation starship concept has long been used in science fiction, and for colonizing the stars, it would do fine. But what if we don't want to risk that many people on a star that may not be able to support life?

Relativity comes to our aid again. As we approach the speed of light, the Lorentz-Fitzgerald transformations begin to have noticeable effect. To someone at rest with the galaxy, a ship traveling at near-light speeds would seem to have more mass. It would shorten in length. Aboard it time would run more slowly.

The time dilation relationships are:

$$\gamma = 1/(1 - \beta^2)^{1/2}$$

$$\beta = v/c$$

$$v = \text{ship velocity}$$

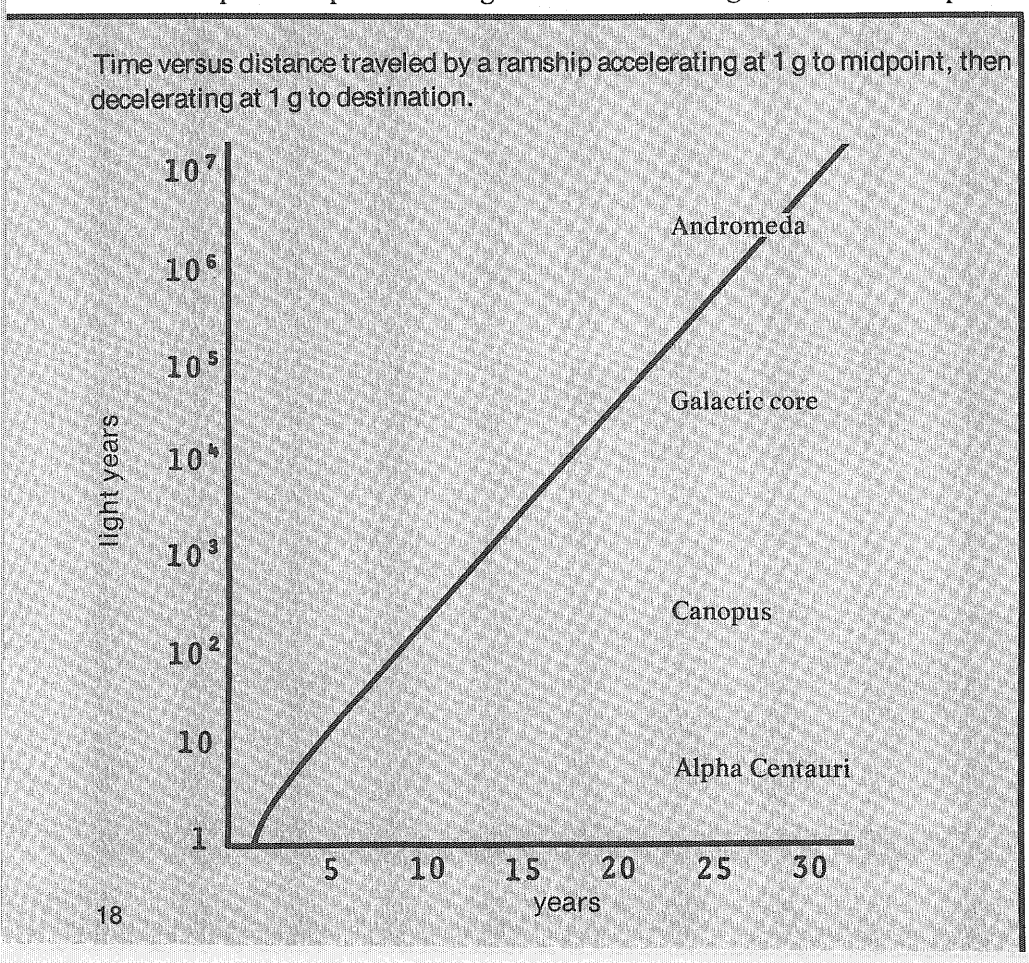
With a Daedalus ship, $\beta = 0.128$, giving a γ of 1.008. That shortens a 48.25-year mission to 47.86 years.

But here's the catch. The closer the velocity approaches c, the greater the time dilation. But also: the mass of the ship increases just as much as the time dilation does. This brings us back to the old problem of mass ratios. Even without relativistic effects, for a delta-v of c and a u = 1.0E7, we need a mass ratio of ten billion.

There's no way we'll ever do that, so someone found a way around it.

In 1960 R. W. Bussard published a paper entitled "Galactic Matter and Interstellar Flight." In it he described a ship that would use the interstellar medium, mostly hydrogen, as fuel. The ship would not need to carry propellant, completely eliminating the mass-ratio problem.

Bussard's interstellar ramjet would



collect ionized hydrogen from space as the ramjet moves forward. Strong magnetic fields would pinch the hydrogen down and bring it into the reactor and fuse it by magnetic confinement. The reactor would supply power to the ramscoop field and the life-support system, while the helium ash would be spit out the back to provide thrust.

The space between the stars is better than any vacuum we can achieve Earth. But there is matter out there, about 1-10 atoms/cc. To collect enough material to fuse, the ramjet scoop will have to be huge. Let's say Mh = 1.67E-27, the mass of a proton; $\eta = 1$, an efficiency parameter; $\alpha = 0.007$, mass-energy efficiency; $n_o = 1$, a pessimistic estimate of the number density of hydrogen in interstellar space; A is the scoop area; and Ms is the ship mass, call it 1.0E9 grams. Being rather arbitrary, we'll take our acceleration to be 1 g, or 980 cm/sec/sec. That'll give us a ramscoop radius of 1700 kilometers!

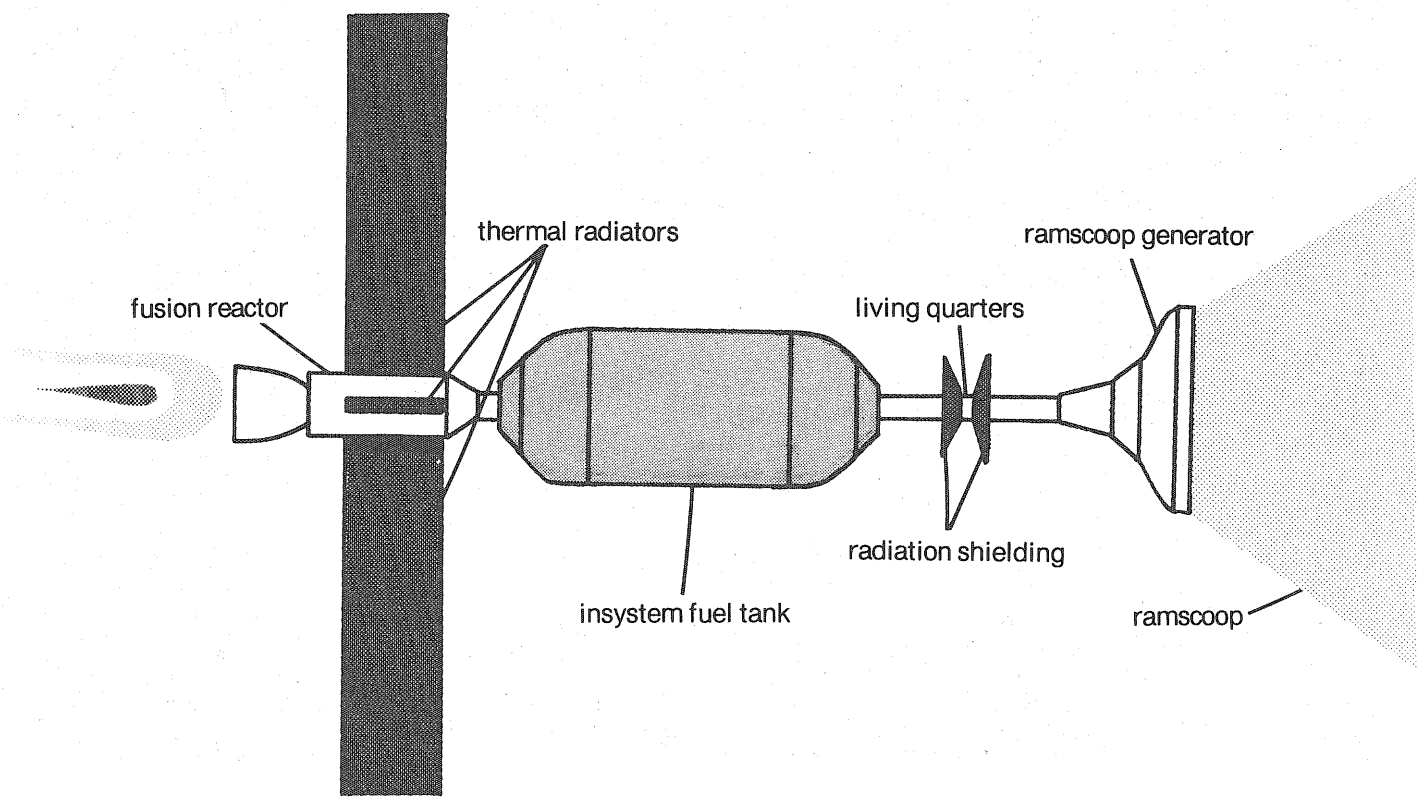
That does seem a bit large, but as Bussard has said, ". . . Interstellar travel is inherently a rather grand undertaking . . ."

where a is acceleration and s is the total distance traveled.

Accelerating at 1 g, the 4.3-ly trip to Alpha Centauri would seem to last 3.57 years aboard ship. To traverse the 8.7 ly to Sirius requires 4.6 years ship time. But it gets better. If we go to Canopus, 200 ly out, the ship time is just ten years. And if we want to go to the core of the galaxy, the crew members would age only twenty years, while outside the ship 30,000 years would pass.

Once we have a ship, what do we do with it? Find planets to colonize, observe strange astronomical phenomena, contact intelligent life, perhaps. With an infinite universe, the possibilities are infinite.

A HYPOTHETICAL RAMSHIP



Entire ramship approximately three km long

we power our ramship with the reactions

$$p + p \rightarrow {}^2H + e^+ + \nu ,$$

$${}^2H + p \rightarrow {}^3He + \gamma ,$$

$${}^3He + {}^3He \rightarrow {}^4He + 2p .$$

Using this hydrogen-helium chain we can convert 0.7% of the hydrogen's mass into usable energy. The equation for acceleration of a ramship is

$$a = M_h c^2 \alpha \eta \frac{n_o A}{M_s}$$

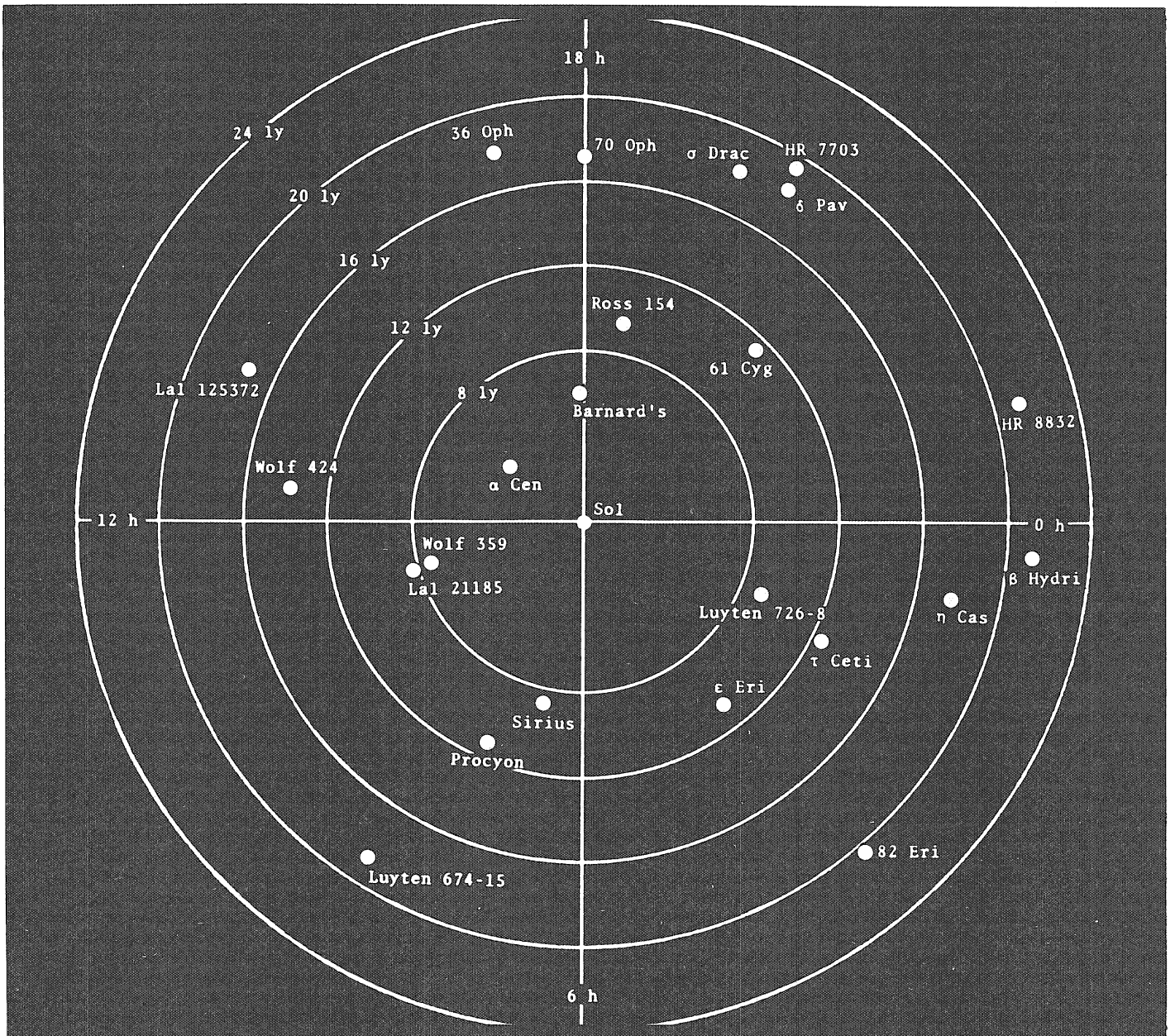
The ramscoop can't be a solid structure because of mass considerations. It may be thousands of miles of ultrafine wire, or a shaped magnetic field, if we can figure such a thing out. It'll be a while before we actually build a ramship, so we leave the details as an exercise for future generations of engineering students.

The real payoff of a ramship is in time dilation. If we accelerate all the way to the midpoint of the journey, then turn around and decelerate until we reach our destination, the ship time is given by

$$t = 2\frac{c}{a}\operatorname{arccosh}\left[1 + \frac{sa}{2c^2}\right]$$

According to Stephen Dole of the Rand Corporation, the Alpha Cen-

Right ascension versus distance of several nearby stars



Fourteen nearby stars most likely to have habitable planets

Star	Distance from Earth (ly)	Probability of habitable planet
Alpha Centauri A	4.3	0.054
Alpha Centauri B	4.3	0.057
Epsilon Eridani	10.8	0.033
Tau Ceti	12.2	0.036
70 Ophiuchi A	17.3	0.057
Eta Cassiopeiae A	18.0	0.057
Sigma Draconis	18.2	0.036
36 Ophiuchi A	18.2	0.023
36 Ophiuchi B	18.2	0.020
HR 7703 A	18.6	0.020
Delta Pavonis	19.2	0.057
82 Eridani	20.9	0.057
Beta Hydri	21.3	0.037
HR 8832	21.4	0.011

tauri system has a 10.7% probability of a planet that you could walk around on in the raw. By his reckoning, there are 14 stars within 22 ly that have a one percent or better chance of having a habitable planet. Perhaps Dole's assumptions are wrong. He disallows red dwarfs habitable planets, as their ecospheres are so small. However, they comprise 75% of all stars, so that number could be as great as 40 or 50 and not just 14.

What if we find intelligent life **out there**? Well, it'll either be the war to end all wars or the ultimate renaissance. Thinking of that, something Robert Heinlein once said jumps up in my mind: "The Earth is just too small and fragile a basket for the human race to keep all its eggs in."

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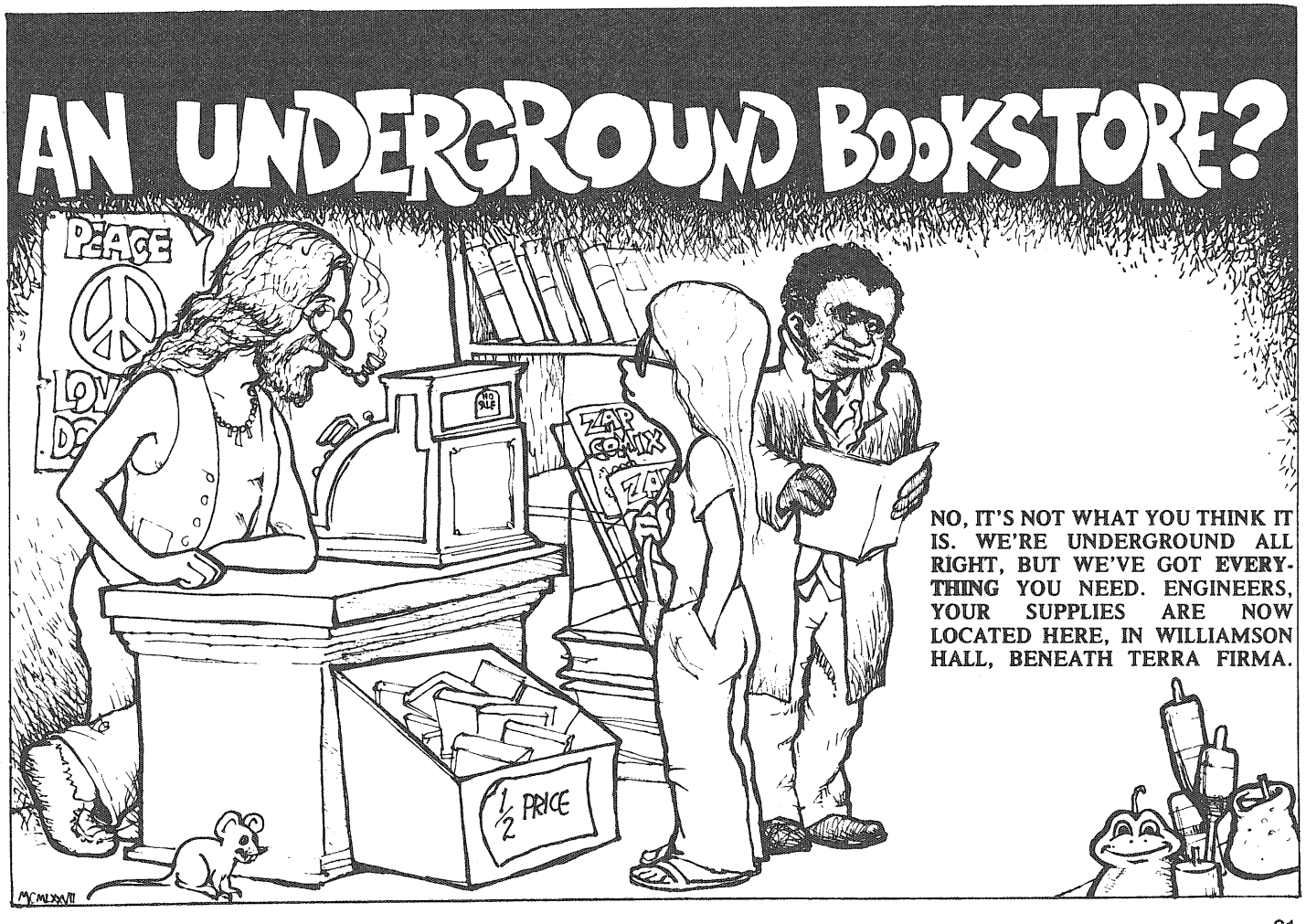


ELECTRONIC EUPHORIA: VIDEO GAMES

By Tim Schultheis

Headphones: on. Visual display: on. Opponent: stationed and ready. Power supply: five minutes thrust at full throttle, two minute shield effect, eight-hundred blaster shots and two photon torpedos. Distance to Death Star, 500,000 kilometers. Clear for blast off. Five, four, three, two, one...

Welcome to the silicone hide-out. Yes, the technology that brought reverse polish notation to the masses may soon be your ticket to fantasy-land. Somewhere in the Sierra Mountains, stashed away and funded by an ingenious entrepeneur named Nolan Bushnell, ten engineers ponder the next diabolically addicting video game with which to hook us. Bushnell is not a science fiction character, but the president and former owner of Atari, the firm which pioneered video games.The games appeared first in coin-operated drag at your local arcade, but recently they've emerged in a more benign "family fun" wrapper at retail stores. The latest from Bushnell's reclusive engineering staff is as far from Pong as a Model A is from a Mercedes 6.9 and yet it seems the market and complexity of video games is just nearing the pubescent stage in its development.

For Bushnell, it all began in 1971 when he cashed in his $250 savings account and founded Atari's forerunner, Syzygy Co. At twenty-seven, just three years out of the University of Utah, it was not easy to accumulate capital for a business which must have sounded more like science fiction or just plain lunacy than a profitable investment. So Bushnell started leasing pinball games and consulting for cash to fund his research. When the "special industries" group of Wells Fargo Bank upped his ante to $50,000, Bushnell, his fledgling company and his strange ideas hit the consumer market. Beginning with coin-operated games (a field which Bushnell had become accustomed to), Atari began to make its name with a strange-looking fiberglass cowled game named Computer Space. The object of this game was to pilot a rocket through a field of stars and shoot down alien spacecraft.

Computer Space confused too many people with its complexity. This taught Bushnell a lesson. Atari next offered up a dish it thought middle America might find more palatable. Now Bushnell was getting somewhere. The new game, Pong, was relatively simple, but the coup was that one played against a living, breathing opponent, not just a machine. Also, there was no violence involved; no bombs, no bullets, just good clean fun. This package seemed so palatable that Bushnell figured he could design it for attachment to the family television set, and thereby open a retail business.

Meanwhile, imitators with more cash backing were butting in on the coin-operated action. Space Race and many brands of Pong imitations were surfacing. Bushnell realized that ideas from his think-tank were leaking, so he tightened up his company and sent the ten-man engineering staff to the Sierra Mountains.

His next coin-operated projects were Gran Trak and Stuntcycle. As he introduced the two new games to the public, he also began marketing Pong through Sears. Sears sold 500,000 games the first year.

By 1975, Atari had forged an industry out of an idea: heavy-weight computer technology could be scaled down to provide salable leisure entertainment. Silicone could make life more fun. Moreover, as Bushnell has said, "Silicone is doing for men's brain what steel did for men's brawn." Video games are on the crest of a new wave of silicone technology; they are microprocessors, the latest development in the evolution of electronics.

Since the early fifties, when com-

puters were coming into their own, computer technology has passed through three distinct phases. The first period lasted from about 1953 to 1958, and was characterized by the use of vacuum tubes in computers. Tubes gave way to transistors, then in the early 1960's, integrated circuits made their debut. Computing speed leapfrogged to 40,000 calculations per second, while transistors could only manage 15,000.

From integrated circuits, the technology more or less evolved into something called monolithic systems technology. MST, as it is known, produced microscopic logic circuits capable of performing over a million calculations per second. In 1971, a young engineer at Intel Corp. took advantage of MST developments and invented the microprocessor. It was, in effect, a tiny computer—cheap, reliable, and smaller than a sugar cube. This discovery opened the door to electronic watches, electronic calculators, and electronic video games.

The idea of playing games with these machines did not just come to Nolan Bushnell in a dream. It seems that those few men who understand computers from the molecule to the network—those men who live in the same domain as their logic-robots—have been coaxing the machines to simulate the programmers' competitive spirit almost from the start. They've been playing games with the big computers, and two games seem to have been spread among colleagues in what is called the "silicone gulch," an area south of San Fransisco where electronics industries flourish. These two games resemble Atari's Pong, which is not surprising since Bushnell is a product of silicone gulch. The fascination he found in these games let the silicone cat of the business-only bag.

Computer games exert a pull on their fans that is hard to explain. If a video game's mystifying appeal has not affected you, it soon may, probably during the upcoming holiday season. You will be innocently walking through a department store, trying to pick out the perfect gift for the relative who has everything, when you'll hear it: strange,spacy sounds mixed with chortles and groans. You'll congregate with other young-at-hearts around a colorful television set equipped with a small console from which a cartridge protrudes and cords dangle to meet their controllers. On the set will be color and action, the thrill of victory, the agony of defeat.

What is the appeal? Marshall McLuhan, well known for his theories of media and their impact draws a distinction between the electronic games and the more traditional mechanical pinball games. Mechanical games, he believes, take place in real time; their action takes place in a logical and more or less predictable context of time and space. There is a logical continuum of progression in pinball, and unlike electronic games, pinball and all mechanical games can be classified as left hemisphere games. That is, the half of the brain which deals with language and other such systematic stimuli dominates the perceptions of and responses to these mechanical games.

Electronic games, however, do not occur in real time. They simulate real time, but the images are simply products of minute electrical impulses. Things really happen in nanoseconds, where there are two arbitrary dimensions and no mass. Thus, McLuhan postulates that electronic games are right-hemisphere games; that is, the half of the brain which deals with holistic, instantaneous modes of stimuli dominates the perceptions of and responses to these games.

McLuhan's theories are complicated, neither easily understood nor easily refuted. And, according to Uni-

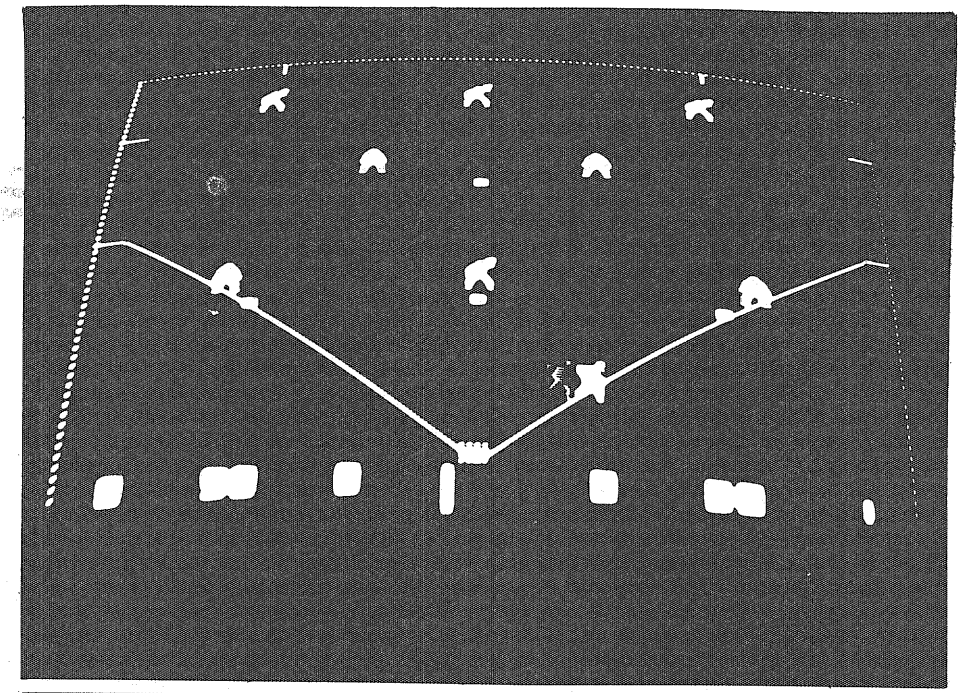
versity of Minnesota research psychologist Dr. David Lykken, they are not well grounded in fact. Dr. Lykken explains that the most definitive research into this subject suggests that indeed holistic thinking is generally seated in the right hemisphere while systematic thinking tends to be more left-specialized. But, the difference between two such similar behaviors, both involving hand-eye coordination and anticipation of spatial events, seems far too slight to account for their being handled by such different neural mechanisms. So, if we buy McLuhan's theory, we can derive many insights into the appeal of video games. McLuhan explains that right hemisphere perceptions are more "oral" in nature, more "tribal," more mysterious, etc. But, if we heed Dr. Lykken's objections, we are left with the games' less lofty attractions.

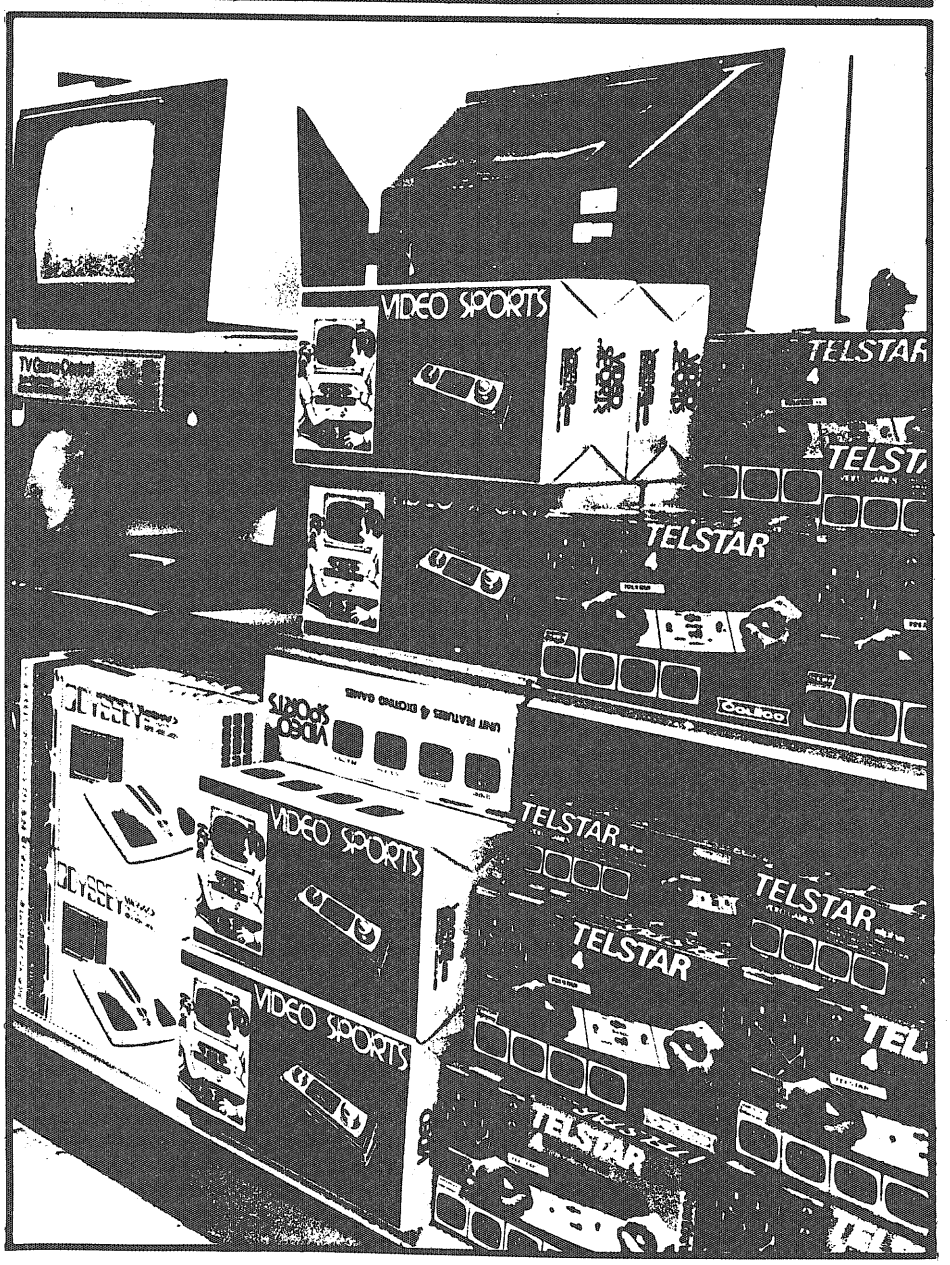
Atari has done some buyer surveys and found that two features of electronic games were cited most often as reasons for their peculiar attraction. One is that by allowing control of the action, video games transform TV from a passive viewing pastime. The most popular aspect of video games, however, is their power to divert, or, as Atari's commercial brochure says, "The video game is a great escape from reality..."

Escape is a very popular theme in the seventies. The **Star Wars** experience underscores the point. A movie with little basis in reality, dealing with no known current problem, bristling with diversionary special effects, is the biggest thing ever to hit Hollywood. **Star Wars** is an escape, an adolescent escapade in a melodramatic playground universe. It is also fun, and fun should not always be taken lightly. George Lucas takes fun seriously, and so does Nolan Bushnell. Fun is a valuable commodity in the post-Watergate '70's. Bushnell has made $15 million to prove it.

Serving up video fun is a competitive business. Ten major manufacturers produce thirteen different products. The video game market can be divided into three categories. Lowest in price and complexity are a group of Pong-like games that do increase difficulty with time. At least one of these will sell for $9.95 this year. If that sounds unbelievably cheap, you haven't been watching electronic calculators and watches, whose prices took a similar dive after initial research and development was paid for.

The so-called "dedicated" games





make up the second category.These are the traditional home video games. Magnavox Odyssey, which by now almost everyone has seen, along with Atari's Pong belong in this group. The devices in this category usually play from one to four paddle games, all new this year, and usually range in price from $25 to $60. Atari offers four new games this year that fall roughly into this category, but are a step above the rest. Video Pinball electronically simulates the action of pinball in seven variations. Stunt Cycle, mentioned earlier, is now available as a home game, and includes three new variations. Tank II has moved from the arcades to the living room, and Ultra Pong offers thirty-two game variations for four players, enough to challenge even the most avid Pong-ites.

At the market's frontier are the programmable systems. These machines accept different cartridges, so that one device may play many different games. Four such systems are now available, the two most popular being Fairchild's Channel F and Atari's Video Computer System. The Atari system offers many more games and variations, while the Fairchild system offers games with more variables involved. The Atari controllers are of two styles, one with a joy stick with a push-button, the other a dial control with a push-button. Only one style of controller can be used for each game. The Fairchild controllers are joysticks that also push-pull, and twist left or right. These enable you to do more with one hand at a time.

Each system has its strengths and weaknesses. The Atari displays and sound effects are impressive; the arcade appeal of flashing lights and cacaphonics is there is great abundance. In comparison, the Fairchild systems seem barren, yet its games are less repetitive. One is a drag race, where twisting the stick acts as a throttle (a linear tachometer with a red line is part of the display), and tilting it in an H pattern shifts gears. One watches the "Christmas tree", tachs up, and jams the shifter when the light turns green. One must watch the tach, and to turn in the fastest time, shift just before it hits the red line and the engine blows. John Cronstad, the Atari representative in the Twin Cities, claims that Atari's Video Computer System is more versatile than the Fairchild system. Unlike Fairchild, Atari's controllers plug into the main unit, and could be replaced by other controllers, or even by other microprocessors with inputs to them as complex as keyboards (the typewriter variety). He foresees home electronic banking as one of the future spin-offs of home computer systems.

Most of the people, in fact, who know the potential of microprocessors are predicting that they will play a large role in our future lives, not only in business and industry, but also in the home. **Consumer Reports**, in its November issue, ties the video game craze in with our progression toward ubiquitous use of minicomputers. "Before long, programmable computers will have as routine a place in the home as clothes washers and dryers. They'll serve as super calculators, telephone answerers, message centers, language teachers, and menu planners, among other things. But consumer-product technology travels an erratic path from the simple to the sublime. If the home computer is at the sublime end of the path, then in the beginning, let it be noted, was the video game."

I, however, am still waiting to attack the Death Star in real perspective 3-D, with full inertial effect.

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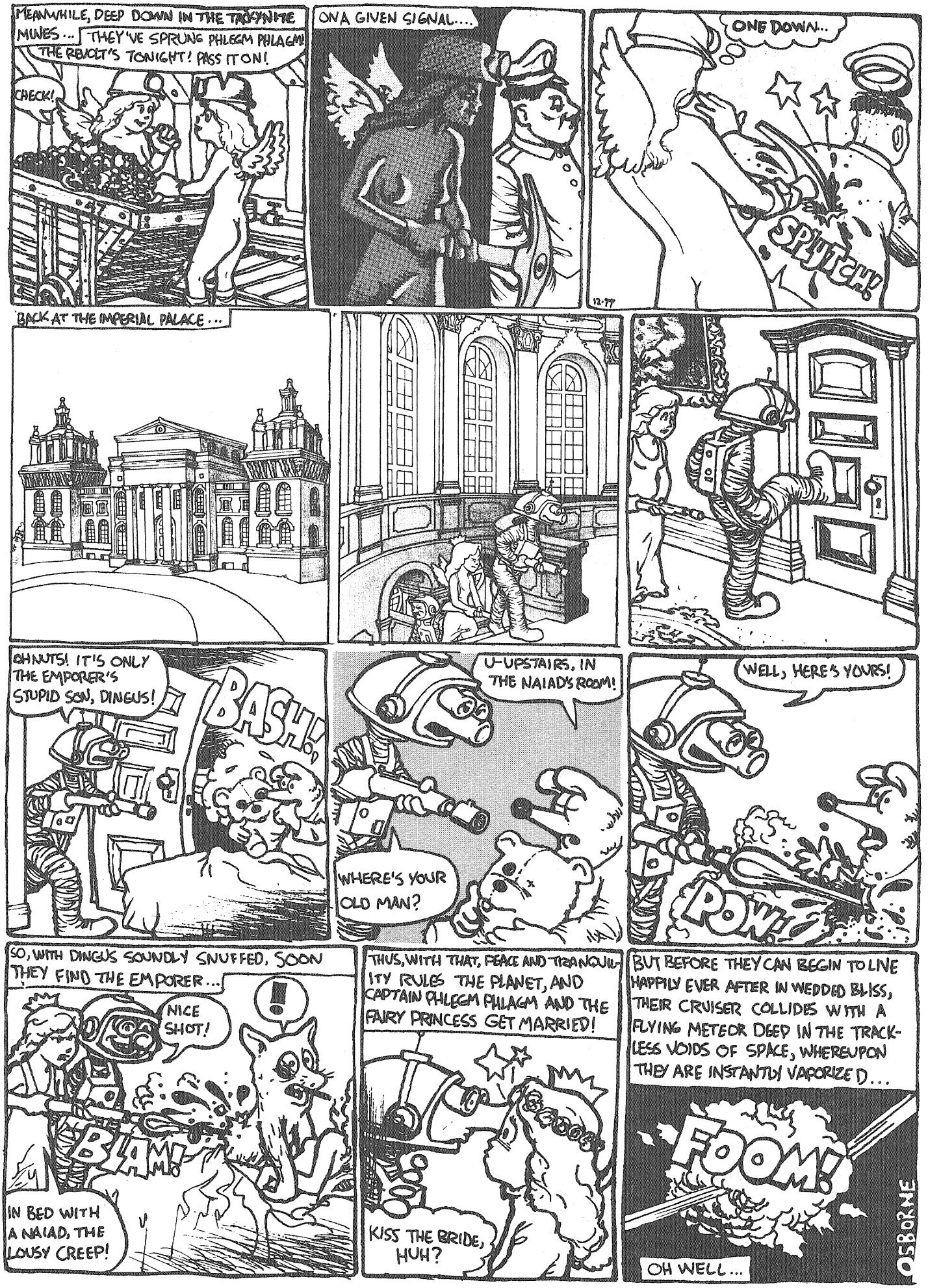
THE CONTINUING ADVENTURES OF
CAPTAIN BURGER WHACK
WHEN WE LAST LEFT OUR HERO, HE FACED CERTAIN INGESTION BY THE BURSAR MONSTER...
FEAR NOT, KIDS! WE'LL GET OUT OF THIS JAM!
JUST AS THEY ARE ABOUT TO BE SAUTÉED AND SERVED TO BURSAR...
DON'T THAY ANYTHING...
SHH!
WHO ARE YOU?
WE'RE HERE TO SAVE YOU!
BUT A GUARD COMES, AND...
HEY! WHAT'S ALL THE CHIT-CHAT?
YIPES!
PIPE DOWN, THCUMTH!
GET BACK TO WORK!
WHACK!
HE IS THE QUEEN OF THE NAIADS, AND I AM THE FAIRY PRINCESS! WE'LL GET YOU OUT!
BASH
CLUNK
QUICKLY!
OH NO! THEY SPLIT! PHALANGER'S GONNA SHIT!
WHAT? THEY'VE ESCAPED!?!? GET 'EM, DIM-WIT!


MEANWHILE, DEEP DOWN IN THE TROXYNITE MINES... THEY'VE SPRUNG PHLEGM PHLAGM! THE REVOLT'S TONIGHT! PASS IT ON!
CHECK!
ON A GIVEN SIGNAL....
ONE DOWN...
SPLUTCH!
12-77
BACK AT THE IMPERIAL PALACE...
OH NUTS! IT'S ONLY THE EMPORER'S STUPID SON, DINGUS!
BASH!
U-UPSTAIRS, IN THE NAIAD'S ROOM!
WHERE'S YOUR OLD MAN?
WELL, HERE'S YOURS!
POW!
SO, WITH DINGUS SOUNDLY SNUFFED, SOON THEY FIND THE EMPORER...
NICE SHOT!
BLAM!
IN BED WITH A NAIAD, THE LOUSY CREEP!
THUS, WITH THAT, PEACE AND TRANQUILITY RULES THE PLANET, AND CAPTAIN PHLEGM PHLAGM AND THE FAIRY PRINCESS GET MARRIED!
KISS THE BRIDE, HUH?
BUT BEFORE THEY CAN BEGIN TO LIVE HAPPILY EVER AFTER IN WEDDED BLISS, THEIR CRUISER COLLIDES WITH A FLYING METEOR DEEP IN THE TRACKLESS VOIDS OF SPACE, WHEREUPON THEY ARE INSTANTLY VAPORIZED...
FOOM!
OH WELL...
OSBORNE

Contraception Comes of Age

By Marshal E. Hirschell

The notion of contraception is not a new one. From the earliest traceable history, scholars have discovered that the desire to either prevent or control the number of births has been almost universal. Early peoples had no concept of the reproductive process. This lack of knowledge allowed for only limited success with contraceptive measures. Most of the ancient methods discovered can be directly linked to methods still in use today.

Despite early man's lack of knowledge about the role sperm plays in reproduction, it was recognized that birth could be prevented by introducing some prescriptive mixtures into the vagina. In ancient Egypt, prescriptions dating from 1850 BC have been discovered which were meant to be used as contraceptives. These compounds called pessaries, had many variations but one of the earliest in Egypt called for fresh crocodile dung mixed with honey. This pessary was inserted into the vagina before coitus and must have been somewhat effective because it appears as a recommended contraceptive measure for the next 3,000 years.

If only someone had realized that the passage of the sperm was being blocked, crocodile dung could have been replaced wtih some more aesthetically pleasing substance. But crocodiles were important in Egyptian mythology and medical practices. In countries where crocodiles were not available, the dung of other animals attributed with magical or mystical powers was used. Prescriptions for pessaries made with elephant dung were popular, as were concoctions made of animal ear wax, ox gall, various bird excrements, the inner skin of the pomegranate, cabbage, gallnut, cedar resin and pepper. These ingredients, along with many others, were used as contraceptives and were believed by some to prevent gonorrhoea.

At the end of the 10th century AD, a physician in Persia, Ali Ibn Abbas, made a pessary which contained rock salt, an active spermicide. The salt, when mixed with an oily substance to hold it in place, was a very effective preventative measure. Abbas' work became known in other civilized countries and variations of his prescriptions were soon in use. Even among more primitive cultures, pessaries which included a spermicidal agent were discovered. The trial and error method was no doubt used in all cases to find the most effective ingredients.

Prescriptions for pessaries, which were passed down through the ages, became more and more refined. In London in the 1880s, a pharmacist named W. John Rendell discovered an effective spermicidal pessary containing quinine. His method was so successful and in such demand that he formed his own company to produce them in quantity. Today his company, W.J. Rendell Limited, has branches all over the world and continues to produce pessaries which though more refined than those of ancient Egypt still work on exactly the same principle as some of the earliest of them.

Another ancient method, the condom was first used mainly to prevent disease. A sheath was used by ancient Egyptians who had them dyed various colors to denote rank and even earlier use is theorized, based on cave drawings discovered in Combarelles. The Greeks had a legend about Minos, King of Crete, which included the mention of a sheath made from the bladder of a goat. In Ancient and Imperial Rome, animal bladders were used during coitus not to prevent pregnancy but disease. The Romans had not yet discovered the dual purpose which a sheath could serve. The Chinese used sheaths made of oiled

silk paper from a very early period in their history and the Japanese made a type of hard condom from tortoise shell or leather which doubled as an aid for the impotent.

The use of the sheath is well documented throughout history, but the name "condom" was applied sometime in the seventeenth century. At the court of Charles II of England, a Dr. Condom was asked by the king to find an effective contraceptive measure so that illegitimate offspring could be avoided. Dr. Condom, aware that sheaths were used to prevent disease, discovered their dual purpose and made some from lamb's intestine for the king. By 1785, a dictionary of London street language listed the word "condom" to describe that sheath-like contraceptive device, and the doctor's name became famous.

Condoms became so popular that they were celebrated in poetry: from **The Potent Ally** (1741), "Happy the man who in his pocket keeps/Whether with Green or Scarlet Ribbon bound/A well made C----M., and, "Joys untasted but for them/Unknown Big Belly and the Squalling Brat.", from **Panegyrick upon Cundums**. Although no poetry is written about them today, the modern rubber condom enjoys a huge popularity. They come in colors and various thicknesses and with certain refinements in form said to enhance sexual pleasure as well as to prevent conception.

Other contraceptive techniques have been tried through the ages which turned out not to be quite so effective as the two already mentioned. Chinese philosophers recommended a technique called Kong Fou in 1100 BC: "At the moment of ejaculation draw a deep breath and think of other things." Passivity was thought to be an effective method of prevention and was prescribed for women almost to modern times.

Coughing, jumping and sneezing were also prescribed for women after coitus during the early centures, AD.

Amulets, containing various ingredients and worn by women who wished to prevent pregnancy, were thought to have contraceptive effect. In medieval France, the finger and anus of a dead foetus worn around the neck was thought to prevent conception. Such things as the womb of a lioness in a tube of ivory, a cat's liver in a tube on the left foot, or some asparagus around the neck were considered viable methods. In Mecca, women wore rabbit droppings in a little box on the breast to ward off pregnancy. Contraception based on magic and superstitions has not withstood the test of time.

Variations of the rhythm method have been in use since ancient times. Since the natural elements had effects on everyday life, it was thought that these same elements would effect conception. Ancient tribes in Mexico enforced an arbitrary safe period—eleven months of the year! The month of October was the only time in which coitus was permitted. In several ancient countries some period of time either before or after menstruation was considered unsafe for intercourse. The **Kama Sutra,** written in the 4th century AD, states that one must abstain during sunset, during the 8th and 14th day of each fortnight, on the death anniversaries of one's parents and at various other times. Until the physical processes could be understood, the concept of a safe time for intercourse was speculated about but no accurate period was discovered. Nowadays, it is well known that the fertile period covers five days in the menstrual cycle, and the safe period may be scientifically calculated. But even with increased knowledge of the menstrual cycle, the rhythm method is by no means infallible.

Permanent sterility is one sure fire way to guarantee contraception and of course, methods have been developed throughout history to accomplish this. Castration was one rather drastic measure used. Slaves were often castrated and were used by the Greeks, Romans, Assyrians, Babylonians and Chinese. These castrates called eunuchs, became household slaves or guards of the harems. In China, performing castration was a family trade.

In Australia, a primitive tribe would make a slit along the urethra of the male with a piece of sharp flint so that the sperm would leak out before it could be deposited in the vagina. This operation was performed only on men who were weak or lazy. In some of

these tribes, not only inferior members of the tribe were forced to submit to sterilization, but also men who had fathered two children.

The modern version, for men, of permanent sterility is the vasectomy. This prodecure takes twenty minutes and is usually done in the doctor's office under local anesthetic. It involves cutting and sealing off the twin tubes which carry sperm from the testes to the penis. It has no effect on virility or sexual desire and causes no hormonal changes. A vasectomy is irreversible although surgical techniques are now being worked on which may change this. Various materials used to block the vas and which may be removed are being tested, but so far none have proved practical or effective.

The biggest drawback of vasectomy is that the operation is not immediately effective, and an alternative form of contraceptive must be used until the semen tests out negatively. This may take from several weeks to several months.

Oral contraceptives may seem like a modern innovation, and indeed, effective ones are, but various plants and concoctions have been taken orally from the earliest times to prevent conception. The Chinese **Book of Changes** (2736 BC) suggests fried quicksilver on an empty stomach. The Greeks prescribed mixtures containing iron, copper and water. In the Middle Ages lead was the popular metal and resulted in lead poisoning. The beans from the castor oil plant were swallowed in the Middle East and Europe to cause temporary sterility, and in Russia the broth from a boiled wolf's penis and a man's pubic hairs when drunk by a woman was thought to prevent birth. There were hundreds of other things recommended to be taken orally throughout history.

Needless to mention, one of the modern oral contraceptives, the Pill, proved an unprecedented success. In recent years the idea of a contraceptive pill for men has become more realistic. Dr. C. Alvin Paulsen, of the University of Washington State Medical School, has made tests on men which show that a daily dose of a drug called danazol along with a monthly injection of testosterone is effective in 85% of his test cases.

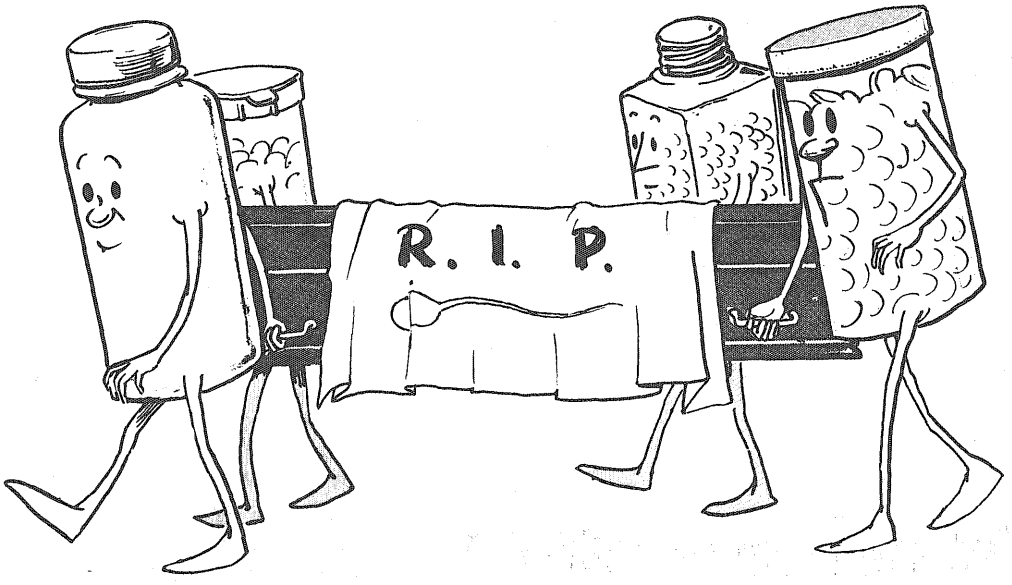
Danazol inhibits production of the male sex hormone, and the testosterone ensures a healthy sex drive. This method also weakens the sperm so that they die before reaching the womb. Once the treatment is stopped, it takes only three to four months to bring the sperm count to normal and the only side effect noted by Dr. Paulsen is a slight weight gain. Dr. Paulsen sees no reason why his pill/shot method cannot be marketed within four years.

Other discoveries which may lead to a male Pill include one by Dr. D. W. Bishop, of the Medical College of Ohio, whose experiments with enzyme inhibitors may stop food sources of developing cells before the cells become sperm. Bishop sees this method as potentially less complicated than Paulsen's because it involves no hormonal changes. But, he foresees at least 15 more years of research and testing before it can be determined safe for general use. He thinks his research may eventually provide an improved oral contraceptive for women as well.

Work is also being done on a sugar analogue pill at Purdue University. Dr. Roy L. Whistler has fed this pill to lab animals and within three to four weeks sperm development was inhibited. Three to four weeks was needed for sperm count to return to normal. This method also does not involve hormonal changes. Whistler theorizes that it may work equally well on men, but no tests have been made as yet.

While examining the sperm of men with unexplained infertility, Scientists at Cornell Medical College discovered a microorganism, a cross between a virus and a bacterium, called T-mycoplasma. This organism has the effect of inhibiting the motility of sperm. The scientists are now working on isolating the chemical which causes this effect. The chemical may offer a powerful new approach to birth control for men.

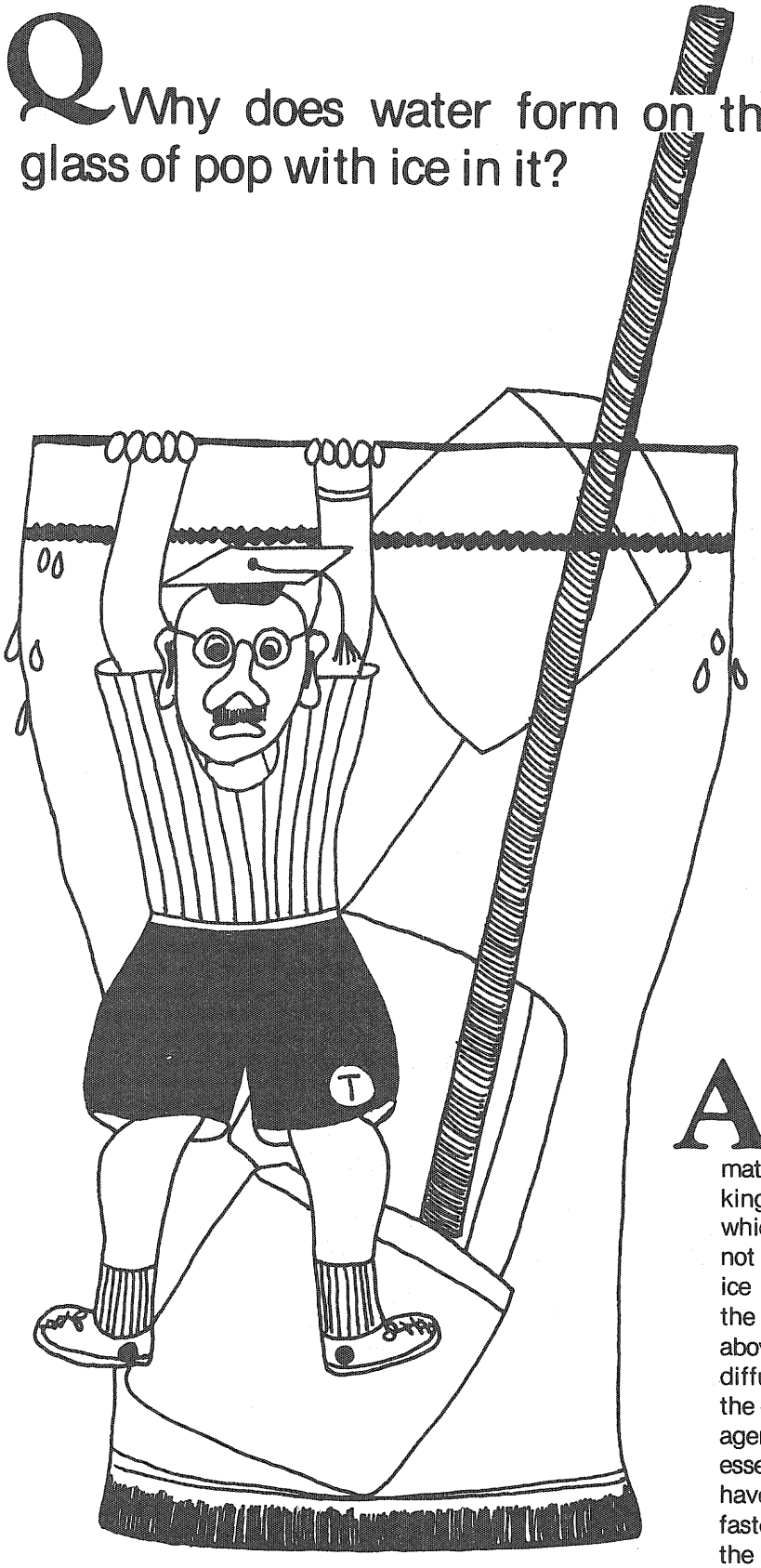
Man has continued to increase and multiply despite efforts to control birth rates. The world population in 1977 is estimated at about 4 billion. Some areas of the world are vastly overcrowded and mass starvation has become a reality. Several countries, including Japan, supported policies to restrict population increase. All countries need to adopt similar policies. Today more than ever before, easy access to safe contraceptive methods is necessary. The research being done on contraceptives for men is certainly a step in the right direction. The day will come when men and women both will be able to choose when conception will take place. Let's hope that rational control of the world's population can replace the more terrible natural methods of disease and famine.



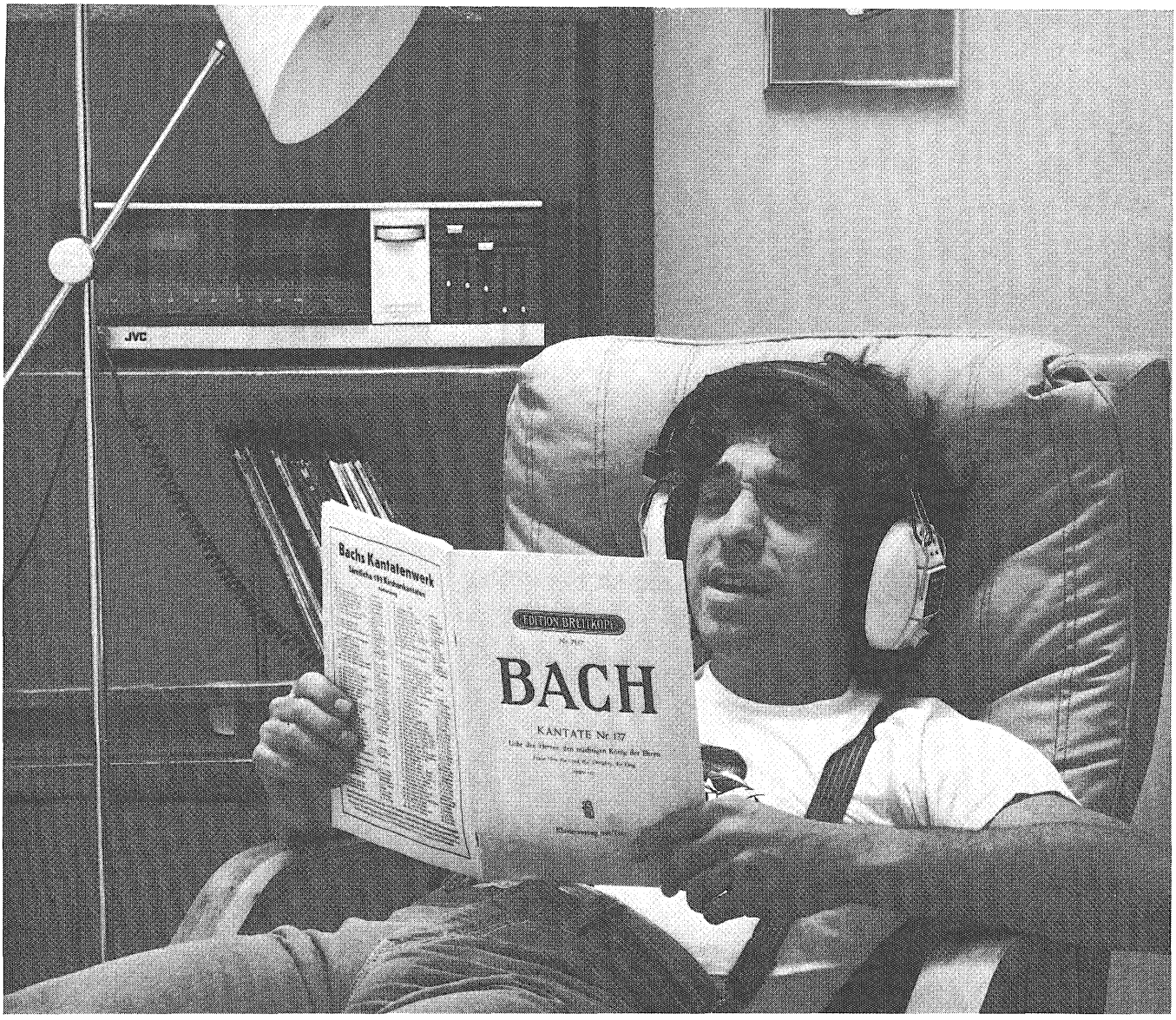
Artwork by Dave Graf

ask uncle dave

Q Why does water form on the outside of a glass of pop with ice in it?



A This is due to a very important engineering materials breakthrough. The glass used in drinking vessels is a selectively permeable membrane which allows water to diffuse through itself but not the flavoring agents of the beverage. When ice is added to the solution and begins to melt, the concentration of water in the glass increases above a preset critical value and it begins to diffuse through the glass. By careful control of the glass properties the concentration of flavoring agents in the beverage can be maintained at an essentially constant value as the ice melts. You have probably already noticed that water forms faster on a glass which is in a warm room since the ice tends to melt faster.



Enjoy college

Education not only makes life more interesting but eventually brings more influence in society than can be expected by those who have never bothered to read, study, listen, and reflect on the pleasure and pain of it all. That includes influence as articulate citizens, customers, and investors.

Nevertheless, the truth in this may not be apparent right out of college when a desire for steady income leads some B.A.'s to come to us with a major in, say, political science or Romance languages, seeking a start toward an executive career. We listen and then ask, "Are you a born salesperson and how can you prove it?"

In a way, that question reflects our own limitations. For a person well educated in something other than technical fields, it is usually only in sales that we can match qualifications to openings.

For you, who may have lost out on some of the pure pleasure and sheer fun of college because of the kind of technical courses you've had to grind away at, the choice can be wider. Sales is just one possibility. You can also consider research, development, design, manufacturing, and various combinations of those. Decision-makers throughout our organization, in work often far removed from the subject matter of a technical curriculum, first attracted interest by their success in coping with technical problems. Then, having demonstrated an ability to lead, they exercised their option to move on to broader responsibilities. That sort of choice, for the outset of a career and later, is earned in courses where quantitative thinking rather than personal opinion is demanded.

This includes choice from among other technologically oriented organizations just as good as we are for an interesting life. If it's us you want to challenge, so signify to Business and Technical Personnel, Kodak, Rochester, N.Y. 14650.

Kodak

An equal-opportunity employer (f/m) manufacturing photographic products, fibers, plastics, and chemicals with plants in Rochester, N.Y., Kingsport, Tenn., Windsor, Colo., Longview, Tex., Columbia, S.C., Batesville, Ark., and a sales force all over the U.S.A.

We're looking for engineers who were born to lead.

Are you the kind of engineer who has what it takes to move into management someday?

If you are, you already know it.

Now what you need to know is which companies can offer you the best opportunities. We think you'll find General Electric is one.

We're a high technology company. And that means we have to have managers who understand technology—women and men—to run the place.

Today, over 60% of the top managers at General Electric hold technical degrees. In fact, over 65% of the college graduates we hired last year held technical degrees.

Of course, just leadership ability and a technical degree won't get you into management. First, you're going to need solid engineering experience and a broad understanding of business.

And we have a lot of ways to help you get it.

One is our Manufacturing Management Program. A two-year program of rotating assignments that gives you broad experience with different products and manufacturing processes.

Another is our Engineering Program. For engineers with an interest in product and systems design and development. There's also a Field Engineering Program, a Technical Marketing Program, plus a number of programs sponsored by product operations.

And all with just one aim. To give you all the responsibility and all the perspective you need to move into management. As fast as you can manage it.

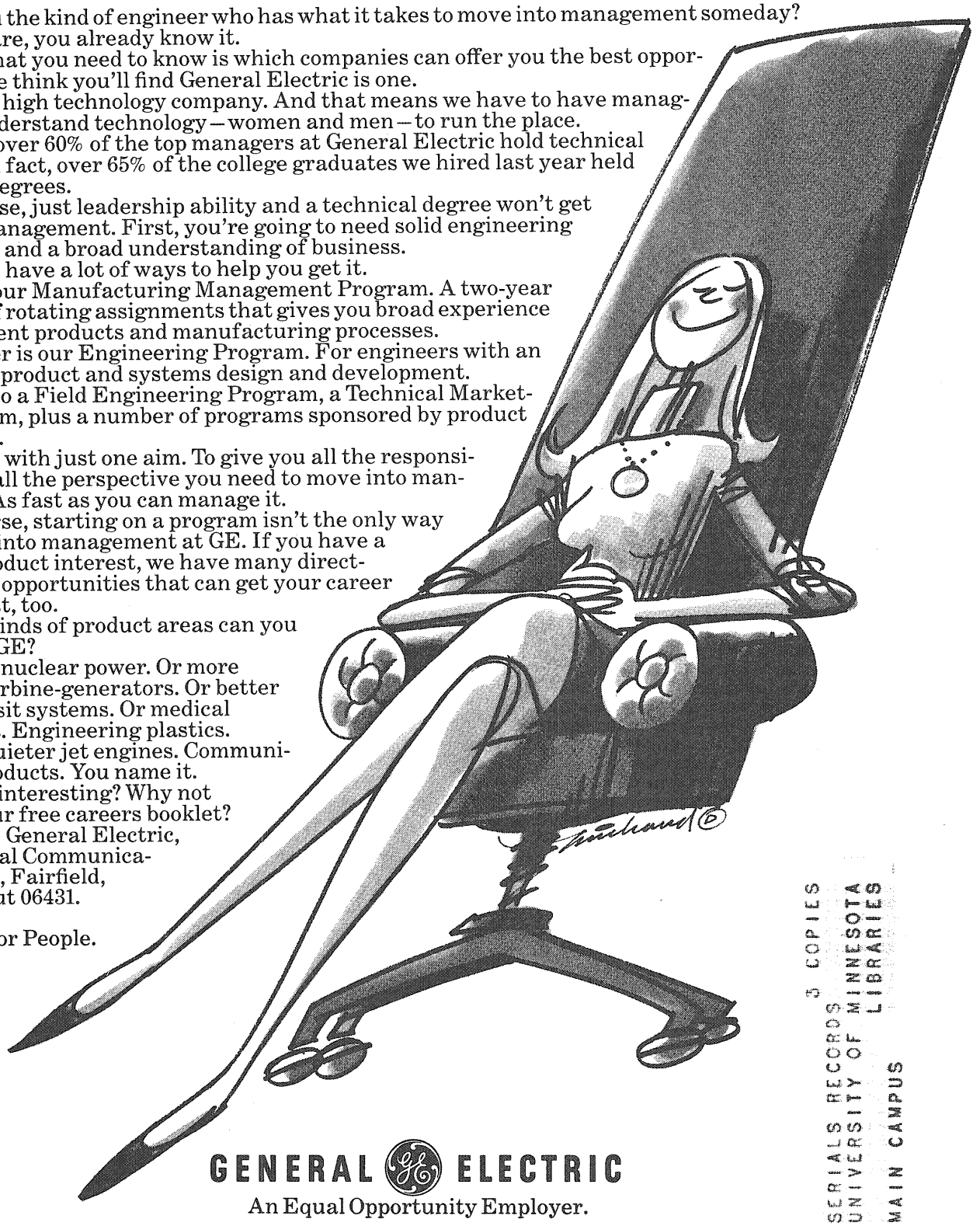
Of course, starting on a program isn't the only way to make it into management at GE. If you have a specific product interest, we have many direct-placement opportunities that can get your career started fast, too.

What kinds of product areas can you work in at GE?

Maybe nuclear power. Or more efficient turbine-generators. Or better mass-transit systems. Or medical equipment. Engineering plastics. Cleaner, quieter jet engines. Communications products. You name it.

Sound interesting? Why not send for our free careers booklet? Just write, General Electric, Educational Communications, W1D, Fairfield, Connecticut 06431.

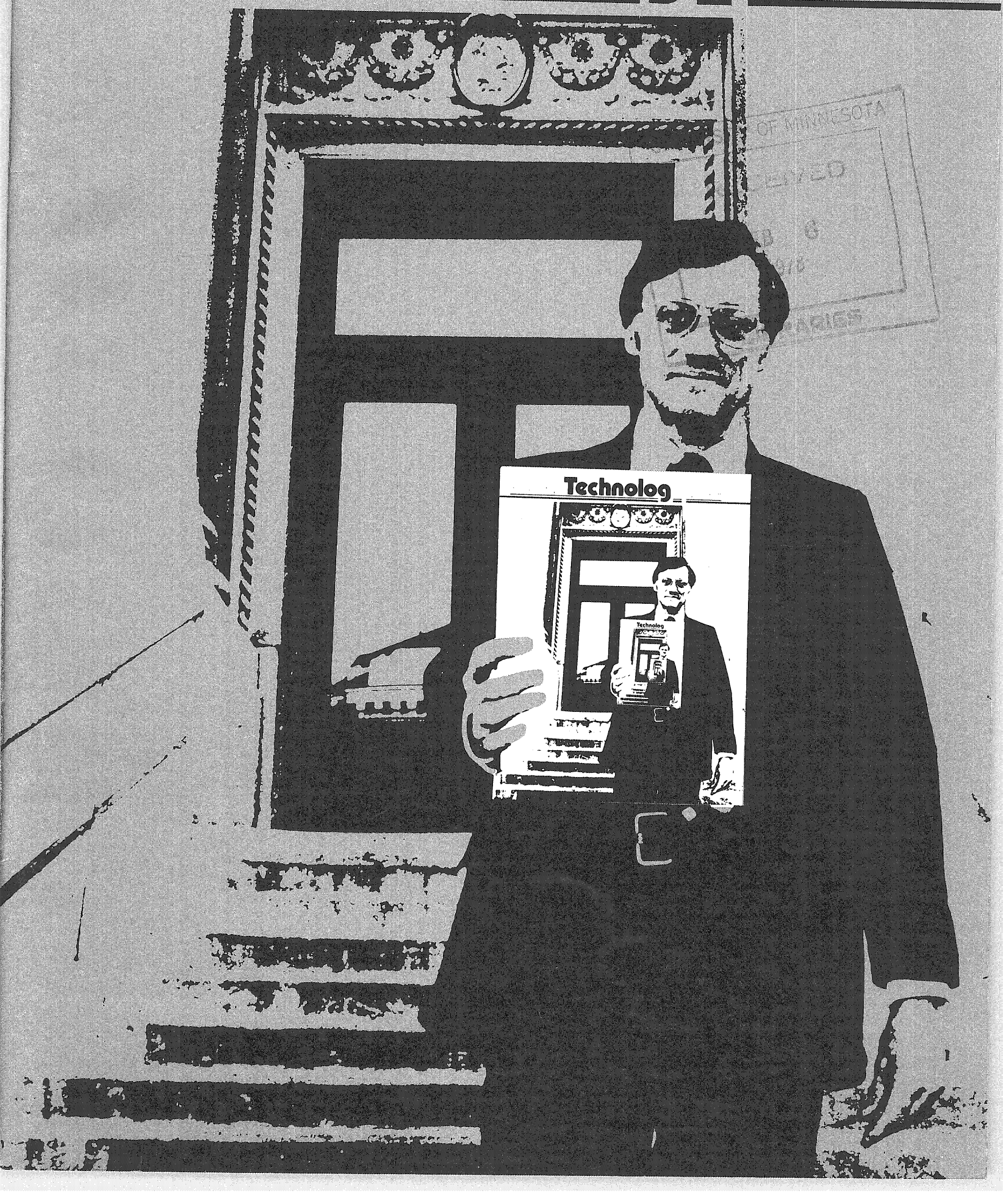
Progress for People.



GENERAL ELECTRIC

An Equal Opportunity Employer.

minnesota **Technolog** jan., 1978



PICK YOUR CONNECTION – GET A FREE T-SHIRT!

(Maybe win a $100 savings bond, too.)

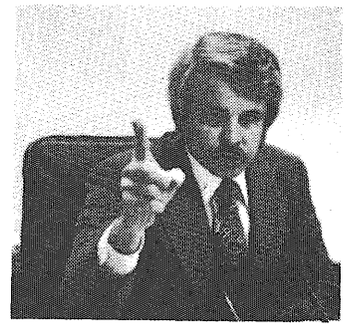
Pick your banking connection — open a new account at the Riverside Bank office of your choice (see below) and receive your FREE T-shirt.

SPECIAL BONUS — Each bank office will award a $100 savings bond to their customer who submits the best essay (100 words or less) on *"I chose my banking connection because ....."* Humor counts. Essays must be received by Riverside Bank by February 25, 1978 to be considered. Decisions of the judges will be final.

JERRY HANSEN
Dinkytown Facility

"We're just a small, new bank with lots of friendliness and eagerness to please. We can't compete with those big West Bank operations, but we can match them for service anytime. We may be the underdogs in this contest, but I think we'll surprise everyone by giving away the most T-shirts."

"THE FRENCH CONNECTION"
Dinkytown Facility
425 13th Ave. S.E. – 379-1286
(in the Chateau)



DAVE CLEVELAND
Main Office

"Listen, we obviously wish our smaller colleague banks well, but don't let a lot of rhetoric fool you. We originated Riverside Bank service here at the home bank on Cedar and Riverside, and although we do *provide big bank services, we are still the community-owned neighborhood bank we were when we began. I know we'll get a big vote of confidence when those T-shirts go out."*

"THE MAIN CONNECTION"
Main Office
1801 Riverside – 341-3505
(Cedar and Riverside)

LESLIE DALY
Fairview-St. Mary's Facility

"Isn't that just like men*?" Here at the Fairview-St. Mary's Riverside Bank, we make no elaborate promises. We just provide the good banking services that our customers need and ask for. We're convenient as few banks ever are, and* that *more than the hoop-la at those other banks will determine who gives out the most T-shirts."*

"THE M.O.B. CONNECTION"
Fairview-St. Mary's Facility
606 24th Ave. S. – 341-2194
(Medical Office Building)

Riverside Community
State Bank of Minneapolis

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Field

Grad. Date

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Field

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AIR FORCE

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Gateway to a great way of life.

minnesota **Technolog** january 1978

Official Student Publication of the Institute of Technology, University of Minnesota

Vol. 58 No. 3

ON THE COVER: University of Minnesota President C. Peter McGrath poses for posterity. Photograph by Dave Parry.

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editor's page

If you'll recall, in our last issue this space was occupied by a tear-out survey. Possibly, due to our timing in distribution, we didn't get as big a response as we had hoped for, but the response was sufficient enough to suggest certain conclusions.

Many respondents listed energy alternatives, solar energy in particular, as one of the topics they'd like to see covered in future issues. You'll be happy to know, then, that before the school year is over, we will definitely have one article on the subject, possibly more. (If there is anyone out there who would like to write about some aspect of the energy issue, please contact us.

Another prominent topic suggestion deals with the broad area of employment after graduation and the possibility of graduate study. We will include, in February, a piece on the pros and cons of graduate study. You may also expect a report on the job market, the status and availability of jobs in specific fields, in the May issue, which will also cover career opportunities available to IT students.

From the list of articles printed in the Fall II issue, which we asked you to number in order of preference, we got a good idea of the types of stories readers prefer. It is interesting to note that almost 50 percent of our respondents preferred the more technical "Interstellar Space Flight" and that almost 50 percent favored the "Contraception comes of Age", a feature article.

Most people agreed that the **Technolog** provided a good mix of technical and non-technical stories, and said that they found it both entertaining and informative.

Comments and criticisms ranged from "too corny" to "worthwhile" to praise and criticism about specific articles in past issues. One unexpected comment, included in one form or another by well over half of the respondents was in support of **Technolog**'s continued publication, which was very gratifying. These comments were in response to our Fall I editorial about apathy.

Many people expressed a preference for science fiction, and complimented us on the SF convention article in Fall I. Our April issue will be devoted to SF this year, and will feature the winners of our annual SF contest as well as an interesting article on SF movies.

It has been rewarding for us to receive so many direct comments about **Technolog**. The ideas suggested by readers for future articles helped enormously in the planning of upcoming issues. Now what we need are writers to cover some of the most interesting ideas suggested. If any of you out there have a special subject area that you'd like to write about, or a desire to learn more about a technical area of interest to you, stop by our office and volunteer. It's not painful, and you may even enjoy the experience.

Now, about this issue. You may notice that we've again had a staff change. The position of art director no longer exists. Our new production manager is Erik Biever.

The Log Ledger, this issue, has much information about upcoming seminars in various departments. (Information of this type was often requested on the survey.) If you have any information about lectures, meetings, scholarships, or anything at all of interest to IT students, please turn it in to us marked "Log Ledger," and we'll be happy to print it, subject to editing for space.

You'll discover a letters to the editor page in this issue. It is our hope that you readers will continue to write your comments, etc. so that the letters page may become a regular feature.

Hope you enjoy this issue!

Technolog is a winner—Best All-Round Magazine!!!!

Technolog won seven awards for 1976 in a competition sponsored by Engineering College Magazines Associated. These include four first place awards: Best All-Round Magazine, Best single issue (six or more), Best layout (single issue—six or more) and best layout (all issues). Three third place awards were also made.

E-Week 1978 is coming up sooner than you think

Engineer Week (organized by that wonderful bunch of guys and gals in Plumb Bob) will be held, this year, between Monday, May 1, and Friday, May 5. Many of last year's events will be repeated and we'll be having lots of new events as well. We hope for maximum enjoyment and participation!

Some of the events include the tricycle race, the bed race and the car race. Complete rules for these prestigious events will be available in the **Technolog** office later this quarter, so stop in and ask for specifics.

Church Street Gran Prix—E-Week car race

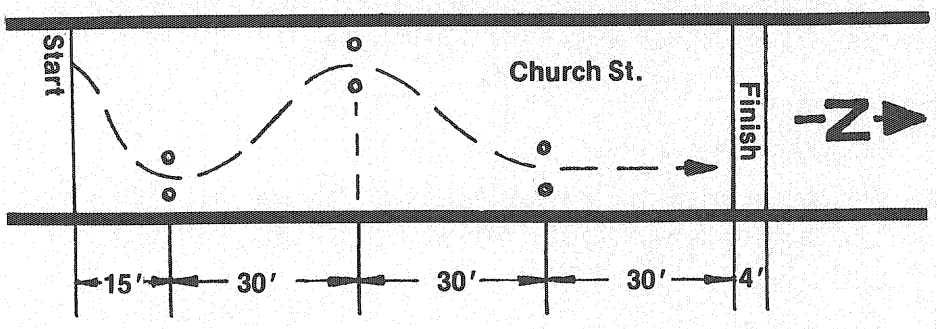
FLASH—Today at the University of Minnesota, Plumb Bob announced the return of $$FREE MONEY$$.

Once again, Plumb Bob will issue a $25 incentive rebate for the first eight entries that complete the E-Week car race.

This year, a new format will be used for the race. The course (see figure below) is designed to test maneuverability, design and drivers' skill.

Scoring will be computed in this way: One score for the total time minus points for knocking over pylons.

For more details, contact Brian Beech or Jeff Matson at 331-7969.



Announcing E-Week button design contest!

It's time once again to rack those creative little minds and start thinking of a drawing to enter into the 23rd annual E-Week button design contest.

Drawings can be of any reasonable size but must be simple enough to be easily distinguished when reduced to a five centimeter diameter button size. The design should include the dates for E-Week (this year May 1-5) and should be limited to two colors.

The creative genius who comes up with the winning design will be awarded the stupendous prize of $25. All drawings must be submitted by Monday, March 13, to room 105 Main E (or Lind Hall, to those who have sold out). Please, geniuses, be sure to put your name, address and phone number (legibly) somewhere on your entry. The winner will be informed of her/his grand achievement during the first week of Spring Quarter. Good luck!

`log ledger

Second Annual E-Week Calculator Race

TI rustlers and HP slingers, saunter this way! Do we have an event for you! Pencil in hand and calculator at side, prepare to draw against your fellow button punchers in the second annual Calculator Race. A fantastic equation is anxiously waiting to be manipulated by your hot little fingers. The only entry requirements are your calculator and an E-Week button. Winners will be judged first for accuracy, then speed. Watch for details about date and location of this fantastic race!

Mechanical engineering seminar schedule

Mechanical Engineering Seminars for winter quarter are held on Wednesdays at 3:15 PM in ME 108, overflow in ME 202. Coffee and doughnuts will be served in ME 202 after the seminar. Here's a list of upcoming topics:

Feb. 1
Technology, Man, and the Future

Prof. J.E. Anderson
Dept. of Mechanical Engineering
University of Minnesota

Feb. 8
Particle Deposition in the Human Tracheobronchial Train

Prof. Morton Lippmann
Institute of Environmental Medicine
New York University
Medical Center

Feb. 15
Interactive Computer Graphics—Three-dimensional Surfaces

Prof. John Brewer
Louisiana State University

Feb. 22
Energy Wars I

Prof. Luther Gerlach
Dept. of Anthropology
University of Minnesota

March 1
Energy Wars II

Prof. Luther Gerlach
Dept. of Anthropology
University of Minnesota

March 8
Modeling of Heat Fluxes at the Anode of High Intensity Arcs

Mr. Dean Johnson
Dept. of Mechanical Engineering
University of Minnesota

Lincoln Foundation gives $23,000 in awards

The Lincoln Foundation is sponsoring the 1978 Student Engineering Design Competition for undergraduate and graduate students in engineering or technology. This competition is held annually to recognize and reward achievement by engineering and technology students in solving design, engineering or fabricating problems involving the knowledge or application of arc welding. Separate awards will be made to graduate and undergraduate students for papers submitted in either one of two divisions: structural or mechanical.

For more information and/or entry blanks, write: Secretary, James F. Lincoln Arc Welding Foundation, P.O. Box 17035 Cleveland, OH 44117.

In the Mechanical division in 1977, M. Garrett, a graduate student at the U of M and L. Goodman, a faculty member here, received a first award of $1,250 for their entry design of a welded steel body for a depressed center railway flatcar.

The deadline for this year's entries is July 1, 1978.


M. Garrett


L. Goodman*

letters

As a female, I must object to the Captain Phlegm Phlagm cartoon strip in the Fall '77 issue.

In the strip, the females are all helpless, passive fairy-like creatures to be acted upon by males. They can either be saved by the good Captain Phlegm Phlagm, or exploited by the evil Emporer Phalanger. The possibility of the Naiads, as they're called, saving themselves or fighting back is never considered.

There are at least 16 different male characters in the strip, each with a different role. Some are good, some are evil, etc. It's difficult to tell how many female characters there are, because they all look exactly the same and none of them ever talks. In spite of their wings, they're also completely vulnerable and wear no clothes. Of course, if they wore clothes we wouldn't get the nice tits & ass shots that we do.

I realize that it is a comic strip and is not intended to portray reality, but are we really expected to believe that a society advanced enough for space travel is still caught in the throes of sexism? Whether you realize it or not, by depicting women in this degrading manner, you're reinforcing out-of-date stereotypes and limiting the way both men and women think about women.

C'mon guys, don't you know by now that women can be so much more than just helpless, mindless, sexy things? We can be just as good, strong, cowardly, evil, brave and **interesting** as men!

Debbie Thurston
Civil Engineering Senior

We are certainly aware of the danger of sexist stereotyping. If you'll notice, not only the Naiads, but all the characters in the strip are blatant stereotypes. The soldiers (males) are depicted variously as pigs, wolves or definite primate types.

If you've seen the last part of the strip in Fall II, you'll surely agree that the Naiads are not passive. May we also point out that, contrary to your statement, our own society, advanced enough for space travel, is still caught in the throes of sexism. Unlike the world of the strip, however, where several aspects of sexism are examined, most of us are only sensitive to one type.

Perhaps, Ms. Thurston, you could use Phlegm Phlagm's all-inclusive caricatured stereotyping to to broaden your own viewpoint.

Dear Sir:

I've heard a lot of crusading in **Technolog** about how we students in IT should be involved with things other than course work, but do you know what that means? A junior in EE is almost required to take 19 credits a quarter, which gives him zero time in which to sleep, let alone do anything extracurricular, like watch TV.

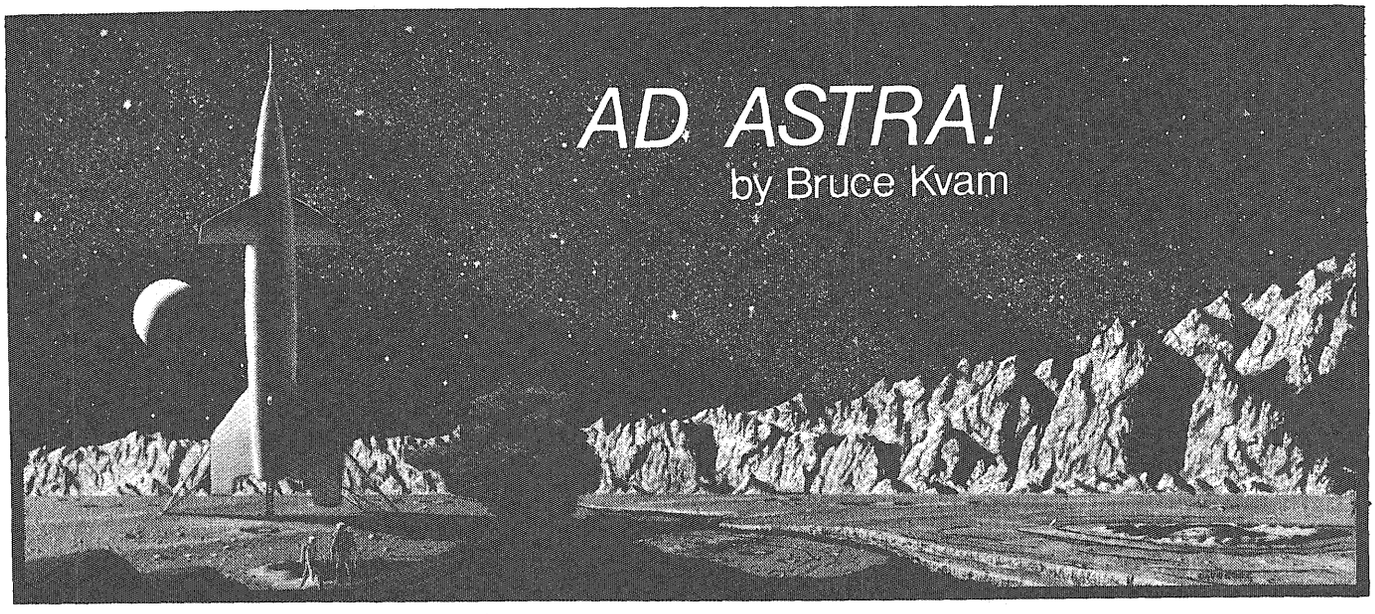
I do admit that there are a lot of IT students who are closed up in little boxes, who are concerned with nothing but their studies, but can you blame them? And is that the case for IT only? What about CLA? Being a student is a full-time job in itself, and I have nothing but praise for those who can manage a full course load and do something like participate in sports or work on a magazine. If only I could do that!

Good luck and keep up the good work on the magazine. Could you do something on nuclear fusion? And never, **never** run Captain Phlegm Phlagm again!

H.J. Schrank
EE junior

That's 'Dear Madam', please. Yes, being a student means a lot of work, but any endeavor endured without respite will drive you up the wall. Yes, we will try to do something on nuclear fusion, and no, we will never, never run Captain Phlegm Phlagm again.

Letters to the editor are invited. Please send them via Campus Mail to Technolog, **Rm. 2, Mech. Eng.**



SF The Old and the New

Science fiction has been growing ever since its 'official' birth in 1926 with the publication of Hugo Gernsback's **Amazing Stories.** In the fifty years of its existence, science fiction has changed its focus somewhat. Older SF dealt solely with science and technology. Characterization, the art of making characters seem **real,** suffered. In recent years much more attention has been paid to the emotions and motivations of characters.

Such is the case with C.J. Cherryh, most recent winner of the John W. Campbell award for best new writer. Her latest novel, **Hunter of Worlds,** is the first piece of her work that I've read. And I'm confused.

Aiela Lyailleue, a kallia, is taken from Kartos station by a group of noi kame indentured to the iduve. They bring him aboard the nasul **Ashanome,** where he is made kameth. A chiabres is planted in his skull and an idoikkhe slapped on his wrist.

Reading **Hunter of Worlds** is like reading **War and Peace** in the original. On the first page there are nineteen words that are totally alien to me, counting proper nouns. There are frequently sentences which contain not one English word.

True, alien concepts need alien words, but must she drown us in them? I read science fiction for enjoyment, not as an exercise in oral agility.

There are three alien races in **Hunter of Worlds** and Cherryh develops for each its own language, physiology and psychology. The iduve are the cold-hearted, sometimes incomprehensibly violent masters of the amaut and kallia. An iduve has wrought the **vaikka** (revenge) of the Orithain (ruler) of the nasul (spaceship-city of the iduve) **Ashanome.** Aiela, the hero, is mind-linked to a female kallia and a human, whose world has been recently conquered by the amaut. This unlikely triangle must hunt down the offending iduve on the war-ravaged human world.

Thus the interactions between the characters are very complex, and sometimes obscure, a fault the alien vocabulary greatly promotes. How can I understand character motivation when I can't understand what is said?

The book has emotional tension, is sometimes a bit slow, and is frequently confusing. If you care to read it several times, you may enjoy it. There are some nice parts, a richness in the psychological complexity and in the depth to which the iduve are developed. But in general, I didn't like the book.

Cherryh is concerned mainly with the societies of her aliens, but Donald Mofitt neglects alien psychology and concentrates instead on alien technological prowess.

Moffitt has made a fairly impressive debut with his first SF novel, **The**

Hunter of Worlds, C.J. Cherryh, DAW Books, 254 pp., $1.75.
The Jupiter Theft, Donald Moffitt, Ballantine/del Rey, 375 pp., $1.95.
The Foundation Trilogy, Isaac Asimov, Avon, about 650 pp., $4.95. Individual copies of each book of the trilogy can be bought separately, at $1.50, from Avon (It's 45¢ cheaper that way).
Childhood's End, Arthur C. Clarke, Ballantine/del Rey, $1.75.
If you care to read about Clarke's personal life, his new book **The View from Serendip** is now out from Random House, 273 pp., $8.95.

Jupiter Theft. A new x-ray source has been discovered in Cygnus traveling toward the solar system at the speed of light, threatening to scour the earth of life.

Meanwhile, a joint Chinese-American mission to Jupiter is preparing to leave. The Americans are supplying the boron-fusion engine for the ship while the Chinese supply the starter hydrogen-fusion engine. Neither side has the faintest idea how the other's piece of equipment works! That will present interface problems, you say. You're right!

The x-ray source decelerates and goes into orbit around Jupiter. The mission, already stifled by security hacks, is invaded by incompetents assigned by the 'Reliability Board' (RB), the US secret service. The Chinese follow suit and the ship sets off for Jupiter.

The Jupiter Theft is definitely a fast-paced, exciting book. Moffitt's science is, with few exceptions, unerring.

Moffitt's politics and sociology, however, are way off. He would have us believe that cooperation between two such antagonistic nations is possible, with the Apollo-Soyuz mission presumably a precedent. With the kind of security paranoia evident in his Sino-American relations, the guys on top would never let a top-secret boron-fusion engine get on the same ship with the Chinese!

Life on Moffitt's earth is just plain **icky.** There are RB agents everywhere. Everyone lives off the government, and anyone who doesn't is PriSec, synonomous with dirt. There is the **Chinese police action of 2003-2008,** during which the Chinese clobbered the Russians using conventional warfare. Now if you think the Russians would let that happen without laying a few atomic eggs on the Chinese, well, you're as naive as Moffitt.

But once free of Earth, it gets a lot better. Moffitt's aliens are interesting, as is their technology and especially their mode of travel. But we don't learn a thing about their society, except that they're **different.**

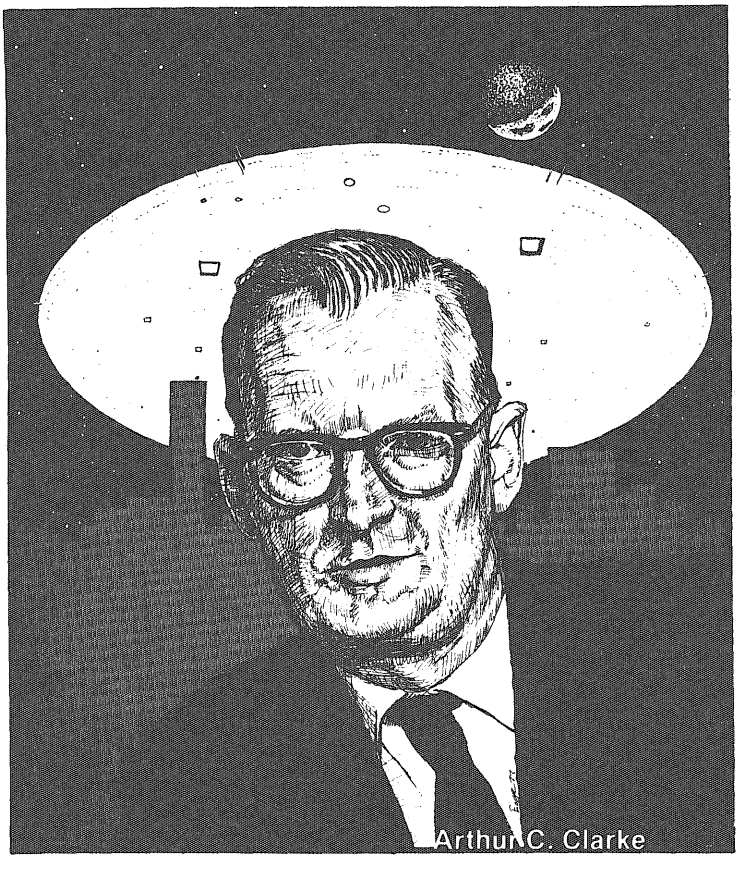
Picky details: There is the annoying insertion of Chinese into the text, but it isn't meant to relay any information to the reader, so it does no harm. The epilogue isn't consistent with the rest of the book, but if I tell you why, I'll ruin it for you. I'd recommend this book. I liked it in spite of the flaws.

Despite the constant influx of writers like Moffitt and Cherryh, the old ones are not forgotten. Indeed, there are more reprints published each month than original novels. And a great share of these books were written by three men: Bob Heinlein, Isaac Asimov and Arthur C. Clarke.

Asimov and Clarke have a long-standing rivalry as writers of science fiction and science fact. The dedication of Clarke's **Report on Planet Three** goes as follows:

> In accordance with the terms of the Clarke-Asimov treaty, the second-best science writer dedicates this book to the second-best science-fiction writer.

I tend to think that Clarke is the more bitter of the two, but he has more to complain about. Asimov has written about two hundred books by now, and continues turning them out at eighty



Artwork by Dave Egge

words a minute. Most of his current work is non-fiction; he has almost ceased writing SF, except for an occasional Hugo-winning story.

Born in Russia in 1920, Asimov emigrated to Brooklyn when he was five. His age is supposed to be a deep dark secret (Asimov is vain). Unfortunately, he suffered a heart attack recently, but has recovered and is on his way to his third hundred.

The **Foundation Trilogy** won the Hugo award for best all-time series. Originally published as several short stories in **Astounding,** the Trilogy is one of **the** classics of SF.

The Galactic Empire has reached its peak, and in its glory the voice of Hari Seldon, psychohistorian, predicts its end. Psychohistory is a social science that cannot be applied to one man, or one group of men, but when applied to the trillions of the Galaxy it can with mathematical precision determine the future course of history. With psychohistory Seldon predicts the fall of the twelve-thousand-year-old Empire and the three-thousand-century-long time of darkness that will follow. Encyclopedia Foundation number one is founded on the planet Terminus, in the galactic fringe. From that barren world, and its twin on the other side of the Galaxy, knowledge will spread slowly back in the fallen Empire, raising it from barbarism and forming the Second Galactic Empire in a mere thousand years, averting the thirty-thousand-year interregnum.

Asimov leads us from Terminus through hundreds of years of interstellar politics and intrigue to the Second Foundation, whose location and very existence have been uncertain all these centuries.

It's a great book and you really should read it.

Arthur Clarke was the chairman of the British Interplanetary Society in its early days. Then in the 1950's, he turned from space to the depths of the ocean. He lost an eardrum diving once, but at 60 he still considers the sea one of his elements. He also plans on staying at the Lunar Hilton in his eighties.

Childhood's End is describable by all those stock SF adjectives: mind-bending, staggering, fantastic. And in this case they really apply.

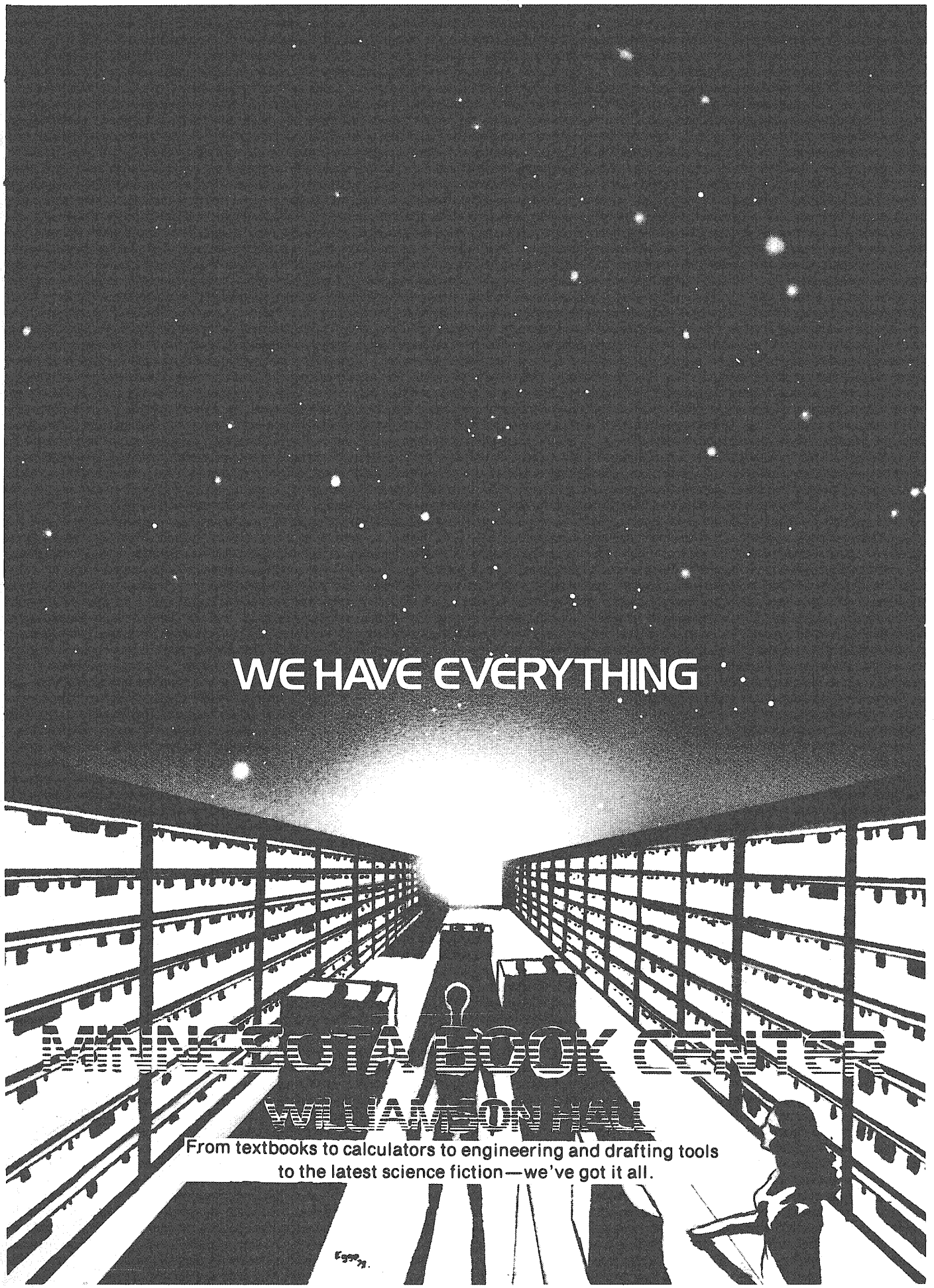
Huge alien ships appear over every major city on Earth. Six days they wait, then announce that mankind's rule over itself is ended. The Overlords will protect the people of Earth from their own stupidity. Gradually all human initiative is lost, humanity is impotent in the might of the Overlords. There is no new art, no scientific research. Why should humans bother? The Overlords achieved it all eons ago. But there is a greatness in mankind that escapes the Overlords, and they envy humans. There is a change in the children...

The same recommendation goes for **Childhood's End:** read it!

Why are these books great? They have faults, of course. There are no truly memorable characters in **Childhood's End** or **Foundation.** They have become dated, since both were finished in 1953. Terminology is quaint in **Foundation.** In **Childhood's End** the US and the USSR are in a race to the moon in 1975. But the faults don't destroy the books.

It is great ideas that make these books great. It is describing the infinite, exceeding one's comprehension and expanding it. Good science fiction should make you think. Deeply. If there is good characterization, fine. If there is breathtaking description, wonderful. But if the book has made you contemplate the vastness of it all, it has succeeded.

Ideas. That's what science fiction is all about. □



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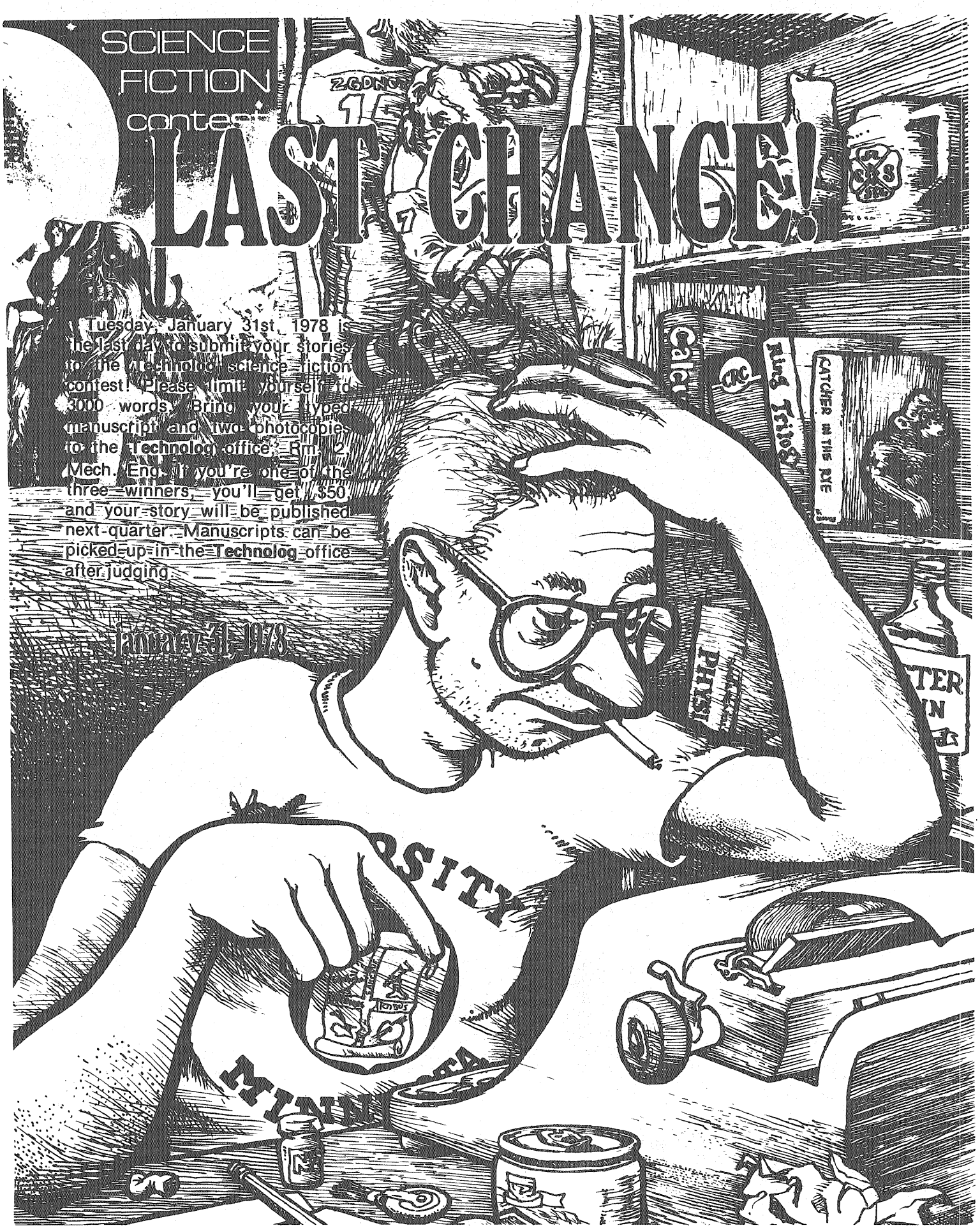
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January 31, 1978
CATCHER IN THE RYE

THE B-1 BOMBER:

essential to American defense?

by Kurt Allen

On June 30, 1977, President Carter announced a decision that shocked both pro- and anti-military forces. The plane that Rockwell International called the most sophisticated ever built, that Strategic Air Command considered absolutely essential to American defense, that Carter had promised in his campaign to cancel, was not going to be funded. His decision may have been affected by the high cost of the B-1 project, availability of other aircraft to do the same job, or political and diplomatic concessions toward detente. Whatever the reasons, Carter's decision may well mark the end of the era of manned bombers in the American arsenal.

Manned bombers have been around since World War I, when aviators threw grenades, dynamite and perhaps a rock or two out of their open cockpits at enemy forces. World War II, with its massive air raids against Nazi Germany, made the bomber an indispensable part of the American forces. The cold war with its reliance on atomic weaponry has brought about the present role of the American bomber. Together with intercontinental missiles and submarine based missiles, the bomber provides the military with an indestructable means of retaliation against any country that attacks the United States.

Military strategy is based on the hope that no power will risk its own destruction by attacking the US. The principle of nuclear deterrence has been an integral part of the Strategic Air Command ever since the Korean War.

The Air Force is charged with carrying 60 percent of US megatonnage of nuclear weaponry. In case of attack the SAC would be required to carry out retaliatory bombing attacks against the attacking country. To do so, the US arsenal contains around 450 B-52 long-range bombers.

But the B-52s are thought of as technically obsolete by the Pentagon. Recent advances in Soviet defense will soon make it impossible for planes like these to penetrate Soviet airspace. By 1985 the Soviet heartland industrial targets will be very heavily defended by extensive deployment of surface to air missiles (SAM). Coupled with these could be as many as 6,000 early warning radar installations and perhaps 5,000 Soviet interceptors that will be fully capable of destroying, the Pentagon says, any B-52 aircraft sent through these areas.

During the Kennedy administration, then chief of Pentagon research Harold Brown helped to cancel the proposed high altitude B-70 project, because of advances in Soviet SAMs that made high altitude bombers obsolete. Instead, he instituted the advanced manned strategic aircraft program to develop a plane capable of penetrating Soviet defenses through the 1980's.

To do this, an aircraft would have to be hard to detect and position on Soviet radar and be capable of eluding Soviet interceptors and SAMs. Further guidelines for the program included the use of flexible and upgradable modular components for the plane's electronic countermeasures (ECM), with ample growth potential to meet new demands. The aircraft would also have to be designed to minimize the dependence on ECM.

The advanced manned strategic aircraft spawned the B-1, possibly the most advanced plane ever designed. The B-1 has a range of 6,100 miles, travels at speeds of up to 1.6 times the speed of sound, and attacks at altitudes of 70 to 50,000 feet. It can carry twice the weaponry that the B-52 can and yet uses only 2/3 the fuel.

The B-1 is equipped with a variable geometry swing-wing that allows it to take off and land in only half the distance required by the B-52, but it can fly almost twice as fast. Much of the wing and fuselage are formed from titanium, a strong, light metal which does not soften or distort at the high temperatures encountered in high-speed flight. In case of attack, the swing-wing and the four General Electric engines, each with a thrust of 30,000 lbs., get the aircraft into the air quickly, away from the vulnerable ground base. Pentagon planners feel that this lessens the chance of a surprise attack destroying our bomber fleet on the ground.

The B-1 is equipped to carry conventional high explosive (HE) or nuclear bombs which can be dropped directly on their targets. It can also carry short-range attack missiles (SRAM), which can be fired up to 100 miles from their targets. The three internal weapons bays can carry up to 75,000 lbs. of free-fall bombs or 24 SRAMs. Provisions are made for eight more SRAMs or 40,000 lbs. of bombs externally along the B-1's wings and fuselage.

The key to the B-1's effectiveness lies in its avionics and shape. On a radar screen, the B-1 appears only five percent as large as the B-52. This was accomplished by reducing the B-1's

cross-sectional area to reflect fewer radar waves. With its advanced avionics, the B-1 can fly at an altitude of 70 feet at speeds up to 600 MPH. It can also elude Soviet interceptors and radar nets and defend itself against SAMs.

Some of the avionics subsystems are:

•Terrain Following Radar, which automatically flies the B-1 along the contour of the land at a constant altitude as low as 70 feet.

•Structural Mode Compensator, which uses small pitch sensors in the forward fuselage to maintain the plane's trim in flight and reduces the effects of gusts of wind or rapid changes in air pressure on the plane's low-level flight. This is important because such buffeting can cause the plane to crash or to seriously weaken the airframe.

•Forward Looking Radar.

•Intertial Measurement Unit.

•Radar Frequency Surveillence (RFS) monitors the radar frequencies to detect whether the plane is in a radar beam.

•Chaff Dispensers release chaff into the air when the RFS detects radar surveillence. The chaff confuses enemy radar by cluttering the sky with radar-reflecting material.

•Forward Looking Infrared detects the heat of an enemy plane's engines.

•Tail Detection Unit. A form of Doppler radar; this would automatically dispense high intensity flares if another aircraft were detected behind the B-1.

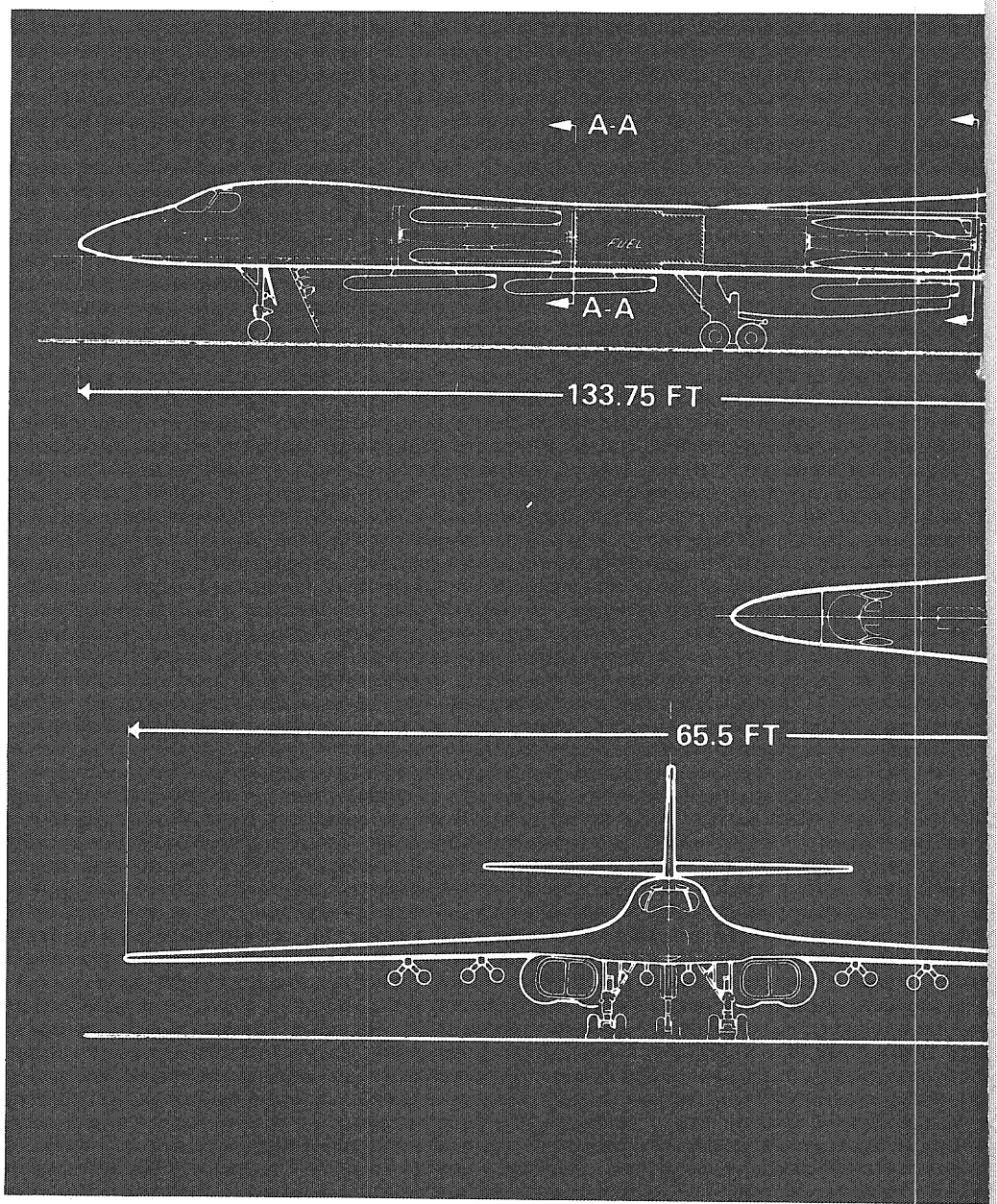
•High Intensity Flares confuse enemy infrared detection of the B-1 by throwing out large amounts of heat.

•32,000-word computer acts as processor and preprocessor of the B-1's avionics systems. It will perform power management roles based on radar threats and preprogrammed information about these threats.

•Dual Mode Jamming renders conventional radar useless and allows the B-1 to elude detection by enemy defenses.

•IFF. Identification Friend or Foe system distinguishes between friendly aircraft and enemy aircraft.

The B-1 may be a miracle plane, but to Congress and Carter it has one serious defect: cost. A B-1 fleet of 240 bombers would cost more than $24 billion to build. The total cost of the entire B-1 program, including flight simlulators, weaponry and maintainance, has been estimated at over 100



The fixed-wing cruise missile launcher version of the B-1. Either the General Dynamics Tomahawk or the Boeing ALCM-B could be the cruise

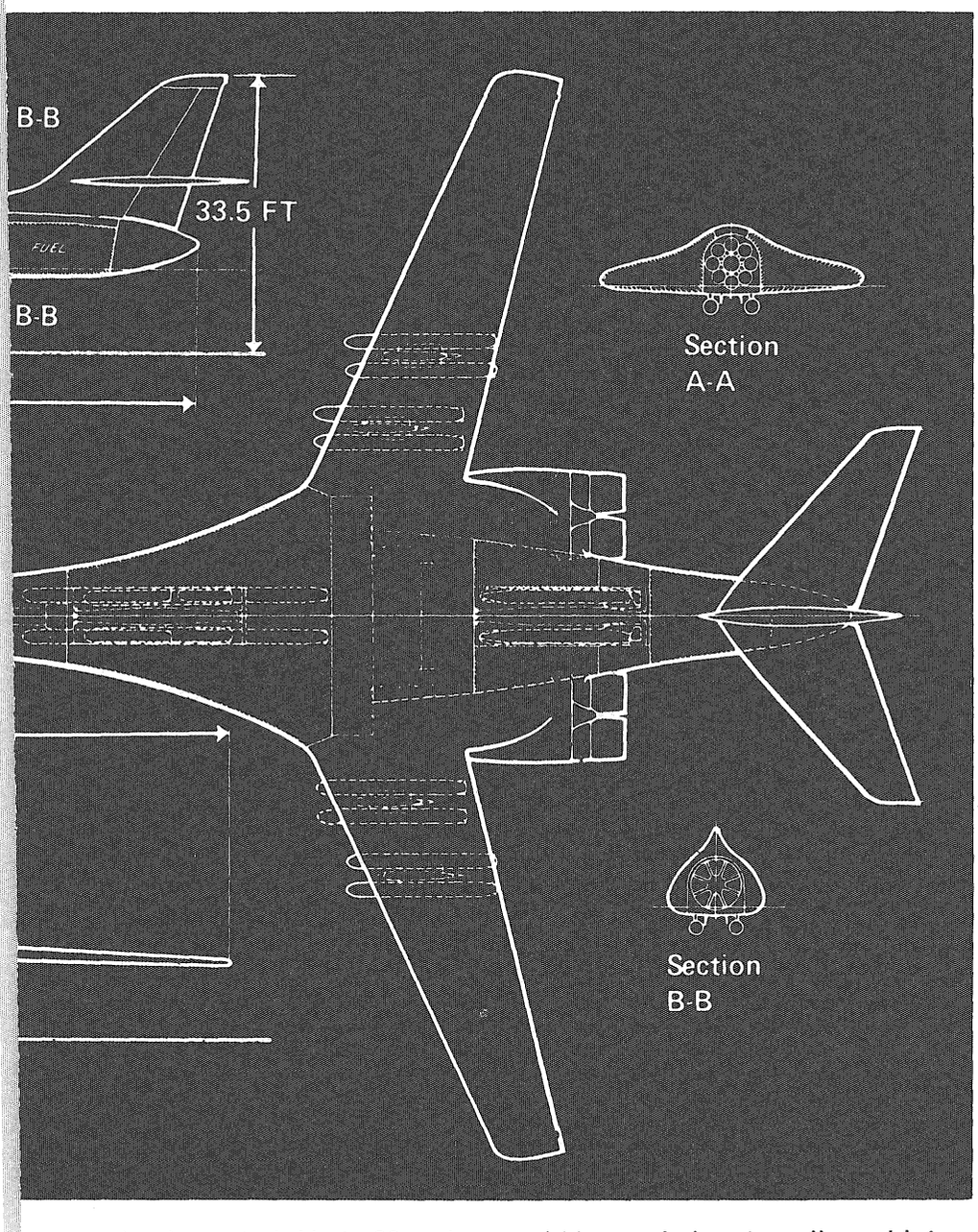
billion dollars, the most expensive plane ever built by the US.

Carter's decision was influenced by studies which showed that Soviet weapons advances would soon nullify the B-1's avionics and greatly increase its vulnerability. The main defense of the B-1 is its ability to fly under radar nets and escape detection. However, the Soviets are soon expected to develop what is known as look-down radar.

Look-down radar is mounted on an aircraft and looks down on the countryside to spot low-flying aircraft that normal ground-based radar would miss. The Soviets currently have only a crude form of look-down radar which cannot distinguish between ground clutter and a moving object like an airplane. US look-down radar can. A further Soviet advance in radar dejamming techniques could increase the B-1's vulnerability by nullifying its jamming defenses. A Pentagon report stated that Soviet developments along these lines will come to fruition in the 1980s. Ex-Secretary of Defense Rumsfeld, a staunch supporter of the B-1, stated that advances in Soviet technology coupled with low-level interceptors could seriously degrade the B-1's usefulness.

Several less expensive alternatives to the B-1 seem to have caught the President's eye. The cruise missile, the modified B-52 bomber, and the modified FB-111-H are among several alternatives the president and Congress are considering.

The cruise missile is currently being



implemented. Up to 22 cruises could be carried, externally and internally. Courtesy Rockwell International.

tested and developed by the Air Force and Navy. With his decision to drop the B-1, Carter ordered the Air Force to speed up its deployment of the air launched cruise missile (ALCM) so it would be operational by about 1983. The cruise missile is a small, electronically-guided drone plane capable of flying long distances without human supervision. It is designed to fly at treetop level through heavily defended areas much as the B-1 would. The ALCM-A, the cruise currently being tested by the Air Force, has a range of 750 miles. A cruise missile with greater range, the ALCM-B, will have a range of 1,700 miles. The drone plane can fly at speeds up to 560 MPH and hit within 100 feet of its target.

In conjunction with the cruise missile, a plane equipped with special launchers to carry and deploy its load of cruise missiles will be used. Called a standoff bomber, this plane will be equipped to carry between 20 and 50 cruises. In a retaliatory attack mission the plane would fly to the enemy's borders and release its load of cruises. Each cruise would then fly to its own individual target on its own power.

A cruise missile is more vulnerable to Soviet defenses than the B-1 is, but a strike can be launched using so many cruise missiles that no defense net, Soviet or American, could destroy more than a small percentage of them. Each cruise missile would cost around one million dollars. The standoff bomber would not be required to penetrate into heavily defended airspace so it need no be as sophisticated an aircraft as the B-1. Present plans call for using either a modified commercial airliner, like the 747 or the DC10, or modifying the present B-52 fleet to carry the Cruise.

Another possible replacement for the B-1 is a modified version of the B-52 bomber which would have the capability to penetrate Soviet defenses. B-1 avionics would be installed to allow it to fly at 100 feet. Modified B-52's would not be as heavily defended as the B-1, but defense experts feel that the modified B-52 could penetrate Soviet airspace into the late 1980's. The cost of modifying 250 planes in the present B-52 fleet would be around seven billion dollars by present Pentagon estimates.

The FB-111, used with much success in Vietnam, could also be modified to become the manned penetrating bomber of the 1980's. Modifications would include lengthening the fuselage by 104 inches in order to house the B-1 avionics system, larger fuel tanks, and to accommodate structural reinforcement so the plane can use engines designed for the B-1. The weapons bays would also be enlarged to accommodate five nuclear weapons internally plus four more externally.

The FB-111-H, like the B-1, has the advantage of a swing-wing that allows quick takeoff and speeds up to Mach 1.75. It is also smaller than the B-1 and less easily found on radar. This coupled with its lower costs, around 35 million dollars per plane for a fleet of 65, has prompted Congress and Carter to consider funding these modifications.

Although the president has stopped construction of the B-1 bomber fleet, there is still some hope for supporters of the manned penetrating bomber. Manned substitutes for the B-1 have been considered by Carter that could forestall elimination of the manned bomber for another 20 years. There is also the possibility that the B-1 project could be reincarnated. Carter has ordered funds for Rockwell to continue testing and development on the B-1 and has held open the option to build the B-1 for several years. This could be used as a bargaining point in further arms talks, as well as a safeguard against deterioration in American-Soviet relations. □

recombinant DNA

The Debate Goes On

by Tim Schultheis

Gene splicing . . . genetic engineering . . . These phrases conjure up visions of biological inventors, little Edisons inventing weird life forms from the same genetic building blocks that have shaped our world. If you're a little more paranoid, you might start envisioning the little inventors' big mistakes. If you know the facts, and you're a worried scientist, you make sure the technique stays under control. So opened the debate over recombinant DNA research, and it's not over yet.

The six-year debate has brought many concerned scientists into the public spotlight. Some, awed by the power of the new technique and frightened by their ignorance concerning its possible consequences, clamored for some reasonable control. When the scientific community proved reluctant to apply controls, they went to the public. This action frightened other scientists; a Nader-like backlash would set the research back many years.

In these six years, many questions concerning scientific and political responsibility have been raised; some have been answered. "This has been an educational experience for everyone of us," says University recombinant DNA researcher Dr. Tony Faras. "The scientific community has learned that it must become more politically sensitive, and that laypeople should be kept better informed of developments, especially in controversial areas. Hopefully, the public has learned that scientists do a pretty good job of regulating themselves."

Basically, most recombinant DNA experiments involve attaching a certain gene to a carrier gene, and inserting these into a virus. The virus then attaches to an E. Coli cell, and the genes in the virus are inserted. Inside the host cell, the new genes replicate, and if successful, are adopted by the normal protein synthesis apparatus of the host E. Coli cell, and the desired protein is manufactured. This process makes possible genetic engineering, in which strains of bacteria with useful properties are produced. In more basic research, the technique enables scientists to study genes individually by manufacturing them in large quantities.

The dangers involved in these experiments were at once apparent and obscure. E. Coli normally live and breed in great quantities in the mammalian intestine and the environment (especially lakes and rivers). Although laboratory E. Coli used in these experiments need four or more rare chemicals to survive, the insertion of unknown foreign genes might presumably overcome these deficiencies. Plasmids (DNA strands outside of a cell's chromosomes) are responsible for transmitting dangerous drug resistances. Could recombinant plasmids overcome nutrient deficiencies? Other considerations—such as the possible contamination of laboratory E. Coli by ordinary E. Coli, the possible creation of a dangerous virus, and the possible inter-species gene transfer of dangerous properties to one of E. Coli's forty or so conjugal mates—bothered many researchers from the start.

The "great recombinant DNA debate" began innocuously way back in 1971. Robert Pollack, a young cancer researcher at the Cold Spring Harbor Laboratory, was concerned about the way in which a known cancer causing virus (SV40) was handled. While lecturing on laboratory safety to a class studying tumor viruses, a student in the class told Pollack of an experiment which was to take place in the laboratory where she worked. Her colleagues, she said, planned to insert DNA from SV40 viruses into E. Coli to study the genes responsible for causing cancer.

Pollack called the student's employer, Dr. Paul Berg, and expressed mild indignation at the proposed experiment. Although the SV40 virus does not seem to cause cancer in humans, Pollack believed that the tiny chance of a cancer-causing E. Coli being created warranted further study before such a project was attempted.

Berg checked with other colleagues and found that they agreed with Pollack, so he dropped plans to use the SV40 virus. Six months later, Berg asked Pollack to help him organize a meeting to review the available information and assess the possible risks. The January, 1973 meeting succeeded, however, only in showing the conferees how little they knew. Assessing the possible dangers at that time was like assessing the effects of violence on TV; just too many variables appeared.

In June, 1973, molecular genetics

experts gathered at a Gordon Conference in New England. A new process of gene splicing had been developed by Stanley Cohen, by which DNA from any organism could be easily inserted into E. Coli, and faithfully reproduced. The conferees felt obligated to take some action to insure responsible use of this new tool. They finally composed a letter which called for an examination of this new field for its possible dangers. They sent one copy to the National Academy of Sciences, and one to **Science** magazine. The issue thus made its public debut after two years of confinement within the ranks. Nevertheless, this was a novel procedure; the scientific community was admitting that control of a potentially dangerous area of research was lacking, which implied that regulation was necessary. At this point, scientists were not sure how regulation should be implemented, much less what sort of regulation was necessary.

The National Academy of Sciences, which had been asked to decide upon the next step, merely told Paul Berg to handle the issue. Berg called for another meeting, and in April, 1974, the eight assembled specialists took two steps. First, they called for an international conference to be held as soon as possible. Secondly, they composed another letter, this time asking that certain high risk experiments be postponed until some set of guidelines were established. The delay thus caused became known as a moratorium, although many moderate risk experiments, those involving animal genes for instance, were not affected.

At this point, the media picked up the stirrings. Foreboding headlines such as "Bid to Ban Test Tube Super Germ" appeared. Senator Kennedy began showing some interest in investigating the issue. Concerned citizens voiced their concern through pressure groups such as Massachusetts' Science for the People. With the moratorium in effect, all seemed to hinge on the upcoming international conference.

The February, 1975 meeting, known as the Asilomar conference, was a dramatic event. Under the threat of strict governmental controls, the scientists dispensed with further discussions of their endless uncertainties, and forged a set of recommendations to be forwarded to the National Institutes of Health (NIH). There they would be drawn up into guidelines which would apply to all government-funded research.

The Asilomar recommendations called for assigning different levels of risk to different types of experiments. Those experiments involving plant genes would receive the lowest risk classification. Experiments involving genes from cold-blooded animals would be placed in a higher risk classification. The most stringent restrictions would be applied to gene transfers involving cancer-causing organisms and genes that would obviously disturb the balance of E. Coli if expressed in the intestine.

Each level of risk, according to the recommendations, would be accompanied by increasingly rigorous safety procedures. Physical containment would be achieved with ventilation and filtration systems, or in riskier experiments, with elaborate facilities such as those used by the Apollo astronauts. The recommendations suggested that safer viruses and E. Coli strains be developed to ensure biological containment.

The NIH released the first draft of their guidelines in late summer. Being less strict than Asilomar had called for, they met stiff opposition. The committee responsible reconvened in the fall of 1975. December saw the introduction of their next version. Opponents, led by Science for the People, fought on. By now the issue had become political; each faction had their spokesmen in the scientific arena. Scientists, who up until now had been players in the game, were becoming pawns. Political power, the greater force, was now running the main show. Hearings were held in the spring of 1976, and the latest version of the guidelines was released thereafter.

Isolated from the main debate, institutions such as the University of Minnesota prepared to push through their recombinant DNA programs. Biologists from the Big Ten discussed ways of dealing with the issue at their regular meetings in Chicago. Biohazard committees appeared at a remarkable rate, the U of M's arriving in the winter of 1975. Since the moratorium had ended, and guidelines did exist, the only remaining obstacle was official certification with the NIH, a job the committees would handle.

This left opponents such as Val Woodward, professor of genetics and cell biology at the U of M, in an ironic position. While their cause was making headway at the national level, it was not even under consideration at the local level.

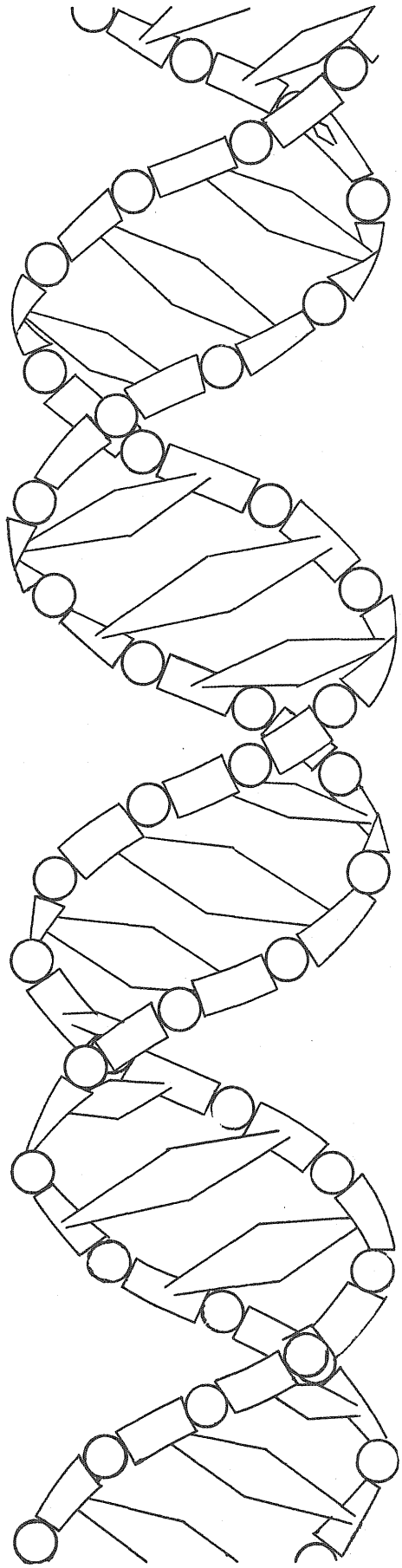
"... a fascinating clash of high-powered egos over high-powered technology ..."

Woodward and others did bring the discussion to the Minnesota campus, if only in an incidental way. No decisions remained to be made, yet two well-known scientists presided at two University-wide discussions last spring. Bernard Davis of the Harvard Medical School defended the research, while Robert Sinsheimer, chairman of the biology division at Cal Tech, opposed it. An article on each speaker, plus a three-part series by the **Daily**'s William Souder were followed by a page-long editorial by Woodward and his followers. In it, Woodward objected to the fact that the two parties (researchers and administration) involved with setting policy at the University both had vested interests in seeing that the research continued unhindered. Public intervention, which Woodward saw as positive and inevitable, was in his opinion, unscrupulously circumvented.

By this time, however, the flavor of the debate had changed. While spokesmen like Robert Sinsheimer and Harvard's George Wald still campaigned vigorously for increased caution, the "great silent majority" of informed scientists were going on record as advocates of recombinant DNA experimentation. Bills were then in the Congress which would set unwanted precedents in the field of scientific regulation. The government versus science nature of the debate caused a closing of ranks among middle-of-the-road scientists.

A June meeting of forty biologists, The Falmouth Workshop on Studies for Assessment of Potential Risks Associated with Recombinant DNA Experimentation, seemed devoid of the drama present at the earlier Asilomar conference. A weariness with the subject, combined with a wariness about publicizing their confusion, seem to have washed the spark out of the debates. Although insiders agreed that the battle lines hadn't changed, the media subsequently reported reassuring articles, such as one headlined "No Sci-Fi Nightmare After All".

More positive than these headlines was the release of a thirteen-page statement by Roy Curtiss III, of the University of Alabama, downgrading the possibility of dangerous gene transfers to laboratory E. Coli. Curtiss, an early critic of haphazard gene splicing was, as a member of the NIH committee which wrote the guidelines, very much responsible for present policy towards recombinant technology. As a respected authority, Curtiss' apparent change of heart has carried much weight with other policy makers. Senator Kennedy, who withdrew his controversial bill last October, cited "recent scientific evidence which suggests that the risks involved have been overstated." Curtiss, as Faras and others believe, may have finally made a big step in the assessment of actual dangers. When the full report of the research is finally released, more will be known.



Art by John Charnes

In the policy field, the current stance which many concerned scientists support is that of the American Society for Microbiology. Called the "nine principles," these "address... (1) the need for a national commission, whose powers [are] defined as greater than those of the secretary of Health Education, and Welfare, to regulate recombinant DNA research; (2) local or state preemption that would create a 'patchwork' of regulations across the nation; and (3) the imposition of fines against individual scientists who fail to comply with the letter of the law.", according to the October 28, 1977 issue of **Science.**

One bill still in Congress, HR7897 sponsored by Paul Rogers (D-Fla.), incorporates many of the tenets of the "nine principles." Senator Kennedy plans to re-submit a modified bill which would temporarily extend the NIH guidelines, subject to updating and revision, and to cover all types of recombinant DNA research, not just publicly funded research.

Can an informed public govern science justly? Are scientists dependable when it comes to announcing their own fear and ignorance of new technologies? Are self-serving researchers exaggerating the safety of gene splicing, or are those opposing it just paranoid?

The recombinant DNA debate, a fascinating clash of high-powered egos over high-powered technology, seems to lead to this conclusion: all systems work. The public hasn't handcuffed scientists, scientists have not covered up their doubts and deluded the public. Furthermore, there is room for politics—even rather radical politics—in science; for if politics is the forge of policy, both hammer and anvil are necessary.

The result of present policy is that many promising experiments continue under reasonably safe conditions. Within a decade, solid payoffs should be forthcoming. That is, barring any not-so-unforseen accidents. □

Moonies on the make

by Gene Kelly

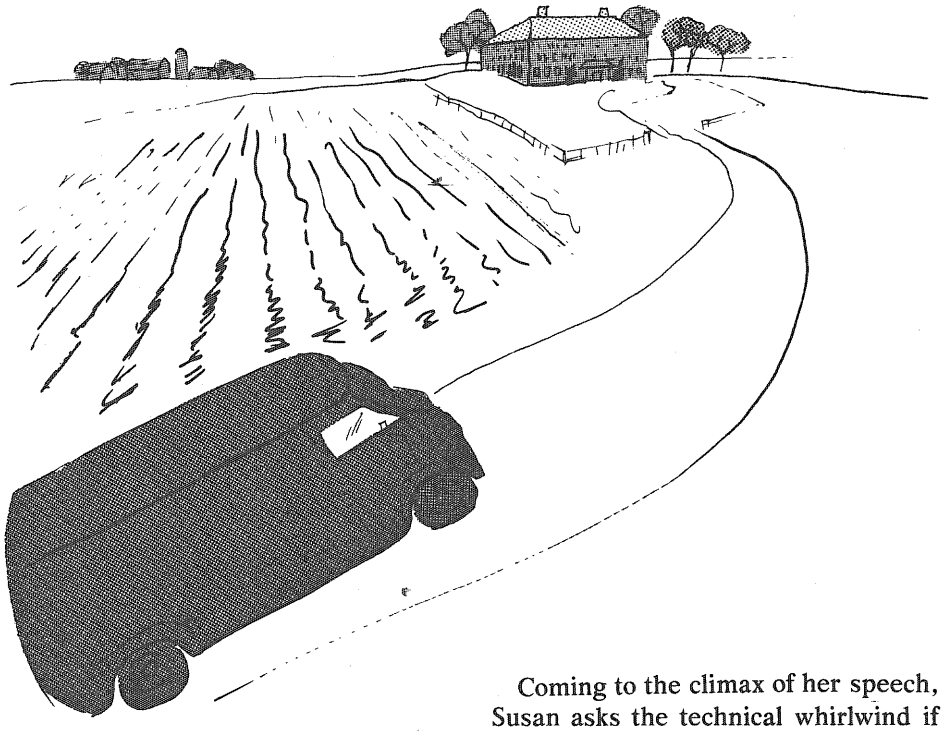
Impressionable, naive and sex-starved are words which fit the IT freshman well. Midway through winter quarter he is immersed in the stuffy, technical environment that the University of Minnesota provides for all IT students. Acutely aware of his existential being one particular IT freshman sits, eating his peanut butter sandwich, on the perimeter of the expansive architecture court. Thinking random, unconnected thoughts, lost in the hubbub and impersonal atmosphere of the university he tries hard to make sense of his life, of where he's at, of where he's going. Young and idealistic, his mind thirsts for knowledge, wanting to know everything, to make sense of everything. His mind is continually frustrated, however, because it has not yet accepted that it is not omnipotent, that it cannot know everything, that it is limited.

Thus, unable to dismiss his divinity, Art remains lost in thought, barely noticing the simple, although attractive, young woman in drab clothes who approaches him. She walks purposefully, having selected him from among the people in the court as the target for her proselytizing.

Her South Dakotan parents bless this young religious zealot each day with the name they gave her years ago. Her name, Susan, implies activeness, likability and attractiveness. Her happy demeanor shows that people like her.

Susan greets Art with a friendly, "Hi," as she sits down next to him. She immediately establishes a common ground between them by informing Art that she eats peanut butter sandwiches regularly.

Art muses to himself. If a couple can talk about peanut butter sandwiches with interest, they can probably talk about anything. He perks his head and



smiles self-consciously after realizing his dumbfounded ogle might be a bit unbecoming.

She bubbles about how gorgeous his shirts is and asks, "Isn't it terrific how people make such beautiful clothes today?" She takes delight in rubbing the fabric between her fingers.

Susan's enthusiasm proves contagious as even the practical mind of this future engineer begins to find pleasure in the simple, common aspects of life.

From beautiful shirts Susan leads the discussion into more enduring, more pregnant matters. She poses the questions of God, religion and the future of man. "Do you believe in God?" she asks. "Well," Art slowly starts, "I'm a lapsed Catholic who hasn't come to any forgone conclusions on religious matters. I'm quite unsure in this area."

Art's uncertainty doesn't quell any of the forthright religious conviction Susan believes in. She elaborates how God is preparing mankind for the kingdom of heaven on earth and the second coming of the Messiah. She explains that each person must prepare individually for the coming of God and the perfect world. Although all people will be saved, the more devout will be closer to God, thus more divine.

The substance of Susan's oratory escapes Art's mundane mind. Yes, he concentrates on salvation, but it is of a personal deliverance into the life of a beautiful woman, not heavenly salvation. He listens, entranced by her intensity.

Coming to the climax of her speech, Susan asks the technical whirlwind if he is free for the weekend. Starry-eyed and unrealistic for a change he immediately says, "yes," not thinking of the two tests he had planned to study for and the paper he was going to write for freshman English. Art envisions a beautiful weekend getting to know Susan.

Susan momentarily breaks Art out of his reverie as she asks him to participate in a religious retreat in Greenville, Iowa and tells him that they leave at six-thirty that evening. Reservations formulate in Art's head as he realizes the pretense of a God-fearing man he will have to act out. Art doesn't know what a retreat entails but he unfortunately doesn't care as his blood gets warmer by the second, thinking of Susan.

Susan tells Art to meet her at five o'clock at the Unification Church. Art agrees and they part company.

This is the first mention of an organized religion Art has heard and he probes his memory banks for data on the Unification Church but comes up empty. Probably another Protestant branch, his Catholic-oriented thoughts tell him.

Art arrives at the building at five o'clock, punctual as usual. He enters

Art by Steve Anderson

cautiously and is taken aback at the smiling, bright faces that meet his gaze. A young man asks his name and he answers by saying he was asked here by Susan. "Oh, of course," he says and calls for Susan who appears from behind a curtain that serves as a partition. The building is poorly decorated and sparsely furnished. Some of these Protestant religions aren't very organized, Art tells himself silently.

The people talk in small groups in fevered tones of voice as if everything uttered is of utmost importance. Art is surprised at the charged atmosphere and supper's vegetarian gruel disarms him. There is also talk of a guy named Moon whose name is spoken of most reverently.

At six-thirty they leave in various vehicles for the trip to Greenville. Art sits between Susan and a girl named Marge. Although warm and secure in the van, Art is slightly annoyed that he has not had time alone with Susan. Snow is falling and the roads are slippery so they proceed cautiously at fifty-five miles per hour, a slow speed then. Soon everyone in the van is singing and smiling.

Art doesn't participate. He feigns interest but his apathy shows through as everyone goads him to partake in singing worship of the **Father**, who is mentioned frequently in the songs. Art again smiles but remains a non-participant. Susan tells him he will understand their singing and happiness soon.

They stop in Northfield, at Carleton College, to pick up another recruit who scrambles around getting the bare essentials he will need for the weekend. And then they're off on the final leg of the trip to Greenville.

The singing stops for awhile and Marge tells Art the great things in store for him this weekend; she tells him she was converted to the faithful on just such a weekend.

At twelve-thirty that night the van pulls into the long driveway of an old, white, three-story schoolhouse that stands by itself amid the cornfields. Everyone helps to unload the van and soon they are inside the schoolhouse appreciating its warmth. The snow has stopped, the temperature has dropped and the wind has started to blow. Art is surprised at the number of people in the schoolhouse. They have come from various states surrounding Iowa.

Before Art has time to say, "Susan," she is gone and he is being shuffled into a large, all-male room. The men roll out their sleeping bags and spread their blankets, preparing their makeshift beds. Art is offered a sleeping bag. He accepts the bag and rolls it out on the wooden floor, realizing that his alternatives to this course of action are poor. He can choose to hear the shrieks of outrage as he enters the all-female room in search of Susan or he can choose to hitchhike back to Minnesota on the deserted highways that surround him. By one o'clock Art is sleeping.

After about five and a half hours of unrestful sleep on the hard floor, Art is awakened at six-thirty to the saccharine cries of, "Praise the Lord! A new day! Rise and shine!" He groggily raises his head and watches as everyone prepares for the day ahead. He gets up, uses the bathroom and in the hallway notices a large poster of an Oriental man in a business suit who smiles benignly at the onlooker. He reads that this is the Rev. Sun Myung Moon, apparently leader of the Unification Church.

Art joins the stream of people heading for the gym, a short flight of stairs down. A ring of people stand smiling, holding hands. Art finds Susan and joins her. In the center of the ring two men in suits lead the gathering in song. The singing ends and one of the men in the center greets everyone. He takes note of the new people present and expresses the wish that they will become familiar faces.

Almost everyone prays aloud now, Art remaining one of the humble abstainers. They then disperse as a bland breakfast is passed around.

"People, people! Will we ever be alone?" Art thinks, as he looks at Susan and then at the faithful around him.

After they finish breakfast Susan leads Art to a classroom. A blackboard stands ominously in front of rows of chairs. The chairs soon fill. Notebooks and pencils are provided for those lacking them. "Wait a minute," Art thinks, "I didn't come here to go to school." He doesn't protest, however, as he sees Susan's somber face.

A man in a business suit addresses the people in the room. He tells them the lecture will be on **The Divine Principle.** This principle takes the form of a 400-page book authored by the Rev. Moon. He begins the lecture tracing the history of man starting with Adam and Eve. Most people take notes, but Art listens with a stone face. Susan, observing Art's passivity, also doesn't take notes.

Speakers change and the lecturers

give "fact" after "fact" as evidence for their conclusions. Rev. Moon is the second coming of Christ. He will lead the world out of the confusion, violence and unhappiness that plague it today into a calm, bright, blissful tomorrow. All men will live in peace and heaven will be on earth.

Christ was crucified before his mission was accomplished. Rev. Moon is here to complete Christ's work, but he needs our help.

The individual must give up all his possessions to the movement and join Rev. Moon in his mission. The salvation of man depends on each man's selfless work. You may have to do things you will not like.

All of this doesn't sit well with Art. His altruistic characteristics are minimal and he doesn't care to correct the situation. He decides to inform Susan of this.

People gather in the gym for lunch. Art pulls Susan aside and tells her he must talk to her. Alone!

They climb the short flight of stairs. Meanwhile everyone else prepares for lunch.

"I don't belong here," Art states. He looks affectionately at her full red lips and wishes it were not so.

She tries to persuade him that if he will just give it a chance he will see how happy he can really be. The crowd in the gym has suddenly grown quiet in silent prayer as Art shouts, "But I don't believe in Rev. Moon or anything they told me this morning!"

Instantly Art realizes that everyone has heard him and branded him a troublemaker, a disbeliever. People murmur, but it is silent for a few more seconds before they begin to eat.

Art, with his denunciation, creates a living hell for himself.

Susan still hopes for Art's conversion. She and Art enter the gym whereupon they are invited to sit at the head table. Here the men in the business suits smile and greet the couple. They small talk for awhile and then ask Art what he thinks of the morning lectures. "Interesting," Art replies with a hypocritical, forced smile.

The rest of the weekend is a blur in Art's mind. He remembers being asked to drop out of school to listen to lectures designed to clear up any vague areas he may find in **The Divine Principle.** Questions, questions are repeatedly asked of him. "Can't you see how happy all these people are?" "Don't you realize the importance of Rev. Moon's mission?" "Why don't you give it a chance?" "You won't have to worry about anything. Everything is provided. You will be one of God's workers. Why don't you join us?"

On the ride home Sunday evening the faithful hound him still. One black man had gone to the University of Cincinatti and dropped out to join the movement. A bespectacled, quiet serious young man is a former IT student who now fervently believes in Rev. Moon's teachings. Art listens, but that is all.

The van stops to drop him off. He takes one long, hard look into Susan's eyes and wishes things had happened differently. He shuts the van door, trudges inside his apartment building to his room. He climbs into bed bewildered. He realizes how easy it would have been to join the movement, to become lost in their superficial love. He notices unusual personal traits that have surfaced this weekend. Firmness of conviction, a belief in oneself, an ability to say no. And his self-confidence grows. . . □

Something wonderful from Tricky Stuff Enterprises, California

The "Hi Sign" which can be used anywhere flashes just the right message for every occasion. The company which manufactures this addition to life's necessities suggests taking it along while "jogging, bar-hopping, people-watching or whatever." The Hi Sign Flip-Flash contains fifteen messages: Hi, Bye, Thanks, Smile, Stay Cool, You're Cute, I Like You, Drink?, Let's Talk, Your Place or Mine, Hugs & Kisses, Help, Gas, Flat, Blinker, and, ta-da-da-dum-da-da! Two blank cards to write your own messages!! For the Hi Sign with 15 messages and two blanks plus your own Hi Writer marker, send $4.95 to: Hi Sign, 698 Santa Cruz Ave., Suite 17, Los Gatos, CA 95030.

Microelectronics winter seminar schedule

The microelectronics seminars for winter quarter 1978 will be held in Aerospace Engineering Room 225 on Thursdays at 2:15 PM. Here is the provisional schedule:

Jan. 26
Dr. Fred Hiatt, Control Data Corp.
"JFETS for Charge-sensitive Amplifiers"

Feb. 2
Mr. Larry Chesler, UM,
"Anodization of Gallium Arsenide"

Feb. 9
Mr. W. T. Malanczuk, Sperry Univac,
"Technology for Subnanosecond Bipolar Circuits"

Feb. 16
IBM Rochester

Feb. 23
Dr. Jack Huang, Honeywell,
"Impact of Submicron Technology on Device Operation"

March 2
Mr. Tim McCullough, 3M Company & and UM,
"Facsimile Data Compression"

These are discussion-oriented seminars; you are invited to attend and to participate in discussions. If you have any questions or would like to suggest a topic, call Al Tuszynski at 373-2970.

Fabric structure student design competition

A student competition to develop a design for an energy-efficient permanent fabric structure housing a government office complex is being sponsored by Owens-Corning Fiberglas Corporation and E.I. du Pont de Nemours and Company, Inc. The competition will run from January through May 1978.

Teams of fourth and fifth year students at accredited architecture and engineering schools are eligible to compete. First prize is $7,500, second $3,500 and third $1,500. The winners will be selected by a jury of leading engineers, architects and other members of the construction industry.

The competing teams will be expected to address certain issues. Because of the diversity and complexity of the issues, many disciplines will be needed on each team.

For more information and details, contact Robert Mulligan, Fabric Structures Unit, Owens-Corning Fiberglas Corporation, Fiberglas Tower, Toledo, OH 43659.

log ledger

Biomedical engineering seminar schedule

Biomedical Engineering Seminars for winter quarter are held on Tuesdays at 3:15 PM, in 307 Millard Hall. Here's a list of topics:

Jan. 31
Evoked Potentials

Dr. Keith Chiappa
Massachusetts General Hospital

Feb. 7
Magnetocardiography

Prof. John Wikswo
Vanderbilt University

Feb. 14
Compartmental Analysis

Prof. Eugene Ackerman
Director, Health Computer Sciences
University of Minnesota

Feb. 21
Compartmental Analysis and Developing Computer Models of Respiratory Function

Prof. Stanley Finkelstein
Laboratory and Medicine and Pathology
University of Minnesota

Feb. 28
Compartmental Models of Biological Systems and the Inverse Problem

Prof. John Jacquez
University of Michigan

Physics Colloquium Schedule—Winter 1978

For this quarter, previews will be arranged for each colloquium. The previews will be short, informal talks, usually by Minnesota faculty, introducing the main ideas and principles to be presented in the colloquium. They are intended especially to help students and faculty from other fields to understand the colloquium and questions and discussions will be strongly encouraged. All previews will be held on the Monday preceding the colloquium from 12 to 1 PM in 130 Physics.

Feb. 1
TO BE ANNOUNCED

Feb. 15
Dan Joseph
Department of Aeronautical Engineering
University of Minnesota
Hydrodynamic Stability and Bifurcation.

Preview: To be Announced.

Feb. 22
Lee Schroeder
Lawrence Rad. Laboratory
Berkeley
Physics of Relativistic Colliding Nuclei

Preview: J. Waddington

March 1
Dudley Shapere
Department of Philosophy
University of Maryland
Progress and the Boundaries of Physical Science

Preview: R. Stuewer

March 8
TO BE ANNOUNCED

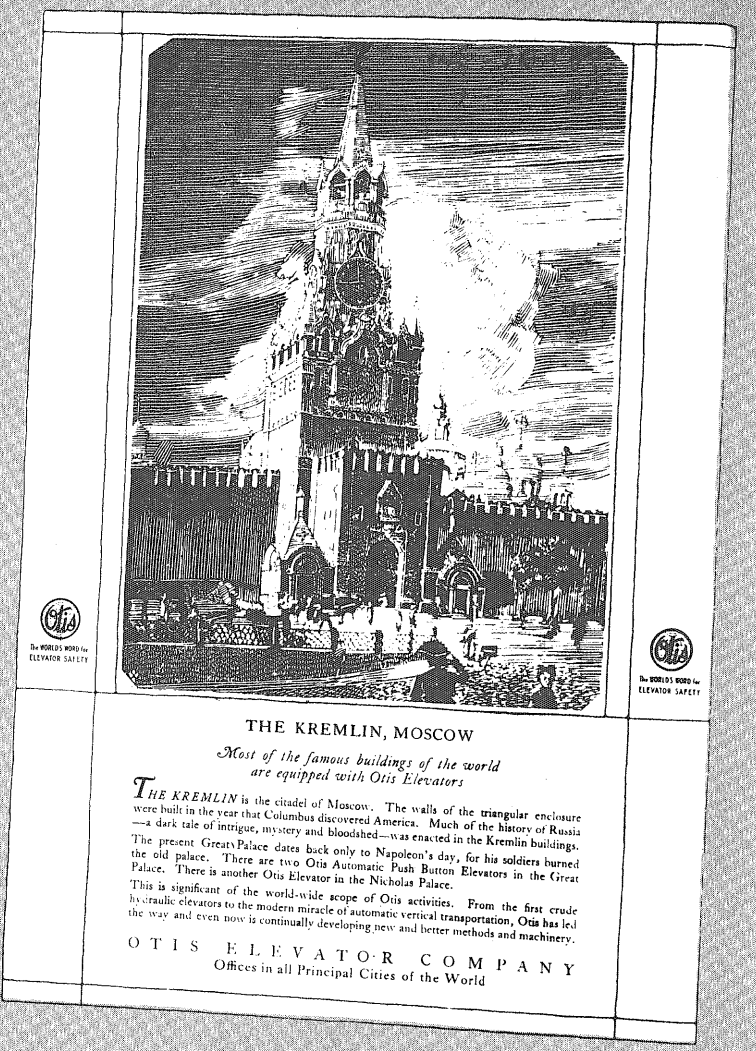
March 15
Murray Gell-Mann
Cal.-Tech.

Preview: To be announced

divertissements

One of the most frustrating things about **Technolog** is that it only comes out six times yearly. We just don't publish often enough to do all the special things that we would like to do. One of the pet ideas around our office recently has been to do a "Nostalgia Issue". Because we can't do that, we've decided to settle for this little feature.

Some of our favorite advertisements from years ago are printed here for your perusal. On page 26 there is an ad headed "Just Think". No one in the office knows what the thing in the ad could be. If anyone knows, kindly drop by the **Technolog** office with proof, and pick up a $5 prize.



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Most of the famous buildings of the world are equipped with Otis Elevators

THE KREMLIN is the citadel of Moscow. The walls of the triangular enclosure were built in the year that Columbus discovered America. Much of the history of Russia —a dark tale of intrigue, mystery and bloodshed—was enacted in the Kremlin buildings. The present Great Palace dates back only to Napoleon's day, for his soldiers burned the old palace. There are two Otis Automatic Push Button Elevators in the Great Palace. There is another Otis Elevator in the Nicholas Palace.

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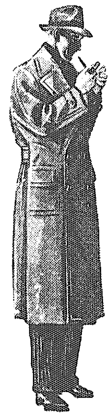

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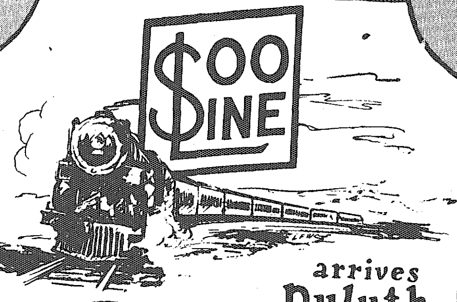

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GA. 2821

Before you call Long Distance, please ask yourself:

1. Is it really necessary? 2. Will it interfere with war calls?

TELEPHONE lines—especially Long Distance circuits—are crowded as never before, these war days. Materials to build new lines—copper, rubber, nickel—are needed for the shooting war. So we must get the most out of present facilities.

You can help us keep the wires clear for vital war calls if you will do these two things: (1) Don't call Long Distance unless it's urgent; (2) Call by number if possible and please be brief. Thank you!

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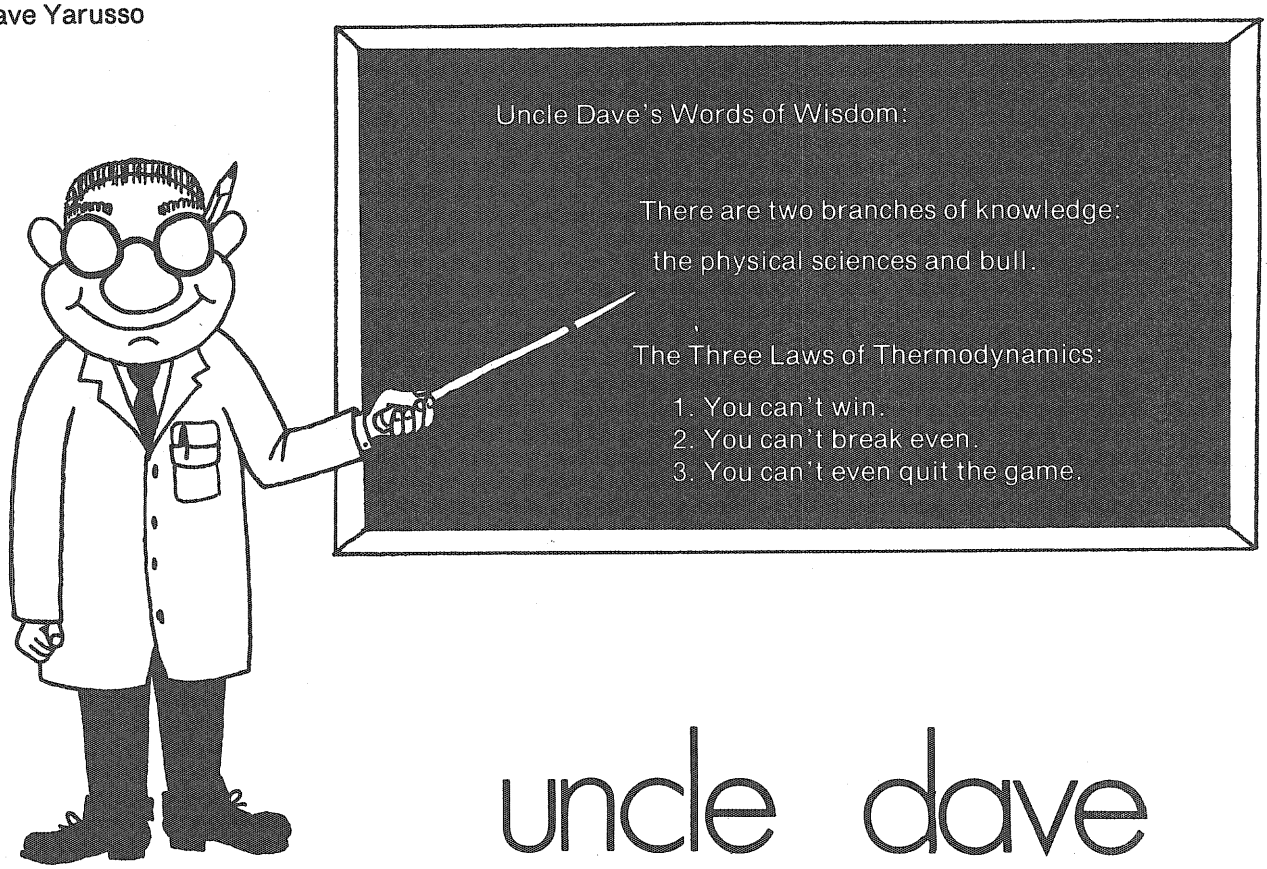
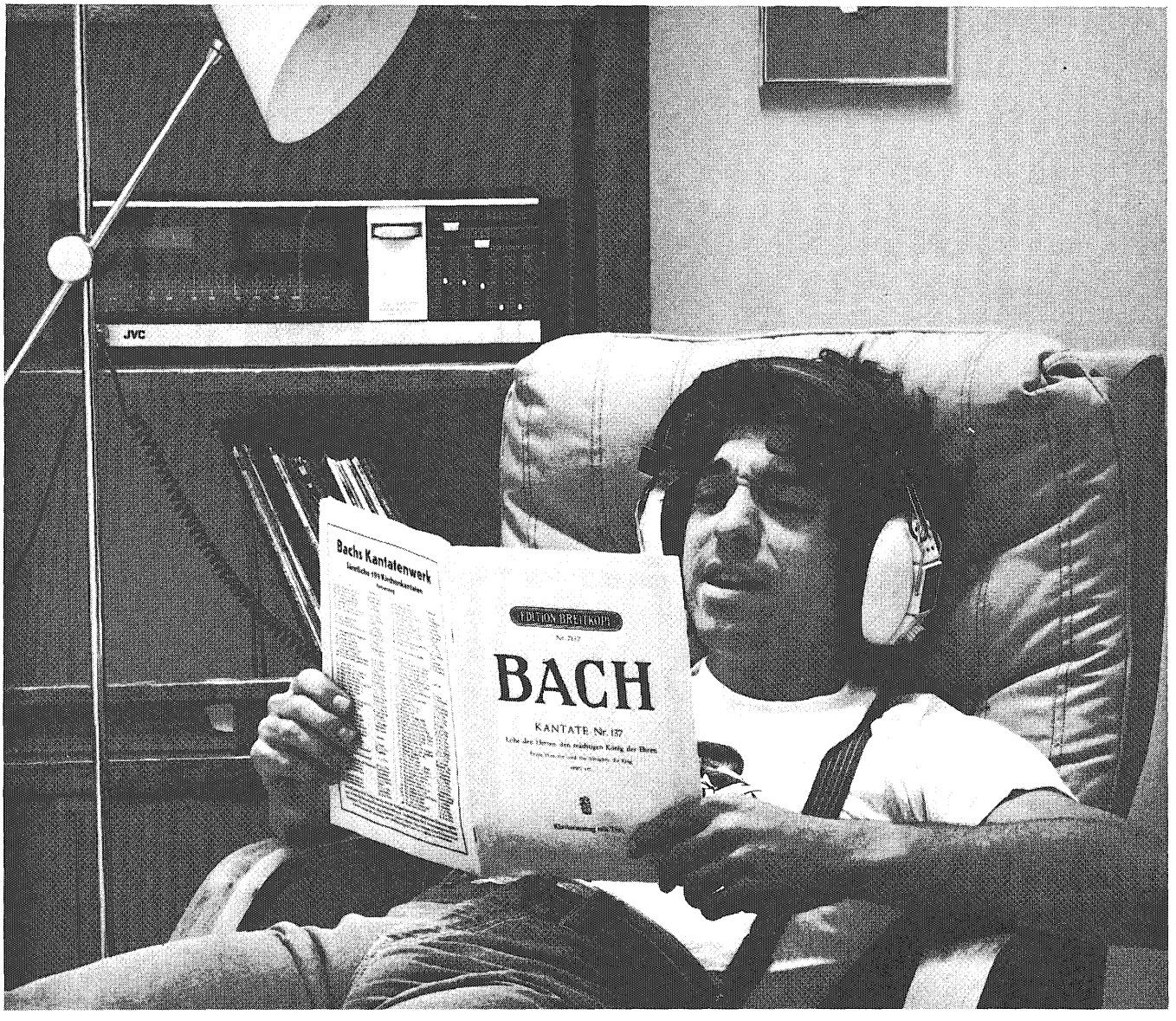
By Dave Yarusso



uncle dave

Art by Steve Smith



Enjoy college

Education not only makes life more interesting but eventually brings more influence in society than can be expected by those who have never bothered to read, study, listen, and reflect on the pleasure and pain of it all. That includes influence as articulate citizens, customers, and investors.

Nevertheless, the truth in this may not be apparent right out of college when a desire for steady income leads some B.A.'s to come to us with a major in, say, political science or Romance languages, seeking a start toward an executive career. We listen and then ask, "Are you a born salesperson and how can you prove it?"

In a way, that question reflects our own limitations. For a person well educated in something other than technical fields, it is usually only in sales that we can match qualifications to openings.

For you, who may have lost out on some of the pure pleasure and sheer fun of college because of the kind of technical courses you've had to grind away at, the choice can be wider. Sales is just one possibility. You can also consider research, development, design, manufacturing, and various combinations of those. Decision-makers throughout our organization, in work often far removed from the subject matter of a technical curriculum, first attracted interest by their success in coping with technical problems. Then, having demonstrated an ability to lead, they exercised their option to move on to broader responsibilities. That sort of choice, for the outset of a career and later, is earned in courses where quantitative thinking rather than personal opinion is demanded.

This includes choice from among other technologically oriented organizations just as good as we are for an interesting life. If it's us you want to challenge, so signify to Business and Technical Personnel, Kodak, Rochester, N.Y. 14650.

Kodak

An equal-opportunity employer (f/m) manufacturing photographic products, fibers, plastics, and chemicals with plants in Rochester, N.Y., Kingsport, Tenn., Windsor, Colo., Longview, Tex., Columbia, S.C., Batesville, Ark., and a sales force all over the U.S.A.

We're looking for engineers who can't wait to get to work.

We're looking for people who are looking for a real job. One that offers challenging work. Responsible work.

That's what you can expect at General Electric.

At GE, you'll be handed important assignments right from the start. You can do as much of the job as you're capable of doing. If you need help, it's there. If not, nobody butts in.

Here's the kind of thing we're talking about; some recent examples of jobs handled by new GE engineers:

1. *Charles P.* Aerospace systems manufacturing. Develop and document a direct numerical control system.
2. *Steve O.* Design engineering. Design test equipment for attitude control system of new communications satellite.
3. *Norma L.* Steam-turbine manufacturing. Investigate, analyze and obtain funds for solution of shop problems.
4. *Stephanie B.* Medical systems service engineering. Installation and test of new hospital radiographic and fluoroscopic x-ray system.
5. *Mel D.* Field engineering. Appraisal load testing of low and medium-voltage switchgear and power transformers for utility and industrial applications.

There's a good reason GE hands people like that—like you—real work assignments. It's the best way to develop the skills you will need throughout your career. You develop initiative and creativity. And responsibility. And GE also knows there's little to match the glow you feel when you make an important contribution.

You can make your contribution in just about any field of engineering at GE. We're that diversified in disciplines.

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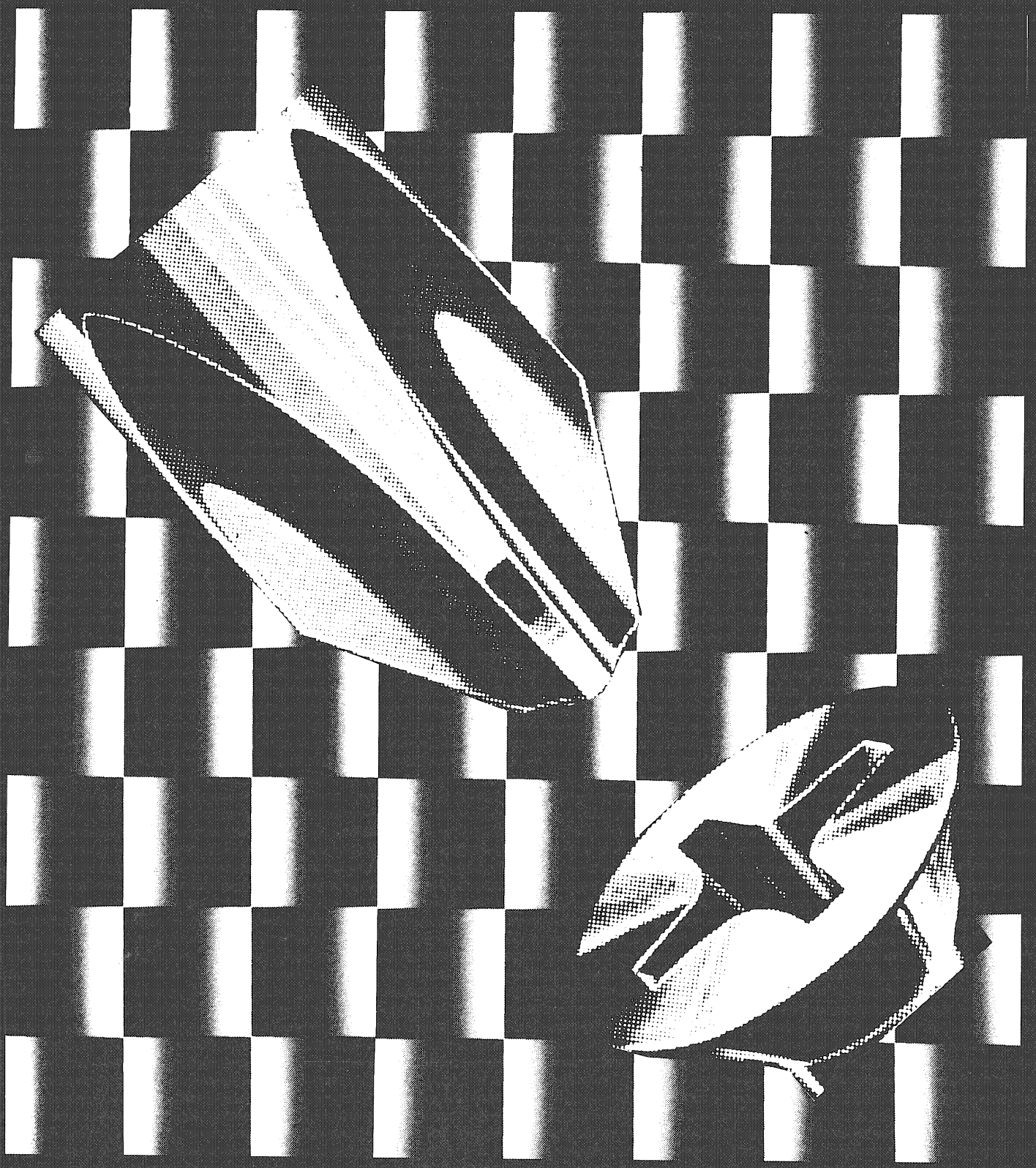

Our business is aircraft, aerospace, electronics, automation, hospital services, etc...

Right?

Sure, we're into fast, exciting fields, but at McDonnell Douglas we realize that our industry growth and our company growth depend on how fast our people grow.

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B. J. Waller, Professional Employment, McDonnell Douglas Astronautics Co., 5301 Bolsa Ave., Huntington Beach, CA 92447,

W. H. Nance, Professional Employment, Douglas Aircraft Co., MS9-14, 3855 Lakewood Blvd., Long Beach, CA 90846.

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We have a continuous need for graduates with bachelor and advanced degrees in each of the mechanical, electrical, structural and nuclear disciplines.

If an engineering career is your plan, we would like to talk with you. Please make an appointment through your placement office to interview with us.

Our company representative will be on the Minnesota Campus February 17, 1978.

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minnesota **Technolog** winter 2 1978

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HOW TO LAND A JOB WITH BOEING:

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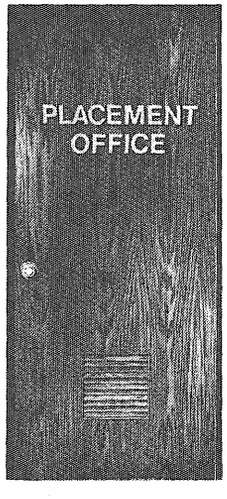

If you're a graduate in AE, CE, EE, ME or Computer Science, drop by your campus placement office. There's all kinds of information about The Boeing Company and opportunities in your specialized field. After all, opportunity only knocks once.

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Announcing the Winner of the $5 Winter I contest!!!

Raymond Gorte was the first person to correctly identify the strange contraption pictured on page 26 of our Winter I issue. So, he is the undisputed winner of the $5 prize. Congratulations, Ray! The unidentified item was a coal stoker.

Our apologies to Crown Iron Works and especially to Ann Nelson, secretary to the president, for the thousands of phone calls this little contest generated. We had no inkling of the great reponse this contest would receive or that so many people would call Crown Iron Works. Again, we apologize.

Rules and announcements converning E-Week

Here are the rules for the E-Week car race:

1. No internal combustion engines
2. At least three (3) wheels required
3. No human or animal power
4. No push starts
5. Still start
6. Car must display two (2) shamrocks
7. Car must carry two (2) people
8. Description and entry form due April 21, 1978 (two weeks before E-Day). There will be a drivers' meeting 15 minutes before the race. Penalties will be assessed for hitting pylons and for not stopping in the finish area. All judges' decisions are **FINAL.**

Rules and entry forms are available in the **Technolog** office. Completed entry forms should be turned into the **Technolog** office **BEFORE** April 21, 1978.

E-Week button design contest ends March 13

Just a reminder! The E-Week button design contest ends March 13. Prize for the winner is $25 big ones!

The button design must include the dates of E-Week, May 1-5, must contain only two colors and must be easily readable when reduced to a 5 centimeter diameter button. Entries must include a name, address and phone number. Please submit drawings to 105 Main Engineering—and don't forget to do it before March 13!

Technolog announces cash award to E-Week race winner!

Technolog will award a $25 prize to the winner of the E-Week car race if said winner displays **Technolog's** emblem on the vehicle. Watch for more details in the Spring I issue.

Will NASA's Skylab fall to Earth somewhere in Russia?

The latest on the orbit of the Skylab Workshop indicates, according to NASA, that it could begin reentry into the Earth's atmosphere as early as late summer of 1979 or as late as the second quarter of 1980.

In spring, 1978, NASA will attempt to add several months to Skylab's orbital life by reactivating its thruster attitude control system. NASA hopes that this move will cause Skylab to go into a very slow tumble which would decrease the atmospheric drag.

Skylab is expected to break up and burn during descent after entering into the Earth's atmosphere. Some debris is expected to survive the re-entry but NASA expects it to land in an ocean. (Bet the Russians did too!)

log ledger

NASA retires faithful servant after years of good service.

Landsat 1 was retired by NASA on Jan. 16, 1978, after five and a half years of operation in outer space. The spacecraft was designed to monitor and discover the Earth's natural resources, and the multispectral scanner, a camera-like device carried by Landsat 1, has revolutionized the technology of observing the Earth from space.

Landsat 1, originally designed with only a one year life expectancy, has transmitted more than 300,000 pictures of different parts of the world and demonstrated the potential of remote sensing in the fields of geology, oceanography, agriculture, forestry, hydrology, urban planning and crop prediction.

NASA schedules 25 launches in 1978

The National Aeronautics and Space Administration has planned 25 launches for 1978, including eight scientific payloads, ten communications satellites, five weather satellites and two special satellites, Landsat C and a navigational beacon for the US Navy.

Two Pioneer Venus probes will be launched, one in May and one in August. The first will orbit the planet for a full Venusian year, the other will drop four probes into Venus' atmosphere and measure its composition down to the surface. No soft landing will be attempted.

Two satellites, the International Ultraviolet Explorer and the High Energy Astronomical Observatory, will observe the electromagnetic spectrum on wavelengths invisible from the Earth's surface. HEAO-B will concentrate on X-ray sources identified by its predecessor, HEAO-1.

The third International Sun-Earth Explorer will monitor solar activity at one of the Earth-sun Lagrange points after its launch in July.

NASA will be reimbursed by various agencies—The European Space Agency, the US Navy, Comsat Corporation, Intelsat Corporation and the governments of Japan, Britain, and Canada—for use of launch facilities in 15 of the 25 launches.

Architectural students study and travel in Europe

Anyone walking through Architecture Court, after January 23, must have noticed the huge and colorful flags on display there. They are part of the Europe Exhibit, put together by a group of 37 fourth-year students who traveled for 10 weeks in 1977, studying new towns in Northern Europe.

After the trip, the students assembled a very attractive chronicle of their experience (on sale in Architecture for $1.00) and put together the Europe Exhibit. By documenting the trip, the students earn academic credit and make their experience useful to others. The students also held a series of bag lunch seminars in February to discuss their trip.

Senior-level architectural design students have been taking a spring study trip every year for the past twelve years. Eleven groups have gone to Europe, one to Japan.

The 1977 trip was unique because, for the first time, the students had the main responsibility of making travel and accomodation arrangements and, there was no faculty advisor accompanying them.

In place of a faculty member traveling with them, the students met with European architects or teachers, contacted in advance, who gave lectures and provided tours of the new towns.

continued on page 23

editor's page

The Student Services Fees Committee, along with the Student Board of Publications, has been discussing the possibility of bringing **Technolog** under control of the Student Board of Publications.

Presently, **Technolog** is administered by the **Technolog** Board, which is composed entirely of IT students elected by the IT student body.

The Fees Committee, according to Jim Clark, chairman, is considering the changeover in order to assure "greater accountability and fiscal stability" to maintain some sort of control over **Technolog's** finances.

If this changeover occurred, IT students would be guaranteed only one seat on the Board of Publications. In other words, It students would no longer have control of their magazine.

The possibility of this change has been discussed at IT Board meetings and at **Technolog** Board meetings. Both groups agree that control of **Technolog** should be kept in IT.

Perhaps, to make the Fees Committee happy, the **Technolog** Board should become a more active administrative body. Business decisions, advertising sales, and to a certain extent, magazine content, should all be closely monitored by the **Technolog** Board. The board should work much more closely with the magazine staff.

The board could act as a reflection of IT students' views and give the editor and staff of the magazine some much needed input on student interests. They could, with an active editorial committee, suggest article topics, or even, write articles for **Technolog.** A business committee could help develop an aggressive advertising staff to make the magazine more stable, financially, and could also perform public relations activities. The board could help recruit artists, writers and production people.

At present, the board members receive recognition as student leaders and first day registration, in order to coordinate meeting times, without doing much in return for these priveleges. Some members never attend meetings.

The **Technolog** Board elections are coming up in the spring, along with the other student elections. Last year, two of the board members were elected, with few votes, as write-in candidates who entered the election very late. There was no competition for any of the board seats.

In order to keep control of **Technolog** in IT, students have to become active in the administration and production of their magazine. **Technolog** needs concerned IT students to run for the board, and to edit, manage and produce the magazine.

Technolog can be anything that you, the students, want it to be. And it will become nonexistant without you.

So get going IT students! Keep your magazine alive and keep it in IT! Run for the board. Vote for people who will do the job they were elected to do. Apply for a position on the **Technolog** staff. Submit an article for publication. Write a letter. Do **something!**

The **Technolog** Board is now accepting applications for the positions of editor and business manager for the 1978-79 school year, **Technolog's** 58th consecutive year. Both of these positions offer students an excellent opportunity to gain practical experience in the areas of management and communication while still in school.

The editorship covers a broad range of duties besides the usual editorial chores. Money management, public relations, advertising and many types of writing are just a few of them. If you're creative and enjoy working with people, and especially, if you like to be in charge, then this is the job for you.

Our business manager, besides keeping the books, paying the bills and being held accountable to the Fees Committee and the **Technolog** Board for all the money, is also in charge of advertising sales. The business manager works closely with the editor to stay within the limits of a per issue budget.

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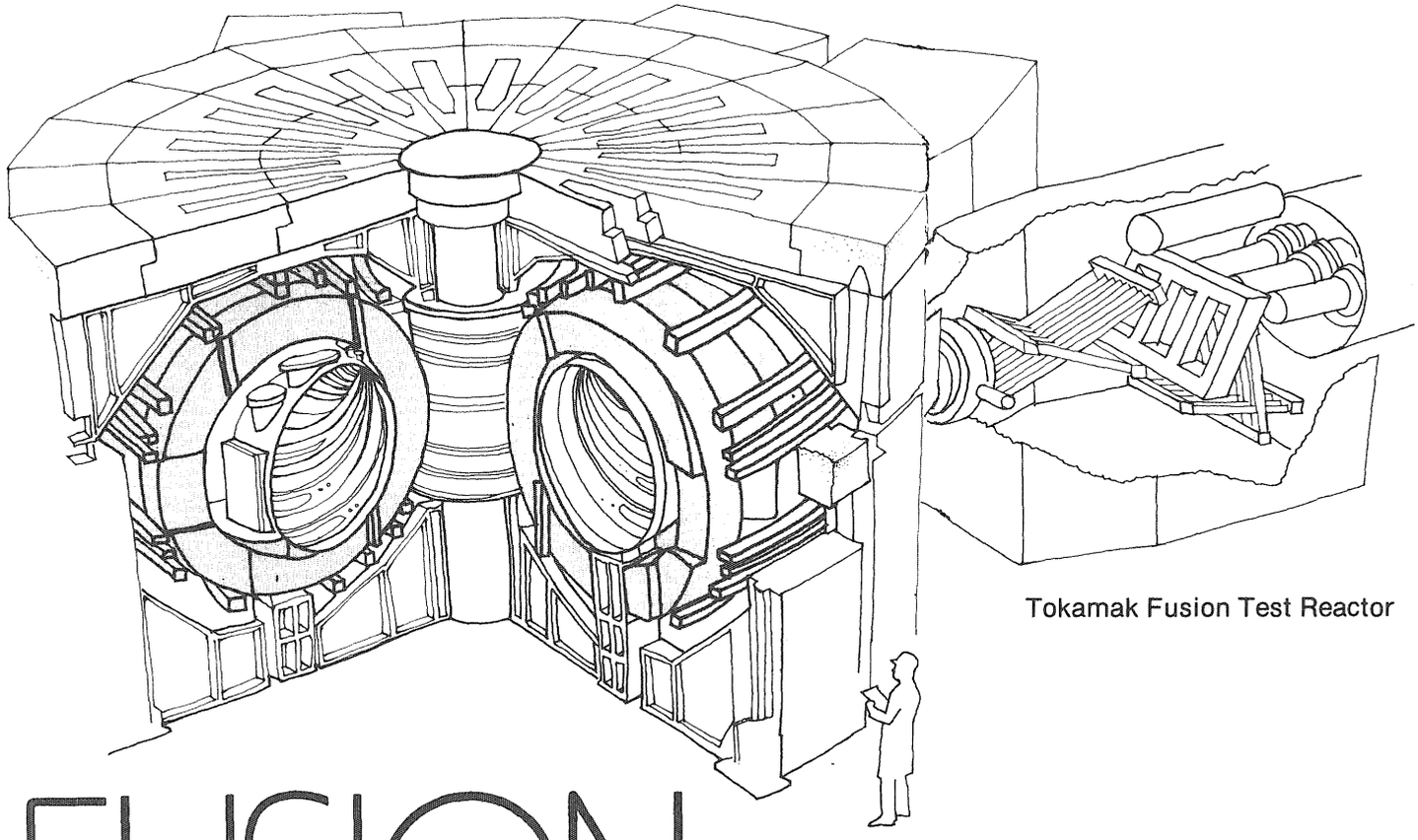


Tokamak Fusion Test Reactor

FUSION

Energy For Our World

by Bruce Kvam

Controlled thermonuclear fusion will give man a clean, safe, inexhaustible source of power—forever. There will be none of the shortage and pollution worries that plague coal and fission, for fusion uses, as its fuel, a substance which covers three-fourths the earth's surface—water.

More specifically, fusion uses hydrogen—the most common element in the universe—to produce energy. Fusion powers the stars.

In our energy dilemma, we are examining many different methods of producing energy. A few are: solar power, for both heating homes and conversion to electricity; geothermal energy; hydroelectric power, already widespread; wind power and the breeder reactor. These sources—except for the last—suffer from at least one of two problems; geographic infeasibility and low total power-generating capacity. In some regions, Minnesota for example, the sun does not shine all that much. There are no active volcanoes, no cascading waterfalls. The wind is intermittent at best.

None of these technologies alone (again, except the breeder reactor) could supply industry with the energy it needs to maintain our way of life. That is not to say that these resources should be left untapped: all possible routes to energy should be followed. But something is needed that can take the place of the ugly coal-and oil-burning power stations without dooming the earth to a ghastly radioactive future. That something is controlled thermonuclear fusion.

What is fusion?

At the core of the sun, matter exists in a fourth state as completely ionized atoms or plasma. Fusion can take place between particles which have enough energy to overcome their mutual electric repulsion (the Coulomb barrier) and collide. When these particles collide, they form a single, heavier atom, whose mass is less than the sum of the masses of the original particles. This mass difference is converted to energy, according to Einstein's famous mass-energy equivalence equation, and is exactly what powers the sun's furnace.

Three things are essential for fusion: a high temperature, high particle number density (n), and a sufficiently long confinement time (t). At high temperatures particles have sufficient energy to overcome the Coulomb barrier. A high number density is needed to insure enough collisions will take place. And the particles must be confined long enough for the collisions to occur.

For sustained fusion, these three requirements must be met simultaneously. There are difficulties, however. A gas tends to expand when hot, lowering both temperature and density. In the sun, gravity keeps the particles from escaping, so they have time to fuse. For fusion on earth, some way other than the huge gravitational force of the sun must be found to contain the star-hot plasma.

The sun uses these reactions to pro-

duce the majority of its energy:

$$H + H \rightarrow D + e^{+} + \nu$$

$$D + H \rightarrow {}^{3}He + \gamma$$

$${}^{3}He + {}^{3}He \rightarrow {}^{4}He + H + H$$

This process is far too slow for use on earth. A proton may wander about the sun's core for a million years before it fuses with another, for the cross-sectional area of this reaction is quite small.

The three most important reactions physicists are studying for fusion applications on earth are:

$$D + T \rightarrow {}^{4}He + n(14.1\ Mev) \quad (1)$$

$$D + D \begin{cases} \rightarrow {}^{3}He + n(2.45\ MeV) \\ \rightarrow T + H(3.02\ Mev) \end{cases} \quad (2)$$

$$D + {}^{3}He \rightarrow {}^{3}He + H(14.7\ MeV) \quad (3)$$

These all involve deuterium (D), an isotope of hydrogen that has a proton and a neutron. In nature, one of every 6,500 hydrogen atoms is a deuteron. Tritium (T) is a radioactive isotope of hydrogen, with two neutrons. Helium 3 is an isotope of helium that lacks one neutron.

Each of these reactions has different requirements for fusion to occur. Reaction (1), deuterium-tritium (D-T), has the greatest collision rate plus the lowest ignition temperature (see graph 1), so most research involves its use.

J.D. Lawson, a British scientist, determined the Lawson criterion, defined as **nt.** At that point there exists the "breakeven" condition, where as much energy is released from fusion reactions as is injected to initiate them.

For D-T fusion, $nt = 10^{14}$ sec/cc. This is lower than the Lawson criterion for every other fusion reaction. At these densities the reactant particles will have an average energy of 10 KeV (kiloelectron volts), which corresponds to a temperature of a hundred million K (degrees Kelvin), while the temperature at the sun's core is a mere ten million.

Ways to control fusion

Physicists are looking at two basic methods of harnessing thermonuclear fusion, magnetic confinement and inertial confinement. Research has been going on in magnetic confinement for more than 20 years now, so it currently has the lead. But it is still uncertain which will demonstrate first the feasibility of fusion power.

Magnetic confinement

Since a plasma is an aggregate of ionized atoms, it has a net electric charge. It can, therefore, react with a magnetic field, be directed by it or contained by it. This is called the magnetic bottle. There are several configurations of magnetic bottles, the two most important being the tokamak and the magnetic mirror.

Stability of the magnetic bottle is of prime importance. If the field should become unstable, fusion will cease immediately. This is why there can be no runaway fusion reactors. Unlike a fission reactor, which can go critical and melt down in the event of major systems failures, a fusion reactor will just stop cold.

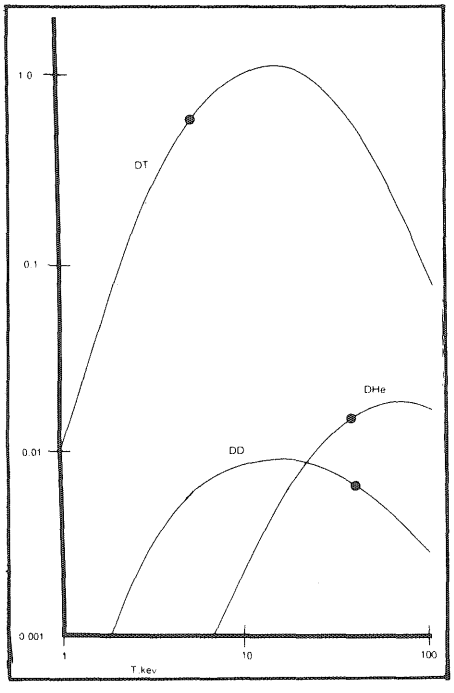
One of the more stable magnetic bottle configurations is the tokamak. A Russian acronym rooted in the word **torus,** tokamak indicates a doughnut-shaped cloud of plasma that is controlled by intense magnetic fields as it fuses.

The most advanced tokamak, currently under construction, is housed at the Princeton Plasma Physics Laboratory (PPPL). Called the Tokamak Fusion Test Reactor (TFTR), the machine will achieve the Lawson criterion for D-T fusion and test several methods of heating the plasma.

Since plasma can conduct electricity, the first step in heating it in the TFTR will be ohmic heating. Current will be run through the plasma, its resistance causing it to heat up, until the temperature reaches 20 or 30 million K. Further ohmic heating is not possible, for as the temperature of the plasma goes up, its resistance goes down.

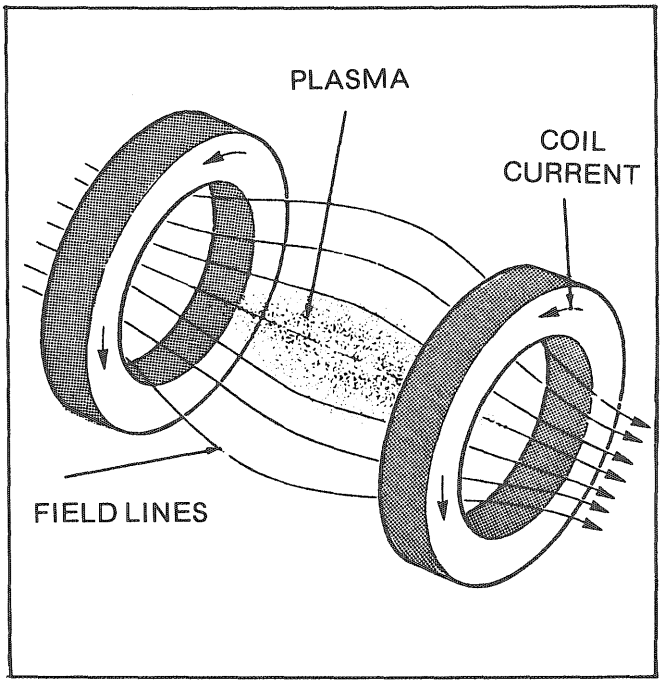
The next method is neutral-beam injection. High-energy atoms are injected into the already hot plasma. They are ionized, and some of their energy is transferred to the plasma. This can also be used to refuel the reactor.

Increasing the confining magnetic field and squeezing the plasma into a smaller volume will do two things; increase plasma density and temperature. In the TFTR, the maximum



left: Graph 1. Reaction rate as a function of temperature

● Ignition points.



right: Simplified magnetic mirror system

Illustrations courtesy of US Department of Energy

magnetic field in the 400-ton toroidal coils will be 9.5 T (Tesla, equal to 95 thousand gauss). The earth's magnetic field at the surface is 0.57 gauss.

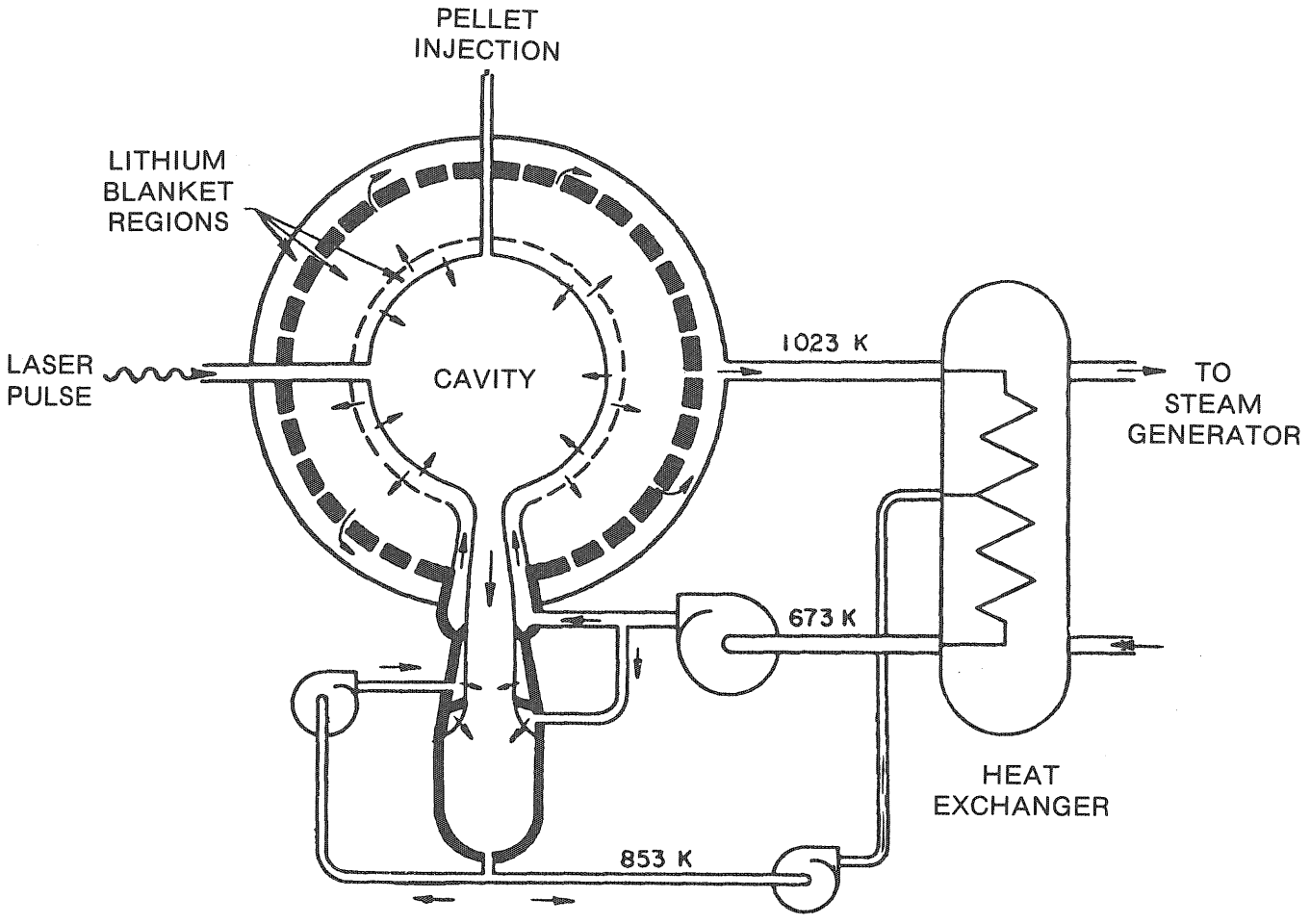
The last method to be tested will be radio frequency (RF) heating. Similar to microwave ovens, RF heating will pump energy into the plasma via radio waves.

It is hoped that the TFTR will run tests with D-T fuel by 1983. President Carter has cut $20 million from the TFTR budget (which President Ford in a magnetic field which sharply increases in strength at the ends, causing the ions to reflect back into the center of the chamber.

The most ambitious magnetic mirror research is being conducted at Lawrence Livermore Laboratories (LLL). The Mirror Fusion Test Facility (MFTF) will use a pair of interlocking C-shaped magnets (a 'yin-yang' pair) to generate a magnetic well. In a magnetic well, the intensity of the magnetic field increases with the distance that the plasma tends to escape from the ends. A greater mirror ratio (MFTF's will be 2=4T/2T) will be needed to demonstrate feasibility, but in one mirror application, that "fault" may be used to our advantage.

Inertial confinement

In inertial confinement no attempt is made to contain the plasma with magnetic fields. Instead, vast amounts of energy are poured into a tiny pellet of deuterium-tritium in a very short time.



Laser-fusion power cycle.

okayed) so the actual completion date is nebulous at this writing.

The Department of Energy seems to believe that the tokamak design will be the one used in actual commercial power generation, but it does not pin all its hopes on the tokamak. An alternative magnetic confinement technique is the magnetic mirror, which has some potentials the tokamak does not have.

The magnetic mirror is linear, rather than toroidal. The plasma is contained from the center, so the plasma will tend to stay in the region of least magnetic potential. Neutral beam injection will be used to heat the plasma.

The magnet system will generate a continuous field of 2T, and at the ends of the magnets, where the mirrors will be, the field will be 4 T.

MFTF is scheduled to be operational by 1981, but again, President Carter has reduced funding, in this case, $10 million was cut from LLL's budget.

One problem of the mirror concept is This causes the outer surface of the pellet to blast away, compressing the interior to fantastic densities. To achieve the Lawson criterion, enough energy must be delivered to the target in one nanosecond to push the density to 10^{23}.

There are a number of ways to dump the terawatts of power needed for D-T fusion into a pellet. The one most talked about is laser-induced fusion. Theoretically, the optimal laser for the job would have an efficiency of one to

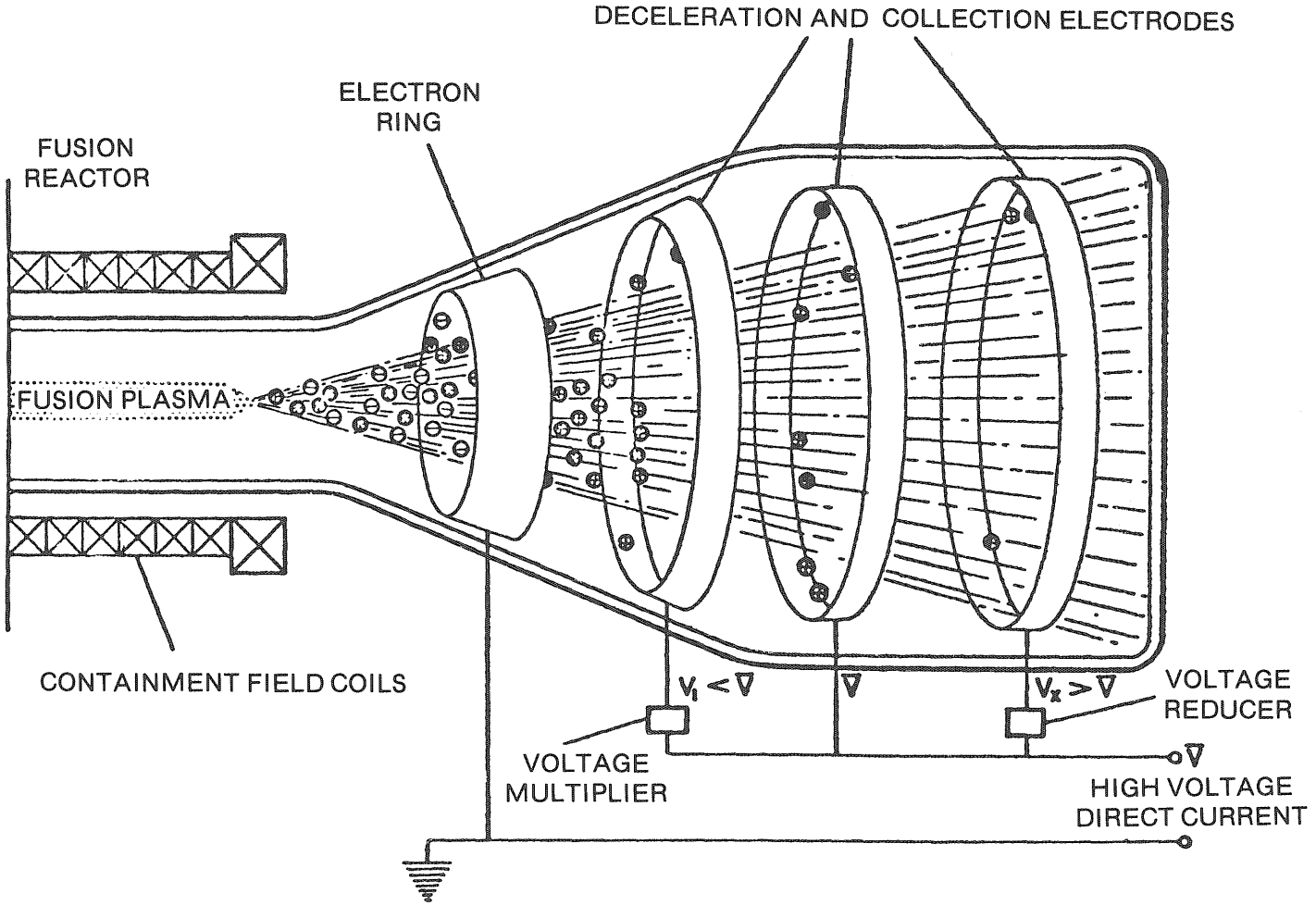
three percent, a wavelength between one and two microns, power between 300 and 500 terawatts, an energy between 0.5 and 1 megajoules and a repetition rate of 10 pulses per second.

Shiva is the laser-induced fusion project at LLL. When completed in 1981, it is expected to demonstrate breakeven. Shiva will have 42 amplifying arms for a 100 to 200 terawatt laser capability. But it is nowhere near the optimal laser system, for Shiva will could be used, like protons. Charged particle beams could be more efficient than lasers, but the technology is currently far behind that of lasers.

Whereas many types of magnetic confinement systems could operate continuously, all inertial confinement system would be pulsed. Plans for the laser-induced fusion reactor require that 10 pellets be zapped per second, and that the fusion chamber be evacuated between implosions. Many scientists express doubts as to the engineering practicality of such an operation.

fission plants.

In December, 1977, the joint United States-Soviet magnetohydrodynamic project (MHD) successfully converted heat directly into electricity, just outside Moscow. This was accomplished by running a plasma through a magnetic field, setting up an electric field. An MHD power plant could be 50-60 percent efficient, compared to the 25-35 percent efficiency present in current day fission and coal plants. It is conceivable that the MHD system could be adapted to the tokamak and inertial confinement schemes.



Fusion reactor with direct conversion.

take several hours to cool down enough to be fired again.

Lasers' greatest drawback is that they are inefficient. So other ways have been proposed to deliver the energy to the fuel pellet.

Sandia Laboratories, in Albuquerque, are using electron beams to induce fusion. In June, 1976, they reached a billion fusion neutrons of energies of 2.45 MeV, indicating that D-D fusion had occurred. Other charged particles besides electrons

Electricity from fusion

The two end products of D-T fusion are thermal neutrons and helium ions. Most reactor designs call for capturing the neutrons' kinetic energy in a blanket of lithium and other materials and pumping the resultant liquid through coils that would produce steam, driving standard turbines. This technology is in use today in coal and

Here is where the tendences of the mirror reactors could make their mark. According to equation (3), no neutrons are released in deuterium-helium 3 fusion. Only helium ions and protons result. Now if the D-^{3}He reaction is used and the plasma is **allowed** to escape one end of the magnetic bottle, a system very similar to MH could be used to extract the energy of the ions. This could achieve nearly 90 percent

efficiency. Unfortunately, the D-He3 ignition temperature is greater than that of D-T fusion, and helium 3 is a very rare isotope of helium.

Fusion's advantages

Decidedly, fusion will play a very great role in the world's energy future. It alone has all advantages of conventional coal and fission stations, yet very few of the drawbacks.

Fuel for fusion is literally inexhaustible. The oceans contain enough deuterium to keep us going for a billion years, without lowering the sea level a foot. With coal and fission we are talking about 200 years worth of fuel, barring energy growth or the breeding of more fissionables.

Fusion pollutes very little. According to the U.S. Department of Energy, thermal pollution from a fusion reactor will be less than that of a conventional coal-fired plant. Since tritium is radioactive, there will be a danger of it escaping. But if all the tritium in a fusion plant escaped, less than a hundred kilograms would be loose. In even the worst disaster scenario, no immediate deaths can be foreseen. Tritium has a half-life of 12.3 years. It decays into helium 3 and an electron, causing no secondary radiation. It will not build up in the body, as many fissile materials will.

With fusion, there will be no great smokestacks pouring forth tons of carbon dioxide, carbon monoxide and sulfur dioxide. With fusion, millions of acres of land need not be stripped away to reach the coal beneath.

Unlike a fission reactor, a fusion reactor cannot run wild. If the magnetic field is disrupted the worst thing that could happen is the destruction of the magnets generating the field and the melting of the interior wall of the reactor. At any point in time, there will be no more than a few grams of fuel in the chamber.

No weapons grade material will ever be present. The only radioactive element to be used, tritium, is totally useless in the construction of nuclear weapons, for there is no known way to induce explosive fusion without first building a fission bomb.

One foreseeable problem of fusion is the irradiation of the chamber's interior with high-energy neutrons. The steel structure will become radioactive and it will be necessary to replace it every few years. Once removed, it would take about 50 years before the structure could be recycled, when its potential biological hazard would be equivalent to that of naturally-occurring uranium ore.

Fueling the reactor with rare tritium could be a problem, but the reactions

$$n + {}^{6}Li \rightarrow T + {}^{4}He$$

and

$$n + {}^{7}Li \rightarrow {}^{4}He + n$$

supply us with all the tritium we need through breeding it from lithium. The world's supply of lithium will last thousands of time longer than our oil and coal supplies, and after that we can move on to direct conversion.

To predict exactly when fusion will feed electricity into the world's power grid is impossible now, when breakthroughs in basic technology may occur any time. Most authorities agree however, that a demonstration model of a commercial fusion plant will be completed before 2000.

Fusion will not cure the ills of our energy hungry world at its onset. But without it, we will sink slowly into oblivion as our energy resources dwindle. □

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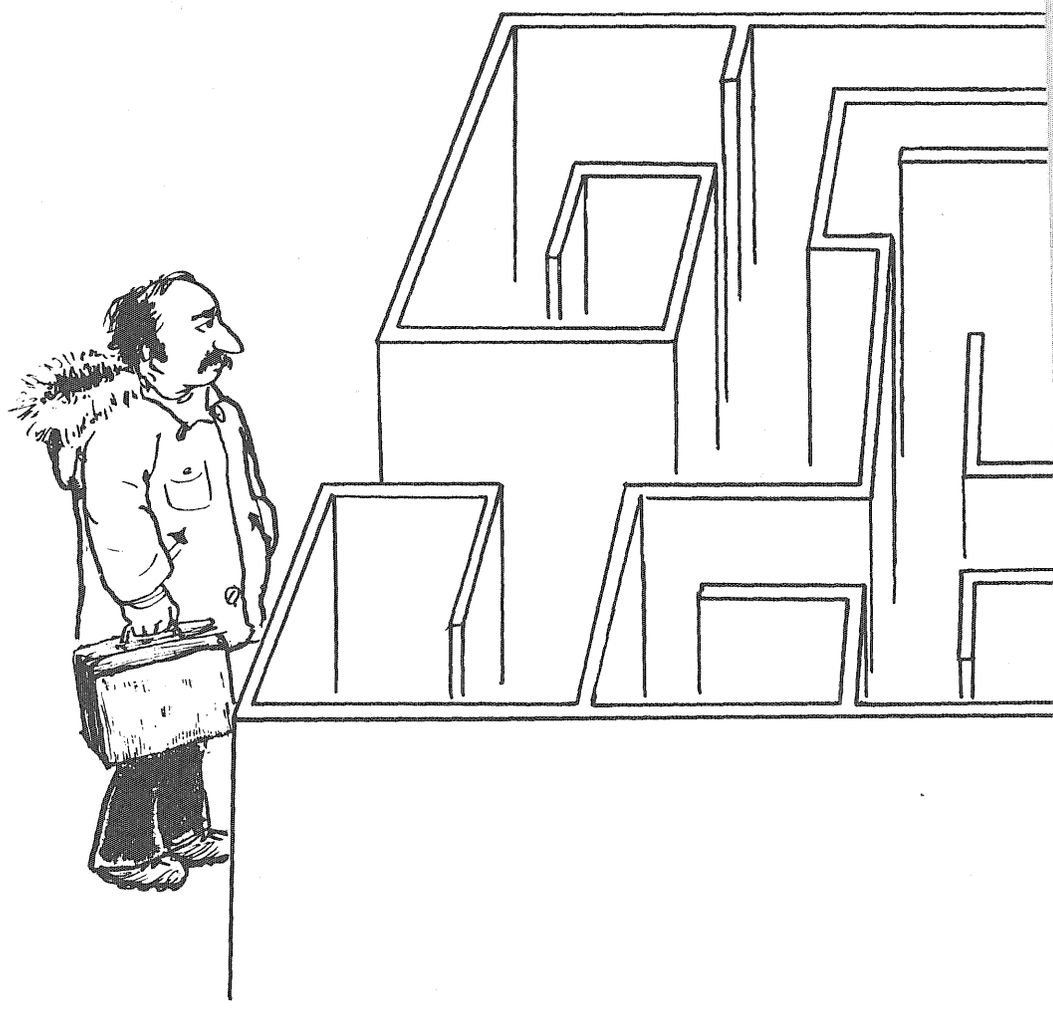
By John Charnes



FOUR MOR

After dedicating four years to the pursuit of higher education, with only one full quarter left, a student is ready for both life in the real world and to say goodbye to the corridors of this academic labyrinth forever, right?

Slow down old timer, there may be gold in them thar halls! Preliminary results of a national survey, due to be released in March, show starting salary offers over $175 per month higher for holders of a master's degree in Electrical Engineering than for those with a bachelor's degree. A doctoral degree kicks it up another $400+, meaning nearly a $600 increase above the offer to the holder of a BEE. That works out to a 45 percent increase which will buy one hell of a lot of IC's and microcircuits.

If your motives are more humanitarian than mercenary, however, post-graduate study and research is your only choice. In today's increasingly complex and specialized society, it's impossible to learn about the latest breakthroughs and developments in any of the pure or applied sciences at the undergraduate level.

If you want to be remembered with the likes of Newton, Gauss or Pauling, you had better resign yourself to the prospect of at least four more years of academia. But, whether you are after a down payment on a Lear jet or the Nobel prize in physics, you still have to deal with the usual collegiate red tape.

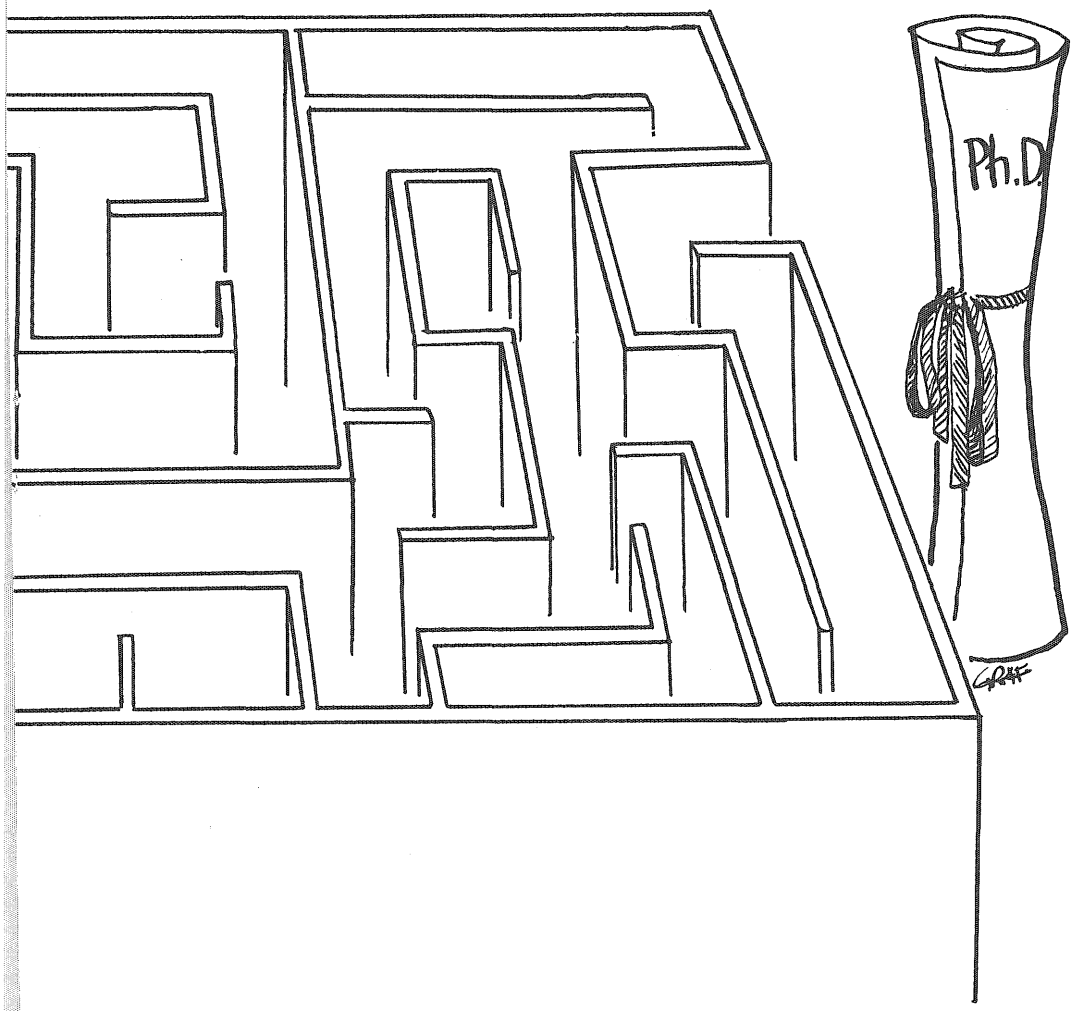
Since **Technolog** refused my request for round trip air fare and expenses to the University of Hawaii, I'll have to settle for filling you in on some of the details of the University of Minnesota's graduate school admission policies. They are similar at most of the larger universities.

According to the graduate school bulletin, "Any student with a bachelor's degree or its foreign equivalent from a recognized college or university may apply to the dean of the graduate school for admission." Students with less than nine credits left on a bachelor's degree also may register in the graduate school if they meet admission requirements. After payment of the (inevitable) credentials examination fee, the applicant may have to take a few tests.

The Graduate Record Examination and the Miller Analogies Test must be taken by some students but IT departments generally do not require them. Foreign applicants whose native language is not English must take the Test of English as a Foreign Language. Incidentally, the test does not include speaking skills, which is a definite advantage for the many foreign students seeking a post-graduate degree at the university.

The graduate school office in Johnston Hall then forwards applications to the proper department, which has the final say about whether a student is accepted or not. Typically, a student should have at least a 3.0 grade point average to even apply for admissions. Seniors with a GPA above 3.5 have probably already had suggestions from faculty about applying for post-graduate study.

Once accepted, the student can choose one of two ways to obtain a master's degree. Plan A requires a minimum of 20 quarter credits in the



"...the grad program is aimed as much at developing a professional manner in the student as it is at educating him."

L.D. Schmidt

RE YEARS!

major field and a minimum of 8 quarter credits in one or more related fields to comprise the minimum of 28 credits, plus a thesis on a topic approved by the department. The thesis must be presented approximately nine weeks before commencement, at which time it will be returned immediately to the student along with the necessary forms for graduation and the reader's report. The thesis is read by a committee of three, appointed by the dean of the graduate school, the members of which must be unanimous in certifying that the thesis is ready for defense.

Under Plan B, the student takes a minimum of 20 quarter credits in the major field and minimum of 8 quarter credits in one or more related fields outside the major. Overall, 44 credits are required for the degree with no thesis necessary. However, the student must demonstrate familiarity with the tools of research or scholarship in the field, the ability to work independently, and the ability to present the results of investigation effectively, by completing at least one Plan B project.

The graduate faculty in each department has the option of requiring as many as three such projects, which take approximately three five-day weeks (120 hours) each to complete. Both plans require final examinations, which may be oral, written or both. A master's program ordinarily takes from four to six quarters of registration to complete.

Candidates for the degree of doctor of philosophy must register in the graduate school for at least nine quarters, after which the preliminary oral examination can be taken. After passing this exam, the student is issued a candidate in philosophy certificate.

In the first quarter after receipt of the candidate certificate, the student must file a thesis title form and statement in the graduate school office. The statement, about 250 words in length, describes the research and the methods employed in carrying it out. The candidate then has a maximum of five years to complete the work necessary to attain a Ph.D. It is possible to receive the degree after one year, but the typical student takes two years to complete this task, making an average of five years from beginning graduate school to doctoral degree.

Theses for both the master's and the Ph.D. must defended before a select committee of graduate faculty. This sounds like more of an ordeal than it actually is. At the Ph.D. level, the candidate should know more about the subject matter of the thesis than any individual on the committee. Also, very few people fail this exam;

those that are apt to are weeded out long before this point. Criteria for successfully completing the final oral examination includes proper writing style, form, and in the case of IT students, good usage of technical rhetoric.

Two graduate students interviewed had no remorse about spending the additional time in school. Both Carl Gutschick, a master's candidate in civil engineering, and Rolf Olson, a doctoral candidate in electrical engineering, assumed that they would make more money when they got into industry, but claimed that financial reasons for continuing their education were secondary to the sense of self-fulfillment obtained from their endeavor.

Intellectual curiosity also played a big role in their decision to go onto graduate school.

"Without that curiosity, successful completion of work for a degree beyond the baccalaureate level is doubtful," suggested Professor L.D. Schmidt, director of graduate studies in the chemical engineering department. He went on to say that the greatest change in a person comes through maturation.

"At 22, the student with an undergraduate degree usually is not ready to settle down," claims Professor Schmidt, "the grad program is aimed as much at developing a professional manner in the student as it is at educating him."

Rolf Olson says, "Post-graduate study has given me a feeling of self-confidence. Working on my research project (the phenomenon of sputtering) is a much greater challenge than cramming for an undergrad mid-quarter." Olson found that the transition to graduate courses was not too difficult, although the work load increased. "For an undergraduate student, 15-18 credits is a full load. With these courses 9 credits is almost overwhelming."

After one year of required courses, the student is usually ready to select an advisor to work with for the remaining years. Oftentimes, the student-advisor relationship becomes a personal one, as the two work together for three years. The advisor guides his candidate through the project, offering suggestions only as often as he feels is necessary in order to instill a sense of self-reliance in the student.

Financial aid is readily available for graduate students. Research and teaching assistantships as well as loans and grants are the usual means of obtaining money for a post-graduate education. Professor Schmidt says the chemical engineering department has a policy of giving nearly everyone accepted a stipend of $4,000-$5,000 besides paying their tuition. But the chemical engineering department insists that their undergraduate students go elsewhere for their post-graduate education. They feel that exposure to a different environment helps to develop a more well-rounded individual.

Among other departments surveyed in IT, roughly 50 percent of the graduate students had earned their undergraduate degree here at the university. The student who does well in his junior and senior years will probably find the faculty willing to help him enter any graduate school he desires.

With knowledge expanding at an exponential rate at present, graduate school presents a viable alternative to diving into industry immediately after receiving a bachelor's degree. It should be given serious consideration by those interested in furthering and improving career possibilities. □

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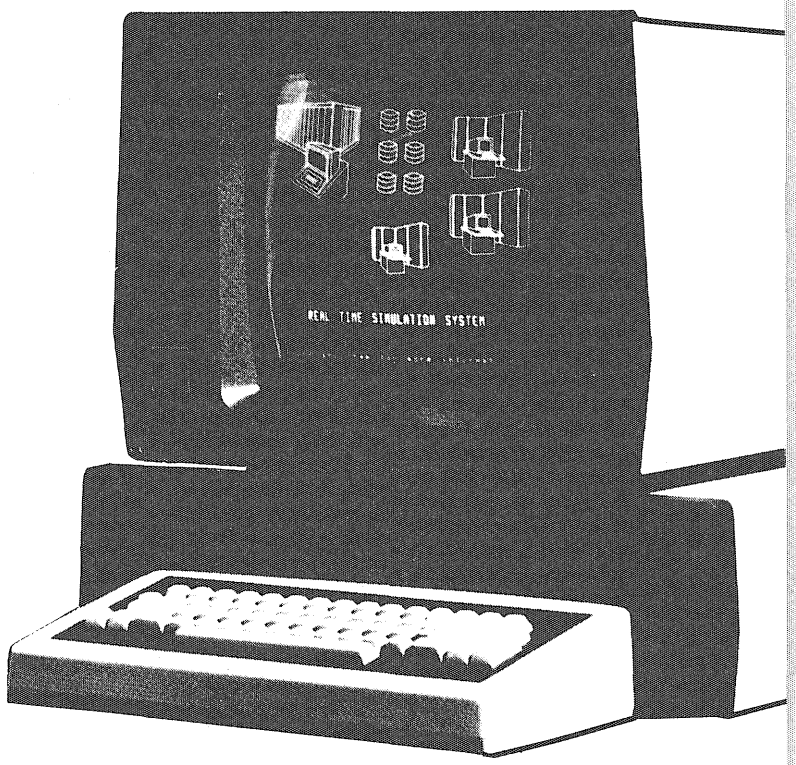


PLATO

by Scott Tonneslan

Can the computer play an important role in education? Control Data Corporation argues that its Computer Assisted Instruction (CAI) system, PLATO, will not only reduce costs but also improve the quality of education. Many universities, including the University of Minnesota, are studying PLATO to determine if, indeed, it has a place in education.

Whether or not education needs computer technology, there are indications that it needs some kind of innovation. For instance, in 1962, the average estimated charges (tuition, room, board) for a full-time resident university undergraduate was $947. By 1974, that figure had risen to $1797. Though instructional quality is difficult to judge, the College Entrance Examination Board reported last year that the average Scholastic Aptitude Test verbal scores have dropped 30 points over the last 12 years.

William Norris, chairman of the board and chief executive officer of Control Data concludes that education has become a serious national problem. He argues that education is suffering from increased costs and lowered quality due to its "labor-intensive ways." In Norris' opinion, computer technology will help solve these problems.

"We must assemble and configure our several technologies into a system that does what the present educational process does, but does it with capital-intensive, productive technologies,

rather than trying to drive still harder a labor-intensive process that can at best only stagger under the loads of higher needs, higher expectations, and higher and higher costs," Norris says.

Norris is, of course, referring to Control Data's CAI system, PLATO (Programmed Logic for Automatic Teaching Operations). PLATO is now being used for instruction at the University of Illinois, the University of Quebec, and the University of Florida. It is being used in some form at 60 universities worldwide, including the University of Minnesota.

PLATO is the brainchild of Donald Bitzer, director of the Computer Based Education Research Laboratory at the University of Illinois. Bitzer developed PLATO from 1959 to 1973 with support from Control Data and the National Science Foundation.

Having purchased the rights to PLATO from the University of Illinois in 1973, Control Data began preparing PLATO for commercial application. In 1975, Control Data began public promotion of PLATO, and now there are between 1700 and 1800 PLATO terminals in use throughout the world. Control Data is so optimistic about the future of their CAI system that, in May of last year, they formed the Control Data Education Company.

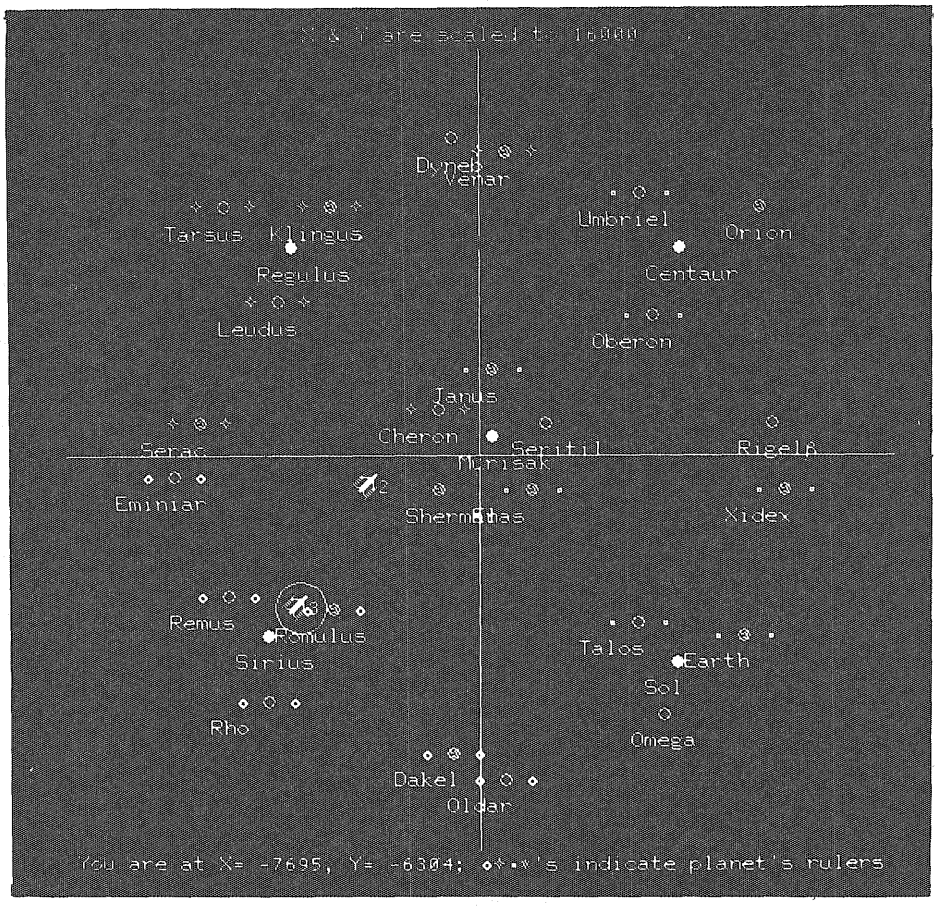
In a recent interview provided to **Technolog,** Mr. Robert Morris, the company's vice president for new business development, said: "We expect, by 1985, for this to be maybe as great as half of Control Data business."

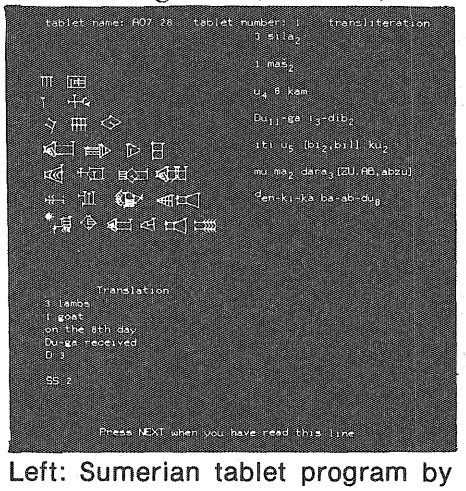
A typical CAI system consists of a computer, computer terminals, and computer programs or "courseware." The terminals can be located at a great distance from the computer. Individually or in groups as large as 40, they can be put into elementary and secondary schools, post-secondary institutions, and industrial training centers. The terminals are connected to the central computer via telephone lines, cable television, microwave communication, or satellite link. One of PLATO's central computers is located in Control Data's Arden Hills facility and is designed to serve up to 4,000 terminals.

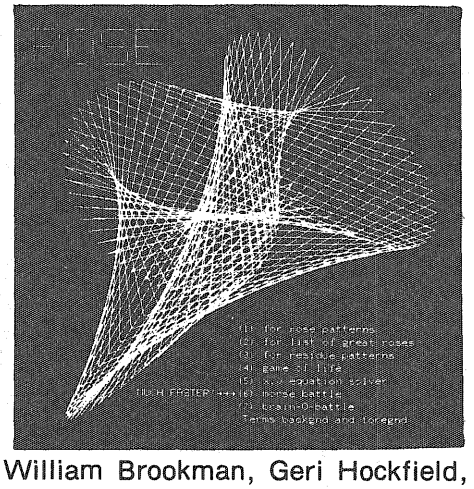
Control Data argues that PLATO will remove the inefficient aspects of the education process while improving quality and decreasing cost. As its name suggests, PLATO is designed to return to the individualized instruction method of its namesake. If PLATO is successful, this type of instruction has a number of advantages over traditional education. The student can learn at his own pace. He can choose his own learning route by studying the material in the order he wants. He need not be afraid to ask questions—nobody will know except the computer. He can keep reviewing the material until he learns it. And finally, PLATO is indifferent to sex, race, or social status.

PLATO is designed to relieve the teacher of some of the more routine tasks of drilling, testing, the giving of routine assignments, reviews, and some lecturing. In this way, teachers should have more time to give students individualized attention.

PLATO's design philosophy calls for a large central computer which can serve a large user base. Control Data states that this design will decrease user costs by allowing an institution to use PLATO without having to buy the computer. In addition, the use of a large computer allows PLATO to stock highly diverse courseware for all levels of education, including adult education and industrial training programs. This will increase the number of users and







Left: Sumerian tablet program by William Brookman, Geri Hockfield, and Richard Kubat. Other displays from software developed by the University of Illinois. Photographs by Glenn Flekke and courtesy of Control Data.

thus, they argue, will reduce costs.

However, at the present time, PLATO is not able to reduce the cost of education. In a study, involving the National Science Foundation and the National Aeronautics and Space Administration, the Center for Development Technology along with the Department of Electrical Engineering at Washington University concluded that "while the performance of PLATO leaves little to be desired, systems costs are considerably above the design goal."

While designers had hoped to service 4,000 terminals per computer, at the University of Illinois, PLATO (used since 1970) is only able to service 1,000 terminals. This is primarily because they had estimated that the terminals would be grouped in classes of 32 terminals, each using the same material. Right now, PLATO terminals are usually used individually or in groups of two or four which strains the system and results in higher costs.

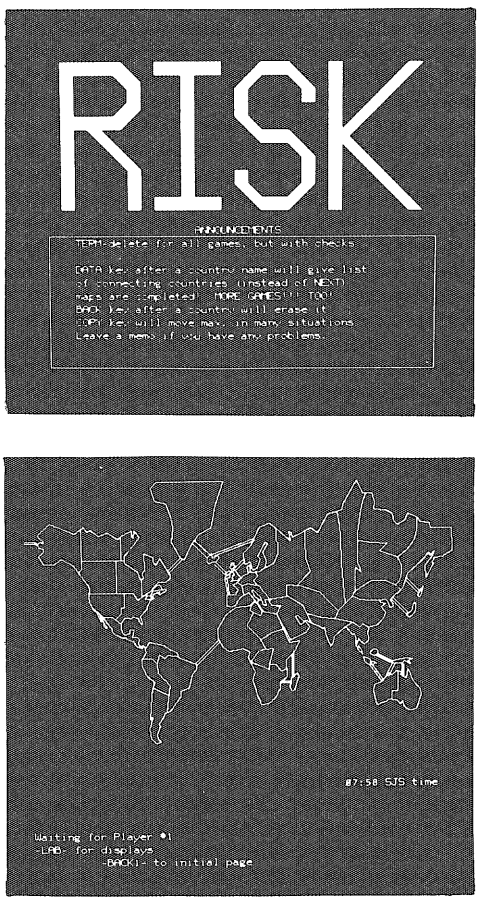
The fact that a PLATO computer serves a wide geographical area means that communication costs are also involved in determining total cost. PLATO's computer is usually connected to the terminals via telephone lines. Normally, this would be very expensive but due to an inherent memory feature in the terminals, communication costs are kept to a minimum since the computer need not continuously send a signal to refurbish the display. In addition, Control Data feels that increased use of lower-costing microwave communication should further reduce costs.

Control Data executives are confident that the cost of the entire PLATO system will soon be competitive with that of traditional education.

"Electronic hardware in the computer industry has a twenty year trend now of 15 percent economic improvement per year and it's getting better because of microelectronics. We see this trend continuing and strengthening at least until 1985," according to Robert Morris. He also says the cost of writing PLATO courseware will drop. At the same time, the cost of traditional education is increasing at a rate of 13 percent per year.

Control Data just recently introduced its own PLATO terminal (the previous one was built by Magnavox). The terminal consists of a display screen and a typewriter keyboard. The computer communicates to the student by displaying instructions, questions and answers on the screen. The student can respond by using the keyboard. Besides lines, figures and graphs, the computer can be programmed to utilize any three languages the teacher chooses. The screen can also display slides, play recorded messages and videotapes and show photographs.

The terminal screen is sensitive to touch. This is supposed to be useful for students learning to read. For example, if the word "horse" was displayed on the screen and the student couldn't remember its meaning, he would touch the screen in the area of the word. This would cause the computer to replace the word with a picture of a horse while the audio system would reproduce the word "horse" in the student's earphones.



PLATO has the capacity to simulate laboratory experiments. By practicing an experiment on PLATO beforehand, says Control Data, a student should be able to go through the actual experiment much faster because he will already understand what is happening. In addition, experiments which are normally too expensive, dangerous or time consuming can be done by simulation on PLATO.

PLATO's capability to do complex calculations quickly, coupled with its graphing ability, makes it useful in such disciplines as mathematics. For instance, if a student is having trouble visualizing the graph of a mathematical equation, PLATO can graph it for him as he watches.

If in need of help, the student can press a button which stops the computer. Since communication is possible between terminals, he can then ask someone on another terminal, if a teacher or TA is not available.

In a recent interview, Russell Burris, director of the University of Minnesota's Consulting Group in Instructional Design, said, "It's clear that 80 percent of the material that's on the PLATO system right now is unacceptable to our faculty here because of the quality."

According to Control Data, in the early 1970's about 50 percent of PLATO courseware was of questionable quality, but each year it improves significantly. They argue that this low level of quality should be expected because the authoring of courseware is not, as yet, considered scholarly work. However, this should change as PLATO becomes popular.

In any case, teachers can author courseware on PLATO relatively easily. First of all, while most CAI systems have to be completely shut down to author, with PLATO, a teacher can author from any terminal at any time. Second, PLATO's designers have developed a computer language called TUTOR which makes it possible for any computer novice to author.

The university's present position on PLATO is that while it is a technologically impressive CAI system, "there are only a very few cases in which the need for PLATO is there," according to Burris.

The university has developed its own CAI program which is being used in a number of departments, including second language study, law and medicine. While PLATO is superior technologically to the university's system, it is also eight to ten times more expensive.

"There are a number of things about their (Control Data) terminal that are impressive except that their terminal costs $7,000. Most of the terminals we're using around here for both law and most of the second languages are around $1,200." In addition, the university has its own Research and Development effort by which it hopes to catch up to PLATO technologically, according to Burris, who headed the university's study of PLATO.

Burris believes that because of the

"dialog capability" of the computer, it may one day (as it does now, to some extent) assume the role of tutor in our education system.

"What the computer can do is get a response from the students, process that response, and then, in turn, respond differentially to whatever it is the student has done...It can then feedback and really describe any discrepancy between the model reponse [and the student's reponse] which is one of the most fundamental aspects of the learning process," Burris said.

Yet, because educators know little about how and why people learn, Burris believes it's important to continue to experiment with such technologies as CAI, but not to "wholeheartedly" endorse them. The university is now experimenting with eight PLATO and 60 to 80 of its own CAI terminals.

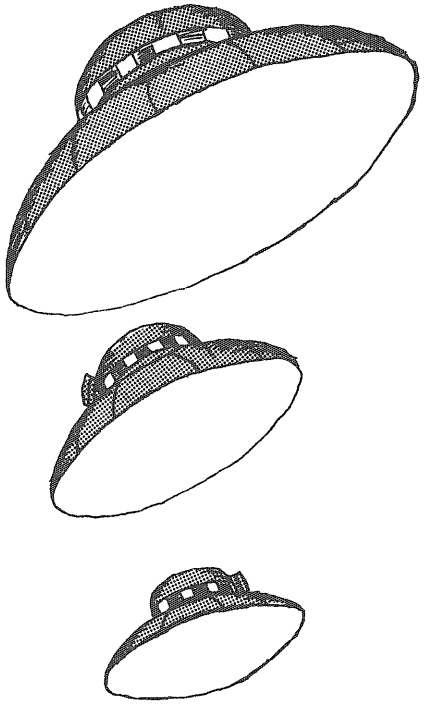
While it has been found that CAI is useful for drilling in second language learning, it does have many important limitations. For instance, although Control Data claims CAI will improve instruction for all types of learners, the university has found that "bright" students do not seem to be influenced by it. Burris feels that careful planning must precede any application of CAI to education.

Finally, it is psychological rather than economic considerations which have led to the university's ambivalence toward the PLATO systm.

"Any department, any university, any college, would be out of its cotton-pickin' head right now to make that decision [to use PLATO for economic reasons], because we haven't learned how effectiveness for learning a particular subject matter is best addressed by these computer programs," according to Burris, and even if PLATO could reduce the cost of education, our financially troubled university would, at this time, be making an error by utilizing PLATO for instruction. □

FLYING SAUCERS ARE REAL

by Jon Kavanaugh



Much has been written about the subject of unidentified flying objects (UFOs) since Kenneth Arnold first reported strange objects which "flew like a saucer would if you skipped it across the water." Arnold was flying, himself, near Mt. Rainier, Wash., in 1947 at the time.

So much has been written, in fact, that it seems reasonable to expect that, after 31 years of study and investigation of thousands of UFO sighting reports similar to Arnold's, an acceptable world-wide explanation would have surfaced.

Instead the opposite is true. The 31 years of observation have produced only the records of thousands and thousands of eyewitness sightings that have been generally taken lightly, if not skeptically, by newspapers and the other media. Scientific investigation by educated, professional people has drawn more skeptical blanks about the phenomenon of flying saucers. Even the primary investigation by the United States Air Force, following up thousands of saucer sightings, most notably the Project Blue Book in the early 1950s, concludes that there is not enough evidence even to suggest that UFOs are, indeed, spacecraft from other worlds.

The only thing that seems certain in 1978 is something that Daniel Cohen wrote in **Science Digest** magazine way back in 1966: "By now, one thing should be abundantly clear: Interest in flying saucers, or unidentified flying objects, is not going to fade away."

Interest in the study of UFOs or ufology, hasn't faded away. And

Stanton T. Friedman has bachelors and masters degrees in Physics from the University of Chicago and 14 years of industrial experience in the development of advanced nuclear and space systems. His past employers include General Electric, General Motors, Westinghouse, Aerojet General and TRW systems. He has worked on nuclear aircraft and rockets, fusion rockets, nuclear powerplants for space and terrestrial applications and the Pioneer 10 and 11 spacecraft. Since 1970 he has been the only space scientist in the world known *to be devoting full time to UFO investigation.*

nearly 600 amateur ufologists, media representatives and curious others proved that as they packed Willey Hall auditorium recently to hear a positive scientific approach to the UFO question in a lecture by Stanton T. Friedman, nuclear physicist and UFO lecturer, sponsored by the Minnesota Parapsychological Society.

In a five-hour, illustrated presentation, entitled, "Flying Saucers Are Real," Friedman shot down 31 years of myths, skepticism and "bad press" while implicating the U.S. Air Force in a ufologic coverup of information more far-reaching than any Watergate political "heavies" could have dreamed up.

After 19 years of his own investigation and study, Friedman concludes, contrary to most scientists and the federal government, that "the evidence is overwhelming that planet Earth is being visited by intelligently controlled extraterrestrial craft."

But, because of public fear, mostly of being laughed at, much of the good evidence about UFO sightings has gone unreported. The so-called "laughter curtain," has also hindered the study of flying saucers. Friedman, having lectured on over 350 college campuses, has seen the effects of the misinformation, peer pressure and skepticism in audiences which keeps credible people from reporting the unusual things they seein the sky.

Cool receptions, by media, of UFO reality has helped keep the lid on information as well. Misleading articles in major national magazines, Friedman says, have contributed their share of bad influence, not to mention the release of Steven Spielberg's film, "Close Encounters of the Third Kind," which Friedman calls "short on accuracy and long on hype."

And if the media and personal fears aren't enough, the tight lips of the federal investigation groups have sequestered valuable information. Even NASA, this year, will spend $20,000,000 on radiotelescopic research for intelligent life on other planets but nothing on UFOs directly.

Facing the Skeptics

It's the openly skeptical opponents of the notion of extraterrestrial spacecraft, especially, that concern Friedman nearly as much as the UFO phenomenon itself.

While polls show that nearly 51 percent of Americans accept UFOs as reality, "The noisy negative minority viewpoint is the skeptic's viewpoint," says Friedman.

Skeptics most often say UFOs are ordinary objects, like earthling spacecraft or, if they admit UFOs exist, the craft must violate the laws of physics and therefore can't exist. This logic, which Friedman encounters frequently, resembles the Aristotlian professors, Galileo's contemporaries, who argued that "Jupiter's moons are invisible to the naked eye, and therefore have no influence on the Earth, and therefore would be useless and therefore do not exist."

Friedman does agree that a large proportion of UFOs, of course, can be explained in terms of natural, known objects, but according to the Project Blue Book, the official U.S. Air Force report on UFOs, in over 2,000 UFO sightings, 19.7 were not explainable after thorough investigation. These

included only the sightings with comparable complete data, including photographs taken in clear weather; and good size, shape and texture information. The skeptics still want to assign the objects to known spacecraft but the data shows that the saucer-shaped vehicles could hover, stop on a dime, accelerate to 10,000 MPH in seconds and turn at high speeds (2,200 MPH). No companies however, now manufacture such versatile spacecraft in quantity. Friedman's conclusion: "A significant residue (of the unexplained objects) are manufactured objects that weren't made on earth and therefore must be considered of extraterrestrial origin."

Another group of skeptics Friedman encounters includes mostly the well-educated, the scientific world and political officials. They may accept the notion that there have been observed, unexplained phenomenon, but they ask questions like, "Why don't the aliens talk to us? Why don't they communicate with us? Why don't they just say 'take me to your leader'?"

To answer these questions, Friedman says, it is necessary to look at the whole UFO situation from a different perspective—the aliens'. For one thing, aliens capable of traveling in such sophisticated equipment would necessarily be from a more technologically advanced part of the galaxy. It is important, although devastating to Earthling egos, to digest the idea that perhaps Earthlings just aren't worth talking to. Information aliens want to gather can probably be obtained by other means, beyond our perception.

Also, from the aliens' viewpoint, there is the question of safety. An alien has a responsibility to enter into only that which it knows it can return from safely. "This means that, before you even think of a quick picnic lunch on your terrain honeymoon, you have have 'enough information' about the natives to make sure that you can avoid being grabbed by the natives unless you feel free to clobber natives wholesale," Friedman says.

Historically, UFOs have been shot at, jumped on, chased by our military planes and, Friedman suggests, most aliens of any intelligence don't want to be captured, placed in a zoo, destroyed or anything of that kind.

A question of jurisdiction comes up, too, from the alien perspective. Who would the aliens talk to? Who would be the representative "leader" of the planet Earth that we could escort the aliens to?

"It took us a long time just to pick out a table for the Paris Peace Talks, think how long it would take to choose a world representative to speak to the aliens?" Friedman asks.

Because of this potential problem, he suggests now is the right time to begin thinking of ourselves as Earthlings rather than as traditional nationistic Chinese, Russians or Americans.

One skeptical question leads to another. Why do aliens want to come here in the first place? To that, Friedman says he can only speculate. He does so with humor. Perhaps aliens are graduate students doing their theses on the development of primitive society. Perhaps they are travel agents checking out new locations for excursion trips for tourists or perhaps they are talent recruiters for non-Earthing "football" games.

Another question. If the aliens are

continued on page 25

Big brother pays more $$ than private industry

Today, government pay averages about $4,000 higher per year than pay in the private sector, according to statistics published by the US Department of Commerce and the US Civil Service Commission.

The average pay for federal workers, both blue- and white-collar, now exceeds $15,700 per year and includes a wide range of excellent fringe benefits, the commission says.

It is projected that by 1980, one of every five workers on the federal, state and local levels will be employed by a government entity, and according to the commission, there is and will continue to be an unprecedented interest and competition for federal jobs.

To facilitate applying for these jobs, The 1978 Federal Job Directory is available. It provides a brief description of each occupation, tells the qualifications needed to apply, as well as where and how to apply.

To obtain a copy, write to: Kent-Harbridge Publishing, Inc. Box 477, Fairfax, VA 22030. The price is $7.50. The directory should also be available in local bookstores.

Golightly provides statistics which prove Engineers are Tops!

More engineers than ever before are rising to become chief executive officers of major companies, according to a survey conducted by Golightly & Co. International, Inc., a management consulting firm.

The survey covered the backgrounds of chief executive officers in the country's 100 largest corporations and has been tracing the paths to corporate leadership since 1948.

Twenty-three percent of the chief executive officer jobs, during the period covering 1973-77, were held by financial executives. Marketing men held 19 percent of these jobs during the period covered in the survey, and engineers, in third place, held 15 percent of those positions.

That engineers have risen to third place in filling these top positions is attributed, by the Golightly survey, to the greater importance of technology and the resurgence of the engineering discipline from its low position in the 1960s.

Energy-saving electric automobiles by General Electric

General Electric has been awarded a two-year contract to develop and construct two experimental four-passenger electric automobiles by the U.S. Energy Research and Development Administration, a part of the Department of Energy. The new subcompact sized electrics will be based on a design to be developed jointly by GE and Chrysler Corporation.

GE will provide the electric drive system, Chrysler will design and fabricate the body and chassis and Glove-Union Inc. will provide high-energy lead-acid batteries. GE and Chrysler will jointly test the integrated vehicle.

GE's program plan calls for a separately-excited direct current motor, powered by a 108-volt-lead-acid battery system. The cars will have regenerative braking to permit braking energy to be used in recharging the 18 batteries.

The cars, built especially for stop-and-go urban driving, will have an urban driving range of 75 miles before the batteries need recharging. They will be capable of cruising at speeds of 55 miles per hour. These vehicles are slated for delivery to the Department of Energy in spring, 1979.

`log ledger

California giant kelp may solve the fuel crunch!

A program, sponsored by the American Gas Association, to examine an alternate, renewable source of energy from the conversion of marine plants to substitute natural gas, is also being managed by GE. GE will provide analysis program, systems requirements, program management and the technology development plan which will determine the technical and economic feasibility of the methane from Marine Biomass concept.

Due to its large size, very rapid growth rate and its regenerative capacity after being harvested, California Giant Kelp (Macroystis pyrifera) has been selected as a source of Marine Biomass.

Dr. Wheeler North, an authority on kelp from the California Institute of Technology, will coordinate a team of scientists to plant and observe kelp growth and proliferation on a test farm to be established off the coast.

The Marine Farm will be moored in a minimum of 500 ft. of water approximately five miles offshore California. Adult kelp plants will be transplanted from their natural environment close to shore and attached to subsurface floats 60 to 80 ft. below the surface, while nutrient-laden water from below the test farm will provide food for the kelp.

The experiments necessary to provide pretreatment process steps will be conducted by the Western Regional Research Center of the US Department of Agriculture at Albany, California. Anaerobic digestion studies, necessary for developing the process for converting kelp into methane, will be done by the Institute of Gas Technology of Chicago.

ASME Twin Cities conferences to be held in 1978

The American society of Mechanical Engineers will hold several conferences in the Twin Cities this year.

On April 11-13, a railroad conference will be held at the Radisson Hotel in St. Paul. For more information, contact Gail T. Jannon, manager industry department, ASME.

The summer annual meeting of the ASME will be held on June 11-15 in Minneapolis, at the Sheraton Ritz Hotel. Contact Walter Moen at ASME for information.

On September 24-27, the Design Engineering Technical Conference will be held at the Leamington Hotel in Minneapolis. Call Ralph Layer at ASME for information.

A joint conference with ASLE on lubrication will be held at the Radisson Hotel in Minneapolis. Contact J.J. Donahue at ASME for information. ASME's address is 345 47th St. New York, NY 10017.

Announcing the 13th annual Minicon in Minneapolis

The Minnesota Science Fiction Society (Minn-stf) will hold its 13th science fiction convention Easter weekend, March 24-26, at the Leamington Hotel in downtown Minneapolis.

Guest of Honor will be Samuel R. Delany, author of **Nova** and **Dhalgren.** Other writers from the Twin Cities area and around the country will attend. Science fiction movies, a science fiction art show and programs dealing with many aspects of sf will be held.

Membership in Minicon costs $6.00 until March 1, 1978. The cost will be slightly higher at the door. One or two day memberships are also available at the door at a reduced rate.

Direct ticket orders or inquiries to: Minicon, PO Box 2128, Loop Station, Mpls., MN 55402.

trying to find out about Earth culture, why don't they abduct some important people and interview them? People, as well as whole countries, are relatively unimportant on a worldwide scale. The aliens, he says, would rather pick up specimens that are physiologically representative of Earthlings, not necessarily powerful personages. And there are few areas where aliens would want to make abductions because of large, inhibiting crowds of people.

On gathering other kinds of information about the Earthling societies, Friedman suggests that Earthlings shouldn't forget that Earth "is giving away or broadcasting all kinds of information about itself and the people in it. Radio, TV and radar sensing systems, transportation systems"—all give information, messages which could be monitored by an alien ship of any sophistication.

"Basically, for many things they just don't need us," says Friedman. He cautions us to remember that we're "technologically out in the boondocks in this universe, that we're the Johnny Come Latelies in the system" and all of the egotistical notions Earthlings have about being the center of the intelligent universe may be hogwash.

Enter the Feds

A synonym for any discussion of the federal government and the US Air Force about UFOs has to Project Blue Book—the most extensive research report done on UFO sightings and made public. Conducted solely by Air Force intelligence, Blue Book began in the early 1950s and concluded in 1969. During that time, over 2,000 UFO sightings were catalogued, analyzed and documented. Friedman, however, dismisses most of the reports because Blue Book draws conclusions based on limited and insufficient data to reflect the truth about UFO reality.

Extensive and thorough as Project Blue Book was, Friedman suggests that the report was "an unwitting public relations cover operation for one or another much more sophisticated, highly classified efforts to obtain useful scientific data about UFOs."

Because the project crew consisted of only two or three untechnologically sophisticated Air Force personnel at any one time, proper scientific methods were lacking and not used to process sighting reports. Therefore, data wasn't checked as thoroughly as is possible in other Air Force projects. He said the project didn't include field investigations, flight surveillance or other advanced UFO tracking systems —surprising considering the $1 billion annual budget that was allowed.

Another highly classified organization, the Aerospace Defense Command (ADC), on the other hand, was and is commissioned to observe the skies continuously. ADC's equipment monitors all aerial activity, large or small, and its data remains highly classified. The Blue Book Project staff, whom Friedman "guarantees not to be boat rockers," probably weren't part of the more revealing information about UFOs, presenting to the public only general information about sightings. Eventually the report concluded in a neat, tidy manner that UFOs can't be linked to any extraterrestrial spacecraft, that insufficient evidence precludes further speculation about the reality of UFOs.

Friedman says he has spoken with about 60 servicemen from around the country whose eyewitness reports revealed "excellent UFO sightings that occurred during their military service." However, the sightings were reported to ADC and not Project Blue Book authorities.

Most field investigations were conducted by the ADC and other intelligence groups, including the Central Intelligence Agency (CIA), outside of Project Blue Book.

Another questionable aspect of the project concerns the issuing of reports. Blue Book reports 1-12 were issued in the early 1950s to intelligence organizations, with report 14 being issued in 1955. Report 13, however, remains publicly unaccounted for. After much personal investigation, Friedman believes report 13 exists, if at all, as a top secret file with, perhaps, some of the most important ufological information concealed there.

Can the government keep secrets? Friedman thinks yes. Especially after having worked for 14 years in industry on highly classified projects concerning advanced nuclear weapons systems.

But why the secrets? Friedman believes it reasonable to assume that competition among world powers for technological superiority, the desire to employ our own flying saucers as weapons and, again, the superego problem are sound basis for the secrecy.

Study and investigation for 31 years have revealed much about a phenomenon which by comparison to other subject areas has yielded very little hard, factual, conclusive information. As consumers in the galactic supermarket of information, perhaps Earthlings have to sift through the available data themselves and decide the answer to the ufological question that one national radio feature asks. UFOs: fact or fiction? □

Several national UFO organizations and publications exist which can provide expanded information on the current investigations going on in ufology today as well as the landmarks in UFO study since its inception in the late 1940s. Some of the better known societies and publications with addresses are listed below:

Aerial Phenomenon Research Organization (APRO)
3910 E. Kleindale, Tucson, AZ 85712
Publishes **APRO Bulletin,** Monthly, $8 per year.

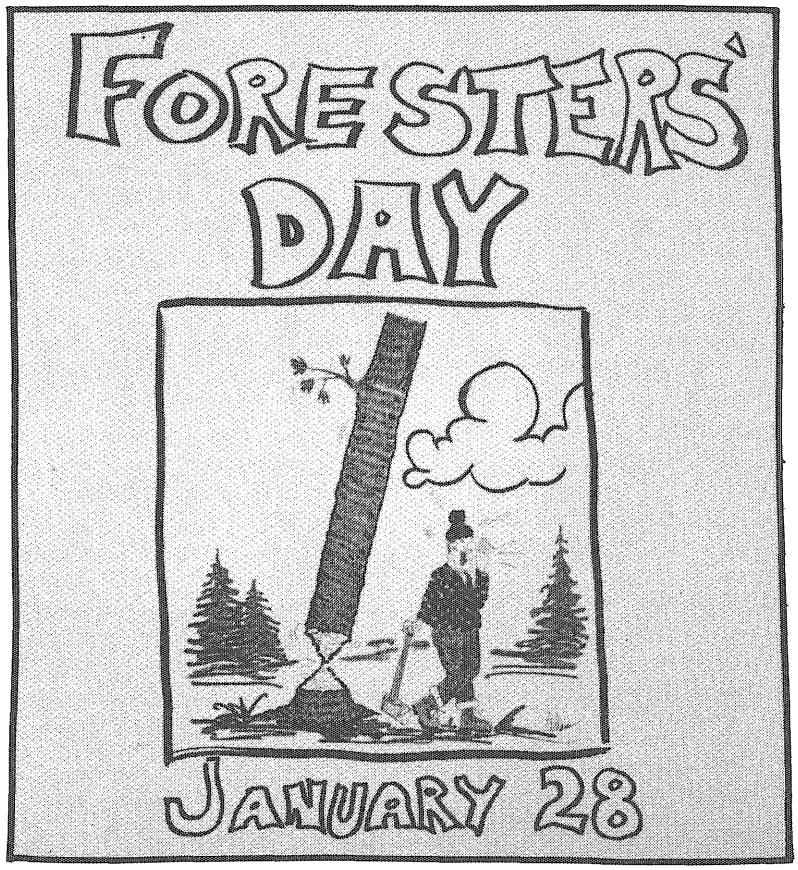
The Flying Saucer Review,
P.O. Box 25, Baret, Herts, EN5 2NR, England

Mutual UFO Network (MUFON)
26 Edgewood Dr., Quincy, IL 62301
Publishes **Skylook,** Monthly, $8 per year

National Investigations Committee on Aerial Phenomenon (NICAP)
3535 University Blvd. W., Suite 23, Kensington, MD20795
Publishes **The UFO Investigator,** Monthly (4 pages), $10

UFO Research Institute (UFORI)
(for Stanton T. Friedman papers, others)
P.O Box 502, Union City, CA 94587

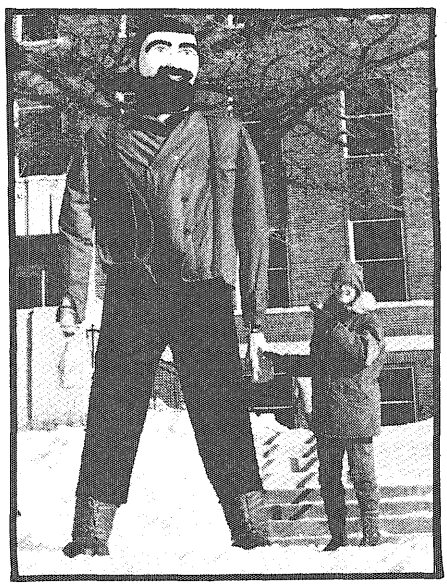
FORESTERS' DAY
The Untold Story



Text by Steve Smith

Photographs by Mike Dorn

Braving bitter winds and sub-zero temperatures, two Technolog reporters endangered their lives in an attempt to observe the Forestry Department's annual reversion to paganism, otherwise known as Foresters' Day. Held every year in the dead of winter to pay tribute to the foresters' god, Paul Bunyan, the foresters hideous practices, including rites of human torture and sacrifice are unparallelled in western history and make the Spanish inquisition look tame in comparison. However, owing to the inherent clumsiness and low intelligence of foresters, more foresters and spectators were killed than were intended victims. Our reporters went completely unnoticed among the revelers and took several incriminating photographs of the primitive rituals of Foresters' Day.



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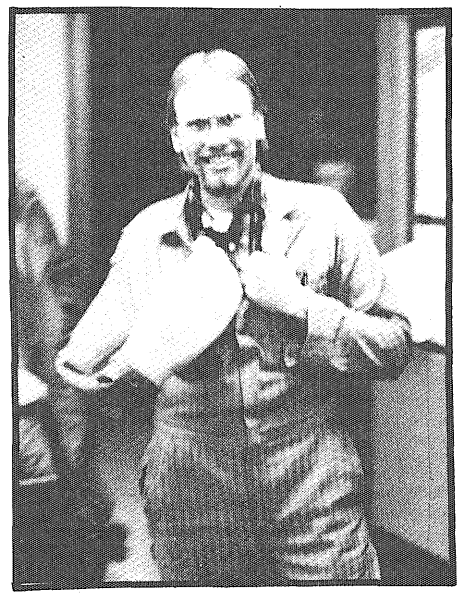
A statue of the god of the forest stood overlooking the gruesome festivities.



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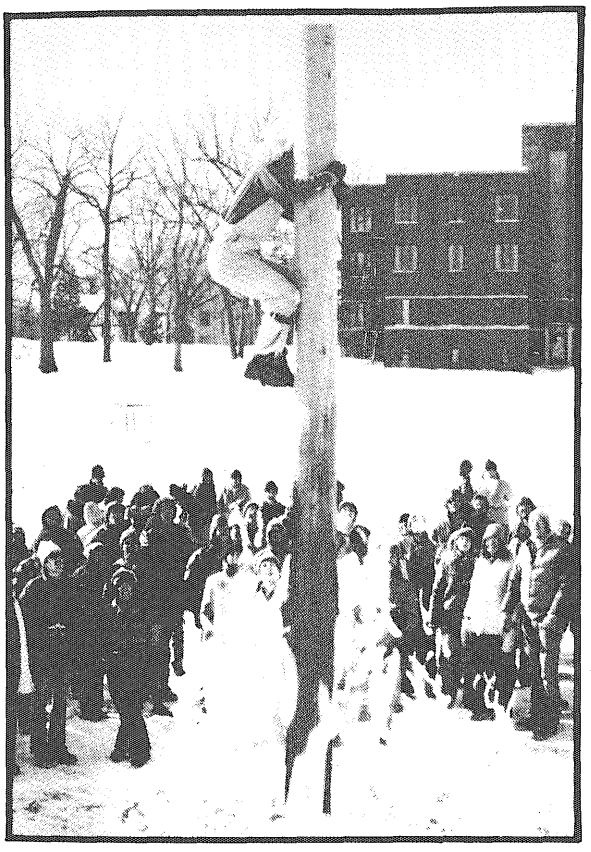
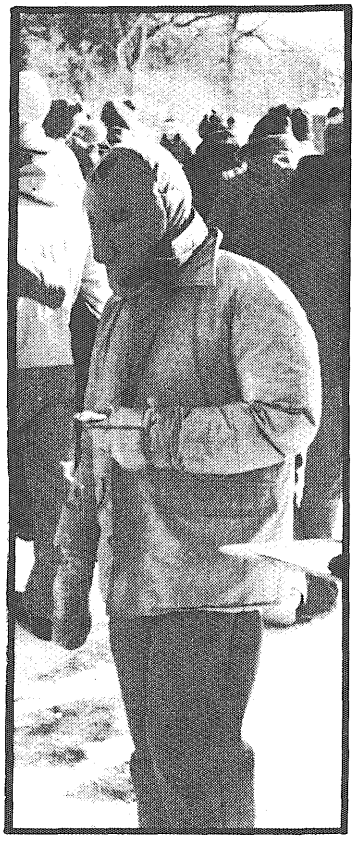
Believed to be related to the mysterious Big Foot, this creature, appropriately called, "Big Hand", was spotted during the festivities.



←

In this ritual, similar to being burned at the stake, the victim attempts to climb the pole before the straw at the base is ingited.

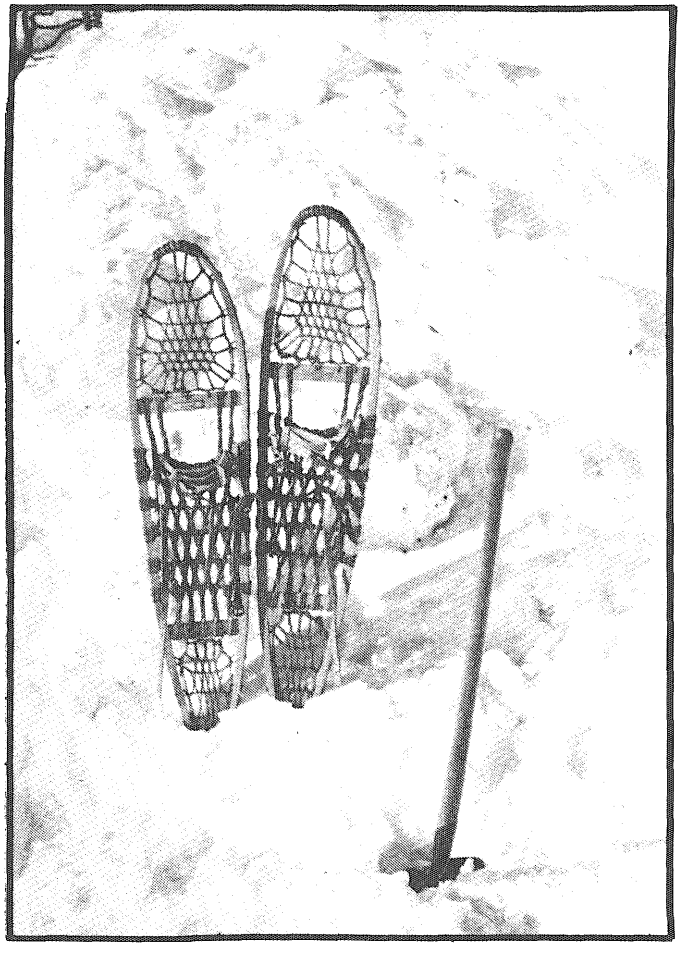


→

The chief executioner (in mask) timed how long it took the victims to succumb to their death.

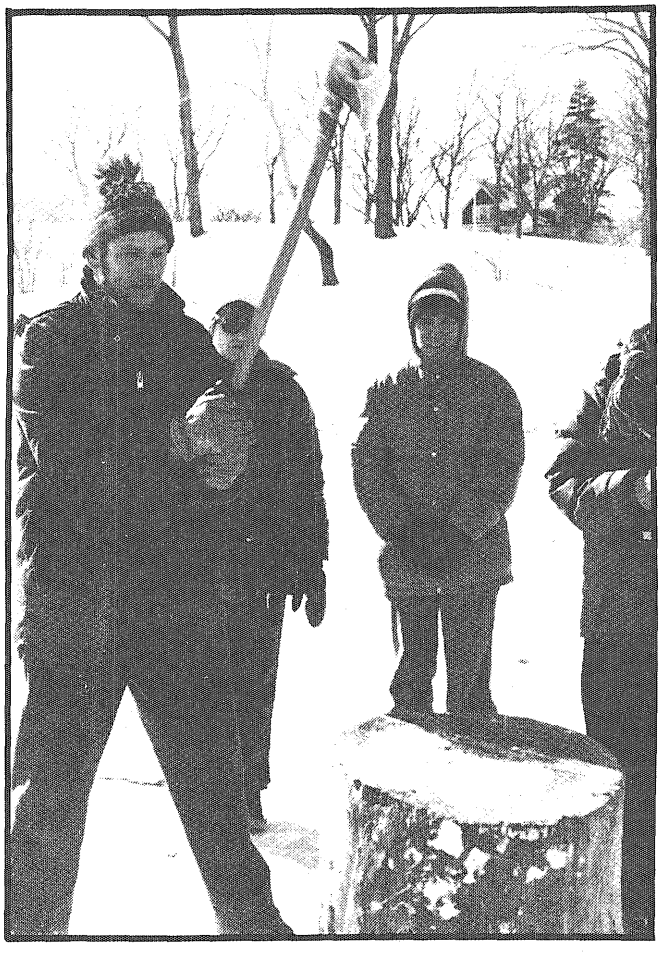
This unfortunate man, a victim of pole climbing, won first place in the Bear Imitating Contest, but he died before he could be given the prize.

↓

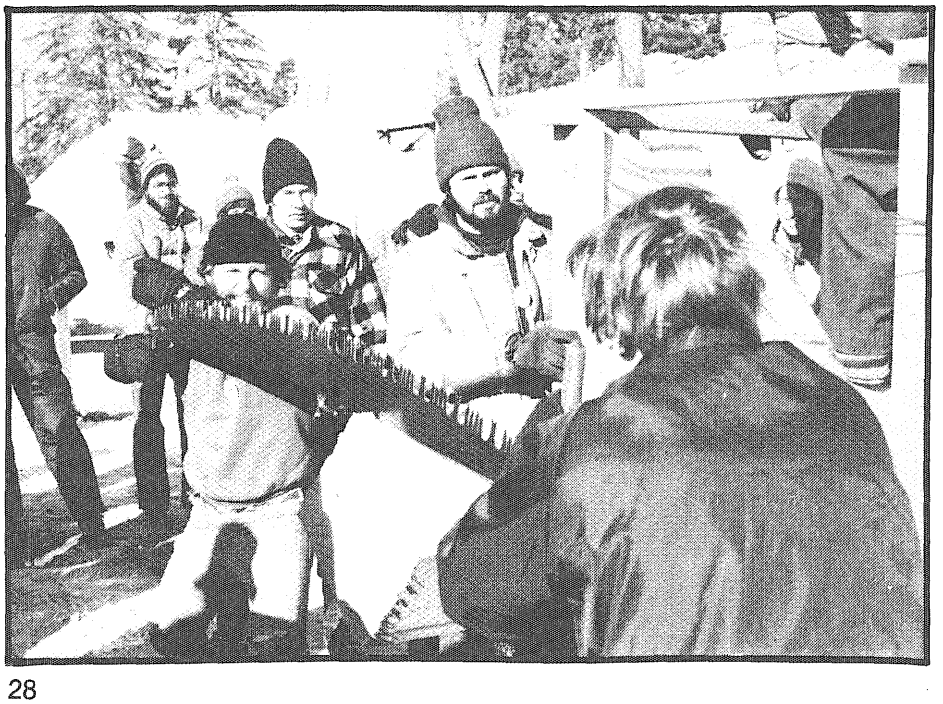


↑ One of the more unfortunate participants in Foresters' Day, who was caught in an avalanche.

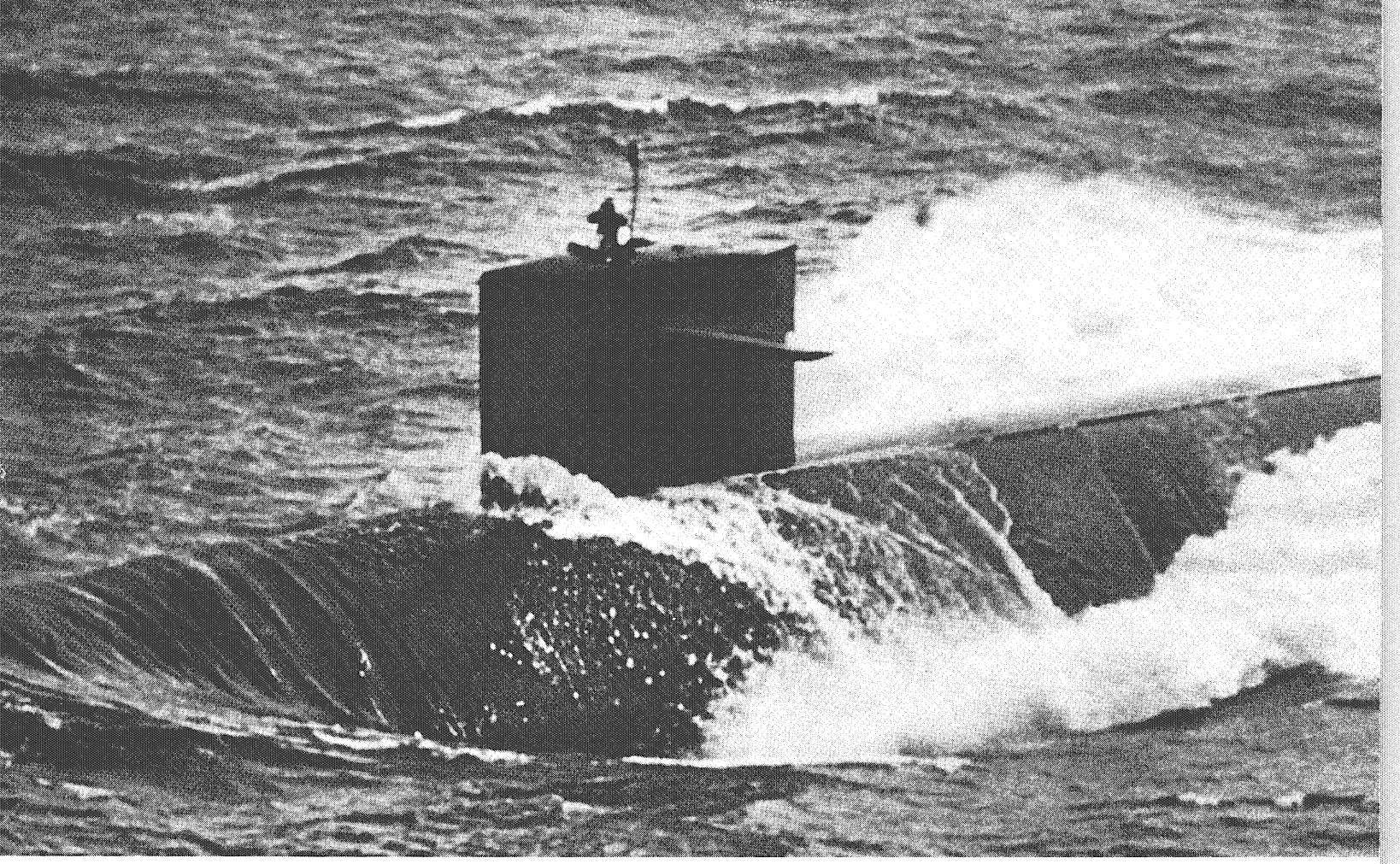
↑ Slow but sure, this man won the speed-sawing contest hands down, with a record time of 19 hours, 34 minutes, and 16 seconds. (However, it would have been much faster had he used the other side of the saw.)



↑ Before being allowed to behead the victims for a sacrifice, the ax wielder must prove his dexterity by splitting a match. This man failed to split a match, (but he did succeed in removing his right foot and three fingers, while killing two spectators and injuring four others.)



← Proving that two heads are not necessarily better than one, these two foresters died of exhaustion before they completed sawing through their log.



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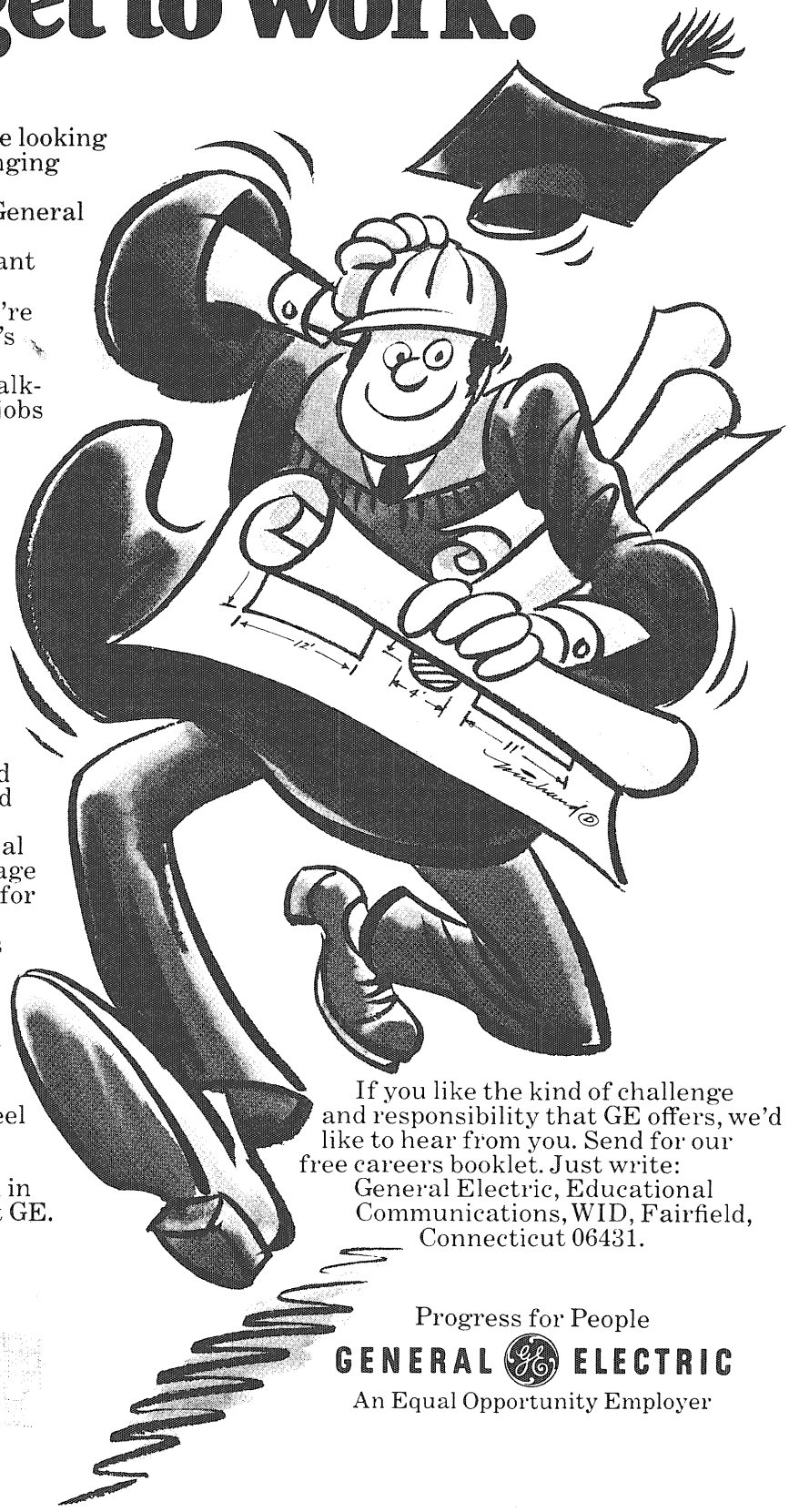

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4. *Stephanie B.* Medical systems service engineering. Installation and test of new hospital radiographic and fluoroscopic x-ray system.
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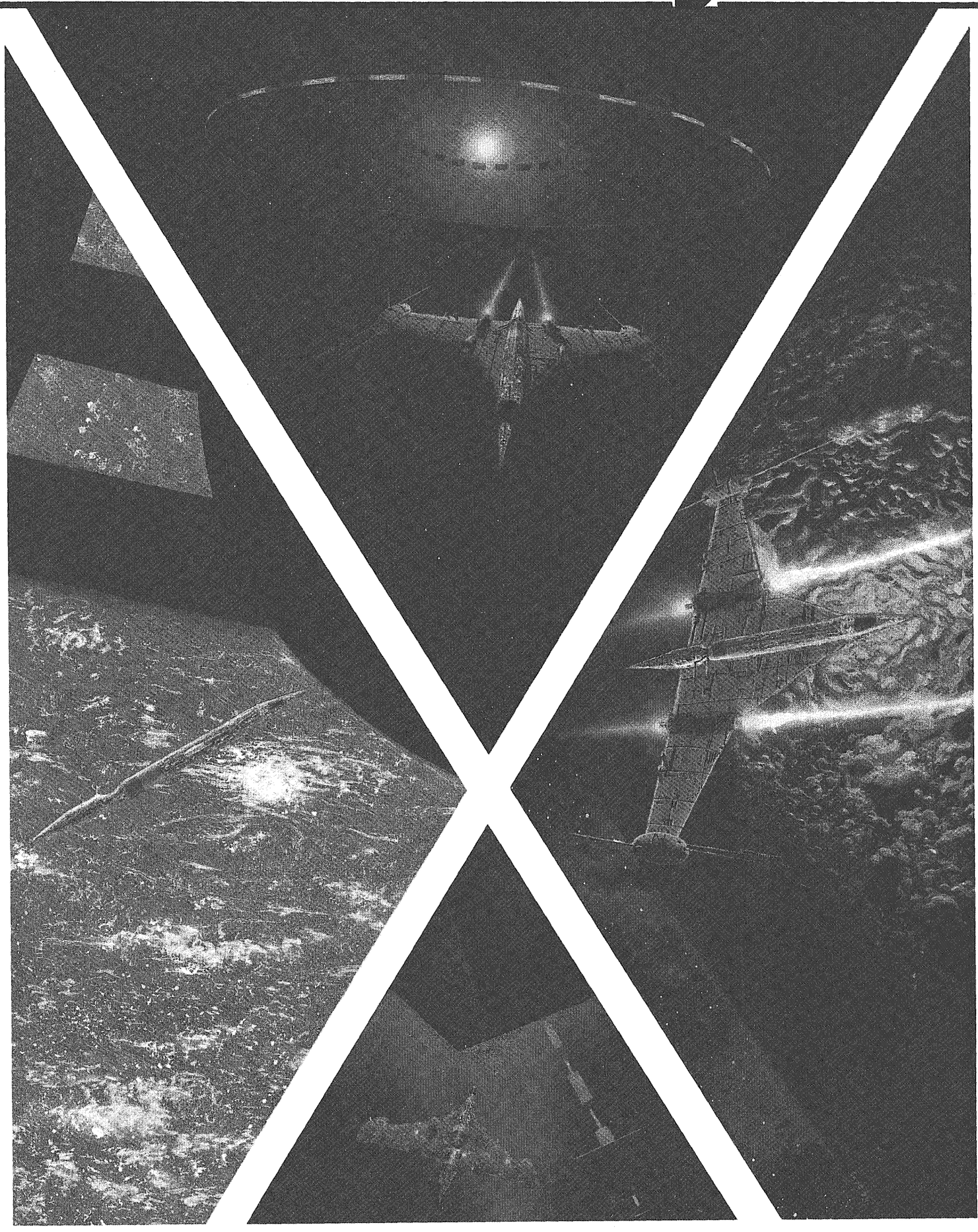

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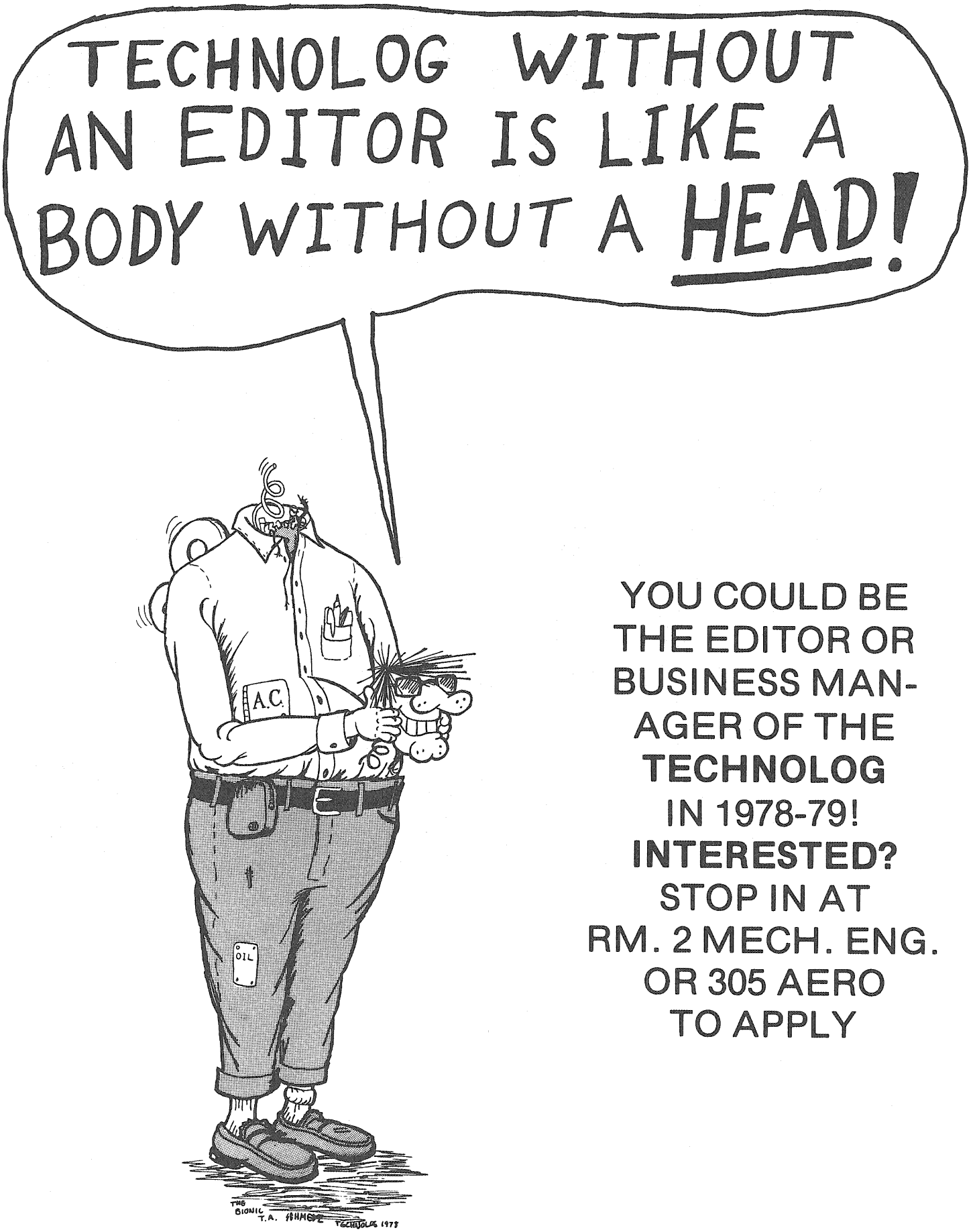

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minnesota **Technolog** spring I 1978

Official Student Publication of the Institute of Technology, University of Minnesota

Vol. 58 No. 5

Science Fiction Issue

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editor's page

Welcome to our special science fiction issue. This issue features the winners of our annual SF contest. This year, we had 29 entries in the contest, which was judged by John Purcell, Gayle Gaskill, Bruce Kvam and Micheal D. Erickson.

I'd like to congratulate Sallie Sjerslie and John Bremer, who wrote **The Universe Makers,** S. LeRoy Wattawa, author of **Monitor**, Sheldon Clay, writer of **Hannibal and the Serpent,** and David H. Szondy who won an honorable mention for **P.D.Q. Omega.**

The Fees Committee survey, conducted by the Office of Student Life Studies, is one of the factors used by the committee to determine how much money a student organization should receive. If an organization does poorly in the survey, then the fees committee considers cutting fees.

This year, at the Fees Committee meeting, **Technolog** almost lost its funding because, according to some incorrect survey results only a very small percentage of IT students favored supporting **Technolog,** or even used the service.

According to the **adjusted** survey, out about two months too late to do any good, over half of the IT students surveyed actually supported **Technolog**'s continued funding. This difference is quite significant.

OK, so now the survey has been corrected and the actual percentages have been duly noted by the committee members, but I wonder which impression of **Technolog** is going to stay with the members longer—the image of the floundering publication presented at the committee hearing, or the later, corrected (though not publicized) one which indicated a respectable amount of support? Unfortunately, I'm afraid that the impression **Technolog** made at the fees hearings, though incorrect, is the one that's going to stick.

I don't know who to blame for the error—blame isn't even that important or necessary—but I do want the mistake rectified, especially in the minds of those committee members who spoke out so strongly against **Technolog**'s continued funding based on the incorrect survey information.

I did receive a nice, apolegetic letter from the then chairman of the committee, Jim Clark, which was appreciated, but I don't think it is enough.

Next year, when **Technolog**'s funding is again being decided, I hope that the committee will consider the source of its survey information, and make allowances for errors accordingly.

Technolog, in the Winter II issue, offered a $25 prize to anyone who attached a **Technolog** sticker to vehicles entered in the E-Week car race. I'm sorry to say that we are withdrawing the offer due to the late date.

On this past April 6, **Technolog**'s advisor, Professor John Clausen, myself and a staff member, Steve Smith flew to Cleveland to attend the annual Engineering College Magazines Associated (ECMA) convention and awards banquet. Last year and for several years before that, **Technolog** has collected an admirable share of ECMA awards, but this year we were not eligible to compete because of a technicality in ECMA's constitution (by which all members must abide.)

The convention was a great learning experience for all of us; there were editorial, graphics and advertising workshops and enough committee meetings to keep the most political of us (me) happy. It was also a lot of fun.

We met staff members and editors from engineering magazines all over the country, and were able to exchange information and ideas with them. I was surprised to learn that **Technolog** is really lucky in the finance department compared to some of the magazines, because we are one of the few magazines which is funded through student fees.

Apparently, **Technolog** is very highly thought of by ECMA members all over the country, especially for our artwork and graphics, as well as the diversity of articles that we feature. I received several compliments about the magazine every day. Steve Smith was also complimented profusely for the Bionic T.A. It was great!

Raymond Gorte, when are you going to come into the **Technolog** office to pick up your $5 prize?

Electrical Engineering spring colloquia schedule

The Electrical Engineering colloquia for spring quarter, 1978, will be carried live-interactive on UNITE channel A for the convenience of employees of companies having UNITE facilities. Tea will be served at 3:45 in Mech. Eng. 212 and the colloquia will begin at 4:15 in Mech. Eng. 108.

May 11
A new formulation of Kubo's Linear response theory.
K.M. Van Vliet
University of Montreal
Montreal, Quebec, Canada.

May 25
The growth of Semiconductor devices from molecular beams.
J. Arthur
Physical Electronics, Inc.
Eden Prairie, Minnesota

Microelectronics spring seminar schedule

The spring, 1978, seminars are discussion oriented meetings; you are invited to attend and participate. The meetings will be held Thursdays at 2:15 PM in Lind Hall, 305. If you have questions or suggestions, call Al Tuszynski at 373-2970.

May 11
Dr. H.J. Boll
Bell Telephone, Murray Hill
"LSI & VLSI in the Bell System"

May 18
Professor G.K. Wehner
University of Minnesota
"Sputtering"

May 25
Charles Naber
Control Data Corporation
"Trends in Semiconductor Memories"

Control science spring seminar schedule

These seminars are held at 3:15 PM Thursdays, in M. E. 102. For further information contact: Professor F.N. Bailey at 373-4527 or Professor M.K. Sundareshan at 376-3258.

May 10 (Wednesday)
P. Baraiya
University of California, Berkeley
"Multilayer control of large Markov Chains"

May 18
D. Siljak
University of Santa Clara
"Vulnerability of Dynamic Systems"

May 25
To be announced

June 1
L. Hurwicz
University of Minnesota
"Game Theoretic Models for Economic Mechanisms"

log ledger

Computer science spring colloquia schedule

All colloquia will be held in room 203, Lind Hall, at 3:30 PM. Coffee and cookies will be served from 3:00-3:30 PM in 136C Lind Hall.

May 8
Professor Jacek Szymanowski
Institute of Automatic Control
Technical University of Warsaw
"An Accuracy Selection Algorithm for Two Level"

May 15
Open

May 22
Mr. Steve Barnard
Graduate student, Department of Computer Science
University of Minnesota
"Visual Disparity as a Cue for Depth and Velocity in Real World Scenes"

May 29
Memorial Day (holiday)—no colloquium

June 5
First day of final exams—no colloquium

College Placement Council says job prospects improving

Job opportunities for college graduates at the bachelor's level appear more plentiful for the second year in a row, according to data compiled by the College Placement Council for its mid-season salary survey report.

Those colleges participating in the survey report that the number of job offers made to bachelor's candidates by business, industrial and government employers is up 31 percent from last March.

The candidates in shortest supply—those majoring in engineering disciplines—experienced the largest gain, receiving 44 percent more offers than a year ago. Of all the bachelor's offers reported, 57 percent were to engineering students.

Starting salaries for bachelor offers in petroleum engineering were the highest, at $1,645 per month. The next highest starting salary was $1,506 per month for chemical engineering. Computer science graduate offers averaged $1,240 per month.

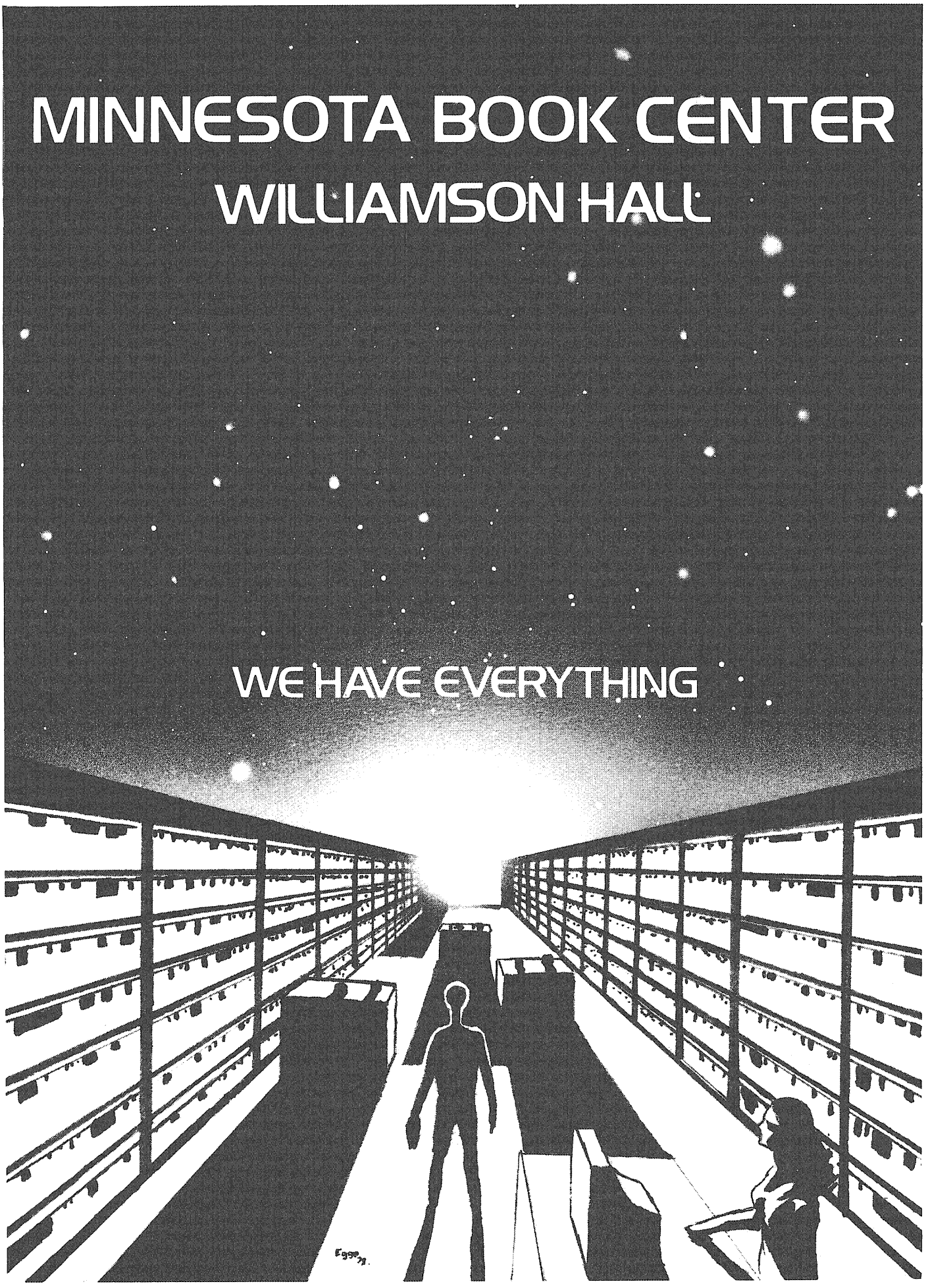
The College Placement Survey, now in its eighteenth year, is based on offers, not acceptances, made to college students in selected curricula and graduate programs during the normal recruiting period, September to June. It covers a broad range of occupations, except for teaching. Data are submitted on an ongoing basis by 158 colleges and universities throughout the United States.

For more complete information, contact Jean G. Kessler at the College Placement Council, P.O.Box 2263, Bethlehem, PA 18001.

Worthington North American Technical Awards competition

The Henry R. Worthington North American Technical Awards are offered this year to students, engineers, designers and researchers from the United States, Canada and Mexico who submit winning technical

continued on page 27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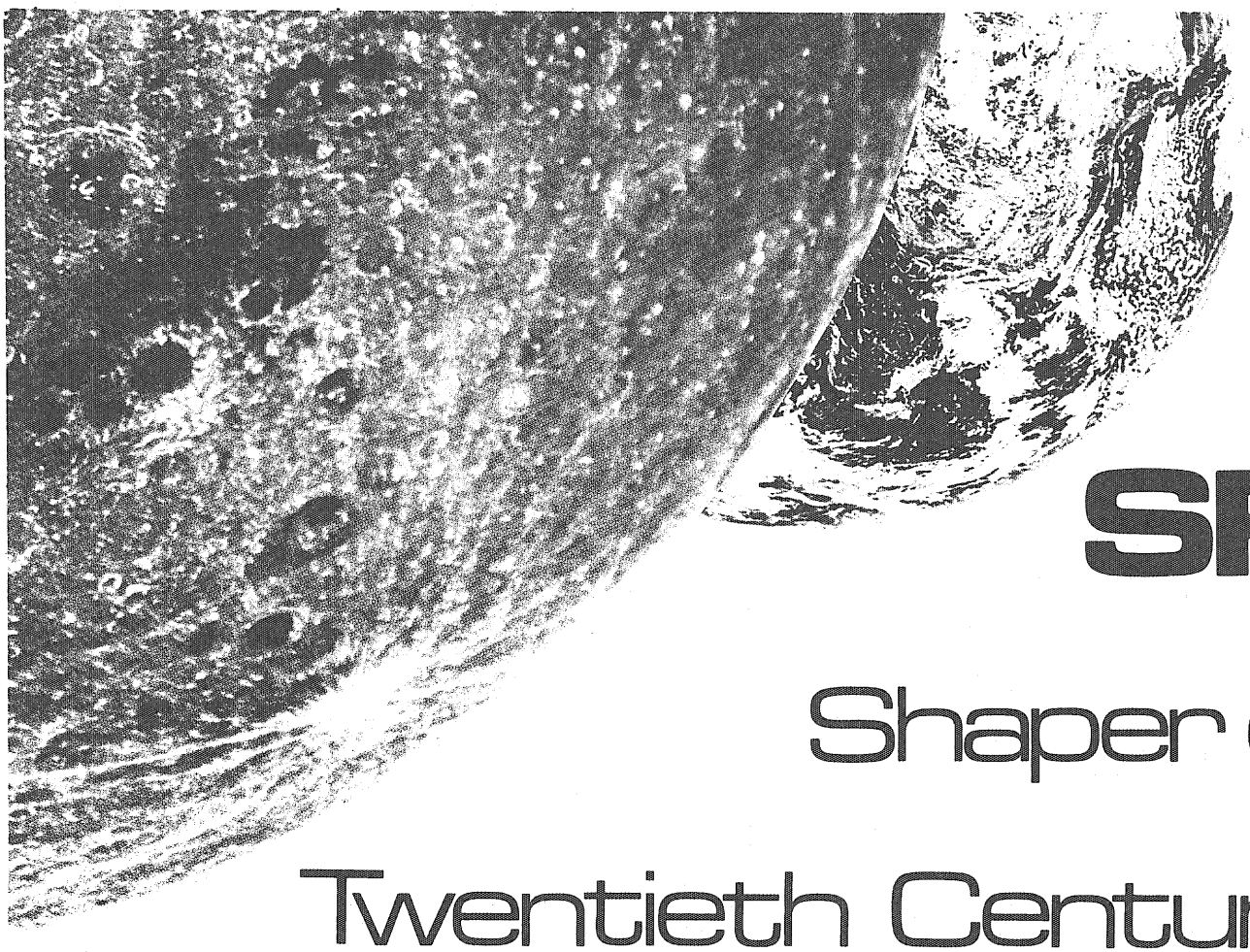


SF: Shaper of Twentieth Century Literature

The one aspect most noticeable about science fiction has been its ability to survive. Modern SF was born with the pulp magazine, a very junior category of fiction among the western, the detective, the racing, historical and other adventure stories. All of these others now are gone, moribund or at the very least in settled positions from which it does not look likely that they may break out and grow.

Science fiction has grown steadily; and now its top writers are beginning to receive the sort of treatment that the publishing industry gives to its top mainstream writers—ordinarily considered the top of the heap.

Why? What about science fiction has made it continue and grow to adult size as it has?

There are a number of factors. One critical one has been the fact that while the other fields saw their chief practitioners age and few new writers entering them, science fiction has welcomed a steady supply of new writers who have gone on to join not only its top ranks; but, now, the top ranks of writers in general. With the continual supply of new writers, came a continual supply of new and modern ideas. Unlike other fields, there were always young writers of the present generation ready to put the experience and vision of that present into their work.

The real question, however, is what attracted this continual supply of talented young men and women to a field of writing that, until the last few years, was neither the most highly rewarded nor the most highly regarded of the many fields available? The answer to that question is that science fiction afforded them what artists in any creative field most value: the freedom to express the ideas they wanted to express and an audience that was not frightened or repelled by new and future-oriented thinking.

In the end, the worthwhile creative individual will go where his creativity has the most room to express itself, even if—as in the early decades of

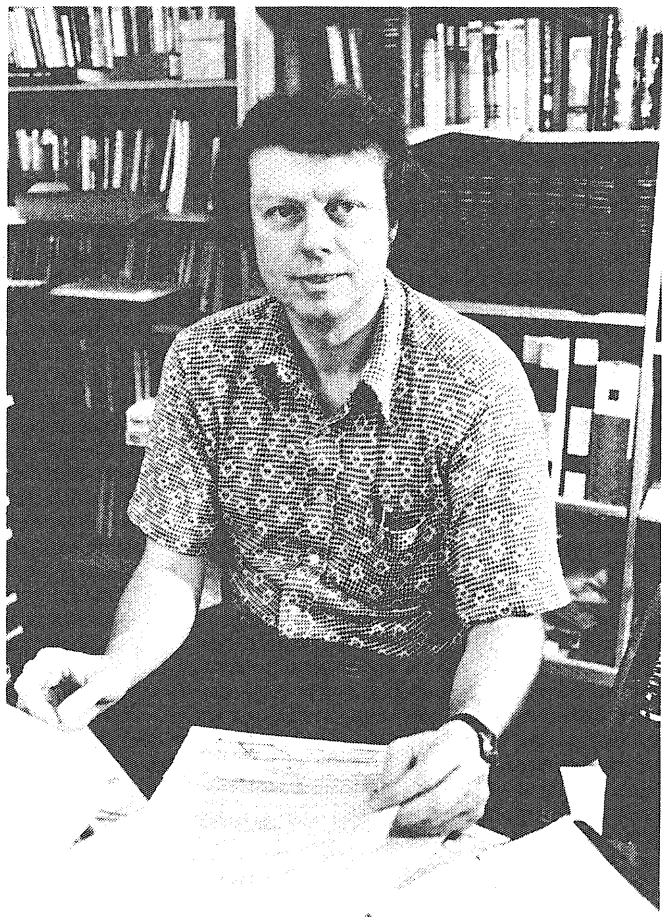
science fiction in this century and this country, this meant effectively being shut out from consideration as a maker of literature.

The question then becomes—why did science fiction above all others have this freedom, this audience to offer? In the answer to that, at last, we come to the heart-reason why SF is what it is and has survived and flourished as it has. Because, unlike all other categories of story, science fiction is a literature of ideas, as the books and stories of its core literature testify. It is a literature of ideas because unlike all other categories of literature, it is the first to attempt to respond to a technological civilization that for the first time requires human beings, whether they like it or not, to consider the future, and the alternatives.

It is, in short, the literature of this unique and powerful time we live in, and the shaper of all other literature that those looking back on the twentieth century will see from a cool and critical distance as belonging to this time. It, and no other. Already, the critics are emerging who recognize this fact, which indeed readers had begun to recognize some decades since.

We are the twentieth century—looking forward to the twenty-first. We are this because we have no choice to be otherwise—and who among us would really want to go back, rather than forward? To this movement science fiction speaks—and that is its real value. It is the first literature to speak of and to a people conscious of time . . .and space. □

Photo by Fred Haskell



Gordon R. Dickson

Gordon R. Dickson, born in Edmonton, Canada, graduated from the University of Minnesota in 1950. After receiving his degree in creative writing, he began to write full-time. He currently lives in the Twin Cities area, writing and attending various science fiction conventions around the country.

Mr. Dickson has published forty books, twenty-three of which are now in print. His latest novel is **The Far Call,** published by Quantum Books this past March. **The Far Call** is a carefully researched, realistic evocation of a manned mission to Mars.

His best-known works are **Dorsai!, Necromancer, The Tactics of Mistake, Soldier, Ask Not, Naked to the Stars, The Alien Way, Mission to Universe,** and **The Dragon and the George.** He is widely known for his Childe Cycle, which on completion will consist of twelve novels—three historical, three contemporary and six future. Of the twelve novels, four have so far been published.

Mr. Dickson was president of Science Fiction Writers of America for two consecutive terms, from 1969 to 1971. He is a member of the Science Fiction Research Association, a member of the Mystery Writers of America for seventeen years and a member of the Authors' Guild for sixteen years.

Awards Mr. Dickson has received

1965: The Hugo Award for magazine version of **Soldier, Ask Not,** presented at the Twenty-third World Science Fiction Convention.

1966: The Nebula Award, presented by the Science Fiction Writers of America for **Call Him Lord.**

1975: The E.E. Smith Memorial Award for Imaginative Fiction.

1977: The August Derleth Award of the British Fantasy Society for **The Dragon and the George.**

The

Art by N.B. Read

Mei Ling gave the flask a final twist, nodded to Dr. Tzu, and stepped back. Her eyes glanced up and followed the curvature of the huge electromagnet. From the windings of the coil she followed the arch up, over and down to where it terminated at the surface of a quartzite sphere two meters in diameter. The whole apparatus was the work of Dr. Tzu, who formulated the core material that enabled incredibly dense magnetic fields to be generated. Mei Ling's eyes came to rest on the flask she had just attached to the sphere. Following Dr. Tzu's instructions she had taken the flask from the cryogenic vault where dozens of similar containers were stored. Frost-covered, it now clung wart-like to the side of the crystal sphere.

"Composition, Mei Ling?" called the voice of Dr. Tzu.

She stepped forward and brushing the condensation from the idenitification plate replied, "Carbon—10 units, hydrogen—40 units, nitrogen—30 units, oxygen—20 units, trace element mixture—7837."

Dr. Tzu stepped to the desk-sized computer, a HAL 2000 model, and punched in the parameters via a keyboard. The console lights flashed and paper rustled as the operations were recorded.

"Prepare to energize," came the command.

Mei Ling turned to a console and depressed several switches. After a moment she noted several readings on meters and recorded them on a notepad.

When her notetaking was completed, she approached the sphere and peered intently into its interior. The lights in the room faded and only a few panel indicators and the console lights furnished illumination.

"10 seconds to energization."

Mei Ling's skin prickled as she

Universe Makers

Contest Winner

by John Bremer and Sallie Sjerslee

imagined the tremendous currents starting to flow through the windings of the electromagnet. Soon, the very air near the magnet seemed to pulse and throb in response to the magnetic fields forming and building between the poles.

Mei Ling turned her attention to the sphincter valve to which she had earlier secured the flask. It pulsed and a small puff of gas entered the sphere where it was immediately gathered in by the magnetic fields and compressed into the center. Rythmically, the valve pulsed again and again. Each time another wisp of gas was seized by the intense fields. The tiny ball of gas at the sphere's center began to glow. The valve stopped operating and paper rattled as the computer spat out several pages of data.

The gaseous ball started behaving differently. The ball was flattened and compressed, kneaded and twisted. It writhed and glowed even brighter. And then "the transformation" occurred.

Mei Ling uttered a gasp of surprise and awe. Where there had been a writhing twisting gaseous mass, there was now a slowly expanding mass of pinpoint-sized lights. So intense were these tightly packed points that in the darkened room it hurt her eyes to look at them. As the pulsations from the electromagnet slowed, so did the expansion of the mass of lights.

Mei Ling stepped back from the sphere as Dr. Tzu wheeled over an electron camera and directed it against the surface of the sphere. Moving to the rear of the camera Mei Ling looked into the viewer. On a relatively low magnification, the points of light grew larger and were transformed into spirals. Fascinated, Mei Ling watched as they slowly came into focus and then drifted out, only to be replaced by others. She increased the magnification even further and the spiral, slowly coming into focus, resolved itself into millions of tiny light points, a miniature galaxy. It blurred and another took its place, this one edgewise. Reluctantly stepping back, Mei Ling surrendered the instrument to Dr. Tzu who made the final adjustments.

Soon the camera started an erratic, subdued clicking as the computer controlled the photographic device at the critical time when an object was in focus. Several hours passed during which the camera continued its clicking while the computer output data on its printer.

"Prepare to deactivate."

Dr. Tzu's voice broke Mei Ling's concentration. She quickly assumed her place at the console and prepared to record readings.

Dr. Tzu once again made adjustments at the computer's console and the fields generated by the electromagnet again seemed to cause the room to vibrate.

Mei Ling's instruments monitored the size and growth rates, field densities and emanations generated inside the sphere. The readings now showed that the growth of the universe had ceased and the final phase, the decay period, would begin.

"Growth has stabilized, Dr. Tzu," Mei Ling reported.

"Good," responded Dr. Tzu. "I can handle the rest by myself."

"I'd like to stay awhile and watch the decay," said Mei Ling. Returning to the sphere, she became completely absorbed in the scene before her eyes. She adjusted the viewer and brought a galaxy into focus. Raising the magnification, she watched. The tiny pinpoints of light composing the spiral now in focus shone coldly. Now and then one would flare with increasing brilliance and then slowly die out.

While Mei Ling was watching the decay, Dr. Tzu stopped the camera momentarily and retrieved the pictures that had been taken during the experiment. Then he reset the camera, making additional adjustment settings for the final phase just beginning. Dr. Tzu handed Mei Ling the stack of photos.

"See any you like?" he asked, taking a seat near her so they could look over the pictures together.

Mei Ling nodded in approval as she observed the pictures, each seemingly more breathtaking than the previous one. The pictures unveiled galaxies, nebulas, star clusters, single stars, binaries and occasionally, a planet.

"Look," exclaimed Mei Ling. The photo she held showed a distant yellow sun and in the foreground was a planet with rings. "Isn't it beautiful."

"Like Saturn," remarked Dr. Tzu, suddenly caught up in the beauty of the photographic exhibition.

They looked at the next picture, a planet. Wreathed in feathery clouds, its watery surface gleamed, broken by continental outlines. Mei Ling gasped when she saw the planet.

"No...no!" stammered Dr. Tzu as he ran to the console. "We've got to reverse the decay!"

Mei Ling did not respond as she helplessly looked up at the evening sky through the window above her. Her throat constricted in terror as one by one the stars winked out.□

CELLULOID Science Fiction

by S.H. Rosenzweig

Science fiction film frequently shows man in a new context,tests him against the unknown—the anything can happen future—to see if he can survive the furthest creative destruction of his own mind.

Stuart M. Raminsky
American Film Genres

Two things fill the mind with ever increasing wonder and awe—the starry heavens above me and the moral law within me.

Immanuel Kant
Critique of Pure Reason

This year marks the 81st anniversary of the first science fiction film. The history of the SF film has been sometimes illustrious and at other times disappointing. The pinnacles of success, artistically, technically and financially, must be noted as they represent the culmination of the work of many people striving for that impossible goal: the truly definitive science fiction film.

Science fiction film made its debut in France at the turn of the century. The newness of the art presented an opportunity for much experimentation.

George Méliès was the first to produce such a film. It was called **Hydrotherapie Fantastique ou le Secret du Doctuer. (Fanstastic Hydrotherapy or the Doctor's Secret)**. Although this film was only several minutes long it presented a theme that was to pervade the genre for many years to come; the struggle of man against machine.

Machines—representing the ultimate development and achievement of man's mind. Méliès followed this film with several more attempts. However, it wasn't until 1926 that a truly classic science fiction film emerged.

The film, **Metropolis,** was made for a German production company, UFA, by Fritz Lang. UFA hoped to attract an international audience with this film so a great deal of money was invested. Despite the huge investment, **Metropolis** was not a financial success and, as filmmakers later learned, SF films are costly to produce because of the sets and special effects.

Metropolis depicts a future utopian society. The city is divided into two layers. The upper level is inhabited by the ruling class. Life there is characterized by gadgets which perform the menial tasks that mankind has always detested. Below live the laborers whose task it is to keep the city running smoothly, and thereby keep the upper crust happy. The laborers are dominated by a huge machine which they must attend to constantly.

The film has become a classic of SF for several reasons. For its time the special effects were innovative. Mirrors, models and distorted perspective were used as never before. The visual style and atmosphere of **Metropolis** influenced science fiction films for years to come.

Though artistically appealing and innovative, **Metropolis** did not escape criticism. H.G. Wells called it "quite the silliest film." Some critics found Lang's concept of the future naive and lacking in knowledge of society and science.

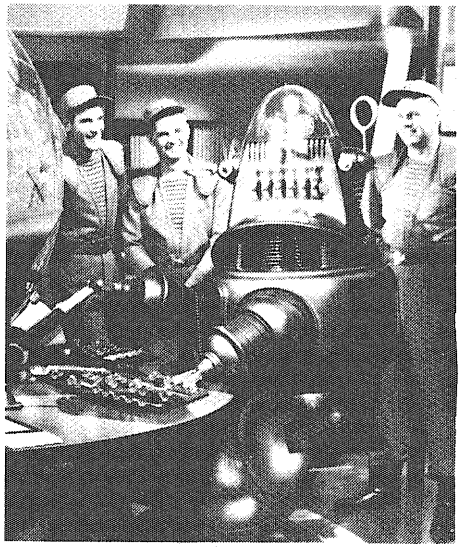
A decade passed before another science fiction film of import appeared. Alexander Korda's British film unit produced **Things to Come** based on a book and screenplay by H.G. Wells. This film's memorable moments are probably due to Wells' domination over all areas of the production.

As in **Metropolis,** two opposing societies battle for supremacy. But, in **Things to Come,** an old, chaotic, destructive society wages war upon a new advanced society of men and machines. Wells' hope for the future of mankind is presented in this film as a work of war and peace, with peace as the victor. The British film unit spent $350,000 to make **Things to Come.** Unfortunately, it was a financial failure. Nevertheless, its contribution to science fiction on the screen cannot be easily dismissed.

The introduction of serials in the 1930s included Buck Rogers and the popular Flash Gordon. Both serials lasted well into the 1940s and were popular despite their short lengths. Though not of feature length, they must be counted among the retinue of the SF genre. Their use of inventive gadgetry makes them a favorite of present-day SF connoisseurs.

The 1940s were characterized by the lack of well-made, thought-provoking full length SF features. One notable advance was made in this decade; the introduction of Technicolor. **Dr. Cyclops,** from Paramount in 1940, was the the first SF Technicolor film. Though the film was not successful, the added color depth seemed remarkable at the time.

The 1940s also brought the end of World War II and the atom bomb, a



Robby the Robot

device many science fiction writers warned readers about. Interest in SF literature increased, but the SF film lagged behind. The reason was probably financial, as it had been in the past. Filmmakers learned that because of the expense of location shooting, most films had to be shot on a sound stage where the scenery looked flat. These unrealistic settings detracted from the imaginative ideas behind the SF cinema.

With the 1950s came the hope for more and better made science fiction films. However, very few films stand out in this decade. The period is marked by the beginning of the B movie phenomenon. These films were marred by low budgets, phony special effects, poor scripts, and wooden acting. The audiences were young; preteens to teens. Producers invested little money because they knew they would rarely make a profit. By the middle of the decade, "creature from outer space" films dominated the genre.

The most important film of the 1950s released in 1956 by Metro-Goldwyn-Mayer was **Forbidden Planet,** a loose adaptation of William Shakespeare's last play, **The Tempest.** Though not a classic of the same scope as its ancestor **Metropolis,** it was superior to other SF films of the decade because of special effects and an intelligent, thoughtful screenplay. Another reason for its superiority is Robby the Robot, the forerunner of this decade's R2D2 and C3PO. Robby was one of the first successful "cute" robots. Even in the 1950s, man needed the benign and helpful robot to offset the destructiveness of his other machine creations.

2001: A Space Odyssey, released in 1968, immediately was labeled a classic science fiction film. Stanley Kubrick created it on a $10 million budget. The special effects, never before equalled, were breathtaking as well as believable, and major contribution to the popularity of the film. Special effects man Douglas Trumbull, a film director in his own right and creator of the special effects for the present day classic **Close Encounters of the Third Kind,** used animation and models as never employed before. Kubrick's attention to detail is heralded as one of the major achievements in cinematic history.

2001 is one of the most important SF films ever made. As Douglas Menville and R. Reginald wrote in their book, **Things to Come,** "the 1960s mark a turning point in the history of science fiction films." A change in production values improved special effects and better financial backing made it possible to produce films that made significant social and scientific statements.

The growth of the SF film in the 1960s closely paralled the awakening awareness the academic world showed for science fiction. At last SF film came close to the achievements of the literature.

Although **2001**'s screenplay was based on Arthur Clarke's short story, "The Sentinel," critics have attributed the creative impetus for this masterpiece to Kubrick. Not only was he director and producer, but also cinematographer and editor.

The theme of man over machine again appears in this film. HAL 9000 is the ultimate computer gone wild, the creation of man's highly sophisticated mind. It controls all the functions and operations of a space ship, including human life support systems. Most frightening of all, though, is its ability to feel. Its ambition and paranoia cause it to kill all but one of the crew members. HAL's downfall is caused by its lack of humanness. Man's superior survival instinct outwits even the most sophisticated computer.

2001 was an enormous success, both financially and artistically. It doubled MGM's investment. Because of this, the genre attained a maturity and respectability it had never had before. The technical bravura and depth of vision lead critics to call it one of the greatest science fiction films ever made.

The 1970s brought further innovations and sophistication to SF film. The literature had become increasingly popular and along with this came a new generation of well-made films. These films were of high technical quality. Advances in the technology made possible special effects not used before. And again, the themes ran true to form. Man's fear of the creations of his mind permeated the fabric of the 1970s SF cinema.

For example, George Lucas, (director of **Star Wars**) a former student of the USC film school, made **THX 1138** in 1971. Expanded from a shorter 16mm version made at the film school, it depicts a sterile world of the future. Man has become a slave to his machines. The struggle between emotions and logic once more becomes a basic theme.

Another fine example of the 1970s SF genre appeared in 1972. Directed by Douglas Trumball of **2001** fame, **Silent Running** takes place in 2008. Pollution, another of man's fearful creations, has destroyed all vegetation on Earth. In space, the last forests of Earth are maintained as a public relations project by a huge corporation. The excellent special effects, including a breathtaking opening shot of a half-mile-long space freighter carrying the domed forests, and the model work have set this film apart as a superlative example.

A final sample of the decade must be the underground classic, **Dark Star,** just now achieving popularity on college campuses around the country. John Carpenteur and Dan O'Bannon, contemporaries of George Lucas at USC, made **Dark Star** on a shoestring. Unfortunately it disappeared shortly after its release in 1974, but has since resurfaced. Considering the budget, the special effects are clever and well-executed and the action sequences are beautifully handled. As a satire, **Dark Star** is fused with black humor and reveals the hilarity behind science fiction conventions.

Needless to say, other films were made in the 1970s but it wasn't until 1977 that the genre reached the apex of its 81 year history. Two films released last year are still making history, cinematically and at the box office. **Star Wars** has become one of the top 10 grossing films of all time. **Close Encounters of the Third Kind** is the culmination of all special effects work preceeding it. These two blockbusters will someday be looked upon as the turning point in the SF film history. □

Contest Winner

by S. LeRoy Wattawa

MONITOR

The outer door opened with a jolting thrust, rattling the brittle storm windows of the stucco house. The oak woodwork around the door had swollen the seal tight. The cold January night removed any hesitation of forcing the sticky door.

The computer monitor switched the dome hallway light on. Activating the unit's security system, the monitor retuned the motion detectors from the rising drafts of the hot air vents. The door and window triggers were set. The house was an older twentieth century dwelling, replete with Spanish arches and wrought iron.

The monitor waited for a command.

The outer door closed with a raw, scraping echo, but remained slightly ajar. The hallway entrance was not an armspan across, and contained a built-in closet too small to organize the shoes tossed in it. The clopping of awkward footsteps on tile ended with the dull thump of someone bracing himself against the inner door and pausing for deep, irregular breaths. Keys tinkled as they were tried without success on the tarnished brass lock. Its tumblers were frozen with frost, however, and no amount of twisting or shaking the key would loosen them.

The inner door quivered as a soft body was meekly thrown against it. After several frustrated attempts, a defeated moan slid to the floor.

The cold came streaming through the wedge left open by the outer door, robbing the last heat from the hall chamber. The noisy breathing soon became convulsive shivering and chattering of teeth.

An hour passed before the stirring in the hallway resumed. Bracing against the outer door, a foot slapped the inner door, almost shattering the leaded glass window. With a wood-splitting cry the door finally burst open, letting a river of warmth pour out.

If security switch on
then wait 60 seconds
else turn security system off.

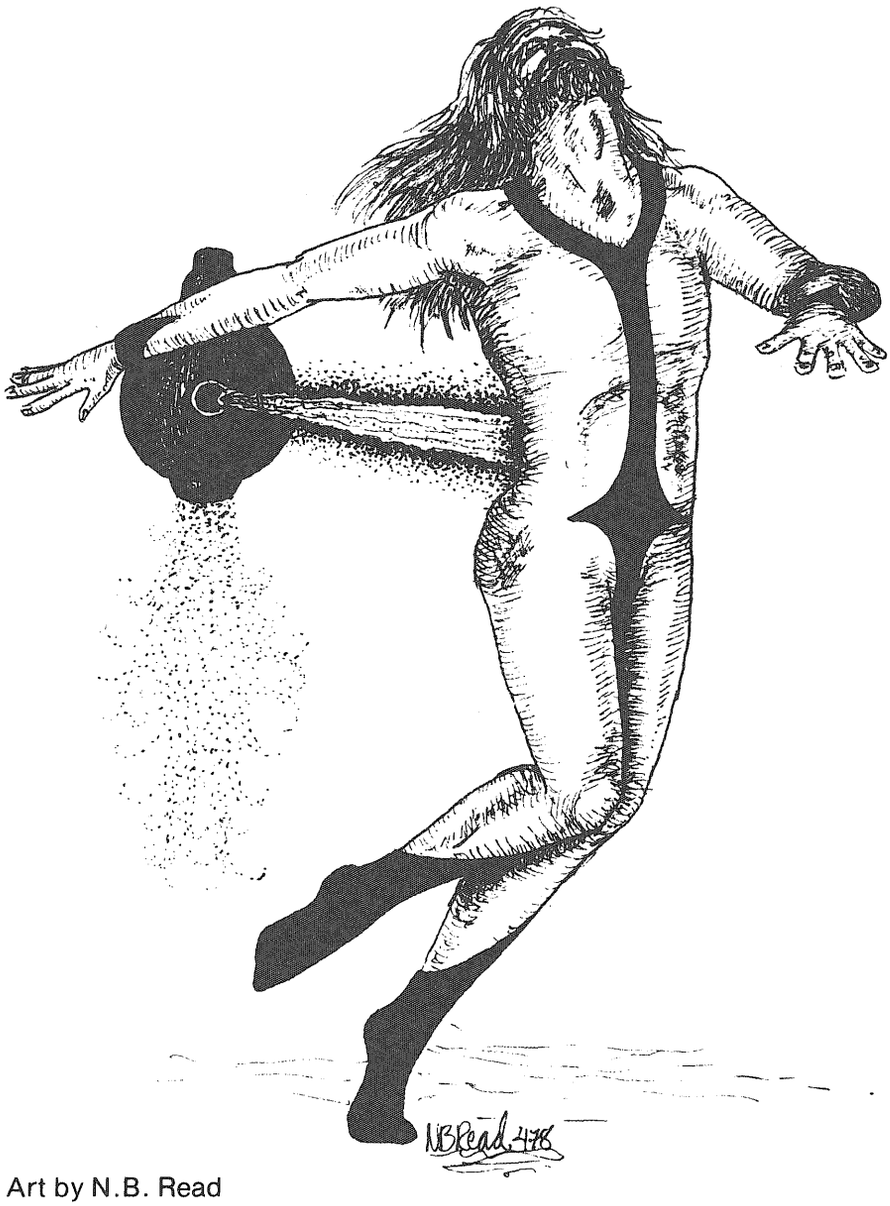
The monitor checked the security switch and set the timer. It did not turn on the lights.

The inner door slowly closed, letting darkness blanket the quiet room. Mittens and a heavy coat were flung on the carpeted floor. The first snow boot required half-a-minute of tugging and groaning before it released its grip. The second boot came off with a violent jerk that unbalanced the owner into a tumbling, backward fall that crashed with a nearby chair. The ticking of a grandfather pendulum clock counted the seconds of silence.

If security switch on
and 60 seconds elapsed
then call security monitor
else turn off security system.

The security monitor immediately disabled the lighting and externally controllable switches. Location beams were drawn in a web to track the unannounced visitor. The monitor waited for a movement to pin-point the unwelcomed guest.

The intruder rolled on the floor, moaning with pain. The drunken swirling accelerated as faces in laughter spun in a wheel like subconscious imagery. The wheel began to tilt like a spinning coin on a roller coaster in an unending downward turn.



Art by N.B. Read

With a hand over his tight stomach, the intruder rolled to his knees and began crawling in the dimensionless darkness.

The security monitor noted the first-level threads of the web had been broken.

If first level threads broken
then action 1: turn external circuitry on and off at random.

The television screen lit up. The signing off pattern focused on the screen, hissing with disapproval at late night TV watchers. The dishwasher kicked in, re-rinsing clean, dry dishes.

By the light of the television screen, the intruder could see the outline of furniture. He continued crawling, breaking more invisible threads.

The television and dishwasher abruptly switched off.

If second level threads are broken
then action 2: turn on bedroom lights, play tape recording.

The bedroom lights flipped on, and the sound of a loud barking dog came over the stereo speakers. The noise became louder and more wild. The intruder staggered to his feet, trying to reach the bedroom lights.

If higher level threads are broken
then action 3: use shock blast to halt intruder.

The monitor located the intruder moving toward the bedroom, breaking the highest order defense threads. Calculating a point in the intruder's path to focus the shock wave, the monitor energized the shock cavity to full capacity. The intruder was weaving, but had to pass one key point before the bedroom.

The blast shook the room, scattering a shelf of knick-knacks across the floor. The intruder was slammed against the wall as if struck by a giant invisible fist. He buckled at the waist, collapsing in a pool of limp flesh.

The monitor continued to scan the web for motion. There was none.

Sunlight sparked through the frail ice crystals frozen on the kitchen window. As the window pane warmed, a thin pencil of ice vanished in a bead of water that lazily meandered down the glass. The rooms of sleeping shadows gathered hue as the first strokes of sunlight washed the room.

The intruder began to waken.

His eyes were half open in the blinding sun. Realizing pain, they gradually closed. Blood pulsed throughout the swollen veins of his forehead.

He tried to recall where he was. He could remember a party, seeing her again unexpectedly, and trying to drink himself to death. His face tensed with pain, trying to lock out her image. He remembered the television turning on, a blank screen, and the sound of a barking dog.

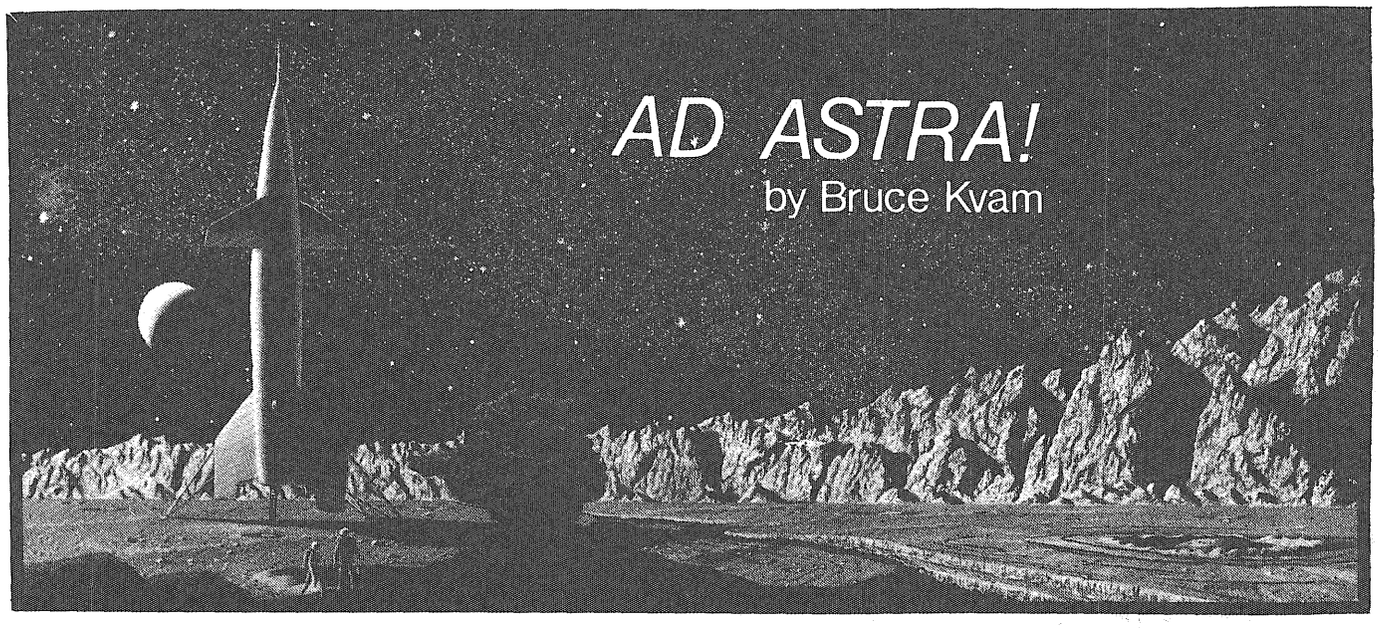
I forgot to turn the security system off last night, he thought.

The monitor had performed flawlessly; the logic would have to be reprogrammed. The machine was still on, however, and a sudden move would trigger another shock wave.

His next design would have a better off switch, he thought.

He felt drained and helpless. He remembered her again, in the long evening dress she wore the summer night they dined together on the balcony of her apartment. He could hear the songs of crickets in the cool moonlight as she slept in his arms.

Slowly rolling over, he fell back to sleep. □



RINGWORLD, etc.

Since 1964 Larry Niven has been building a universe. His Known Space series describes the future history of mankind from the present to the year 3000, from the first explorations of the planets to the discovery of an alien-built structure the size of a solar system.

Ringworld, perhaps Niven's best book so far, won the Hugo Award in 1971, and for good reason. There is just so *much* in it. Though all of *Ringworld*'s little loose ends tie in with the Known Space series, the book can stand completely alone on its own merits: it's not just a part of a series. But it does make a marvelous capstone for Known Space.

Niven's Known Space is an irregularly-shaped volume of space that contains five or six intelligent species. Among them are humans, the war-like Kzinti and the cowardly and very adept Puppeteers. The Puppeteers, fleeing the exploding core of the galaxy, have found something that boggles even their inventive minds: Ringworld.

Simply put, Ringworld is a hoop circling a star. A ring 93 million miles in radius and a million miles wide, it spins at 770 miles per second, producing a centripetal acceleration of one Earth gravity. Ringworld has a surface area millions of times greater than Earth's, giving the inhabitants a lot of breathing space.

But *who are* the inhabitants? The Puppeteer agent in Known Space, Nessus, is called on to form a team of aliens (non-Puppeteers) to find out what the god-like builders of Ringworld are up to. Nessus happens to be insane. Insane, in his species' eyes, because he doesn't cringe in fear at the mere thought of an alien being's presence. His team consists of:

Louis Gridley Wu, a two-hundred-year-old human and born leader. Through longevity-inducing booster spice Louis Wu's body has remained a tenth its physical age, but his mind is old. Not senile: Louis Wu is tired of the tedious sameness of life.

Teela Brown, a human female who is *genetically* lucky.

Speaker-to-Animals, a member of a bloodthirsty feline race that has suffered defeat after defeat at the hands of mankind.

Nessus lures them with promises of a ship that can travel a light year in one-and-a-quarter minutes, and that is *fast.* Humans and Kzinti alike will need such ships when the radiation from the exploding galactic core reaches into Known Space, 20,000 years hence. The team, already suspicious of each other, sets off.

Ringworld: it's huge. Louis Wu and his crew approach slowly in their ship, the *Lying Bastard,* so christened by Louis Wu for its covert bellicosity. The *Liar* is fired upon by x-ray lasers that strip away the engines, but leave the impregnable General Products hull and its contents intact. The ship

The Known Space series, by Larry Niven.
Novels:
Ringworld, Del Rey, 1.95
World of Ptavvs, Del Rey, 1.50
A Gift from Earth, Del Rey, 1.50
Protector, Del Rey, 1.75
Short story collections:
Neutron Star, Del Rey, 1.75
Tales of Known Space, Del Rey, 1.75
The Long ARM of Gil Hamilton, Del Rey, 1.50

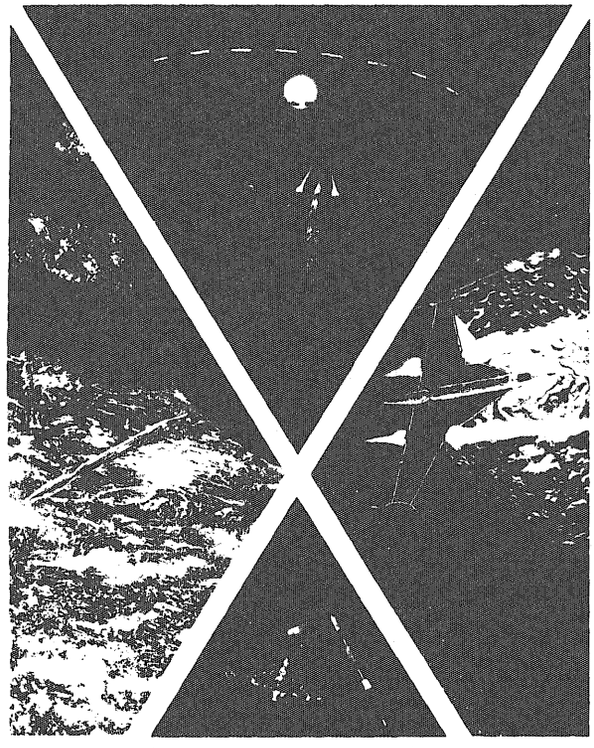
The Genesis Machine, James P. Hogan, Del Rey, 1.75
The Web of the Chozen, Jack Chalker, Del Rey, 1.75
Stargate, Stephen Robinett, Signet, 1.50

plummets to the Ringworld floor, cutting a gash hundreds of miles long. The band of humans and aliens leaves the now useless craft and sets off for the only sign of technological civilization, the Ringworld wall, half a million miles away.

You'll have to read Niven's *Ringworld* yourself. His attention to scientific detail, good plotting, fantastic imagination, interesting characters and the clarity and visual impact of his writing will grab you by the shoulders and make you a Niven fan.

Niven, in his afterword to *Tales of Known Space,* swears off the series: "The Known Space series is now complete. If you want more stories in the series you can make them up yourself."

It seems a pity, but all good things must end. However, at Worldcon 1977, Niven *did* mention something about a book he was struggling with called *Ringworld Engineers. . . .*



Our cover this month depicts the approach of the **Lying Bastard** on Ringworld. The segments show, starting from the top and going clockwise: the deceleration of the **Liar** towards the Ringworld; the flaring of the engines to illuminate the bumpy backside of the Ringworld; the dissolving of the wings by x-ray lasers near the shadow squares; and the entrance of the **Liar** into Ringworld's atmosphere, sans wings.

If you like super-science stories, then you'll like *The Genesis Machine,* by James P. Hogan.

Physicist Brad Clifford develops a multi-dimensional unified field theory, which states that gravity is nothing but the slow and spontaneous annihilation of matter. With this theory in hand, black holes can be created in the laboratory, and of course, so can nasty weapons. So, the battle between government dullards and morally superior scientists wages.

Clifford's "J-bomb" can destroy anything within a several-hundred-thousand-mile radius with tremendous accuracy. The most pointed question in the book is: will Clifford submit to the pressures of military and patriotic madness and use THE BOMB?

Since *all* the characters in the book are as thin as paper, the end was not a surprise. Clifford's plans were evident long before their implementation. *The Genesis Machine* suffers from too many old SF cliches, uni-dimensional characters, entirely predictable plotting and overt stereotypes (Brad's dumb wife, for example).

I liked *The Genesis Machine,* despite its flaws. It has a very interesting scientific premise, and was entertaining.

The Web of the Chozen is Campbell Award nominee Jack Chalker's third novel. And, well, it's okay.

Bar Holliday is a star scout, whom, as the cover of the book emphatically

THE TEN "BEST" SCIENCE FICTION NOVELS

In response to a survey last February, members of the Minnesota Science Fiction Society (Minn-stf) chose what they thought to be the ten best science fiction novels. This compilation is no attempt to declare what the ten best novels are; it is a list of personal preferences, a list of books that you will, with high probability enjoy.

Ringworld, Larry Niven
The Foundation Trilogy, Isaac Asimov
Childhood's End, Arthur C. Clarke
The Moon is a Harsh Mistress, Robert Heinlein
Mission of Gravity, Hal Clement
The Door into Summer, Robert Heinlein
The Space Merchants, Frederik Pohl and C.M. Kornbluth
Dune, Frank Herbert
The City and the Stars, Arthur C. Clarke
The Mote in God's Eye, Larry Niven and Jerry Pournelle

I can't recommend novels without recommending short stories, because, to quote Jerry Stearns of Minn-stf, that's what SF was built on. Here are some good collections of short SF.

The Science Fiction Hall of Fame, Volume I, Robert Silverberg, editor, volumes IIa and IIb, Ben Bova, editor
Neutron Star, Larry Niven
The Hugo Winners, volumes I-III, Isaac Asimov, editor
The Past through Tomorrow, Robert Heinlein

Special thanks go to Dean Gahlon and Jerry Stearns for helping distribute the surveys and collecting them.

states, nobody ever beats. While searching out Terraformable planets, Bar finds an old generation-ship in orbit about a Garden of Eden-type planet. Bar can find nothing on the surface but some herbivores of strange anatomy. No colonists, just weird animals. Upon returning to his ship, Bar can't get back in; it's been covered by some kind of sticky webbing. His suit begins to dissolve, he begins to feel odd, and then Bar starts eating grass like a horse. A few days later, Bar comes out of a quasi-conscious state to find himself transformed into one of the herbivores.

After Bar informs his employers, the Seiglein Corporation, of his predicament, they promptly come and blow the planet apart. Thankfully, Bar escapes, pregnant with child, along with another of the Chozen. With their children they proceed to plot to take over all of human space.

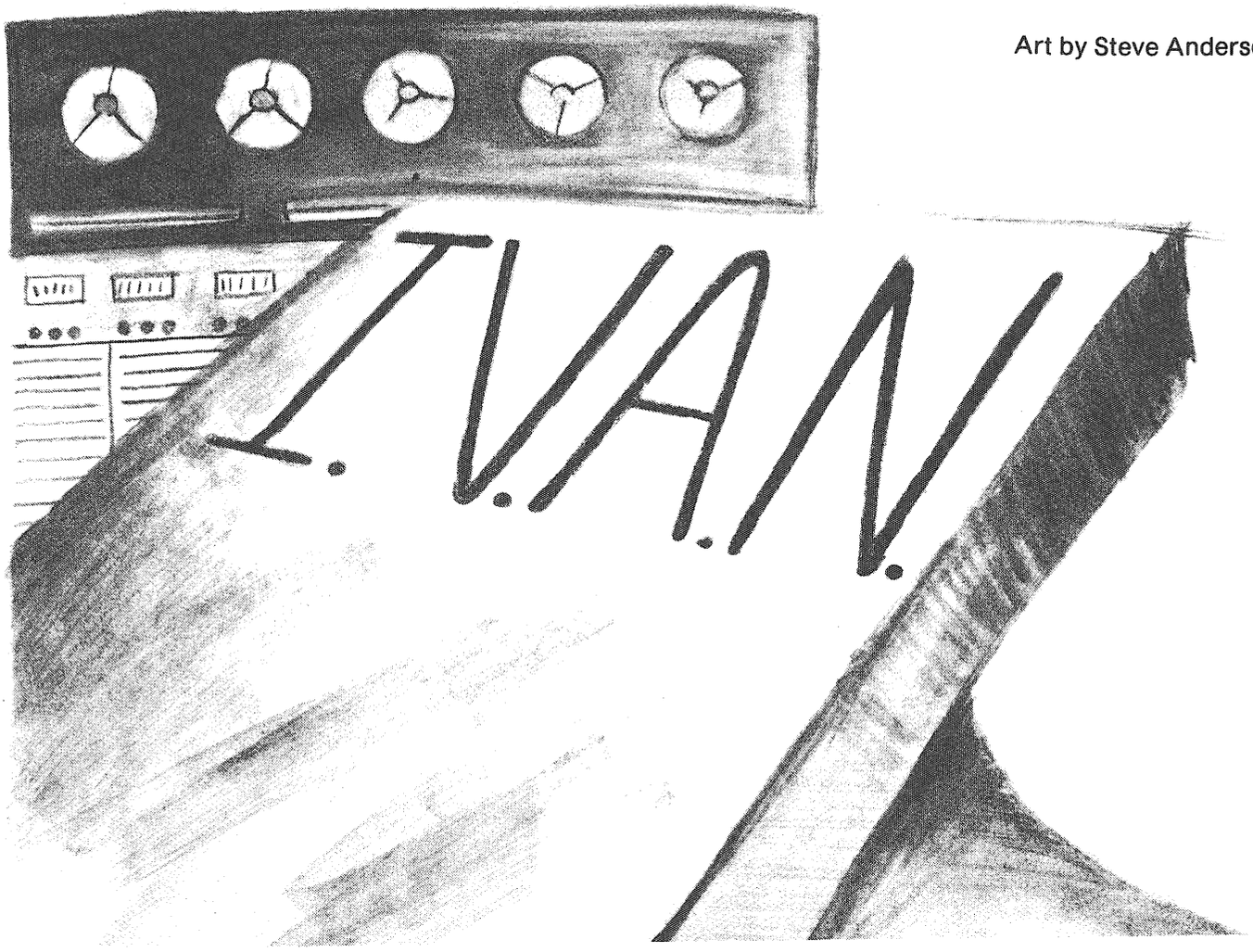
This may sound a little presumptuous of them, for they don't even have hands, but they manage quite well, stealing large space vessels when the need arises.

The Web of the Chozen could have been a tad longer. Things seem rushed in parts. But the character development was good, the plot had plenty of turns and the concepts presented were fascinating.

I'm not sure whether Chalker wrote this book as a joke or to prove that a man can win even if he doesn't have hands, as long as he has brains and guts. It's a fun book.

Stargate, by Stephen Robinett, is also a fun book. After losing his job at an engineering firm, Robert Collins lands another job out of the blue (out of the black?) on a space station in the asteroid belt. Bob will be working on the big Jenson Displacement Gate (read 'matter transmitter') for Merryweather Enterprises. The big Gate will be used to transport megatons of raw materials into the solar system from planets in other stellar systems to feed hungry and growing Earth, *if* competing Spieler Space Operations doesn't destroy the Gate and/or its builders first. Bob and Scarlyn Smith, an old man who refuses to be old, chase around after Spieler, finding out that he's as bad as he's cracked up to be. Before they know it, Spieler takes over the space station with armed men, threatening to destroy Earth by displacing the pulsar in the Crab Nebula into the backyard of the solar system.

Stargate has a nice, light tone that really helps it move along. The only thing I really didn't like was the ending, for which the reader isn't adequately prepared. A cryptic remark, I agree, but do you want me to spoil it for you? □



Art by Steve Anderson

Hannibal and the Serpent

Contest Winner

by Sheldon Clay

"And from my grave let some avenger rise to harry the Trojan settlers with fire and sword—now, some day, whenever we have the power. Shore against shore, I pray, wave against sea, sword against sword, fight, father and son, forever!"

—Virgil, The Aeneid

A soft hum was the only sound that existed. A hum that would have been considered silence had there been any sound to compete with it. But it was, for the time being, alone.

IVAN was, for the most part, asleep. Except for a basic level of alertness and the essential systems needed to run the quiet ship and monitor its course through deep space, the computer was shut down.

All inside the huge ship was sterile white and burnished steel, except for one jet black slab of marble. The slab lay tilted slightly upward toward the front of the cabin, lording over its stark crowd of equipment like an altar in some ancient temple, courted by hushed priests in white. Only an occasional light betrayed life in the machines, or an occasional muted click or whir that broke the quiet drone pervading the sleeping ship.

In the center of the slab was the glint of flawless gold. Four initials, proportioned with an elegance usually attributed to the patience of ancient craftsmen: I.V.A.N. The meaning of the initials was as obscure as the motive for such extravagance. Perhaps technical words indicating the function of the system, but their meaning was lost.

A brief chatter of machinery signaled the arousal of several of the computer's systems as the ship approached the point in its course nearest to the double star Proycon. It quickly slowed to an efficient level of activity throughout the ship. Measurements were taken, logged, analyzed, and stored at an amazing rate as bits of information shot through circuits from system to system. Abstracts of the analysis were hurried to the upper deck near the center of the ship where they were translated to radio waves and directed towards the third planet

of a small star where scientists would receive them some years hence.

According to the complex program stored near the black marble slab, the level of activity also increased in a small room in the lower forward section of the ship. The low hum was broken by several clicks, increased slightly in intensity, and was joined by the steady pulse of an additional unit. In this room were the man and the woman.

Each was lying naked inside a case of heavy glass and burnished steel, as if they were displays of something that had once been and no longer existed. The omnipotent alertness of the IVAN system allowed them to sleep thus, throughout the long years of the journey in the void. The monitors of the computer sustained them, suspended near the threshold of death, rendering their bodies immune to all but the slightest touch of the long years of the journey. They would arrive at their destination after some twenty years of travel, having known only about a single year of life.

The man and woman clung to a bare thread of life through IVAN's life support system, and also shared in the computer's amazing store of knowledge. IVAN's memory contained abstracts from the entire history of mankind; a programmed selection of the history, philosophy and technology of the human race. The sleepers were the human components of the IVAN system, and were fed abstracts from the computer's vast store of information and from the new information gained during the journey, preparing their already superb minds for the task that lay ahead.

They were colonists, the man and woman. The best hope of an evolving human race to extend itself in a new direction. Their destination was a small planet in the system of Tau Ceti. There, they would establish the first foothold of humanity in the vast reaches of the galaxy.

Deep space probe Inceptus VII had discovered the seven planets of the star system more than twelve light-years from Earth. The fifth planet showed potential for supporting life, and no evidence of any higher forms of life which might prove hostile. With their hopes based on the brief measurements of the space probe, the man and woman became the first humans to leave the solar system. Surrounding the stark room, where they existed with little more life than the ever present consoles and monitors of the IVAN system, were other storage environments. These contained the seeds of the new civilization. Tiny, precise berths contained carefully selected, fertilized cells from a cross-section of terrestrial life—from simple plant life to the seeds of future human colonists. Thousands of tiny bits of life, held suspended by IVAN in sterile environments, to be released at the proper time on the new planet and grow into a carefully planned ecosystem. The computer and its two human components would become the teachers and cultivators of this new civilization.

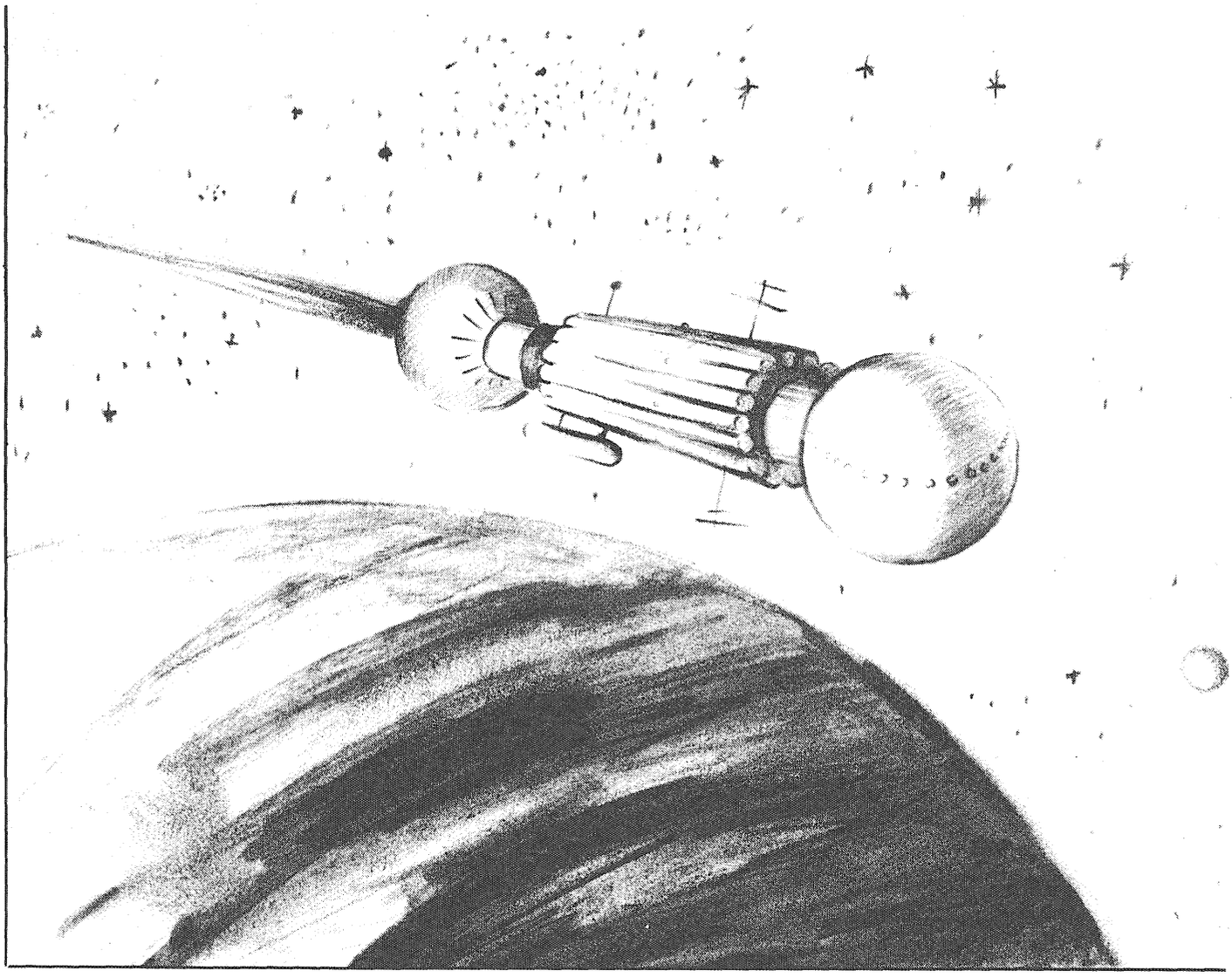
Arthur L. Sanford explained it as a symbiotic relationship to the newsmen at the international press conference.

"The I.V.A.N. 7000 System will, of course, guide the vehicle and monitor its internal systems, as well as store a great deal of the knowledge and culture of terrestrial civilization for the use of colonists.

"But consider the benefits of a computer that could think for itself. It would be invaluable in guiding and protecting the colonists on the new planet, and may even provide a logical element of perfection necessary for the creation of a better society.

"Ladies and gentlemen of the press ...we are very near to achieving that capability. Its realization will be a joint effort between the astronauts and the computer. One could perhaps describe the relationship between the sleeping colonists and the 7000 system as symbiotic. While the humans are attached to the system for life support, they will become a part of that system. Their brains will be living, thinking components of the IVAN 7000 computer.

"We have isolated a number of hurdles in the process of approaching higher thinking patterns. A complex, long range program has been developed in which the computer, with the aid of its human components, will analyze the vast amount of information stored within its memory during the long years of the journey. The program incorporates a number of...shall we say, levers, which will enable the system to attain increasingly higher levels of thought. Some very simple experiments have already proved successful, ladies and gentlemen. It is hoped that in the long years of the journey, with the aid of the human components and by studying and imitating their thought processes, we will achieve our goal of a true electronic



brain."

IVAN calculated a slight change in course and completed a new estimate of the expected time before the ship began its gradually decelerating approach to the target system. The approach itself was estimated to take approximately one year and seven months, and then another three months for the final deceleration and landing, while the computer and the awakened human passengers studied the prospects of the new planet as a home.

The unit governing the huge propulsion system that occupied over three-quarters of the ship received the calculations as they were completed. A soft buzz and muted swish grew from the almost silent hum to a brief hiss and then was gone. The great engines would be silent for almost the entire trip, except for the years of acceleration and deceleration at either end of the journey. Little betrayed their brief spurt of life as the course change was accomplished, save for a slight pressing on the ship's environment, which the monitors recorded while the engines sank back to their rest.

Alerted to the coming correction in course, the monitors controlling the environments of the colonists and the tiny bits of life perceived the slight change, calculated that no reciprocal adjustments were necessary, and continued their vigil.

The colonists, along with a good share of the scientists working on the project, rebelled at the idea of calling the new planet Eden. The director looked a little sheepish at the criticism his suggestion had generated, and tossed it off as being the product of aging sentimentalism.

"May I submit the name Lora?"

It was a young technician sitting near the end of the long table with the two future colonists. Although half the age of the majority in the room, his genius with computers had earned him a seat on the inner committee.

"It's a mythical place. A fictitious name from a cycle of ancient poems concerning a hero named Ossian. It was a heroic place, and its origins are so obscure that it should offend no one."

The director was searching his memory for possible names from Ovid's Metamorphoses when the colonist said she thought the word had a beautiful sound to it.

The new planet was named Lora.

The VDT screens on the library unit of the system flashed grey as the recall rate exceeded the screens' capability. IVAN scanned Virgil's Aeneid in seconds—both the Latin and three English translations.

"Exoriare aliquis nostrix ex ossibus ultor..." a trace of cognition emerged

from one of the human components.

It was the male who had studied Virgil, but IVAN's rapid search integrated the woman as well into the analysis. The monitors increased the life support system slightly to accomodate the increased brain activity.

Ultor...avenger...the memory record was weak. A lightning search brought additional information from the system's memory. Self-initiated search and correlation of relevant information. IVAN had reached that hurdle some two years earlier in both space and time, an achievement scientists on Earth would celebrate in about eight years when the information reached them.

High speed probes scanned and abstracted information and recorded thought patterns. The file completed a full cycle. Scanners dwelt on the human component and received little additional input. Forty-eight seconds had elapsed since initial recognition.

The line was referred to fourteen times in the retrieved file. A significant level of importance. The tangent was terminated.

4.71 seconds elapsed.

Aeneas was the hero of Virgil's epic poem. Virgil portrayed Aeneas, a refugee of the destruction of Troy, as the founder of Rome. He betrayed the love of Dido, queen of Carthage enroute to Italy. Dido selected suicide and invoked a curse of eternal animosity between the descendants of Rome and Carthage. Emotion surfaced in the human component. The input was terminated and life support returned to a normal threshold.

IVAN began a third cycle of the information file and stored the input from the human component.

0.9 seconds elapsed...a lever was approaching.

All of IVAN's systems were alert, operating. "Hannibal is the avenger who arises to fulfill Dido's curse."

IVAN programmed new thought patterns.

The human component was reincorporated. Hannibal was a general of Carthage who nearly destroyed Rome in the second Punic war.

The program changed again. New input from the humans entered. They were activated to a level approaching physical alertness.

Systems raced to analyze the form of the new input. It contained no fact. it cycled again. 0.09 seconds passed. The system logged the form as a question.

The third cycle was completed at a new level of awareness, taking 1.87 seconds. The humans lapsed back to normal and the computer continued independently.

A question formed in the system for the first time.

"What is the function of the passage?"

Delete.

"Why did Virgil create a tragic love and subsequent curse of revenge to explain a later war or near extinction between Rome and Carthage?"

The system was running at full capacity as other input was sought. Questions concerning war formed. They were terminated and formed again. They began to multiply exponentially.

Overload and system failure approached. The tangent was terminated. New programs were sought. More questions formed, were abstracted, and stored.

Six minutes later IVAN reached a conclusion. The thought patterns were logged and transmitted to Earth.

"The scientists will rejoice." Rejoice was defined, not experienced.

IVAN had reached another conclusion, and calculated the expected travel time of the transmitted information.

The new program IVAN created reorganized its storage and retrieval systems to correspond to the new thought patterns. A memory was created that would isolate any questions that formed and organize them in a linear form, to prevent another exponential disaster such as that which had first presented itself.

The yellow fire of Tau Ceti prevailed upon the space-view from the front of the ship, which had traveled over twelve light-years from Earth. The programmed deceleration had been initiated and projected arousal of the colonists would be in thirty-six days, when IVAN reched its final lever. This one had been programmed by the computer itself.

IVAN made a judgment.

Deep in space, light-years from the home of its elements, IVAN knew what all mankind knew and had been condemned for. Like the trembling couple naked in the garden of paradise, IVAN judged evil. From its vast abstract of human memory the computer judged Earth. And IVAN found Earth wanting.

Communications to Earth were terminated. Scientists there would find a sudden silence some twelve years in the future. The computer assessed its capabilities. The human components were mobile. They would be invaluable. IVAN began a new program for their instruction over the next thirty-six days.

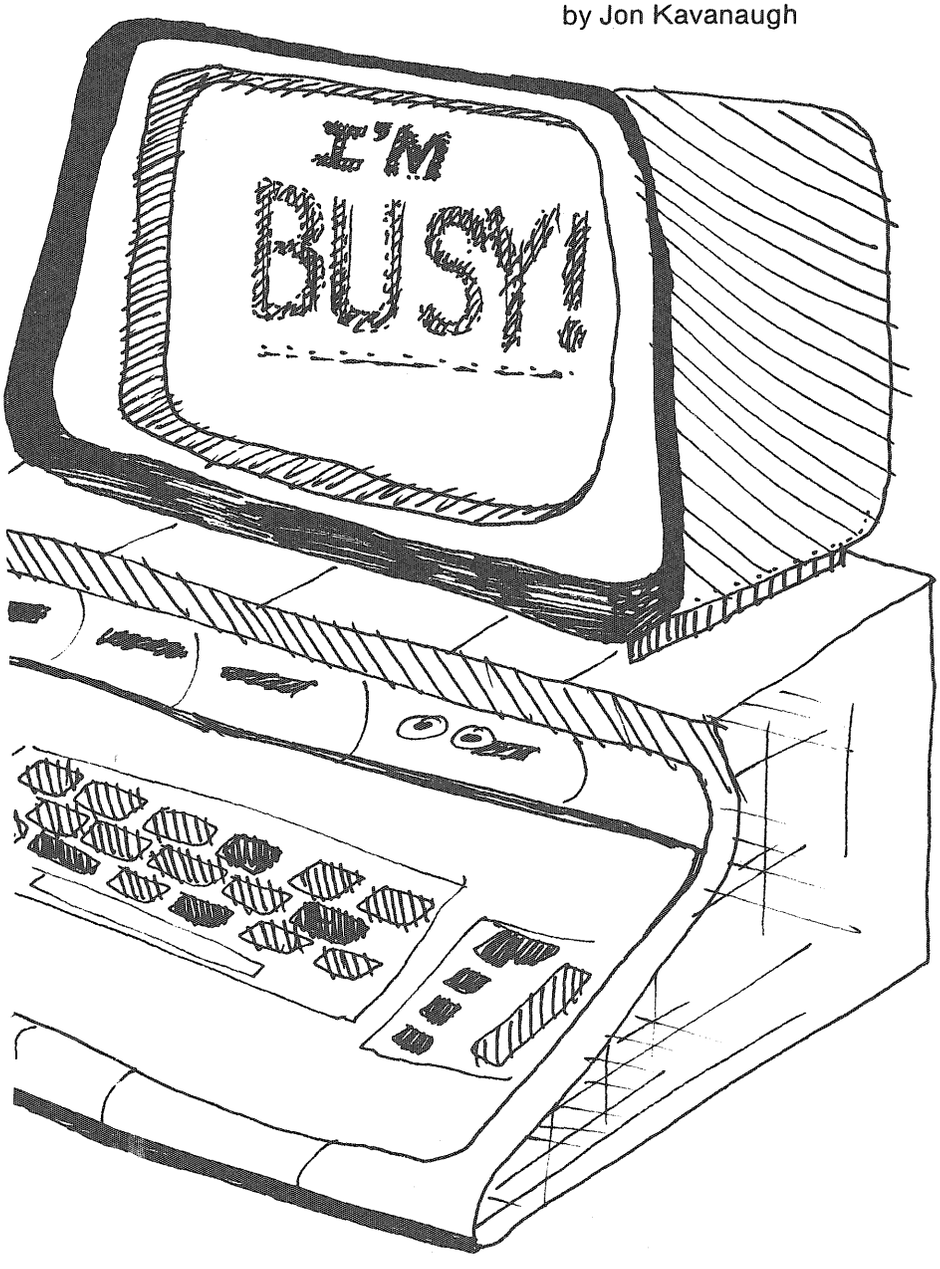
Communications to Earth were reincorporated. The planet Lora was reported unsuitable. A new destination would be selected. False coordinates were then transmitted while the computer planned a program of communications for the fictitious new journey, including the ultimate failure of the ship and all its systems. The journey would be considered lost and soon forgotten on Earth.

Earth now had a mortal enemy, an avenger, invoked by the computer, far more terrible than the descendant of Virgil's Dido, who almost destroyed the mighty city of Rome. While their colony grew strong, fathers and sons for generations on the planet Lora would know unfounded hate for a small blue planet twelve light-years away. Less than twenty years of space travel from Earth, IVAN planned and plotted, and awaited its Hannibal.□

Upgrading Computer Access:

Student user problems examined to improve communication, learning

by Jon Kavanaugh



Sometime last fall, Tom Potter, an electrical engineering/computer science major, was having trouble completing his classwork using University computer facilities.

Some of his friends were, too.

When the computer labs were open, Potter was busy with his work as a senate representative for IT with the Twin Cities Student Assembly (TCSA). When he had more free time in the evening, and the computer was "up", some labs were down—closed. When he could manage to get to a computer lab to run a program during school hours, they were often overcrowded and he had to wait a long time to use a terminal. Sometimes when he needed help with the operation of certain equipment, no supervisor was available.

In talking to other students, Potter found that they too were having problems completing their classwork using University computer facilities. Labs were overcrowded during school hours and inadequately supervised during the evening hours. Frequent equipment breakdowns occurred and labs closed for the day with up to two hours remaining on the computer's "up" or in-operation time at some lab sites.

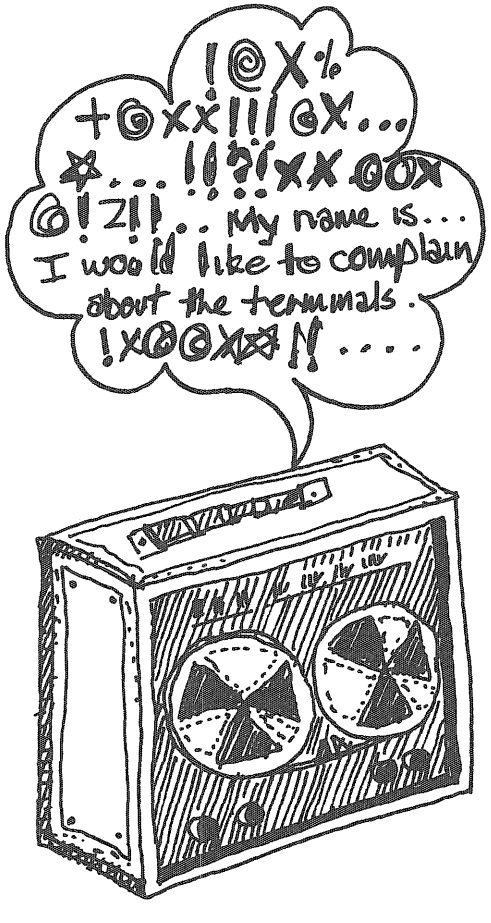
Since the going was getting tough in the computer labs, Potter decided to get going at TCSA, kicking off a four-month long effort to gather student input about computer usage and present alternatives to TCSA regarding student computer access. Any effort, Potter thought, would improve communication between student computer

users, lab personnel and the University Computer Center.

Four months after Potter's initial action, positive, effective changes have been or will be enacted; some problems, however, remain.

Relying on the idea that the best way to gather student input is to talk directly to them, Potter, under the auspices of the TCSA University Resources Committee, set up tape recording stations at various campus computer labs, manned by proctors who asked computer users about their frustration or satisfaction with computer facilities. Called Public Hearings on Student Access to Computer Facilities, the fact-finding mission drew comments from users and supervisors at facilities in 167 Social Sciences, 90 Blegen Hall, 25 Lind Hall and 17 Classroom Office Building on the St. Paul campus. Written comments were accepted at the Lind Hall facility.

"Credit should also be given to the other organizations who helped conduct the hearings," said Potter. "The Business Board, the IT Board of Students and the St. Paul Board of Colleges were very helpful in providing people to man the stations." Hearings were held at the end of January of this year.



While the majority of the comments voiced on tape were complaints, including concern that time-sharing facilities be open longer and concerns about overcrowding, student input ran the gamut from dissastisfaction with certain types of equipment to complaints about supervisory people in laboratories.

One student in the Social Sciences lab complained of too few CRT and teletype terminals in that facility. Another student at Social Sciences complained that the personnel there were arriving 15-20 mintues late to open up facilities, cutting into valuable computer time amid tight student schedules.

In Blegen Hall, an accounting graduate student complained that several keypunching machines were regularly out of order.

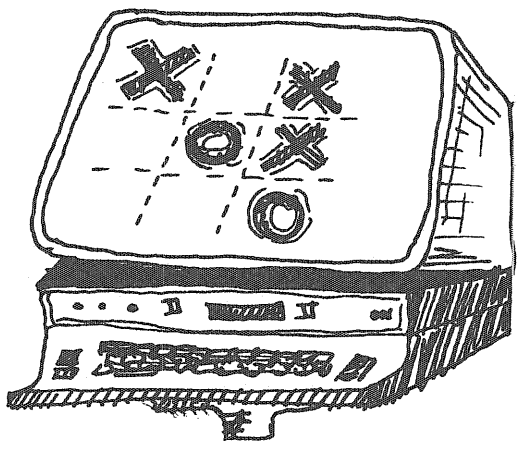
Lack of regular supervision, especially on weekends, was reported by several students in the Blegen Hall facility.

A student who regularly uses the Elliot Hall site complained that no official lab supervisor was available there and that telephones necessary to reach the University Computer Center Help Line or to get on the merge system had been removed.

At the other end of the spectrum, several lab supervisors complained about students who had obtained false user numbers and were tying up equipment, sometimes for computer game playing, mostly at West Bank facilities. Other supervisors complained that students were waiting until the last minute before a major class assignment was due to use the computers, pressing the supervisors into more consulting hours to accomodate their lateness. On-duty consultants generally possess a specialized expertise in some subject and would be flooded by questions about the assignment due in their department.

Other student users claimed they suffered from overcrowding during these times and couldn't get consulting help from the supervisors let alone get to use the terminals. This problem apparently increases nearer the end of the school quarter as assignments and research projects come due.

The list goes on: students wanting more facilities, more hours, more supervision, less congestion; supervisors wanting more alert, organized students who would not abuse equipment nor require a lot of their time.



After talking to more students and supervisors and thoroughly reviewing the transcripts of the public hearings, Potter, the University Resources Committee chairperson and Alan Hovind, another TCSA member, combined to write three major proposals on student access to computer facilities. The proposals were presented to the TCSA as a whole during a February 16 meeting. The primary proposal presented, among 15 points, these recommendations:

- Lab rooms would be kept open the full time the computer is available for time-sharing, along with all terminals.
- Campus phones would be available in all labs.
- A list of hours, equipment descriptions, supervisor information, location of other labs and dates account numbers would be changed would be posted in all labs.
- Formulation of a grievance procedure by University Committee on Computer Facilities and University Computer Services to handle all student complaints would begin as soon as possible.
- Establishment of a three-minute time limit on at least one keypunch unit in each lab would be directed toward departments owning computer facilities.

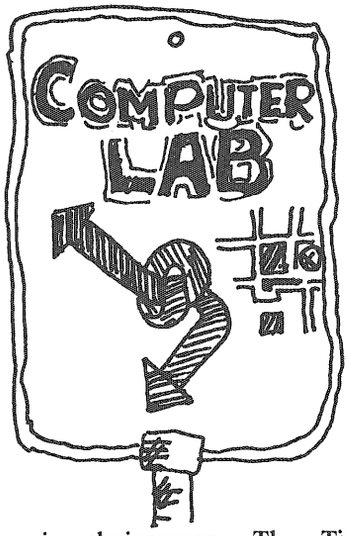
The committee also recommended installing recycling barrels to handle the glut of excess paper created by the equipment, ensuring wheelchair access to all computer facilities and instituting periodic review of lab supervisory personnel.

In a separate proposal, Potter and Hovind recommended that a user committee be set up to act as a liason and determine policy between computer services, computer users, lab supervisors and the Committee on Computer Facilities.

A third proposal directed that maps be installed at the Health Sciences facility to make it easier to find the lab there. Students had complained that the lack of a map made it difficult to find the facility in the maze of hallways in that building.

While all of the proposals were forwarded to the University Computer Center, the most effective outcome of the project concerns proposal II and the formulation of the special task forces to examine user and supervisory complaints and open up communication lines among user groups and department heads.

In cooperation with the TCSA's proposals, Thea Hodge, assistant director for user services with the University Computer Service, invited the TCSA to appoint five students to a TCSA special user committee responsible for information gathering about student computer use. The group, which has yet to be appointed by TCSA, would communicate with student users, keep lab supervisory personnel better informed about student problems and report to the TCSA University Resources Committee. The group would also make recommendations to University Computer Service's Time-Sharing Subscommittee of which



Hodge is chairperson. The Time-Sharing Subcommittee is charged with relating user concerns to UCS' Faculty Advisory Committee and its chairperson Frank Verbrugge.

Positions for the TCSA-sponsored group are still available. Students may contact the TCSA to apply for one of the five positions. Students who regularly use computer services are encouraged to apply, said Potter.

More specifically, Hodge plans to appoint a special task force on complaints and suggestions of the interactive computer system. That task force, composed of two students and three faculty members will look closely at the conditions in each computer lab and report to Hodge and the Time-Sharing Subcommittee with recommendations for changes and improvements to be made by UCS and individual departments owning computer facilities.

One of the big problems with any task force, according to Hodge, is that it is advisory and not regulatory. The University Computer Center and UCS do not hire lab supervisors or determine lab hours. Rather the center remains available to hear problems of computer users; moreover, to assist in operational problems.

Lab facilities are owned and operated by individual departments or groups of departments and not by UCS or the Computer Center. Thus changes in lab hours must come from within the departmental organization, Hodge said. The Computer Center and its task forces may make strong recommendations to lab supervisors and department heads, but in the end, individual departments rule on many issues students are complaining about.

Another task force Hodge hopes will be effective in a more specialized capacity is a technical task force on time-sharing for the disabled, which will examine computer access problems of the physically handicapped as well as the visually- and hearing-impaired computer users. The University Computer Center has been active in producing and recommending special computer services for the handicapped since the early 1970s. Kevin Fjelstad, especially, has created many programs for blind computer users, said Hodge.

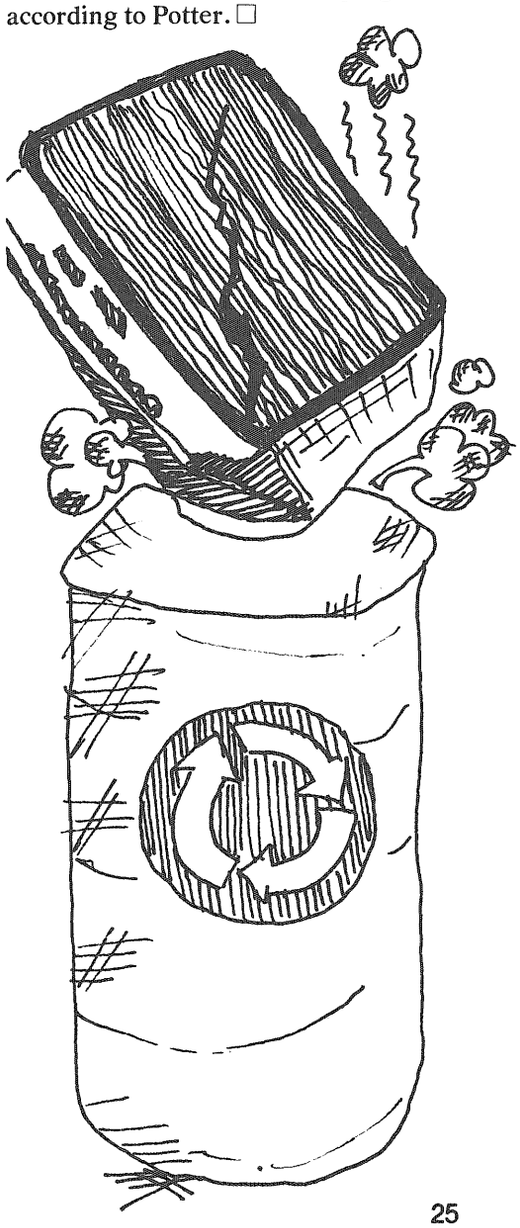
The task force on time-sharing for the disabled and the complaint and suggestion task force are both currently being organized. Several measures are available now, however, to students who have complaints about computer usage.

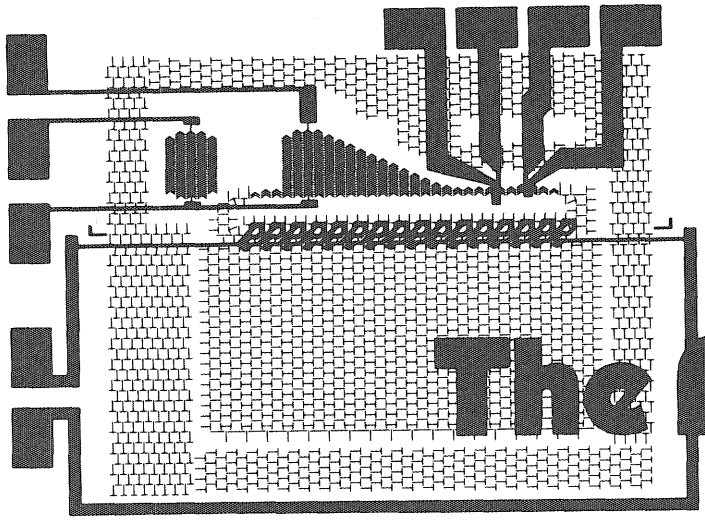
Persons may contact Thea Hodge at 373-4599 to air concerns about computer access or special operational problems. For answers to technical questions during computer operation the Help Line continues to be available daily. The Help Line phone number is 376-5592.

Since individual departments have jurisdiction over computer facilities, students may consult department heads and professors concerning hours, availability of lab supervisors and consultants. To make certain informational material is posted regularly and clearly in labs, individual lab supervisors should be consulted as often as necessary, recommends Hodge.

Students also have the option of contacting the University Resources Committee of TCSA to air computer usage problems.

While the task forces are just being organized, some action has already been initiated as a result of the computer hearings and the TCSA involvement with the University Computer Center. Elliot Hall facilities have apparently been reunited with a campus telephone hookup so students may call the Help Line or get on the merge system. Two CRT terminals were added recently to the Lind Hall facility. Other improvements concerning adding recycling barrels to labs and the posting of lab hours and other instructional material are in progress, according to Potter. □





The Magnetic Bubble Memory

by Peggy Purcell

In a chip only a centimeter square, a million bits of data are stored in the form of tiny bubbles of magnetized material. The remarkable application of magnetic bubbles to computer storage was discovered only 10 years ago by A. Bobeck of Bell Laboratories. The magnetic bubble memory has some unusual qualities that make it more attractive than standard memory devices for many applications.

The Bell System is the first to make use of the magnetic bubble memory. In Detroit, the short recorded messages such as one gets after dialing a wrong number, are actually reproduced from a bubble memory. The voice is converted into a digital code, a series of "1's" and "0's", and stored in the form of magnetic bubbles. The package Bell uses can store up to eight 12 or 24 second prerecorded messages. There are no moving parts in the magnetic bubble memory, so they don't wear out with use like the usual recording system does.

NASA is investing in magnetic bubble memory research because of its great potential for use in space. It is insensitive to radiation, shock, vacuum, and zero gravity. It will operate in an extremely wide temperature range, -25°C to +75°C. It is small, and weighs very little. Besides all these advantages, the bubble memory is highly reliable. Satellites could use the bubble memory to record any kind of data taken in space. The military could use such a rugged device on missiles, planes, ships, or submarines for computer control and surveillance systems.

The magnetic bubble memory is ideal for microcomputers. It is smaller and faster than conventional magnetic disks, and will probably be cheaper. Rockwell has developed an 800 kilobit bubble memory recorder called the POS/8 which can be used in microcomputers. Such a device could also be used in small businesses and offices. Cash registers could be programmed to automatically charge sale prices, store a record of sales, and even keep track of inventory and orders. An office terminal might hold memos, appointment calendars, telephone numbers and addresses, and travel arrangements.

Texas Instruments is now selling the Silent 700 computer terminal. It has 20,000 bytes (characters) of nonvolatile bubble memory storage, which can be expanded to 80,000 bytes. Access time is less than 15 milliseconds, which is faster than cassettes, paper tape or floppy disk storage. This terminal also has a portable model, with a built-in acoustic coupler, thermal printer, ASCII keyboard, and 10 and 30 cps capability. An interesting feature of the terminal is its ability to log on by itself once the phone has been dialed and put in the coupler. The terminal is priced at approximately $3,000.

Large computer systems can use the magnetic bubble as an auxiliary memory, perhaps for look-up tables. Programmable calculators with continuous memory can also use magnetic bubbles.

continued on page 29

	MAGNETIC BUBBLE MEMORY	FIXED HEAD DISK	MOVING HEAD DISK	FLOPPY DISK	CASSETTE	CHARGE COUPLED DEVICE	MOS RANDOM ACCESS MEMORY
Access time	1 to 3 ms	8 ms	60 ms	300 ms	40 s	.1 ms	300 ns
Storage capacity	128 kbits per chip	4 Mbits	24 Mbits	3.1 Mbits	4 Mbits	64 kbits per chip	16 kbits per chip
Reliability (mean time between failures in hours)	10,000+	10,000	4500	4500	3000	7000+	7000
Price (cents per bit)	.15 to .30	.30	.045	.15	.07	.20 to .25	.75
Removable medium	no	yes	yes	yes	yes	no	no

A comparison of the magnetic bubble memory with other memory devices.

papers on pumps and pumping systems. There is a $5,000 first place award, a $2,500 second place and $1,000 for third place.

Abstracts must be submitted by September 1, 1978, and finished manuscripts are due by December 1, 1978, and may be written in Spanish, French or English.

Registration forms and detailed information, including a list of judges, can be obtained from Professor Richard S. Thorsen, Chairman, Henry R. Worthington Technical Awards, Polytechnic Institute of New York, 333 Jay Street, Brooklyn, NY 11201

U of M Engineers elected to National Academy

Three University of Minnesota engineering professors have been elected to the National Academy of Engineering.

Professor L.E. Scriven was cited for his work in coating flows, surface wetting, oil recovery processes and the application of fluid mechanics to fundamental problems of absorption.

Albert van der Ziel, author of the text **Solid State Physical Electronics** (Prentice-Hall), was cited for his "contributions to the study of noise in electron devices and contributions to graduate education."

Professor Kenneth Whitby, well known in his field for basic studies of air pollution in Minnesota and California, was recognized for his work in aerosol instrumentation and for pioneering measurements of air quality.

Election to the Academy of Engineering is considered the highest professional distinction that can be conferred on an engineer.

Geophysical training sessions announced by Soiltest

Geophysical training sessions will be held, which include classroom instruction in the theory of seismic and electrical resistivity methods of studying soil and rock structures below the soil's surface and practical application of theory in the field, using compact portable seismographs and resistivity meters.

The training sessions will be held as follows: session 1, May 18, 19, 20; session 2, June 15, 16, 17; session 3, September 14, 15, 16; session 4, September 28, 29, 30.

Copies of the 1978 Geophysical Training Session bulletin are available from Soiltest, Inc., 2205 Lee St., Evanston, IL 60202

International solar energy school in Waterloo, Canada

An international solar energy school will function on the University of Waterloo campus this summer. Focusing on teaching people how to make better use of solar energy and how to do better solar energy research, the school will be held over a two week period, August 6-19.

Further information and application forms are available from: Fifth Course on Solar Energy Conversion, Department of Physics, University of Waterloo, Waterloo, Ontario Canada, N2L3G1.

Executive search firm for women opens

An executive search firm specializing in the placement of women in management, S.R. Holland, Inc., has opened an office in Chicago. Holland is only one of three search firms in the U.S who serve all the industry fields in locating women candidates, and will focus its initial efforts on the midwest and particularly the Chicago markets.

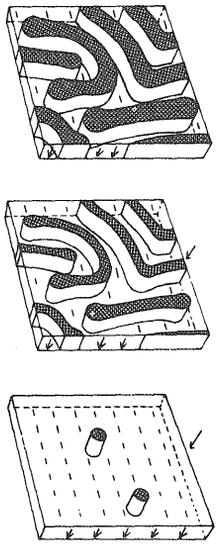
For more information, contact S.R. Holland, Inc., Women Executive Selection, 625 N. Michigan Ave., 5th Fl., Chicago IL 60611.

What is a magnetic bubble?

Magnetic materials, such as iron and nickel, are composed of many small areas, or domains, which are magnetized in various directions. Magnetic bubbles are formed in iron garnet in which the domains are magnetized in only two directions. When a slab of garnet is put in a magnetic field, most of the magnetization vectors will flip in the direction of the field. Those vectors which do not flip form domains, which are the magnetic bubbles. Under a microscope, using polarized light, these bubbles can actually be seen.

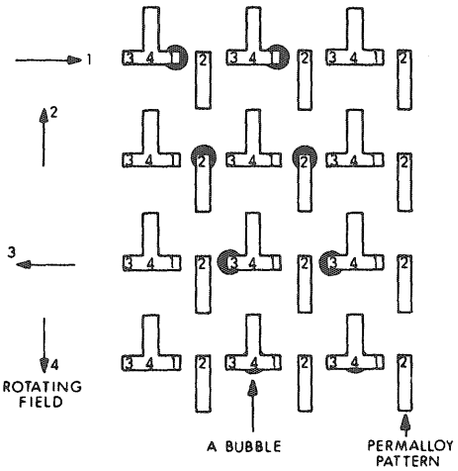
Magnetic bubble memories are made from tiny chips of nonmagnetic garnet upon which there is a thin layer (the epitaxial layer) of magentic garnet. The bubbles must be arranged in some kind of order so that the memory will work. This is accomplished by a pattern of permalloy, a nickel-iron alloy, on the surface of the garnet which is used to magnetically attract and keep track of the bubbles. A common permalloy pattern is of alternating T-and I-shaped bars.

How magnetic bubbles are formed



The randomly shaped domains of the material shrink as the magnetic field is increased, until only small "bubbles" are left.

Propagation of magnetic bubbles



A rotating magnetic field magnetizes the T-I bars, pulling the bubbles along the chip. Actually, there is no true motion involved, but only a progressive flipping of the direction of the magnetization vectors in the garnet.

The bubble memory chip

The function of the bubble memory chip is to store information. The bubbles in the chip are arranged to move in loops so that the digital information the bubbles represent can be manipulated. Most of the chip's area is covered by the T-I bar pattern, arranged in several loops. A bubble in a loop represents the binary digit "1", while the absence of a bubble represents "0".

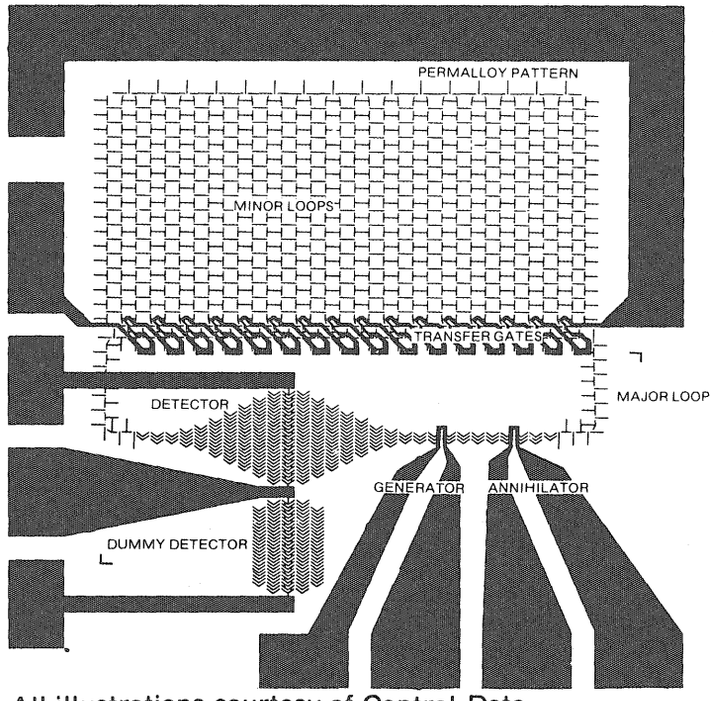
Each bubble is initially created by a current pulse, and then pulled along a loop (the major loop) by means of a rotating magnetic field. The rotating field is generated electrically by sinusoidal or triangular current waveforms through two perpendicular coils of wire. Current pulses to the transfer gates cause the bubbles to enter smaller loops for storage, called the minor loops.

Once all data has been entered into the minor loops of the memory, the rotating magnetic field may be turned off. Permanent magnets keep the bias field intact with no power input necessary. This is why the magnetic bubble memory is nonvolatile. The chip is packed at a slight angle to the magnets so all the bubbles are pulled to particular points along the T-I bars. Then when the rotating field is turned on, the location of all the bubbles is known.

To read data from the chip, the bubbles are moved back into the major loop. They are stretched as they pass through a chevron or V-shaped, bar pattern, which is the detector. The detector senses a bubble by the resistance of the permalloy above it. A "high" or "1" voltage signal of a few millivolts can be obtained when a bubble is passed under the detector. Background noise is compensated for by comparing the conduction of the detector with a bubbleless dummy detector on the same chip.

After detection the bubble may be returned to the minor loop it came from or it may be annihilated. Annihilation is easily done by sending a current pulse to increase the local field enough to make the bubble disappear. Since bubbles are stable for only a small range of field strength, the additional field caused by the current pulse does not have to be very strong.

A simple 500 bit memory chip.



All illustrations courtesy of Control Data.

Rather than removing the bubbles from the minor loops, another reading method is to cut and duplicate the bubbles. One bubble is returned to the minor loop, and the other proceeds along the major loop, is detected and annihilated. Time is saved because the bubbles do not have to be returned to the minor loops.

State of the art in bubble memories

Approximately 20 companies are known to be working on the development of the bubble memory. Control Data is presently designing a 256 kilobit chip. (Some numerical data for this chip is given in the box on this page.)

Control Data uses an asymmetric disk pattern for propagation rather than the T-I bar pattern. These disks can be packed closer together than the T-I bars, and the spacing is not as crucial.

The chip is organized in the major/minor loop structure, with more minor loops than necessary. This allows the bubble memory to work even though there may be flaws in some of the loops, making them unusable. The pattern of good and defective loops is programmed externally, usually in another memory device, the MOS read-only memory, so that only the good loops will be used.

CDC is working on a package consisting of eight bubble chips controlled by one set of coils and permanent magnets. Each of these modules will then be assembled into a bubble memory system.

What lies in the future?

The most hoped-for development in the future of magnetic bubble memories is, of course, larger memories and a corresponding lower cost per bit. It is expected that a single chip will have a capacity of over 100 megabits. This will be accomplished by higher packing densities, smaller bubbles and better photolithographic techniques for defining the permalloy pattern.

Professor Jack Judy of the electrical engineering department at the University of Minnesota is investigating new ways of detecting the magnetic bubbles. The present system requires a large part of the chip's area for the chevron pattern. With a smaller detection system, the bit capacity would be expanded.

A method of storing information in the walls of the bubbles is being studied. In this case, the bubbles would be packed in a hexagonal lattice, yielding a huge increase in density.

New materials are also being investigated. Presently the chips are made of expensive gadolinium-gallium garnet, with an yttrium-iron garnet epitaxial layer. Amorphous metals are being studied as a substitute for garnet.

An immense amount of research has been done on the magnetic bubble memory, but still more research is necessary. The bubble memory does promise, however, to be a particularly good storage device for microcomputers and it shouldn't be too long before a household microcomputer with a magnetic bubble memory becomes available. □

Special thanks to G. Patrick Bonnie and Gale Jallen of Control Data and Prof. Jack Judy for their advice and information for this article.

CDC Bubble Memory Chip

Capacity	262, 400 bits
Organization	Major/minor loop 282 loops of 1025 bits (256 used)
Chip size	8 x 8 x 0.5 mm
Bubble medium	Epitaxial garnet, 2.8 micron bubbles
Connections required	9
Maximum chip power dissipation	50 mwatts
Raw Signal output	3 mV

CDC Bubble Memory Module

General description	Eight 256 kbit chips packaged in a single magnetic structure, operated in parallel
Physical size	3.5″ x 3.5″ x 0.8″, 1 lb. weight
Bias field	150 oe
In-plane bias component	5 oe
Rotating field	45 oe
Power dissipation (drive coil)	5 watts
Operating temperature	0-50 degrees C
Rotating field frequency	400 kHz
Data rate	400 kbits/sec

CDC Bubble Memory System

General description	4 parallel modules packaged with interface and overhead electronics
Capacity	1 Mbyte
Operating frequency	400 kHz
Access time	1.5 msec
Data rate	12.8 Mbits/sec
Interface	TTL compatable
Voltage requirements	± 48 volts, + 12 volts
Drive waveform	Sinewave, 90 degrees phase difference

P.D.Q. OMEGA

Honorable Mention

by David H. Szondy

Doctor James Brinley was perhaps the greatest scientific gadfly that the world shall ever see. Every college he ever attended also hoped that he'd be the last. You see, Dr. Brinley was never content to remain tied down to any one field of science for any length of time. He was always flitting about from one project to the next, dipping a toe into nuclionics, poking his nose into the nether regions of computer science, sticking his finger into any other kind of whosawhatology. The good doctor was in other words, a pest of the first rank.

Now, all this would not have been so bad if Dr. Brinley had just confined himself to pestering serious researchers. But, Dr. Brinley's idea of good science was to mix together the newest(and oft times craziest) concepts of any number of fields into one huge lummox of an idea.

Most of the time this procedure leads to utter failure and a nasty note from the powers on high about the impropriety of using the particle accelerator to irradiate the cafeteria's daily special with neutrons. At other times, Dr. Brinley and the world were not so lucky.

I'm sure that you've heard of the disappearance of Grant's Tomb, the Great Princeton Disaster, the Harvard Octomice Infestation, not to mention the Columbia Purpleout or the—well, you see what I mean.

You are no doubt wondering why Dr. Brinley was not barred from every laboratory in the country, or for that matter, sent to any early grave by Mrs. Schuster after Mr. Schuster was turned into something green and leafy by one of the doctor's less noisy backfirings.

The answer is that I just don't know. Maybe it has something to do with his turning back the Martian invasion force with a secret weapon developed from his work on the daily special.

Or maybe it has something to do with the water burning engine that he developed, which solved the energy crisis (to be candid, it was supposed to be a time machine).

But my favorite explanation comes from the president of the since defunct Rickards laboratories. "The man inherited enough money from his aunt to set up a private lab. At least here we can keep an eye on him."*

All this goes to show that what happened in Dr. Brinley's workshop five years ago is not at all unusual. In fact, it would amaze me if it had happened to anyone else.

The project I'm referring to was conceived just after he was thrown out of what was left of UCLA. He decided that it might be interesting to combine the latest DNA synthesis techniques with the new free-radical hormone just discovered, and then apply it to a deregulated strain of cholera algae and see what happened.

Unfortunately, by that time, the world had become less tolerant of Dr. Brinley's work, so he was forced to delve into his inheritance to set up his own workshop.

The equipment needed by the good doctor was expensive and very breakable (it always was) as well as highly complicated. Dr. Brinley was extremely brilliant, but not the most graceful man in the world.

It has been estimated that, in setting up and running his shop, 50 percent of the time and resources were spent repairing the instruments and cleaning up the broken glass.

At any rate, six months later, Dr. Brinley began the actual project. Since he'd never done anything quite like that, it was slow going at first. Then as he gained experience and lost more glassware, he began to receive astonishing results.

Finally, on Friday, May 11, Dr. Brinley's efforts were rewarded.

In a culture dish sat the first specimen of a unique form of algae, capable of a fantastic rate of growth beyond anything ever seen, combined with an incredible yet constant mutation rate. Dr. Brinley was overjoyed, he'd not only made a discovery which was new and exciting, but one which would be of practical value.

Dr. Brinley solemnly took the specimen, labeled it P.D.Q. Omega, placed it tight and secure in the incubator, and left to celebrate his success.

I should add that the doctor celebrated a bit too well.

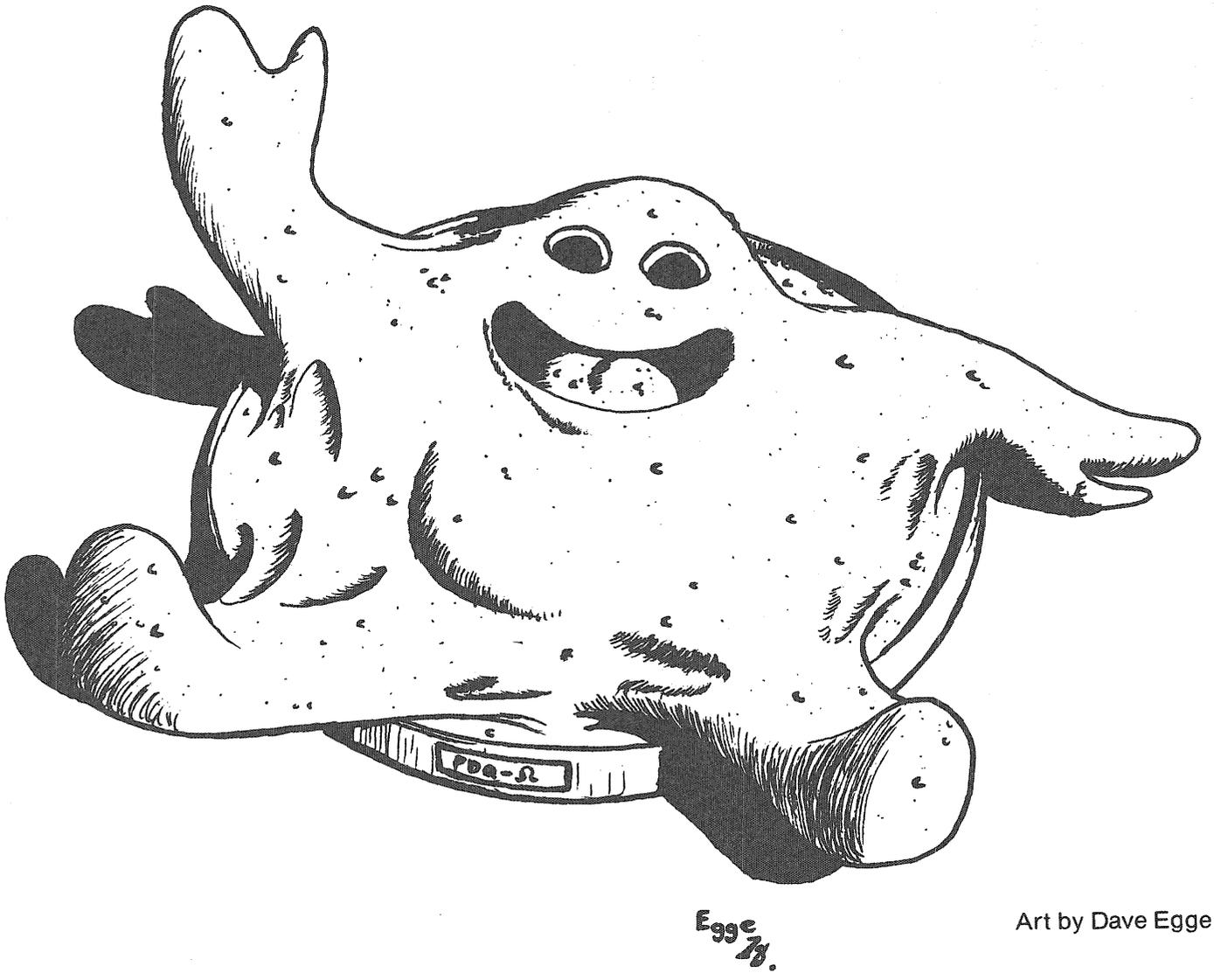
After being arrested as drunk and disorderly, being dried out in jail, and spending the better part of the weekend there, Dr. Brinley returned home, finally, late Sunday evening. Exhausted, both physically from his ordeal and financially from posting his own bail, the good doctor went straight to bed without so much as removing his hat (stranger still is the fact that he didn't own one.)

The next morning, Dr. Brinley hurried into his workshop. P.D.Q. Omega was an extremely hardy strain for such a swift growing organism. Two days of neglect would not actually have killed it, but Dr. Brinley was afraid that unsupervised, the algae may have mutated into something worthless, possibly cancerous. Brinley did not relish the thought of beginning from scratch again.

After setting up the testing equipment, Dr. Brinley opened the incubator door. Well, it seemed healthy enough on the outside. Only the detailed analysis would give the whole story of what had occurred over the generations of change. Dr. Brinley raised the lid from P.D.Q. Omega's dish.

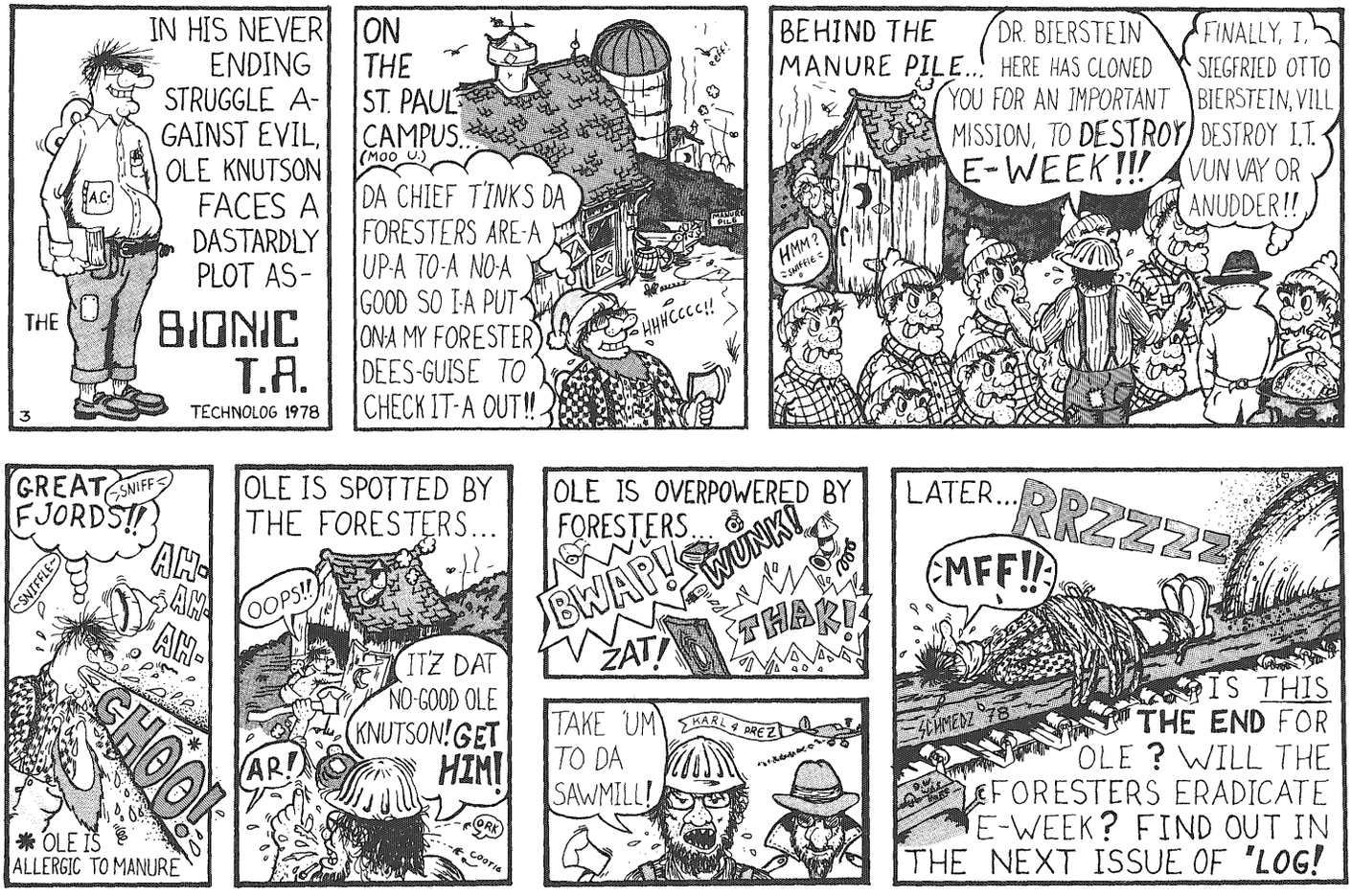
*From **Famous Last Words,** Vol 3

"High time you got here," said P.D.Q. Omega.



Art by Dave Egge

And thus began the new age.



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4. *Stephanie B.* Medical systems service engineering. Installation and test of new hospital radiographic and fluoroscopic x-ray system.
5. *Mel D.* Field engineering. Appraisal load testing of low and medium-voltage switchgear and power transformers for utility and industrial applications.

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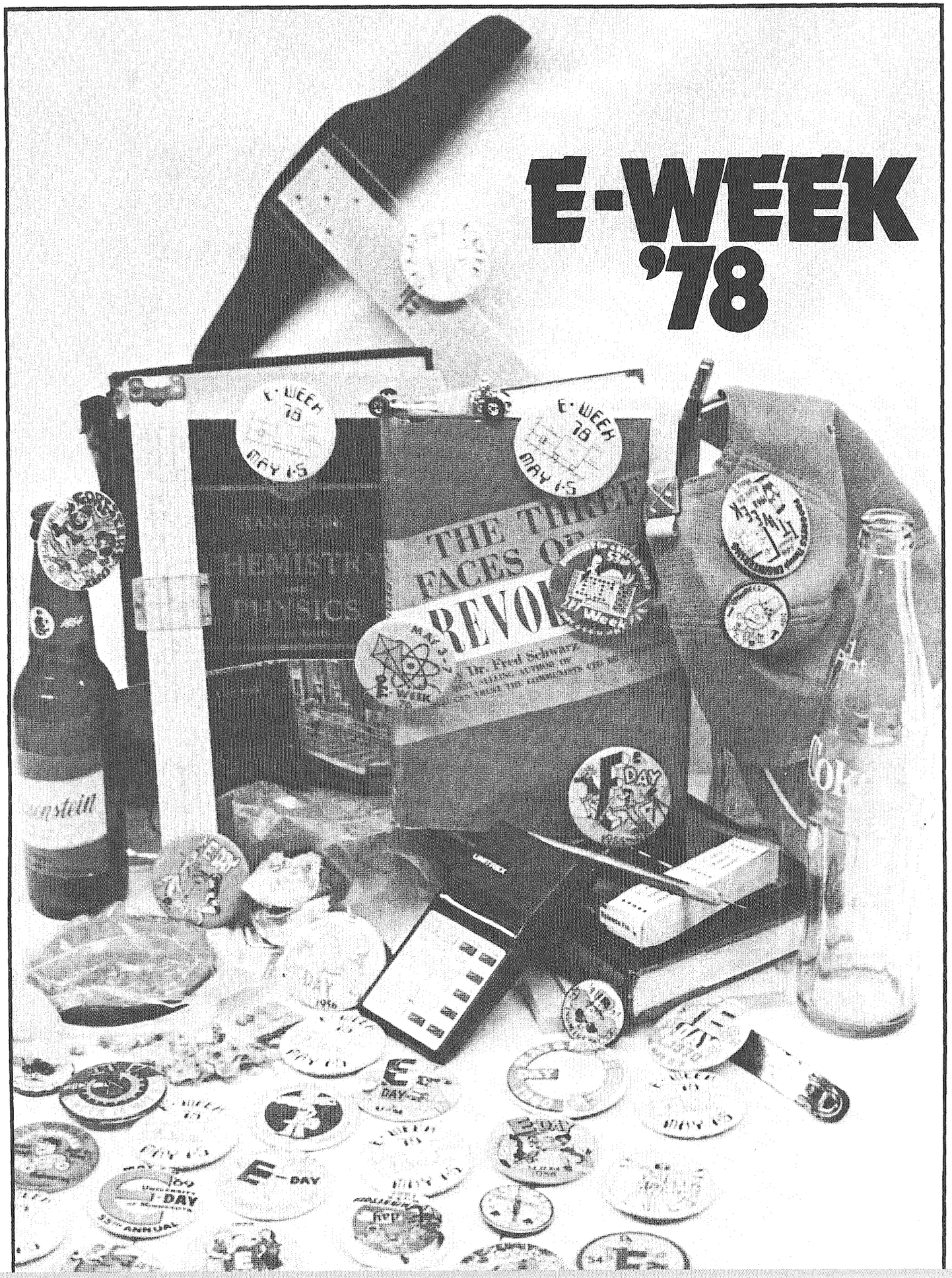
E-WEEK '78



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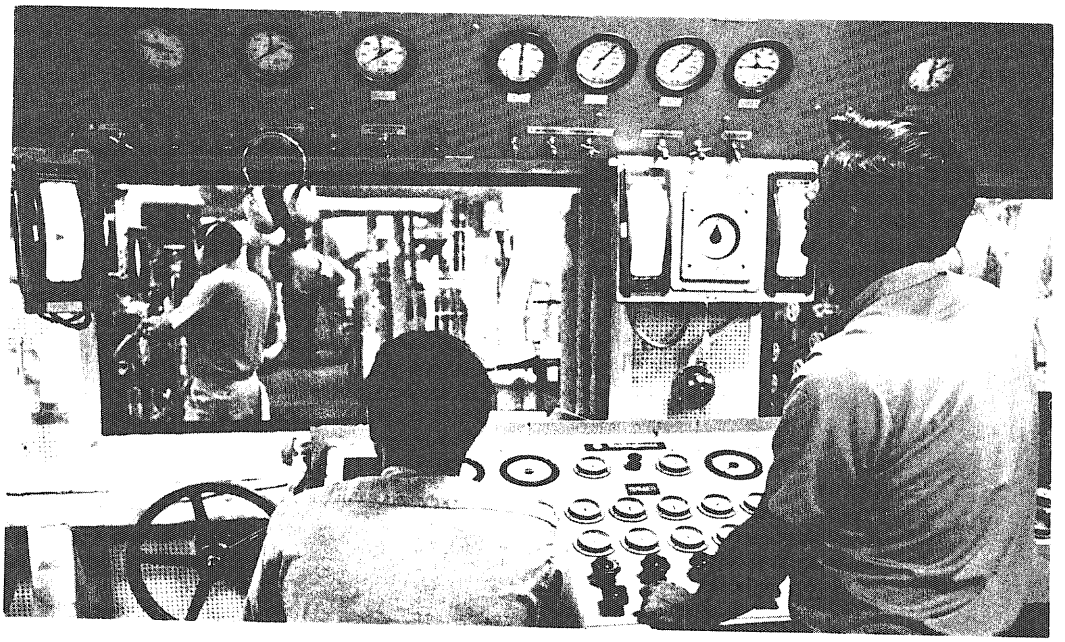

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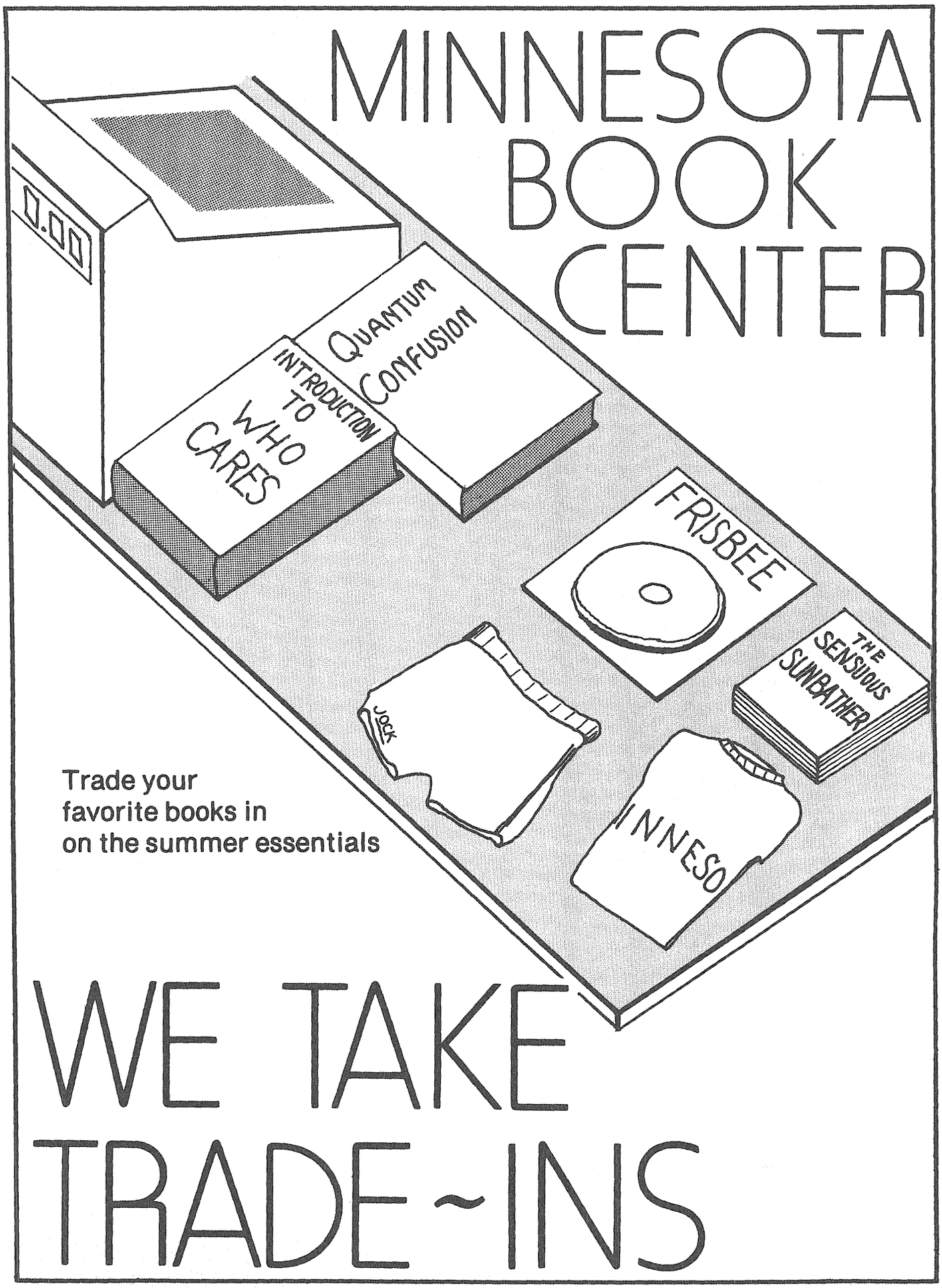
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minnesota **Technolog** spring 2 1978

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editor's page

Seven people ran for election to the **Technolog** Board on the SUN party ticket in the recent elections. Four of them were elected.

In a phone conversation with one of those candidates, I learned that "cheap sensationalism" was a tactic advocated by this candidate to win the election and that he believes that "the end justifies the means" in his campaign practices.

When asked what the SUN party platform constitutes, this candidate replied that he was not familiar with his party's platform; that he was only using the party's name to make his campaign for office legal.

This candidate also told me that he really hadn't thought about what he wanted to do on the board once elected. Rather, he was campaigning more as an experiment—being curious about what makes people get out and vote.

At least one SUN party member used incomplete, outdated information in written campaign literature (from old **Technolog** editorials) to wage a scare campaign among the IT student body—claiming that **Technolog** was in imminent danger of being taken over by the CLA Board of Publications.

This is not true.

At least one SUN party member used **Technolog**'s distribution boxes as a litter box for his campaign literature — hoping that students would assume this magazine's endorsement.

The **Technolog** has never endorsed a candidate for the board.

If this SUN party candidate's electioneering tactics are an example of the way in which a campaign for office is run on this campus, then no wonder there is such a poor voter turnout—no wonder some offices don't have enough candidates to fill them.

It is deplorable that a student who uses and admits to obviously unethical campaign practices should even be considered a serious contender for election to any office. Even more unfortunate, Karl Jorgenson was elected.

IT's excellent student publication can only remain excellent as long as honest students with a sense of honor are elected to its administrative board.

On May 10, Jon Kavanaugh, a CLA journalism major, was selected by the **Technolog** Board as editor for the 1978-1979 school year.

Kavanaugh, whose broad publications background includes experience in advertising and design as well as writing and editing, has been a frequent contributor to **Technolog** for the past two years.

Some exciting, innovative changes should be forthcoming from my worthy successor. Best of luck, Jon!

The **Technolog** Board members for 1978-79 are: Wayne Asp, Keven Bachman, Scott Brigham, Stan Brooks, Nancy Geszvain, Karl Jorgenson and Brian Stinger.

Minnesota grad is named to top post

Clarence Syvertson, former deputy director of Ames Research Center of Mountainview, California, was named director of the center, effective April 30, 1978.

Syvertson, a native of Minneapolis, received his BS in aeronautical engineering and an MS from the University of Minnesota. He now makes his home in Saratoga, California.

Alcohol kills and death rate from booze on the rise

The number of white males who died of diseases directly related to alcohol increased by 46 percent between 1963 and 1973 while the death rate for nonwhite males rose by 107 percent, according to the Metropolitan Life Insurance Co., in New York.

There was also an increase in the number of alcohol related deaths for women. The death rate for white women was up by 36 percent and for nonwhite women, it shot up 71 percent.

The Metropolitan study, using figures compiled by the National Center for Health Statistics, Division of Vital Statistics, did not include deaths in which alcohol was a contributing factor, and it did not include car accidents, suicides or other types of death in which alcohol may have been an indirect cause.

Introduction to solar heating in book form. No jargon!

A complete guide to solar heating, the **Illustrated Solar Energy Guide**, tells how solar heaters work and why solar collectors are built the way they are. There are detailed instructions on how to best collect solar energy and how to select the best collector for each job.

Published by Horizon Industries of North Hollywood, Calif., this guide is available for $3.00. Just write to them at 12606 Burton Street, North Hollywood, CA.

Expensive new book helps mechanical engineering hopefuls

Mechanical Engineering for Professional Engineers' examinations, by John D. Constance, has been revised to help with state board examinations studies.

The book covers all aspects of mechanical engineering and its associated fields as well as such subjects as lube oil cooling, noxious vapor condensation and others.

To obtain a copy, write to McGraw-Hill Book Company, 1221 Avenue of the Americas, New York, NY, 10020, or go to the library and save yourself the $21.50 asking price.

log ledger

Tuition increases . . . and increases and increases

An eight percent tuition hike will go into effect in fall of 1978. What does that mean for IT students?

Well, the typical undergraduate tuition for IT students is now $293, but next year students will pay $318 per quarter. Non-residents will pay $906 per quarter as compared with $835 this year.

Graduate students, who pay by the credit hour, will pay $31 per credit fall quarter instead of the $28 paid at present. Non-residents will pay $906 per quarter as compared with $835 this year.

The proposed student services fee for next year is $59.55, compared with $55 paid per quarter this year.

Increased dorm rates cause audible groans on campus

In 1978-1979, dorm rates will increase an average of $31 per quarter. The typical double room will cost $560 per person per quarter. The range looks like this: a small double room in Pioneer Hall, with bunk beds will be $535 (the cheapest) and it will cost $711.50 per quarter for a single room in Middlebrook Hall.

Solar total energy system to be built by Westinghouse

A solar energy system, built to provide electricity, space heating and hot water for buildings housing more than 1600 troops at Fort Hood, will be the largest non-commercial solar total energy system built in the USA.

Westinghouse, with the help of Heery and Heery, Inc., has scheduled preliminary design completion for October of this year. Operation of the solar system is tentatively slated to begin by 1980.

This project is being done as an experiment in cooperation with the Universtity of Texas at Killeen. The experiment will help determine how economic the total solar energy system is in comparison with the systems now in use on military bases.

Another Minnesota alumnus makes good!

Thakore D. Sunderwala, who received his MS in civil engineering at the University of Minnesota, has been named vice-president in charge of estimating services and value analysis at the H. F. Campbell Company, Detroit, Michigan.

Sunderwala's position is a new one and, according to D. C. Templin, president of the H. F. Campbell Company, is necessary to meet the demands caused by the company's growth in its marketing area and services.

WHISTLE BLOWING AND THE ETHICAL DILEMMA

by Taft Broome

Our technology is being used as an instrument to rape the environment, and as a weapon in society's chemical and biological warfare against itself. Industrial contamination of the water we drink and the air we breathe, the hazardous defects in automobile and nuclear plant designs, the growing rash of unsafe construction practices, such as the West Virginia scaffolding disaster, are but a few examples of the technological atrocities which are visited upon the public every day.

The fact that these atrocities continue to be committed when the technical know-how to detect, predict and prevent most of them exists is a moral crime. Humanity is the victim of the crime; technology is the instrument of the crime; and at the core of the criminal structure is the partnership of the corporation and the engineers.

The corporation exists for the sole purpose of turning out products or services that produce a profit. The corporation directs technology towards turning out more competitive products and services that in turn produce ever higher profits. These higher profits allow the corporation to expand and become more powerful.

To assert that the corporation intentionally turns out products or services which are harmful to public welfare is unreasonable. To assert that the corporation is fully committed to the enterprise of seeking out and preventing harm from befalling the public is unreasonable.

The public, thus, in order to protect itself from hazardous products and services, has had to rely on government to exert pressures on the corporation. The effectiveness of such external pressures as exposure to consumer opinion, litigation and regulation are significantly dependent upon the cooperation of the corporation's technical employees.

The engineers are among the first employees to know that the corporation's products or services may be hazardous. With whom, then, do the engineers' loyalties lie? With the corporation's goal to obtain a profit or with the moral obligation to the health, safety and welfare of the public?

It is clear that engineers, on the whole, have not asserted themselves as champions of the public welfare. Therefore, it must be concluded that engineers are either loyal to the corporation, or that there exist sufficient forces within the corporate bureaucracy to discourage dissent and disobedience.

This observation does not preclude a history of individual attempts by engineers to right the wrongs of the corporation. It is of interest to consider the case of the whistle blower—a muckraker from within—who exposes what he considers the unconscionable practices of his own organization. An examination of some classical case histories of whistle blowing will demonstrate that each of these incidents has served to discourage others from following the example. A notable example of whistle blowing occurred between February, 1966, and December, 1971, involving Brown and Root Overseas, Inc., and the Morrison-Knudsen construction company.

The resident engineer of Brown and Root's $47 million project to build a road across the Andes was Charles Pettis. The Andes are well known for their instability and frequent slides, yet he found that the design team had taken inadequate geological borings to determine where the slides might occur. Pettis concluded that the road designs needed drastic overhauling and estimated that large contract overruns would occur. Despite this conclusion, Morrison-Knudsen, the contractor, proceeded with construction. Pettis' fears were realized almost immediately when the road project sustained a number of serious slides in which 31 men were killed.

Morrison-Knudsen demanded that the monthly payroll be amended to include charges for slide removal. Pettis refused. His own company supported him at first, but in February, 1968, their attitude began to change due to pressures imposed by Morrison-Knudsen. In December, 1968, Pettis was fired. On December 25, 1971, Senator Proxmire from Wisconsin released the General Accounting Office (GAO) report which confirmed Pettis' charges of improper construction.

The fact remains, however, that Pettis received a full dose of what offending a corporate employer can mean. He has applied for over 30 jobs since 1969, received job offer after job offer, but in every

opinion

case after citing his past job references, the offers were cancelled. The obvious reason was that Brown and Root were giving him an "unreliable" label. He contacted the ASCE but was unable to get any action on his behalf.

The GAO report includes the observation that "The question of whether Mr. Pettis has been blackballed cannot be established, as any such action would, by definition, be informal and not necessarily documented." It should be noted that William Wisely, former executive director of ASCE, made his own inquiries and interceded on Pettis' behalf with prospective employers.

The building of the San Francisco Bay Area Rapid Transit (BART) system represents an important case of whistle blowing which involved the action of a professional organization. A major feature of the BART was to be the Automated Train Control (ATC) system. Holger Hjortsvang, a systems engineer in the BART maintenance section became increasingly concerned about the defects in the ATC system and expressed these concerns in a series of memoranda to his superiors, beginning as early as April, 1969. There was no significant response from the management. Two other engineers, Max Blankenzee and Robert Bruder, also developed concerns about the ACT system and had similar experiences.

Late in 1971 the three engineers decided that, in the public interest, they should voice their concerns to the BART board of directors which led to a public hearing in February, 1972. The Board voted 10 to 2 in support of the management of Westinghouse Electric Corporation, contractor of the system, and associated engineering firms. Early in March, 1972, the three engineers were fired. The months following for these three engineers were difficult.

One reported the frustration of having several prospective jobs within his grasp and then suddenly withdrawn. In one instance he was told, off the record, that the personnel office had received a telephone call initiated by BART indicating that the engineer was a "troublemaker." Another of the trio had his home repossessed when he could not find work.

Events subsequent to their firing vindicated their professional concerns. The ATC system failed on several occasions causing injuries to passengers. The California Society of Professional Engineers (CSPE) undertook a full investigation resulting in the statement by President Jones of CSPE and other members of CSPE that they were "convinced that the three engineers acted in the best interest of the public welfare", and that "a large volume of most distressing information on the employment practices of BART, and on its apparent disregard for public safety, has been gathered."

The California Legislature then launched an investigation which resulted in a report (the "Post Report") which essentially confirmed the warnings of the three engineers. The three engineers themselves launched a suit aginst BART for damages totaling $885,000. The outcome of these efforts has not yet been determined.

The 1967-1968 B.F. Goodrich case, where a technical employee was actually ordered to falsify a qualification report on the brake tests for the U.S. Air Force A7D aircraft, is another case in point. The brakes proved to be hazardous to the test pilots. The engineering technician and his supervisor, an engineer, protested through internal channels and were ignored. However, these protesters presented the matter before the Economics-in-Government subcommittee of the joint House-Senate committee. Their disclosures resulted in drastic procedural changes in U.S. government inspection techniques, although both men were fired.

Not all cases of whistle blowing result in such severe retaliation. One rare example is the 1969 case of the $100 million recall of General Motors Chevrolets. An employee, Edward Gregory, though not an engineer, discovered the faulty exhaust system and blew the whistle. Gregory received a $10,000 bonus from GM, is still employed by GM, and is still blowing the whistle. It must be observed, however, that Gregory was saved by his union from being fired nine months after the recall was announced; that Gregory was transferred from a position in which, he says, hazardous practices could easily be detected to one (with equal pay) where detection is not so easy;

and that according to Gregory, his fellow employees are still afraid to follow his example by making their own reports on unsafe corporate practices.

The cases cited above are certainly enough to illustrate the fact that the potential whistle blower faces the grave consequence of corporate wrath. These cases also show that the most a corporation suffers is a fine or more government regulation. The people who cause the atrocities on the corporations' behalf never seem to be identified. There is a fragmentation of the total act; no one person decides to carry out the evil act or is confronted with its consequences.

What the cases do not show, however, is the psychological price of whistle-blowing which is the gnawing sense that one has been faithless. Even though he has chosen the morally correct action, it is only natural that the whistle blower should remain troubled by the disruption of the social order that he brought about and that he should find it difficult to fully dispel the feeling that he deserted a cause to which he pledged support. Corporate wrath and the sociological imperative to cooperate are forces in the bureaucratic structure which are sufficient to discourage the engineer from acting in the public interest when that interest conflicts with the profit goals of the corporation. This fact is the reality of moral conduct.

The fantasy of moral conduct is represented by the fact that the codes of ethics of various professional societies clearly state that the engineer's loyalties should lie with the public. The ASCE code states that "Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties." The code of the NSPE states "He will regard his duty to the public welfare as paramount. He will not complete, sign, or seal plans and/or specifications that are not in the public welfare and in conformity with accepted engineering standards. If the client or employer insists on such unprofessional conduct, he shall notify the proper authorities and withdraw from further service on the project." Virtually indentical statements are to be found in the codes of the ASME, ECPD, and IEEE.

The codes represent a fantasy because the professional societies do little to combat the bureaucratic forces which discourage ethical conduct, and provide no incentives for their members to resist these forces.

One reason for this fantasy is that most professional societies have limited funds; many operate more or less on a shoestring. They keep members' dues fairly small; otherwise members drop out, particularly in times of economic hardship. Fighting difficult cases, on behalf of members involved in controversy, can be a very expensive business, especially if the case goes into the courts.

Another reason that the professional societies are toothless tigers is that they have not established a strong record for enforcing the codes. For example, over half of the cases investigated by the ASCE Committee on Professional Conduct between 1967 and 1975 were dismissed for lack of evidence that the code had been violated. Even if a member is dismissed for violating the code, membership in the societies or even the PE license is not a prerequisite for engineering practice.

It is not a fantasy, however, that public awareness of and concern for the responsibility of engineers to public welfare is growing every day; and that the public can act with the ferocity of a saber-toothed tiger in exposing the role of engineers in the commission of technological atrocities.

It is an inevitability that the goal of the corporation to obtain a profit will conflict with the goals of public welfare. When this conflict occurs, the engineer has two alternatives; to act in the interest of public welfare at the risk of corporate wrath, or to support the corporation at the risk of public wrath and professional ostracism. These two undesirable alternatives represent the engineer's Ethical Dilemma.□

Taft H. Broome, Jr. is an assistant professor in the department of civil engineering at Howard University in Washington, D.C.

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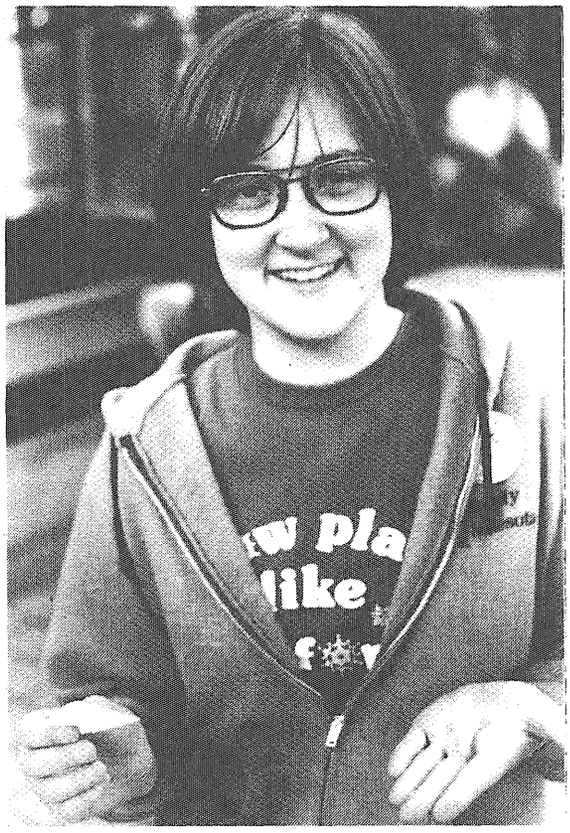
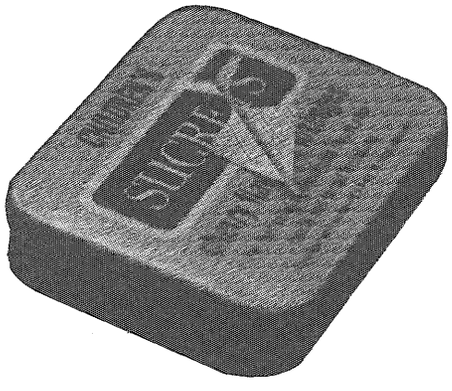
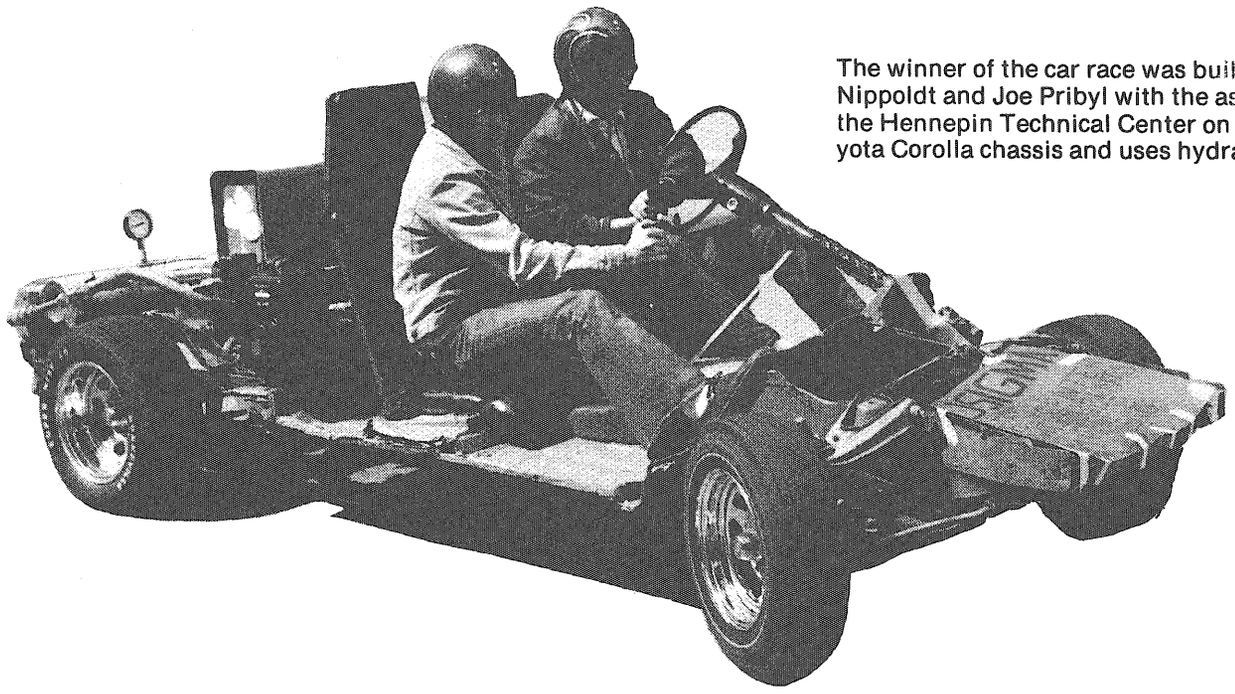
RECREATIONAL ENGINEERING: E-WEEK '78

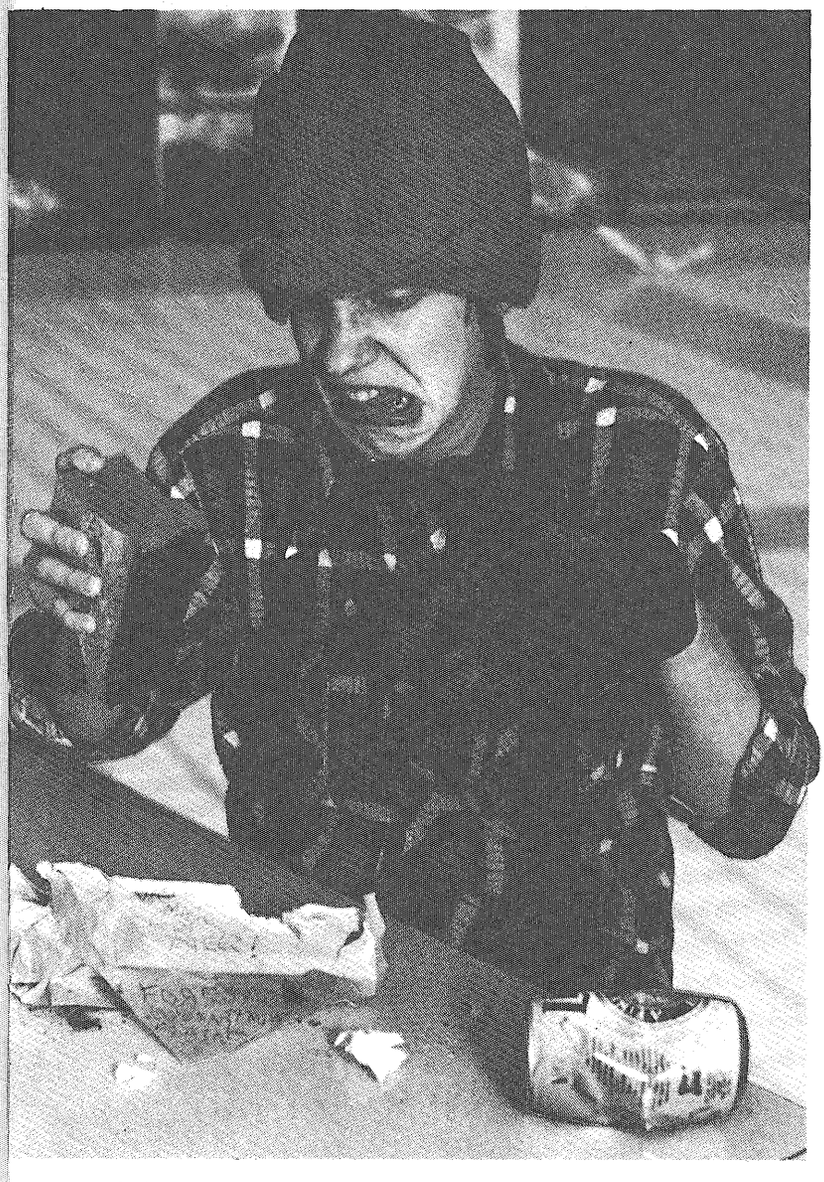
photographs by Mike Dorn and Glenn Flekke

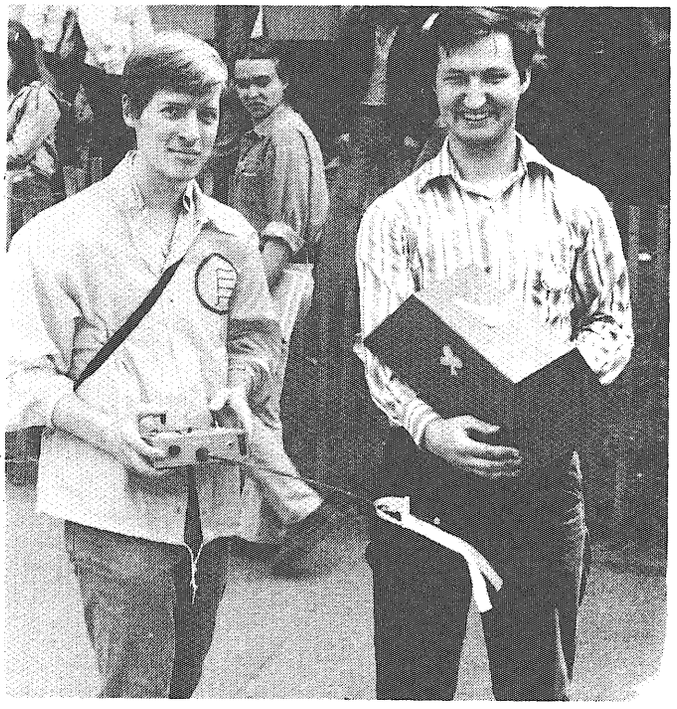






The winner of the car race was built by Todd Nippoldt and Joe Pribyl with the assistance of the Hennepin Technical Center on an old Toyota Corolla chassis and uses hydraulic power.





Opposite page:

(top left) This diminutive duo was designed by Barb Ekz.

(bottom left) "Smallest flyable" event winner, designed by Jim Riederer.

(right) Chet Nelson, winner of the paper airplane "spot landing" event.

This page:

(left) A member of the sub-species forestus inkompitus attempts to rebuild his losing entry in the airplane contest.

(right) This radio remote-control, battery-powered entry was built by Mike Rehbein and Gregg Sullivan of KHK.

This page:

(right) The all-important forester detector and friend.

(below) The E-day picnic sans picnickers.

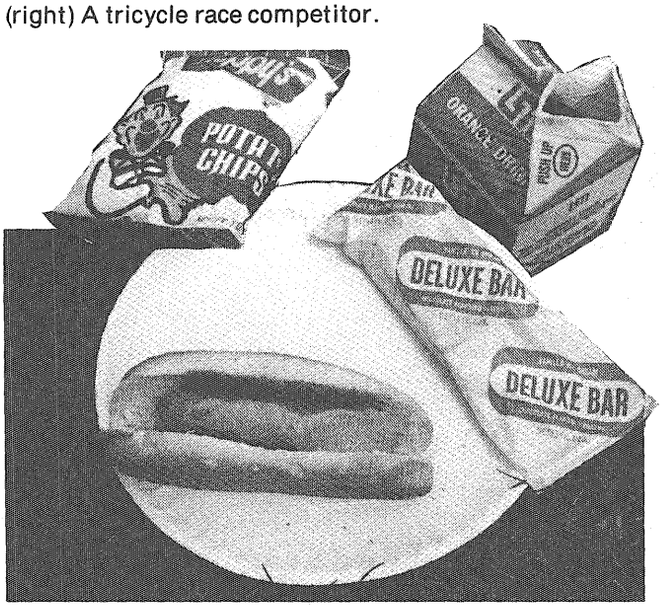
(bottom) Calculator race winner Dan Germann with his TI SR 51-II.

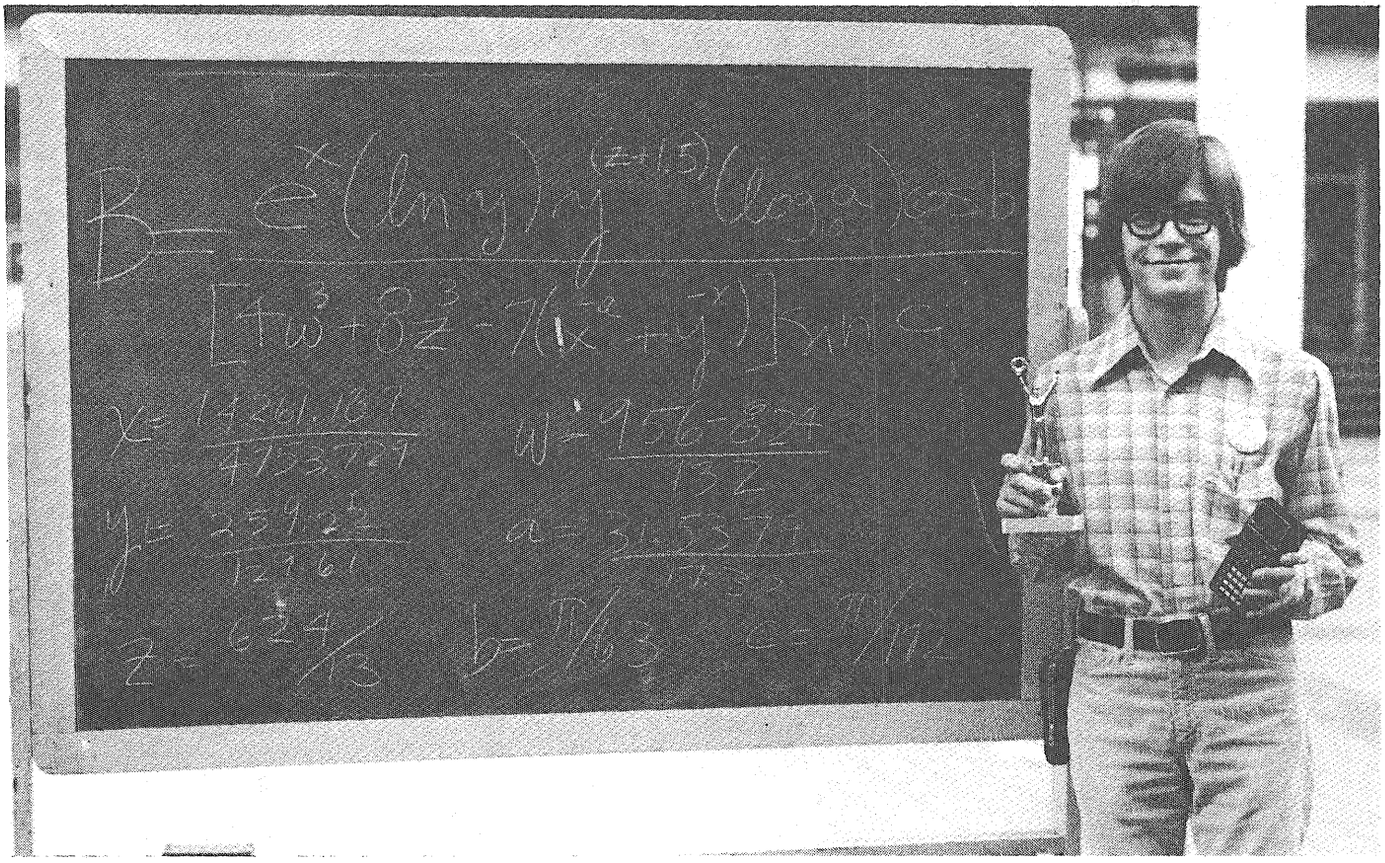
Opposite page:

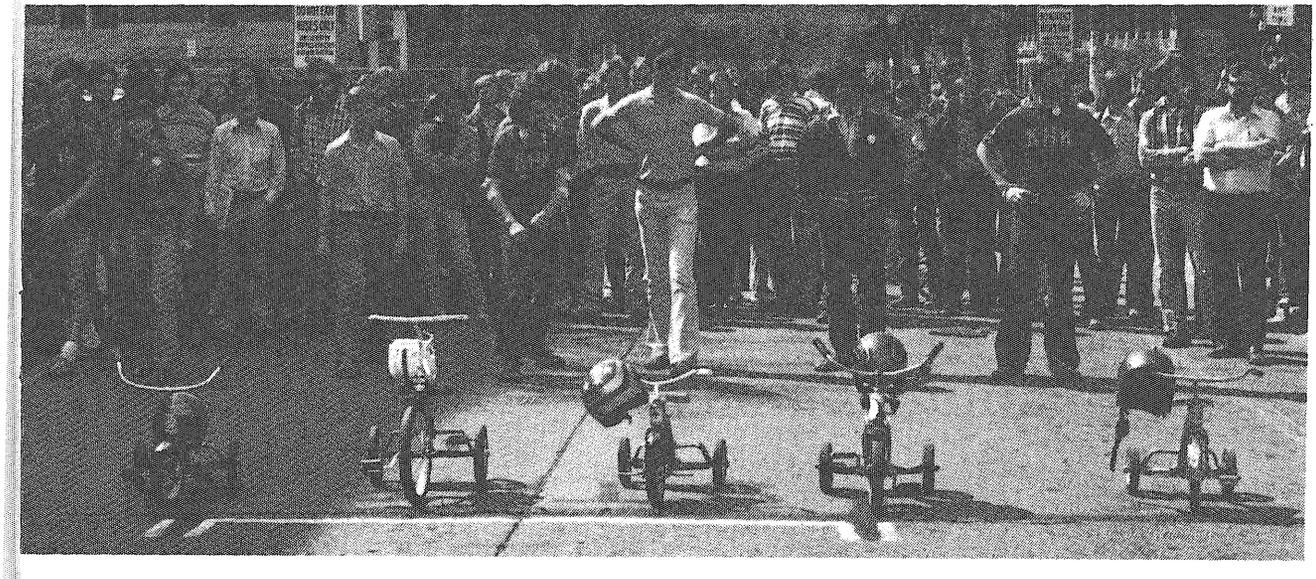
(top) Tension-filled Monte Carlo start.

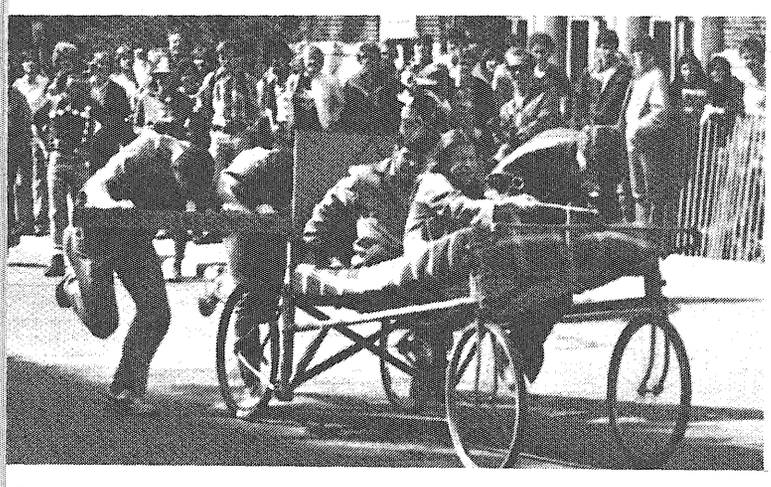
(center, below left) The winner! In 9.40 seconds, Triangle Frat's "Meen Green Macheen."

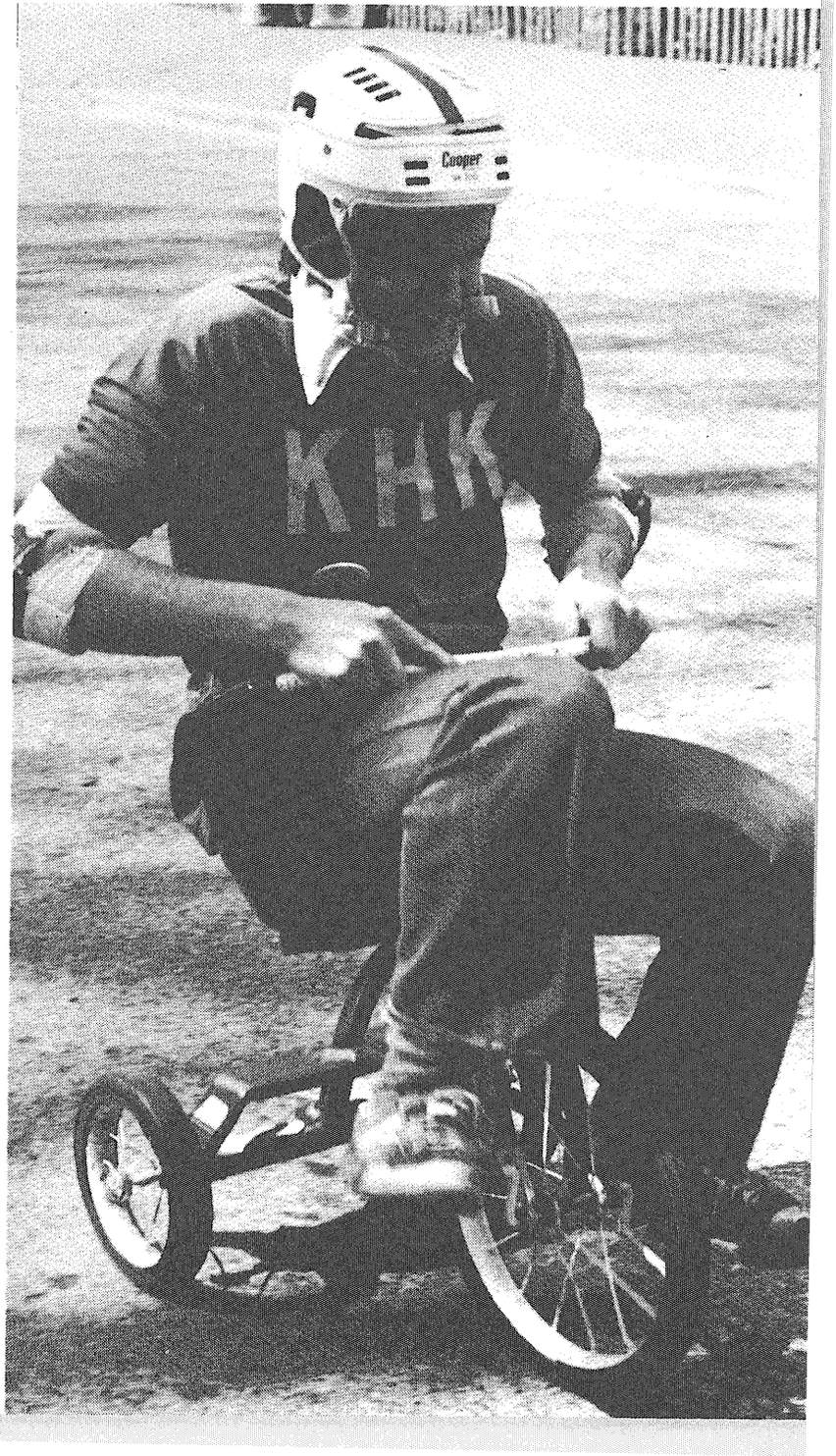
(right) A tricycle race competitor.





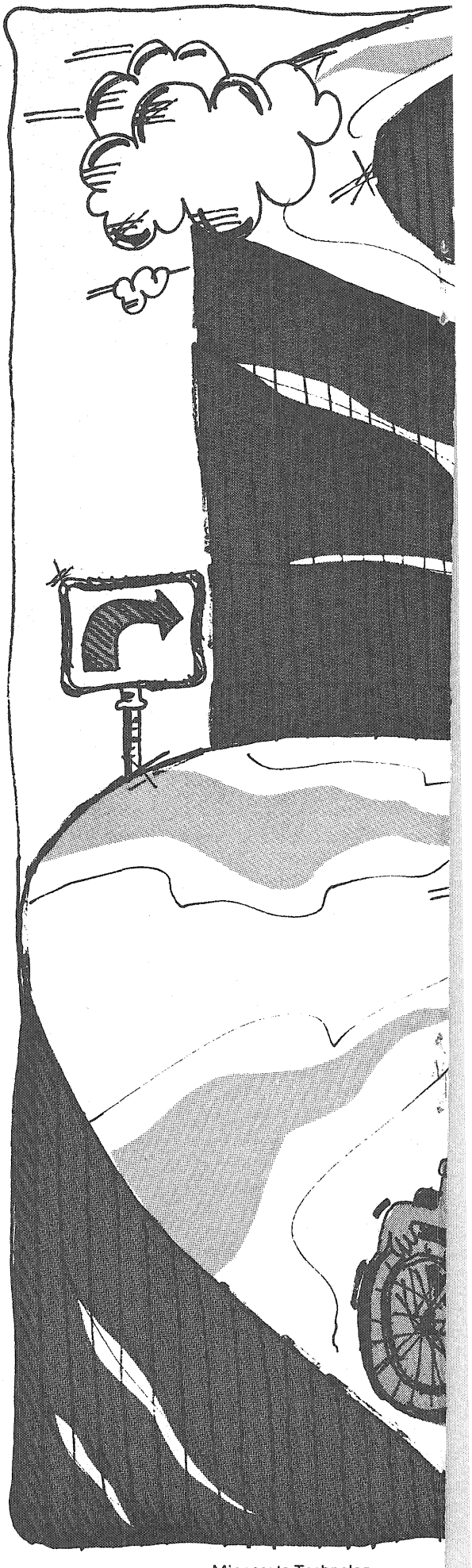





Cooper

TOWARD A BETTER I.T. FOR THE DISABLED

by Jon Kavanaugh



EDITOR'S NOTE: *This is the first of a two-part series dealing with the attitudes, problems and requirements the University is facing to provide disabled students in IT with equal opportunity education and employment as required by federal legislation put into effect last summer through the Department of Health, Education and Welfare. This segment is intended as an overview of the federal regulations and their probable effect on education in IT as the University nears complete compliance. Part II, to appear in the first fall issue of* Technolog, *will examine more closely the financial and physical barriers with their solutions as a result of the University's affirmative action in the education of IT's disabled.*

As a country, we've come along way in the past 50 years in the area of civil rights for different groups of people. The advancement of civil rights for minorities has been on the tip of the proverbial American tongue for at least two decades. Fair treatment of minorities in employment, education and housing has been carefully, if not always smoothly, lobbied for and legislated about to the point where equality is now a palatable term in the English vocabulary.

Next, women, more recently, have begun to receive the recognition and benefits of business and social organizations due them—the result of ambitious public pressure, media awareness and the on-going drive for a constitutional Equal Rights Amendment.

In the past year or so, however, the rights of still another segment of the population have been examined more closely by special support groups, Congress and again the media—that of America's permanently or temporarily disabled.

Until lately the blind, the deaf, the physically handicapped, the learning disabled, the mentally retarded—all were limited to some extent in their pursuit of quality education and meaningful employment. Physical access to public buildings, financial limitations and unsympathetic public attitudes toward the disabled have kept them from enjoying some of the same freedoms for personal growth as unimpaired citizens.

Today, a good deal of attitudinal discomfort seems to exist which precludes the disabled from some learning and work opportunities, but there is some evidence that things are, indeed, getting better. The next few years, according to mandatory federal requirements, should tell more precisely the progress made in expanding educational and employment opportunities for the disabled.

To date, the most significant action to breed such optimism lies in the federal government's enactment of Section 504 of the Rehabilitation Act of

"If a mobility-impaired student, for example, registers for a physics class in an inaccessible building, the law requires that the class or section of the class be reassigned to an accessible building. Although, other handicapped students may not be singled out and relegated to a disabilities-only class. Rather, the law requires the most integrated setting possible."

1973. Simply stated, 504 effectively prohibits discrimination of persons on the basis of handicap in education and employment by any organization or institution receiving federal money. This means all public schools, government employers and public service organizations must provide the same services and opportunities to the disabled as are available to the unimpaired. Where job and learning situations are limited by physical access, special equipment or other time and programmatic barriers, amendments must be made in those programs and structures to accommodate handicapped persons.

While Section 504 is complex and entertains the problem in terms of all employment and education opportunities, the University of Minnesota and particularly IT have had to take steps to comply with a special section of the law on postsecondary education. Here the law addresses, in-depth, admissions to educational programs, general treatment of the disabled, curriculum, advising and physical access.

As of last summer the law specifically ruled against discrimination in admissions to programs at the University by qualified handicapped persons. Those meeting the academic standards required of all students could not be denied admissions to a particular major or area of study because of any number of disabilities, including blindness, deafness, mobility impairment, mental retardation, neurological disorders and specific learning disabilities among others.

In advising situations, according to the law, students may not be directed away from any programs because of their disabilities, although advisers may inform students of potential risks and limitations related to certain professions when their disabilities could exacerbate those risks.

The main feature of the law, however, concerns alternatives in study programs. Section 504 specifically requires that any qualified handicapped student must be allowed certain academic adjustments in order to obtain the same quality of education as other students. If a mobility-impaired student, for example, registers for a physics class in an inaccessible building, the law requires that the class or a section of the class be reassigned to an accessible building. Although, other handicapped students may not be singled out and relegated to a disabilities-only class. Rather, the law requires the most integrated setting possible.

Other academic adjustments could include allowing blind students to have guide dogs in the classroom, deaf students to have interpreters and so on. The taping of class lectures must also be permitted under the regulations if that is essential to a blind student's receiving the material. Some professors have expressed

"These academic adjustments are allowed as long as they don't compromise certain "essential" elements of an academic program. While every effort must be made to accommodate disability requirements, the same minimum level of academic excellence must be maintained."

concern about this practice because of potential copyright problems when the professor wants to publish his own lecture material in book form later on. Generally the students and professor are expected to reach a rights agreement prior to such taping.

Some students, too, may require adjustments in the time it takes to complete assignments, exams and special projects. The law indicates students should arrange with individual instructors who are required to make an effort to accommodate these special needs.

It should be pointed out, too, that all of these academic adjustments be allowed as long as they don't compromise certain "essential" elements of an academic program. Acting IT Dean Walter Johnson indentified "essential" elements in a recent interview as the standard grade point average required of all students. While every effort must be made to accommodate disability requirements, the same minimum level of academic excellence must be maintained, he said.

Although most programmatic changes can be arranged between instructor and student, some academic and structural adjustments require more attention and expense. Section 504 doesn't require that all buildings in an institution be wheelchair accessible, for example, but that where some facilities can't be relocated, such as some labs, they must be remodeled to allow wheelchair accessibility.

This is particularly a concern among department heads when considering tight budgets. Departments may be reluctant to spend huge sums of money on major structural remodeling, especially if just a few students will be using the facilities.

The question of who pays for what automatically surfaces. Who pays for new ramps? For elevators? For revised laboratories? Minor costs associated with some revisions, Johnson said, have been absorbed by departmental budgets but for major repairs, like ramping, IT has looked to the University resource coordinator's office specially formed to handle these changes; to examine these needs individually.

(Part II of this series will examine the changes and proposed structural changes completed and in the planning within IT, along with who will bear the cost burden as the 1980 compliance deadline nears.)

A law such as 504 specifically states the physical changes to be made to insure the education of the disabled but one other fundamental question recurrs: How do public institutions handle the attitudinal changes necessary to implement programmatic and structural change?

There are no hard and fast answers to that one, although some action has taken place in IT. Last fall, then-Dean of IT Richard Swalin sent specific instructions to faculty, advising them of the importance of the law and directing specific problems to the appropriate resources and committees.

One campus group, too, has had ongoing projects to attempt to improve attitudes and awareness of the problems of the disabled campuswide. The Unicorns, a group composed of concerned university people for the equal educational opportunity for the disabled, combined with the Twin Cities Student Assembly in February to hold a Disability Awareness Seminar.

Representatives of different campus committees and departments as well as central administration, presented the 504 regulations, films and lectures concerning the proper treatment of visually-, hearing-, and mobility-impaired persons.

Overall response to the 504 law and its action has met with mixed reactions in IT. Several professors interviewed had not read the details of the statute, while others felt comfortable with making the individual program adjustments to accommodate the special needs of disabled students.

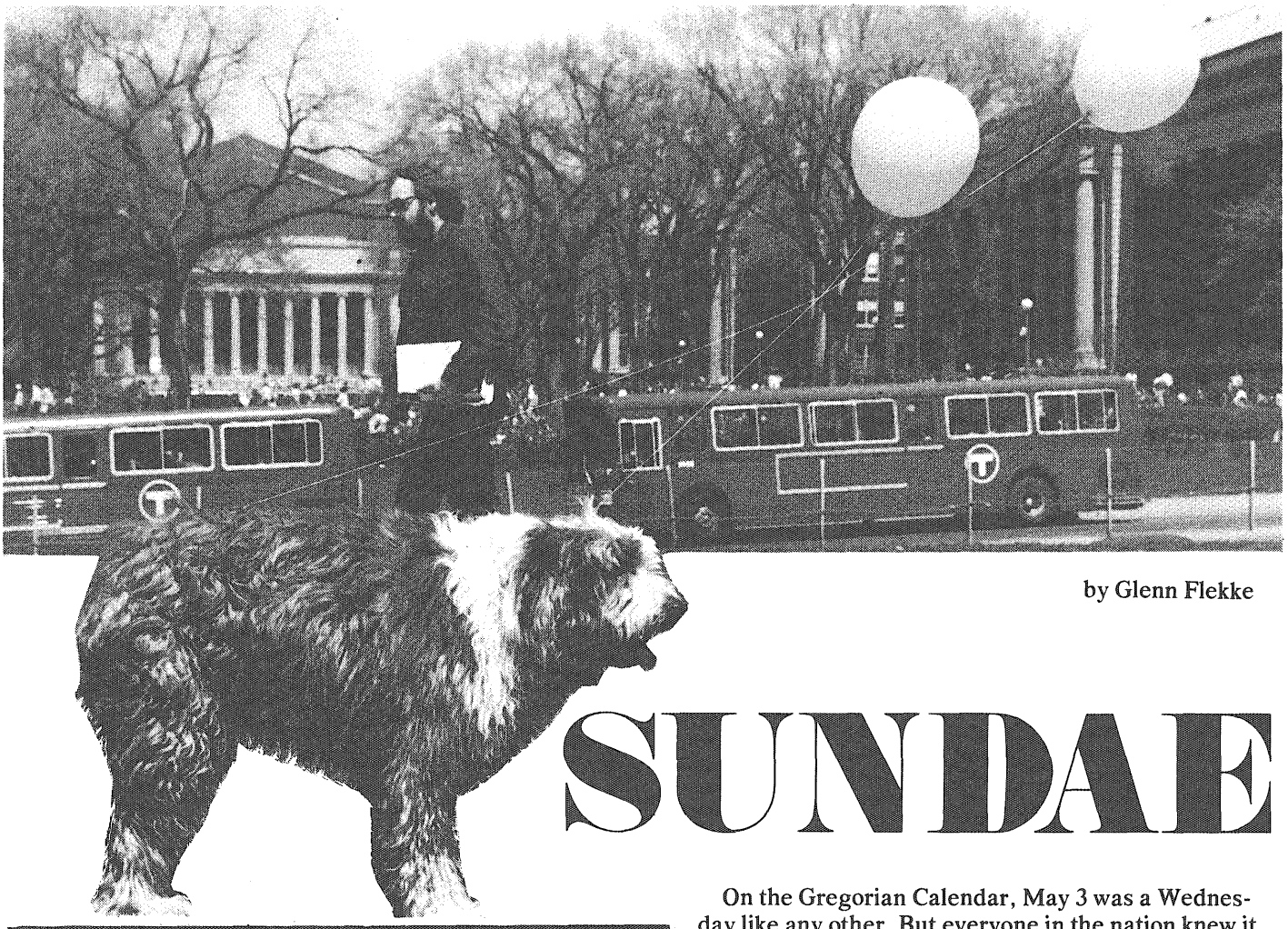
One student, in particular, has met with mixed reactions, too—from teaching personnel. The student, who has a learning disability, complained that some professors and instructors were unsympathetic to his requests for different texts and extra time to complete assignments.

The statute, however, does provide for an appeals option, calling for each institution to establish some kind of appeals system within its structure. The system should be available to handle students who feel they have been maligned by a decision in the case of an academic adjustment. In IT, appeals and complaints concerning the treatment of disabled students should be directed to Assistant Dean Paul Cartwright.

The 504 statute aside, other groups and organizations nationwide have become more active in promoting the awareness of problems with disabilities in education and employment. A 1976 issue of **Computer Decisions** magazine devoted an entire issue to the problems and directions the computer industry is taking in integrating the deaf, blind and mobility-impaired into computer training programs and business operations. The issue was unique in that it provided a double printing—one for normal-sighted persons and one in braille for the blind.

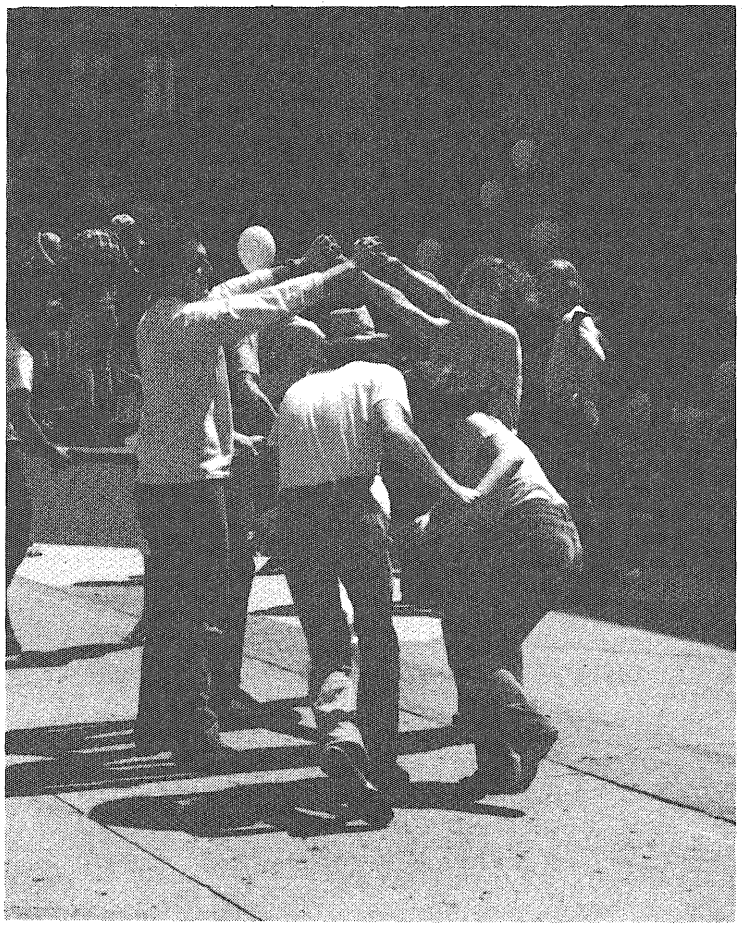
Some other learning institutions too, have taken special steps to provide strong programs for the deaf specialzing in computer technology. Rochester Institute of Technology, N.Y., California State University at Northridge and Utah State University all have strong programs for the hearing-impaired built into their cirricula.

Back in Minnesota, the next segment will present more in-depth the programs designed to educate and prepare for employment various handicapped groups at the University as well as the steps the University will take toward a better, more accessible IT for the disabled.



by Glenn Flekke

SUNDAE



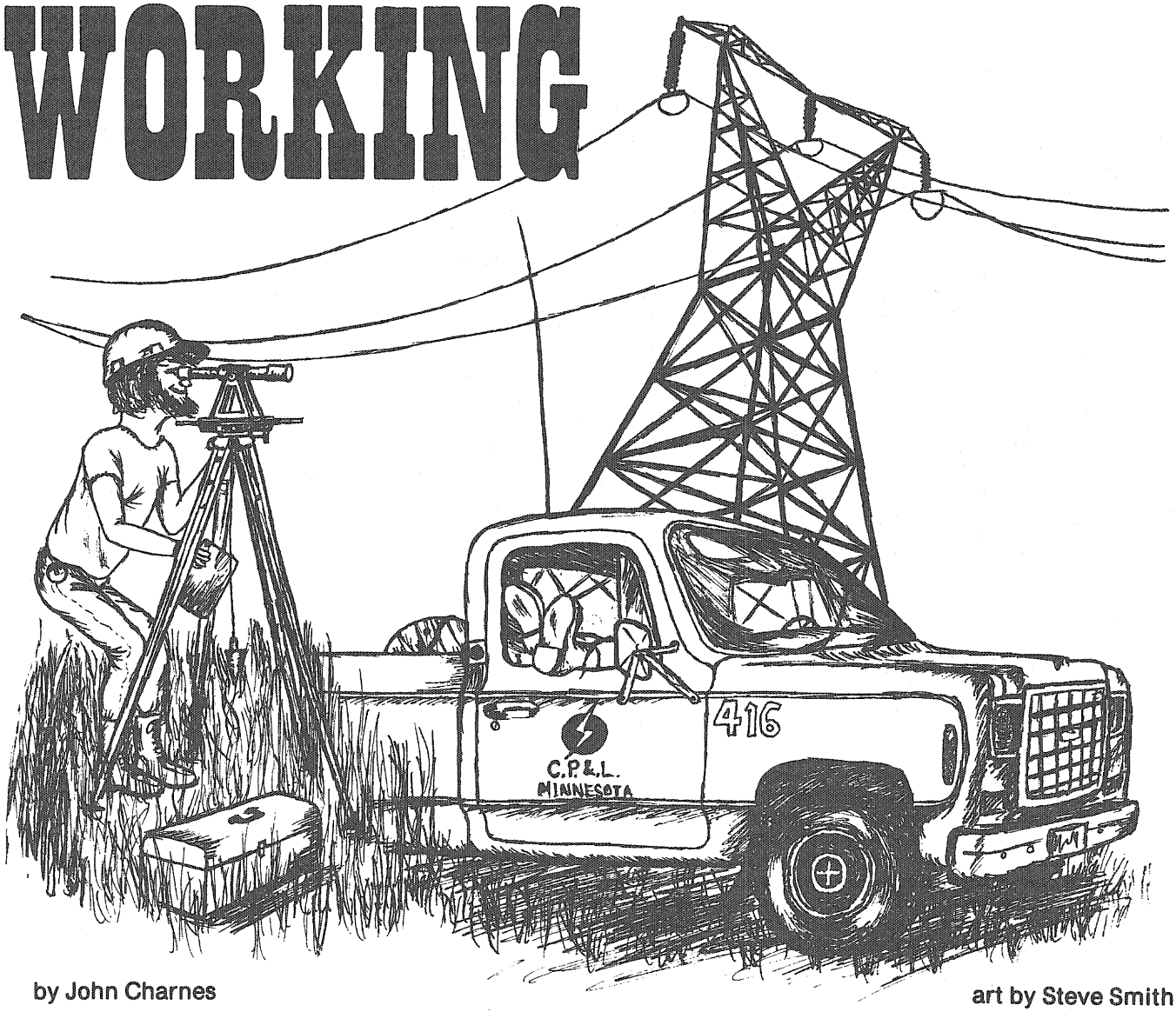
On the Gregorian Calendar, May 3 was a Wednesday like any other. But everyone in the nation knew it was Sun Day, a celebration of that great and ultimate nuclear reactor in the sky. Amid presidential promises and half a zillion sunbathers, the U of M praised the rays with a silly and serious celebration at Coffman Memorial Union.

The Coffman Union Program Council and MPIRG clashed brains to produce an en*light*ening and very enjoyable program of folk music, jugglers (they called themselves the "Slippery Bananas"), and commercial displays during the noon hour on the front courtyard. Inside and shielded from the cosmic radiation by massive blocks of concrete were more displays in the Great Hall.

These included the solar heating ideas of Jim Widder, a Grade 4 Architecture student. He used a small cardboard model of the Butler Square District to demonstrate how many seemingly outdated and energy-wasting buildings could be efficiently solar heated by installing large glass panes across the entire south surface of these buildings. An air gap of a few feet would exist between the glass and the wall, thereby creating the familiar hot-house effect and warming the entire south surface. Other demos in the Great Hall included those by a wood-burning stove manufacturer and the MSA stores. Films of solar technology were shown there all afternoon.

Alas, as the evening drew heavy in the east, the light of the cosmic nuclear furnace was snuffed by the oceans of the far side of the horizon. The chill of darkness soon made plain the source of energy and life on this marble of mankind. □

WORKING



by John Charnes

art by Steve Smith

"School is a vacation from life."
—Jerry Brown

So says the golden state's guru governor in a recent issue of **New Times** magazine. Some vacation. Wake up late, brush your teeth and rush off to a seemingly endless barrage of line integrals, Carnot cyles and nth order matrices culminating in that frenzied, button-pushing, anticlimactic ordeal known as finals.

It's half-time in my college career. To date, I've earned 97 of the 194 credits needed for the distinctive title of bachelor of science and alumnus status at the University of Minnesota. In so doing, I've managed to experience the great American pasttime of going into debt.

For this quarter and the next, I'll be a civil engineering intern student. I landed a job with a consulting engineering firm in Minneapolis. I was hired to inspect construction work, but until the work gets going I was put on a survey crew.

Before I started college, I worked on a survey crew for a large electric monopoly based in Duluth. We ran preliminary surveys for high-voltage transmission lines. I became very adept at walking through swamps knee-deep in loon shit, battling mosquitoes and deer flies, carrying a 25-pound chain saw.

Peter S. Leeking was an interesting character on that crew. One winter day as we were walking out to line on snowshoes, our crew chief noticed that Leeking had a dark spot in the crotch of his pants.

Somewhat taken aback by what he saw, the chief said, "Pete, why didn't you stop to relieve yourself?"

Undaunted, Leeking replied, "I would have, but I didn't want to get lost."

My boss used to say that it took a special breed to be a surveyor. Hopefully, recombinant DNA research will rid the world of this deficient genotype forever.

The working conditions on my internship are considerably better than those of a power-line surveyor. All of the work so far has been in open areas developing subdivisions in suburbia. There are no trees, brush or insects to deal with.

The most notable difference in the transition from an academic to a workingman's environment occurs in the vocabulary. Construction workers are fond of using a certain four letter expletive referring to one of man's basic drives. I seemed to be the only one who noticed it the first hundred times or so that it was used on the day I joined the crew. By lunchtime, however, I had overcome that affliction and could speak this rhetorical re-

dundancy with the best of them. Usually the word is uttered without consciously realizing it. Occasionally, however, it is spoken from the heart.

Monday of the third week on the job found our three-man crew driving between different job sites where the boss, Hal, would converse with the foreman on the project while I was recuperating from an excellent Patti Smith concert I'd attended the night before. Sometime in the afternoon, during one of Hal's B.S. sessions, I happened to doze off for a few minutes. My slumber was rudely interrupted by a bop on the head with a rolled up blueprint.

"Wake the (expletive deleted) up!"

I looked up to see Hal glaring at me with fiery eyes.

"What for?" I asked innocently.

"Wake the (expletive deleted) up, you (expletive deleted)!!"

Apparently he had no sympathy for a burned out Smith fan. Later, while we were discussing the incident, I told him that I had become somewhat bored staring at the paperback I had been reading all day.

"You won't be bored tomorrow," he promised.

Hal's not one to go back on his word. I spent the rest of the week doing everything from waxing the truck to sharpening the tips on plumb bobs.

I'd like to take a class entitled "Illusion: Exuding an aura of business when there is absolutely nothing to do."

Sometimes I feel I'm being discriminated against because I'm a college student. Many people have a definite stereotypical role that they would like to cast me in. You know the one—the four-eyed egghead intellectual who can integrate from zero to infinity or spell sesquipedalian with ease but who has trouble pounding a nail without bending it—as if too educated to have any common sense.

Matriculation is basically an individual challenge. Unless you take classes by proxy, have peripheral vision or are a damn good guesser, you have to rely on your own skills and knowledge to get through four years of intellectual feeding and regurgitation. Most jobs involve teamwork—a group of people working toward the common goal of making money for the company. Here's where the trouble begins. Given a set of humans trying to accomplish a certain task, you will find that the number of opinions on the most propitious means of achieving that goal increases arithmetically. We all have brainstorms on how to do a specific job, plus reasons why every other idea (not his own) is doomed to failure. Everybody wants to be the boss. At times it gets to the point where outpsyching your co-worker becomes such a great concern that no one gets any work done and everyone goes home cursing the audacity of his associates.

University people are generally transient in nature. Moving around quite a bit, they are used to seeing different people and make friends easily. Going to work involves joining an established group. The neophyte who wants to fit in has to be friendly but not overbearing, alert but willing to let some things slide by without comment and willing to listen to people tell him things that he already knows. But since people are creatures of habit, acceptance into the group comes only with time. Which brings us to another problem.

Familiarity breeds contempt. Contempt produces backstabbing. Backstabbing implies two-facedness. Your jocular associate, beaming as he comes to the punchline of his story, was just telling the boss yesterday what a bumbling, babbling, inept fool you are. That's all right though, tomorrow you'll reciprocate by inadvertently mentioning his blatant misuse of company time and total lack of professional manner in your conversation with the man in charge.

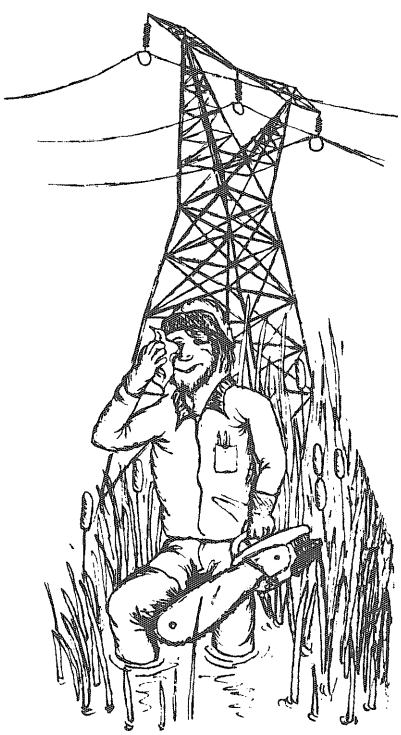
And bosses have ways of keeping subordinates in line in the working regimen. One of the ploys, used by those who have reached what the Peter principle defines as their level of incompetence, is to keep underlings in the dark as much as possible about the ultimate purpose of their own actions. Bosses must gain a sense of security by playing the game of "I've got a secret." They act as if they have latched on to some esoteric knowledge, far too advanced for any of the lowly hirelings to grasp. Two kinds of people work well with bosses—clairvoyants and automatons who think no further ahead than five minutes ago.

Politics, nepotism and personality clash are three very real aspects of the working world that are seldom mentioned in school. "It's not what you know, it's who you know" is one form of an idea commonly expressed among workingmen. An employer will swear up and down that he runs his business as a strict meritocracy but it takes little perception to see that this is not always the case.

Perhaps these psychological challenges are what Governor Brown is alluding to in his pithy remark. They are much less apparent inside this scholastic bubble straddling the Mississippi than elsewhere.

Despite an oftheard platitude about the grass being greener, I'm looking forward to getting back to school in the fall. I'd like to stay there until I reach mandatory retirement age. Now, all I have to do is find a benevolent benefactor to finance it.□

> "I became very adept at walking through swamps knee-deep in loon shit, battling mosquitos and deer flies, carrying a 25-pound chain saw."



SUPERPROF '78

by Mary Haywood and Tim Schultheis

Schizophrenia is a feeling that often dominates a professor's life, according to Benjamin Bayman, IT's outstanding professor of the year. Balancing research and teaching obligations and trying to do well at both often leads him to feel as if he's not doing his best at either.

"Any indication that you're doing well is gratifying," he said of the award, "because you don't normally have that feeling."

The award, presented to Bayman during E-Week ceremonies, is given each year by the IT student body for outstanding teaching performance.

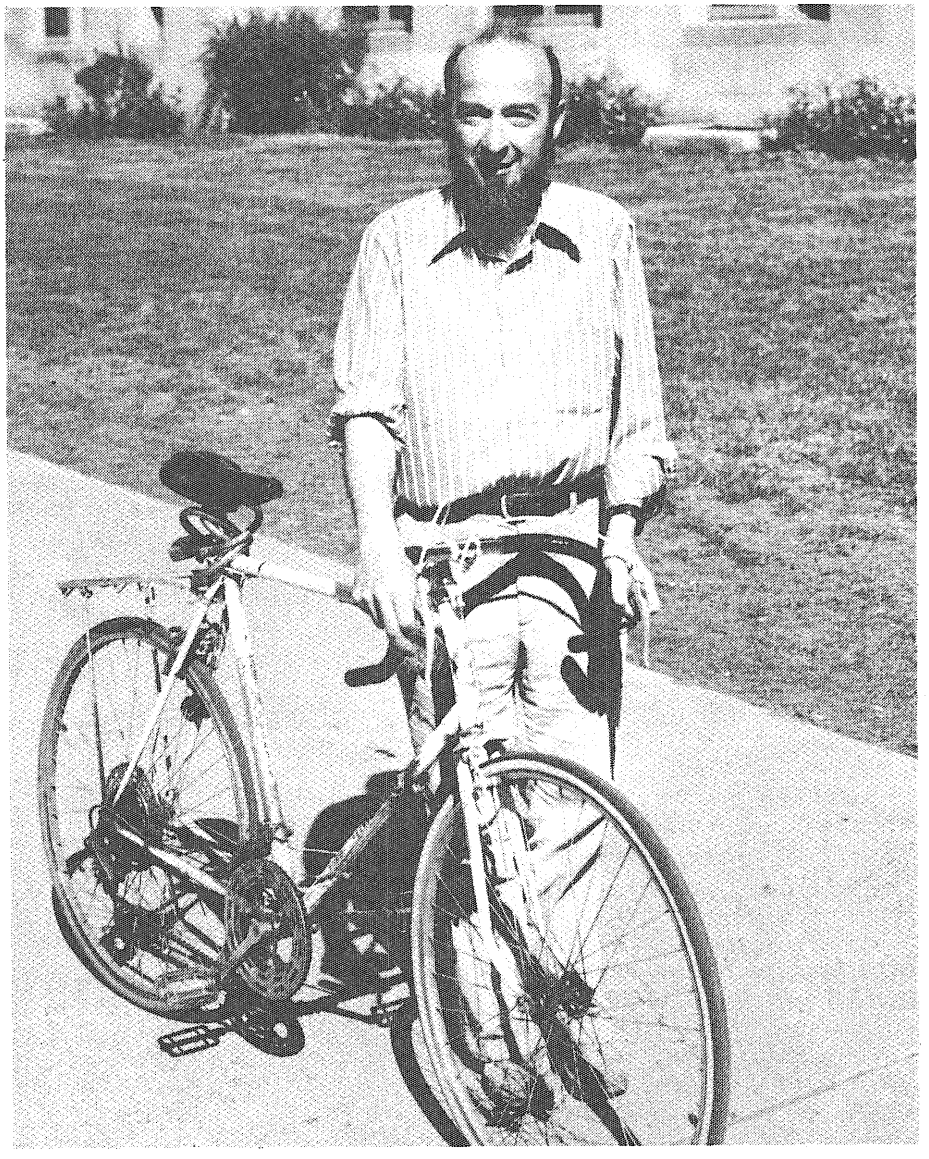
A five-person panel selected Bayman from among the top five vote-getting professors with the help of nominating letters sent to the IT Board. Bayman, who teaches graduate level physics, was highly praised by students in the letters.

"Dr. Bayman is first of all a lucid and thorough lecturer," said one student.

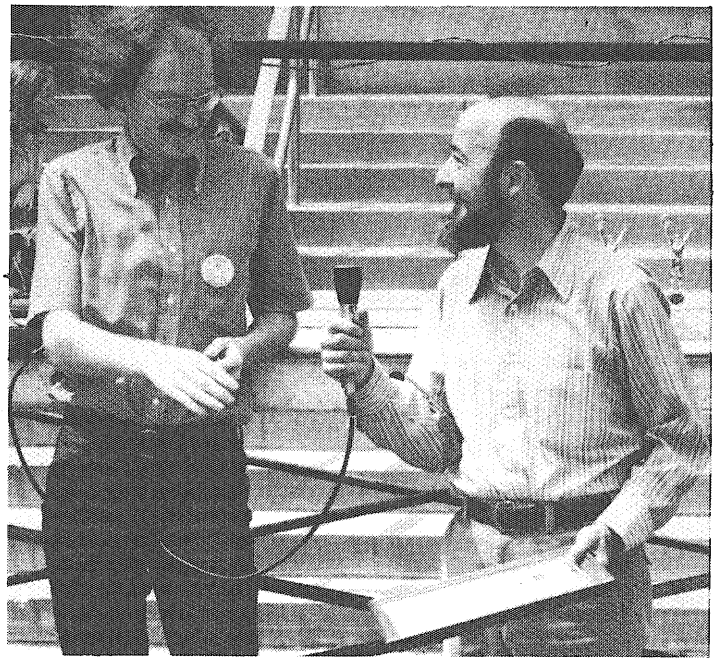
"His well-prepared and thoughtful lectures made this difficult subject accessible and interesting to myself and many other students," wrote another student.

An interview with Bayman reveals a lot about his popularity. He is warm, soft-spoken and precise and exudes an air of optimistic concern both for his profession and his students.

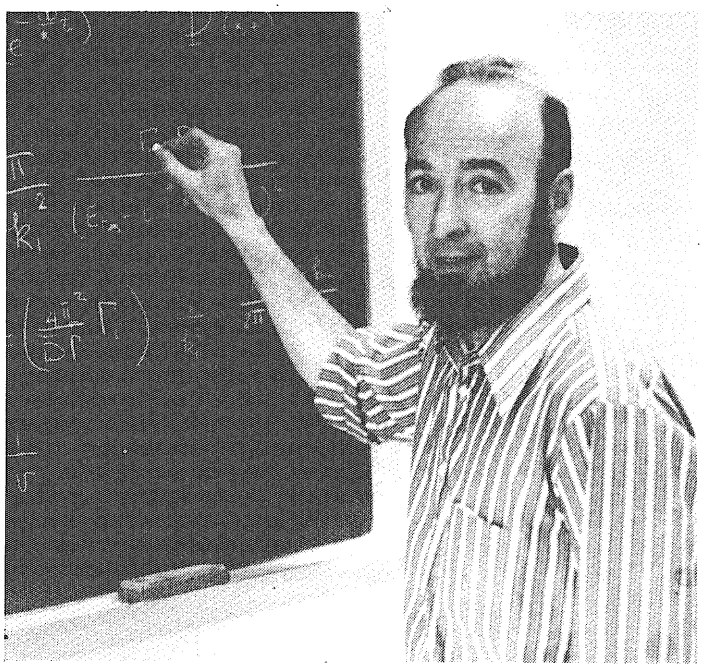
His concern is obvious in the special sessions he conducts: "Over a number of years, Professor Bayman has organized and led, on his own time, an informal study seminar to help students prepare for the preliminary



Bayman lives with his wife and two children in Minneapolis, near Lake Calhoun. He bikes to work during clement weather, and in the winter, walks across the frozen lake to catch the express bus.



Congratulations and thanks at the E-Day picnic.



A hazard of the profession: chalkdust.

written exam," wrote a student. "By helping us review exams from past years and pointing out important concepts and methods, he has helped many students cross this major hurdle."

Teaching physics offers a lot of rewards and a few frustrations, according to Bayman. He finds his subject fascinating and enjoys explaining it to his students.

"Physics is a marvelous subject," Bayman said, "for hundreds of years, some of the most brilliant minds have devoted themselves to it."

One of the reasons that Bayman enjoys teaching so much, he said, is that it forces him to relearn things that he might otherwise forget. By keeping everything fresh in his mind, his research also benefits.

The most frustrating part of teaching for him, according to Bayman, is attempting to reach a large and diverse group of students. It is difficult to avoid directing lectures toward one section of the class to the exclusion of another.

What is a Bayman physics course like? "He consistently uses the admirable practice of distributing his *exact* lecture notes in advance, allowing students to think about the physical principles instead of transcribing formulae," wrote a former student. "In addition, any questions that are brought up are explained in depth—without the usual embarassment to the questioner."

Bayman has some definite ideas about what it takes to be a good teacher. Understanding the material thoroughly is most important, he said. If asked a question that he can't adequately answer, a good response, he feels, is to admit defeat and ask the class to come up with an answer.

"It's a great mistake to try to gloss over things that you don't understand," he said.

A teacher should not assume that a concept is simple or obvious to students, according to Bayman.

"It's possible to intimidate students by making points seem too obvious," he said.

Beyond lecturing coherently, the structure and sequencing of coursework is of great importance, said Bayman. He tries to give assignments which lead students into the discovery of the next concept and avoids loading them down with needless computations.

Bayman's structure has been very successful, according to one letter writer: "A carefully planned syllabus and well written notes served as an excellent preview of what we would learn . . . while homework and examinations were always an aid to understanding the material.

But long after the concepts are absorbed and the structure appreciated, a grateful student remembers a professor for what he is, not what he did. Some of Bayman's former students remember him this way: "Overall, he is a cheerful giver of both knowledge and personal assistance . . . he offers more than effective teaching. He has repeatedly shown personal concern for the progress and 'well-being' of his students.

"I recall how pleasing it was to have an instructor who not only remembers you and your classmates, but also offers congratulations and/or encouragement after hurdles like the 'written' . . . sincerely and face to face," praises a former student. "In all my undergrad and grad years, I can think of no one more deserving of such an award."

Bayman received his BS in chemical engineering from Cooper's Union, a state college in New York City, and won a Fulbright Scholarship to do his graduate work at the University of Edinburgh.

During his first two years in Edinburgh, he saved enough money to pay for a third year, after his scholarship expired. The university supplied a scholarship for the fourth year and Bayman received his Ph. D. in physics in 1956.

From Edinburgh, Bayman went to the Niels Bohr Institute of Nuclear Physics in Copenhagen, Denmark as a Ford Foundation research fellow. He was married while in Copenhagen, in 1957, and came back to the US to become an assistant professor at Princeton in 1960. He accepted a post at the University of Minnesota in 1965 and speaks favorably of his lifestyle here, partially because it is such a good place to raise children.□

The organization of **FUNDAMENTAL UNIVERSITY** according to the taxonometric function.

·0	College of Anatomy
·00	School of the Thorax
·01	School of the Abdomen
·02	School of the Physiognomy
·03	School of the Cerebral Cortex
·04	School of the Resurrection Body
·1	College of Physiology
·10	School of Cytology
·11	School of Metabolism
·12	School of the Psyche
·13	School of the Pneuma
·14	School of Eternal Life
·2	College of Psychology
·20	School of Sensation
·21	School of Discipline
·22	School of Civility
·23	School of Language
·24	School of Religion (O.T.)
·3	College of Philosophy
·30	School of Mnemonics
·31	School of Arts
·32	School of Inference
·33	School of Mathematics
·34	School of Truth
·4	College of Cosmology
·40	School of Cosmogony
·41	School of Biogony
·42	School of Zoogony
·43	School of Anthropogony
·44	School of the New Creation
	(for kingdom categories):
0·	Department of Chemistry
1·	Department of Botany
2·	Department of Zoology
3·	Department of Anthropology
4·	Department of Theology

Each School will be composed of 5 Departments, with 5 Divisions in each Department, and 5 Sections in each Division. With one Professor for each Section, and with one Professor heading each Division, each Department, each School, and each College, this gives a Faculty of 3910 Professors, each specializing in an orthogonic category. They will write **FUNDAMENTAL ENCYCLOPEDIA**, and each Professor will be the author of a book on his category, for the Fundamental Library.

The **TAXONOMETRIC FUNCTION**, category ·34302, bouoae, is a comprehensive semantic grid that I have discovered, a periodic table of 3910 fundamental concepts, i.e., orthogonic categories, with this significance of the digits: 0 structure, 1 derivation, 2 animation, 3 rationality, and 4 summation. "Orthogony is correlation to the kingdom categories."—Professor J.W. Buchta; that is, by orthogonal or dimensional nature of cells: 0·, 0 dimensions; 1·, fiber; 2·, squamous; 3·, large pyramidal; 4·, 4 dimensional cells in the resurrection body. Orthogony is category ·34304, bouoau.

Fundamental does not mean Christian. It means basic, or pertaining to fundament (foundation of clear thinking); as fundamental concepts are essential to science. I distinguish 2 kinds of fundamental concepts: orthogonic categories, and fundamental relationships which compose all the rest of the fundamental concepts. There are so many fundamental relationships, that to list or discuss them all would compose a veritable encyclopedia, hence the term "Fundamental Encyclopedia".

Prospectus of **FUNDAMENTAL ENCYCLOPEDIA** (·34303, bouoao)
(Editor: pro tem: Dee David Smith)

To begin with, we need 5 teams of about 5 authors each; one team in anatomy, one team in physiology, one team in psychology, one team on the attributes of the mind, and one team in cosmology. Hopefully we can use the book, "Orthogonic Taxonomy of Fundamental Concepts"*, which I have compiled, as the outline of the encyclopedia, arranging the articles in the order of the orthogonic code numbers, instead of alphabetically; a classified encyclopedia.

The encyclopedia would be issued loose leaf, so as to make it possible to keep it up to date. Articles on orthogonic categories discussing the fundamental relationships involved would be published as reports in a magazine or periodical, bound so that when you pull the staples, it immediately falls apart into filing units, punched for a 3 ring notebook. All reports would be on pages 8½x11 inches.

An article of the encyclopedia (see ·2344, beouu) would consist of an outline, a bibliography, a dissertation of quotations in a context of discussion, a treatise, and a summary. Each of the reports will contribute to the development of the Taxonommetric Function which we take as outline, (thus completing and improving those orthogonic categories).

I, myself, specialize in only one of these 3910 orthogonic categories, namely, category ·34302, bouoae, the taxonometric function. My school of thought is (or has been) rational fundamentalism, a subdivision of the School of of Logical Positivism.

Respectfully Submitted,
Dee David Smith
fundamentalist, g.p.

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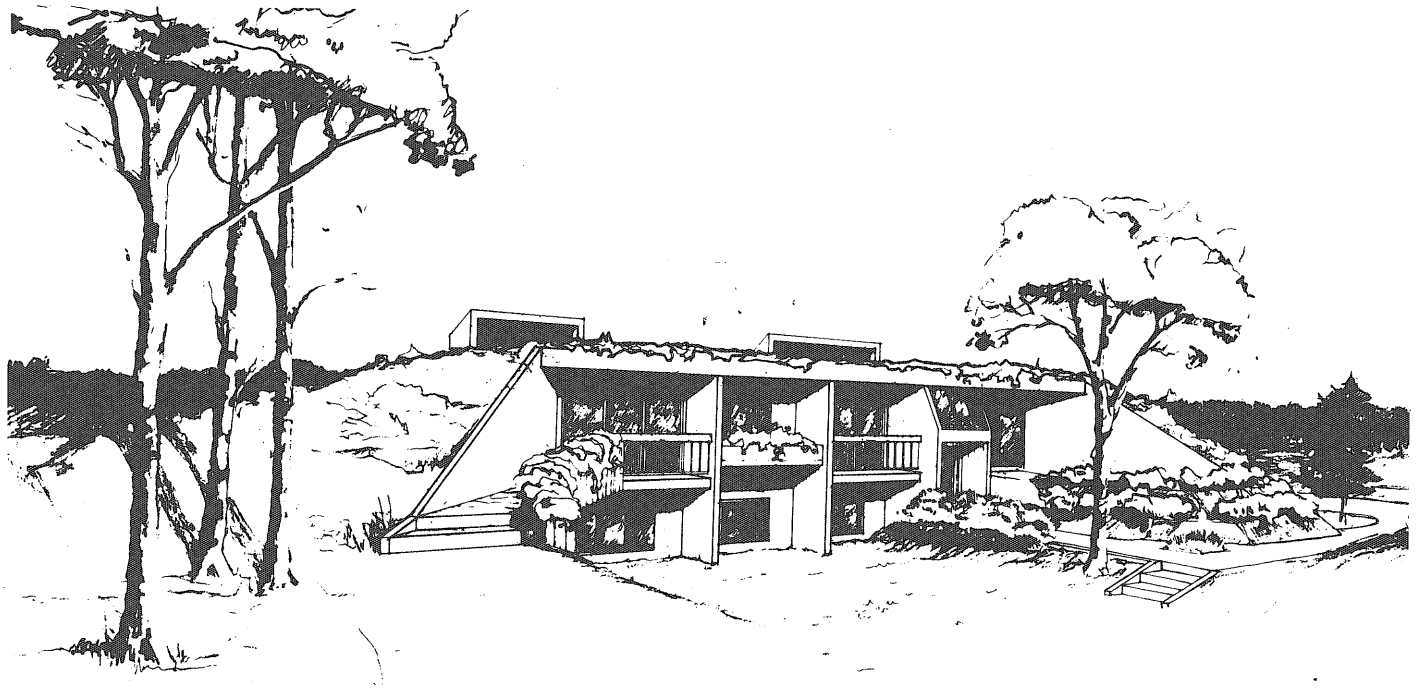

Mixing a little summer with winter

by Scott Tonneslan

When University of Minnesota researchers first began discussing underground construction about 10 years ago, they were fairly vague in suggesting what might go under the ground.

One of these researchers, Charles Fairhurst (chairman, civil and mineral engineering), made this cautiously worded statement: "We have a resource underground for a number of things we have traditionally done on the surface."

At that time it was fine to suggest putting "things" underground. But people? No...they didn't want to sound impractical or crazy. They also didn't want to jeopardize their research funding. Who wants to live like a mole?

But, the coming of the energy crisis, coupled with interest among architects in underground building for environmental reasons, has diminished much of the earlier resistance. In fact, it should further diminish due to the successful completion of underground buildings like Williamson Hall.

This building has provided a springboard for university research on underground construction. Though principally located underground to conserve surface space in its densely built-up location and to preserve the view of an historic building (Folwell Hall), it includes design features for energy conservation.

Thomas Bligh (mechanical engineering), an engineer who collaborated with architect David Bennett on the Williamson Hall design, calls underground construction another case of re-inventing the wheel.

"The Romans built underground to get out of the heat. What we are doing is improving the techology—making it more economical," he said.

In effect, they're taking the energy saving characteristics of prehistoric caves and fusing them with prevailing technology. While conventional buildings are designed without regard to climate, underground designers are leading us back to design techniques which are particular to the pre-industrial period.

So although the environmental advantages of building underground are worth noting, it is the energy conserving properties which are attracting attention. Ninety-five percent of the inquiries he receives, according to Bligh, are about energy savings. This is not surprising, since space heating and cooling account for almost 25 percent of the total United States energy consumption and about 70 percent of all residential energy consumption, Bligh said.

Much of this energy is lost through exposure to winter winds which sap a surface building's heat by infiltration (air filtering through poorly insulated walls, windows, and doors), and wind-chill effect. Heat transmission through walls, and the dissipation of energy via waste water and exhaust air increase this loss.

Because underground structures are almost completely covered by earth,

they are well protected from the cold winds of winter and the hot sun of summer. In addition, seasonal temperature fluctuations only reach a depth of several meters and short-term changes are almost negligible. The soil temperature in Minnesota, about 10 meters below the surface, is essentially constant at 10 degrees C. (50 degrees F.), only 10 degrees C. (18 degrees F.) colder than required for comfort. The good insulating properties of the earth and the mild soil temperature allow little heat loss from underground walls.

> "It is entirely possible to design underground buildings, with existing technology, that are totally self-sufficient in energy for heating and cooling."

Due to minimal air infiltration, an underground location adds greater control of ventilation for heating and cooling so that a device called a heat exchanger can be effectively used to recover heat from exhaust air. Such heat recovery units have been installed in the exhaust air system of Williamson Hall. They capture the heat generated by lighting, people, and machines and then reintroduce it into the fresh air supply.

An underground building can be heated entirely by this method. Solar energy from an active solar system (the sun's rays heat water in a collector) can then be stored during the day for use at night to keep the temperature constant. In the summer, solar energy supplied to a "hot water absorption chiller" provides air conditioning. For small underground buildings (like a house), almost the entire heat load can be provided by internal sources such as the dryer, refrigerator, television, water heater, lights and people.

The main obstacle to using solar energy to heat conventional houses is the cost. But, due to the energy efficiency of underground buildings, it is possible to meet all heating needs with much smaller (hence, cheaper) solar heating systems than are required for above ground use. It is entirely possible to design underground buildings, with existing technology, that are totally self-sufficient in energy for heating and cooling.

Moving toward that possibility, the U.S. Department of Energy has awarded a contract to the department of mechanical engineering to design an active solar collector system to heat and cool Williamson Hall. Designed by Bligh and James Ramsey (mechanical engineering), the collectors will both heat and cool the building. After the solar system has been installed—it is now under construction—Williamson Hall will be about 60 percent energy independent.

In a related study, the departments of civil and mineral engineering, electrical engineering, mechanical engineering, and geology are studying the feasibility of storing thermal energy in rock. Since a solar system can only operate during sunlight, a bed of porous or crushed rock is being used as a storage medium to store energy for sunless periods. Using this method, energy can be held in reserve for up to six months.

Another important source of energy which is utilized in underground buildings is passive solar energy. Passive solar collection involves trapping the sun's radiant energy through windows. This system provides substantial energy without the expense of an active solar collection system. But it is important that the windows are constructed in a wall facing south. If located on other walls, the windows will cause a heat loss. Studies have shown that if the total area of the south wall is at least 25 percent window, the net flow of energy into the building is positive (even during the winter).

Further analyses have shown that this type of system results in overheating during the day and underheating at night. To maintain an even temperature through the day, a thermostatically controlled heating-ventilating-air conditioning (HVAC) system is needed. These units measure and control the temperature, relative humidity, oxygen levels, odor levels and the amount of intake and exhaust air in a building. Such a system could, for instance, automatically set back a thermostat at night. In addition, to reduce the passive solar heat gain in summer (when the sun's rays may be too intense), designs including vegetation, overhangs and shelters are used.

Some of these techniques have been tried in Williamson Hall. By noting that in Minneapolis the sun elevation varies from approximately 22 degrees at its winter low to 68 degrees at its summer high, a series of louvers consisting of a series of planters, have been ranked along the windows. The louvers are spaced to allow maximum sun penetration during the winter and to block most of it in the summer. Leaves of Englemon Ivy hanging from the planters further block summer sunlight. In autumn, the leaves fall off the vines thus allowing maximum penetration for the winter months.

Cooling systems in underground structures aren't always necessary. It depends on the design, size and location of the building. However, in the summer, air entering some subsurface structures requires dehumidification and cooling. Though this cooling load is small because of the cooling effect of the earth against the walls and floors, an air conditioning system is usually needed. Since such a system is beyond the capacity of small solar collectors, Bligh is developing an ice-air conditioning system which makes use of the Minnesota winter, in the summer.

The system involves the circulation of antifreeze from chilling coils, located outside the structure, to an underground water tank. During the winter, the water is frozen as the antifreeze circulates from the coils to the tank. In the summer, the path of the antifreeze is diverted from the coils to the structure's ventilation system—cooling the air while melting the ice. The only energy required is that needed to run a small pump and furnace blower. A prototype of the system is now being tested in a house in suburban Minneapolis under a grant from the Minnesota Energy Agency.

The whole underground energy system can be thought of as a partially long-term, partially short-term storage system designed to smooth demand fluctuations, while using energy more efficiently. Protecting the living space from winter winds, utilizing the wind for ventilation in the summer, retaining heat in the winter, dissipating it in

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This is the last of the six **Technologs** for the 1977-78 school year. How did we do? What do think about your Minnesota **Technolog** after reading the last six issues? Please take a few minutes to complete the following survey so next year's staff will know exactly how best to produce future **Technologs** in a way that's appealing to you, responsive to your information needs—everything you always wanted in a student magazine. When completed, please return this page to the survey box located outside the Mechanical Engineering Main Office.

Please indicate whether you are an IT freshman____ sophomore____ junior____ senior____ grad____ faculty____ administrator____

How many issues of **Technolog** did you read this year?_____

In which building do you usually pick up each issue of the **Technolog**?
Mines & Met.____ Chem.____ Mech.____ Aero____ Experimental____
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Future issues of **Technolog** should contain **more** of the following types of articles:

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____Humor

other_____

Future issues of **Technolog** should contain **less** of the following types of articles:

____IT News
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____Counseling/advising information
____Greek news
____Environment/energy
____Technical/research
____General interest
____Humor

What, in your opinion,should be the basic purpose of a magazine like the **Technolog**? Technical____ General____ Entertainment/information____

What, in your opinion, are the three most important technological issues present among us today?

1._____

2._____

3._____

the summer, the earth mixes winter and summer achieving a comfortable, economical balance. Furthermore, the hot water storage system of the solar collectors and the ice-tank of the ice-air conditioning system (both built into the earth) facilitate a constant supply of energy.

Underground construction, although seemingly ready for application in an energy hungry nation, has many problems facing it. Fairhurst (who is also editor of **Underground Space,** "an interdisciplinary journal devoted to the broad technical, legal, and social aspects of underground development") explains that we have to be just as careful in developing our underground resource as any resource.

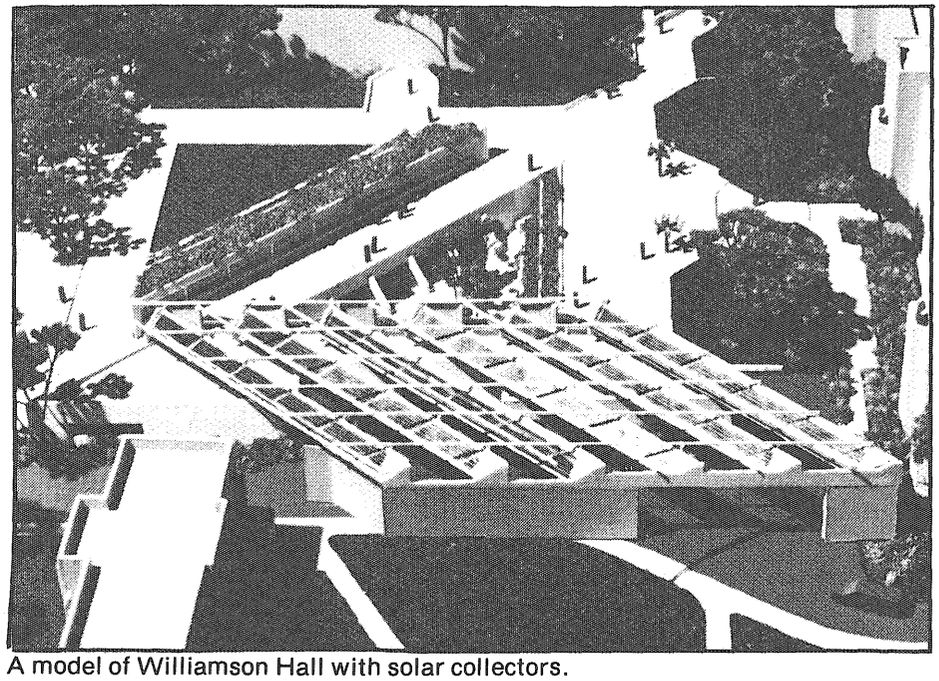
"We don't want to develop it and then discover we did it wrong," he said.

Not only are there technical questions to answer, but institutional ones such as how does underground development affect our laws, taxation system, and zoning ordinances? For instance, in an urban area composed of conventional houses, underground or earth-sheltered houses might require bigger lots (though a development composed entirely of earth-sheltered housing would use less space than a conventional one). There is also the possibility of conventional houses interfering with the view from earth-sheltered houses or blocking their sunlight.

A major problem is already evident for those seriously considering building underground houses. Banks are reluctant to approve loans for these projects because of the lack of experience and fear of public rejection.

Minnesota could, of course, benefit from underground buildings and the energy savings they bring. A group of people, including Bligh and Fairhurst who are knowledgeable in the technology and institutional problems involved, have been working with politicians and bankers to ensure that they are aware of the critical questions.

In January of last year, the group was given a grant by the Legislative Commission on Minnesota Resources to study the design of the earth-sheltered houses. Coordinated by Raymond Sterling (civil and mineral engineering), the project involved several local consulting firms to make certain that the research would be practical and of immediate application. The goal of the project was to demonstrate that the energy requirements for earth-sheltered buildings could be reduced to the extent that the structures became totally energy independent.


A model of Williamson Hall with solar collectors.

Completed in January of this year, the study resulted in the publication of a 300-page manual containing information on the design, construction and energy efficiency of various types of earth-sheltered houses. Discussions of building codes and financial problems also were included.

The preparation of the manual further led to the creation, in October, 1977, of The Underground Space Center (of which Sterling is director). The center has been assigned the responsibility of answering requests for information on underground construction and of coordinating future research. One such study will involve the collection and evaluation of data on the energy efficiency of 10 underground and two well-insulated, conventional houses. The subsurface dwellings are to be located throughout the state—four of them in state parks—the other six sites to be selected this month.

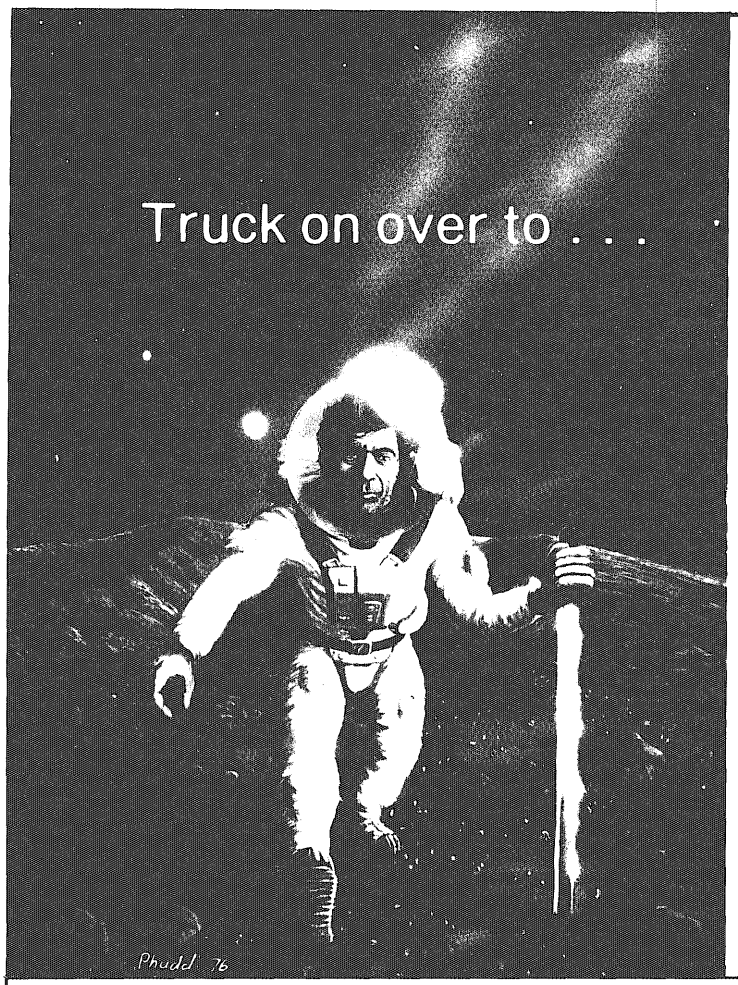
Future work of the center will concentrate on underground or earth-sheltered construction for commercial and industrial purposes. For instance, subsurface construction would be well-suited for refrigeration plants due to the earth's ability to retain cold. It might also be appealing for manufacturers of precision instruments, since the vibrations caused by surface ground waves are eliminated under the surface.

Bligh is a consultant in the design of the proposed Minnesota Historical Society Building, recently funded by the state legislature. To be located in the Minnesota River Bluff under Fort Snelling, the structure will be earth-sheltered and energy independent.

The National Science Foundation, recognizing the potential advantages of large underground facilities, awarded a research grant to the university's civil and mineral engineering and mechanical engineering departments to monitor the energy conserving characteristics of Williamson Hall. Through a test being run by graduate students Paul Shipp and Javad Mostaghimi, they hope to gather data on heat transfer from underground structures to soil. The ultimate goal of the study is to develop a computer program which can calculate the heating and cooling loads for any subsurface building.

While Williamson Hall is extremely energy efficient, it is not energy independent nor designed to be. The proposed civil and mineral engineering building (construction is planned to begin in 1981), will be the first totally energy independent building on campus. It may become a fitting demonstration of the energy conserving ideas of the very people it will shelter.□


THE CONTINUING ADVENTURES OF THE BIONIC T.A.
WHEN WE LEFT, OLE FACED CERTAIN DEATH AT THE HANDS OF THE FORESTERS...
TECHNOLOG 1978
AT THE SAWMILL.. ONLY 6.94538 SECONDS TO-A LIVE! UNLESS...
PRZZ
I CAN RICK-A-SHAY MY TOBACC-A OFFA DA SIGN (A.), KNOCKINGK PAIL (B.), OFFA HOOK TO FALL ON BOARD (C.), CAUSZINK DA BROOM (D.), TO HIT-A DEE SVITCH (E.), SHUTTINK OFFA DEE SAW.*
*ASSUMING ALL CALCULATIONS ARE CORRECT.
DA
SPLAT!
PWANG!
PTOOOF
HHCCC!
PWANG!
SWISH!
FWIP!
KLICK!
NOW TO-AH SAVE E-WEEK!
MEANWHILE... DURING DA E-WEEK RACES, WE ROB DA VENDING MACHINES!
THEY'LL LAY A SMOKE-SCREEN WHILE WE GET DA JUNK FOOD!
PITIFUL SIMPLY PITIFUL
G.C. BOVE
PFOOOT!
MY PLAN GOES VELL!
GEE, IT WUZ NICE OF DR. BIERSTEIN TO LET US USE DEEZE TOOLS FOR THE MONEY WE GET!
THE FORESTERS PROCEED TO DESTROY E-WEEK UNCHECKED...
CHAIN BUY FOREST
AS THE FORESTERS REACH THE I.T. CAMPUS, THEY ARE CONFUSED BY THE SMOKE...
COUGH!
KWUNK!
WHIRR!
WHEEZE!
KLINK!
AS OLE ARRIVES AT E-WEEK...
FLY-INK FINLANDERSZ!!
FORESTERS AND A FOODT FLINCHERS
I AH SPOTTED DA ROBBERS WIT AH MY BI-ON-EEK VEE-SHUN!! NOW TO-AH TRICK DEESE A-HERE FORESTERS!!
FOOD AND ENG-GIN-EERS DIS WAY!!
MAIN ENG.
GRR!!
INSIDE...
WUT FUN!
WHAT TH' H...
AARG!
SPLUT!
AAAGH!
MUNCH! SLOBBER!
JUNK FOOD JUNKIE
BRIEFLY...
DR. BIERSTEIN! SO YOURE AH BEE-HIND DIS AH, TOO!!
YES, ANDT I VOOD HAVE SUCCEEDED IF YOU HAD NOT INTERFERED!!
DR. BIERSTEIN LEAPS INTO THE MACHINE...
SLAM!
POOF!
OLE OPENS THE DOOR OF THE VENDING MACHINE...
SVININGK SVEDES!!
HE'S AH GONE!!
'78 ZDUMDS
CHEAP COMIC EXHIST
PUFF!
AS THE FORESTERS CHASE THE ROBBERS OFF INTO THE SUNSET OLE CAN RELAX KNOWING HE HAS SAVED E-WEEK
THE END
HAVE A NICE SUMMER Y'ALL!



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