60:1

minnesota TECHNOLOG

Fall 1, 1979

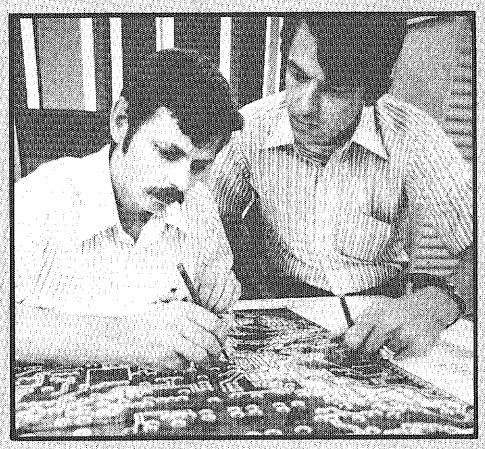
THE MOORE TOY

Nier Goes Far

The IT Auto

The Lighter Side of Technology

People join TI for love of technology. They stay for a lot of reasons.



Texas Instruments is viewed by many people as a technological leader in only one area.

To the electronics industry, we're producers of semiconductor materials and components.

To the oil industry, we're seismic data gatherers and processors who help them find petroleum-bearing formations.

To growing millions of consumers, we're the people who make calculators and digital watches.

To manufacturers of automobiles, TV yoke coils, battery cables and electromagnets, we are producers of clad metals.

The list of our major product and service areas is a long one. We've included it below.

The point is, all this diversity means extraordinary breadth of opportunity for you. Not just initially, but for as long as you're with TI. We've got a move-up environment that also lets you move *laterally* when you want to.

Find out how open-ended your opportunities can be. And how TI has created an environment where you can prove your potential fast.

See what we're doing in:

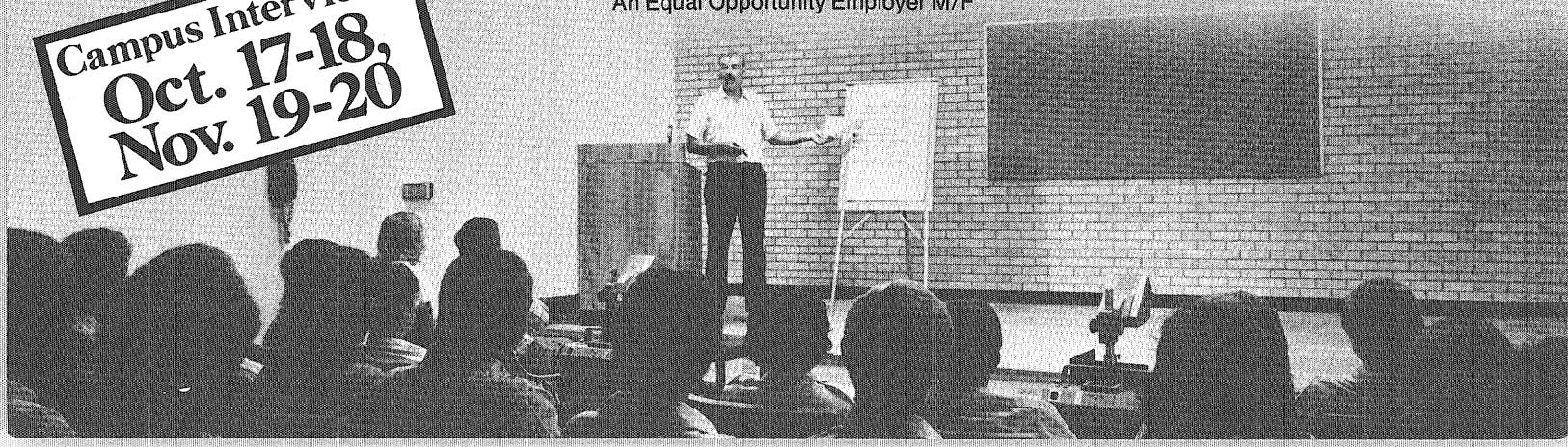
- Microcomputers and microprocessors
- Semiconductor memories
- Linear semiconductor devices
- Microelectronic digital watches
- Calculators
- Minicomputers: hardware, software and systems featuring software compatibility with microprocessors
- Distributed computing systems for business and industry
- Electronic data terminals
- Programmable control systems
- Data exchange systems
- Advanced Scientific Computers
- Digital seismic data systems
- Air traffic control radar and Discrete Address Beacon Systems
- Microwave landing systems
- Radar and infrared systems
- Guidance and controls for tactical missiles
- Worldwide geophysical services
- Clad metals for automotive trim, thermostats and electrical contacts
- Interconnection products for electronic telephone switching systems
- Temperature-sensitive controls for automobiles and appliances
- Keyboards for calculators and for many other products.

Send for the 34-page picture story of TI people, places, and opportunities. And send us your resume in confidence to

George Berryman,
P. O. Box 225474,
Dept. CH2, MS 67,
Dallas, TX 75265.

TEXAS INSTRUMENTS
INCORPORATED
An Equal Opportunity Employer M/F

Campus Interviews
Oct. 17-18,
Nov. 19-20



WANTED

Person or persons with engineering or chemical degrees who are impatient to get on with their careers. Eager, independent individuals who are flexible enough to face a challenge and who won't get lost in an open working environment. Characterized by strong desire to run their own show. Able to respond and develop quickly in a growing company. *Beware* — these people shy away from traditional training programs. Crave responsibility. And thrive on it.

REWARD

A challenging career at Celanese, a $2.6 billion dollar diversified chemical company with solid position in chemicals, fibers, plastics and polymer specialties. Rapid advancement and growth opportunity.

If you know of such a person, or want to turn yourself in, ask your placement officer to arrange an interview with us. Or you can write to Tom Clark, Celanese Building, 1211 Avenue of the Americas, New York, N.Y. 10036.

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Editor's Log

Only five weeks into the fall quarter, and the warm breezes of summer are already a distant memory. The summer brought changes to all of us. It was also a time of flux for the *Technolog* staff. We surfaced at the start of the 1979-80 publishing year with new people filling almost every major position, with a higher percentage of IT student involvement than in many years. Bringing you the issues and answers that are pertinent to IT has got all of us excited. With all of this going for us, I am certain that we will give IT students a magazine they can be proud of, and enjoy reading.

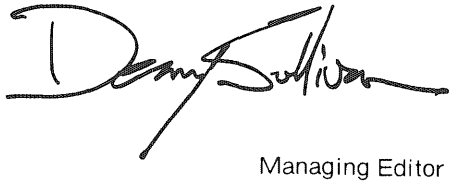
The start of fall quarter also means "back to the drawing board" for the engineering students who will continue to improve a hybrid power-source automobile that took a first place in the SCORE trials this fall. Terri Levy brings you an update as well as the story of how team effort resulted in "The I.T. Auto."

The Toobee has been discovered in California (with the help of a Berkeley professor) and has found its way to the *Technolog* office. Toobees have been "phwhizzing," as Steve Deyo, author of "The Toobee: Frisbee of the Eighties," put it, through the office ever since. Try one out yourself with the do-it-yourself model in this issue.

Mary Jo Hannasch brings us a fascinating story about the amazing Professor Alfred Nier. After several personal interviews with Dr. Nier, Mary Jo unwinds a story that is sure to leave IT students of this generation a little bit more humble. See "Nier Goes Far."

We will have Bruce Kvam's "Ad Astra" as a regular feature again this year. In this issue, he reviews *The Fountains of Paradise* by Arthur C. Clarke, *Jem* by Frederik Pohl, and *Roadmarks* by Roger Zelazny. "After Graduation," another regular feature, will strive to provide information that will make the transition into the "real" world a little easier, "The Lighter Side of Technology " is a new regular feature this year." "The Lighter Side" will, each issue, prove that technois funny. And, of course, everybody's favorite, "The Bionic T.A.," is back again from deep inside the mind of creator Steve Smith.

Good luck this year, and feel free to come down to room 2, Mechanical Engineering, and say "hello."



Managing Editor

Staff

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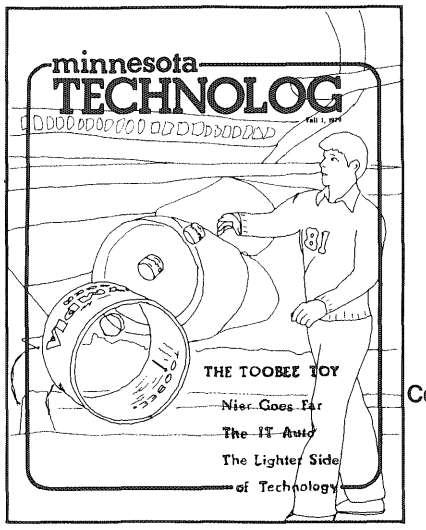

Cover photo by MIKE DORN

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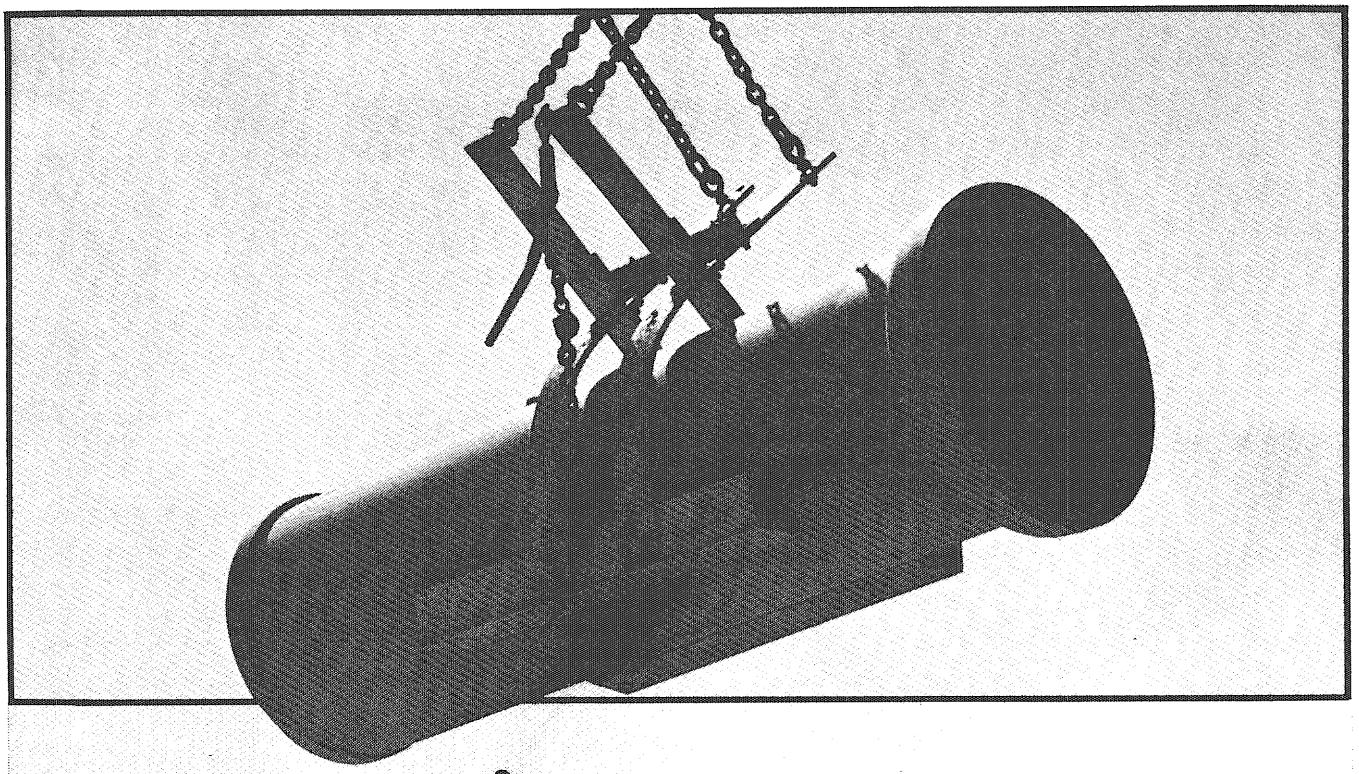

The world's original building material is still the best—clay.

In ancient Crete, clay was used for the original sewers of the Minoan Palace at Knossos. After 3,500 years, they still flow.

That's why clay is still your best choice for sewer pipe. Because it lasts.

Unlike alternative materials, clay is inert. So it doesn't disintegrate through chemical reactions in sanitary sewers.

And unlike some alternative materials, clay is rigid. It supports earth loads well, without flattening. Its strength is not dependent on side fill compaction.

Of course, you can always substitute other underground piping materials. But you should be prepared to pay for expensive repairs, or even more expensive replacement, sometimes within just 10 years.

Which brings us to Dickey Clay pipe's biggest advantage.

At Dickey, we guarantee our clay pipe for 100 years. And that's a truly remarkable guarantee. But not unreasonable in light of how well ancient clay sewers have survived.

Today, we're America's largest clay pipe manufacturer, with a research and development program ensuring products to meet the needs of the wastewater industry. Dickey Plain End Pipe, with flexible couplings for faster, simpler, cost-saving installation is only one example.

If the choice is yours, choose Dickey Clay. It could be the start of something everlasting.

For more information, call your Dickey sales representative.

Or call or write: W. S. Dickey Clay Manufacturing Company, P. O. Box 6, Pittsburg, Kansas 66762, 316/231-1400. 95944

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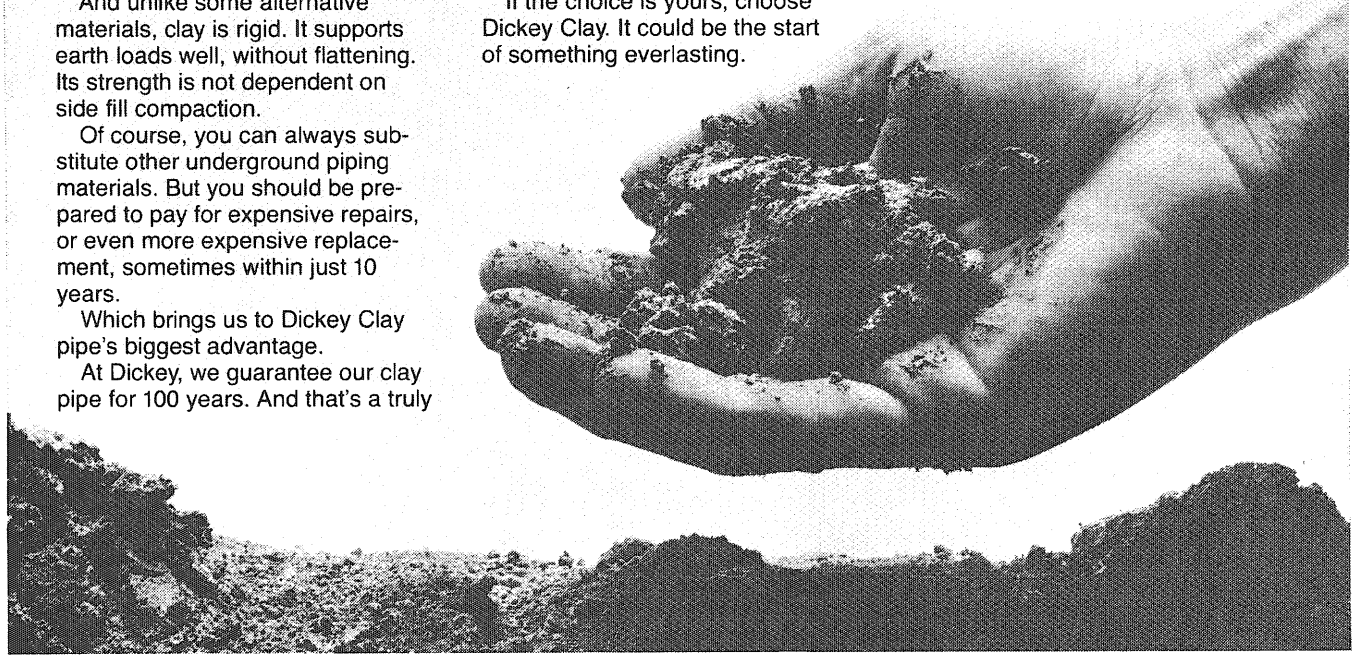


Log Ledger

awards

John Hinsverk, Jr., a Mechanical Engineering junior, and **David McCleary,** a 1979 Civil Engineering graduate, were each awarded a $500 engineering scholarship by the Consulting Engineers Council of Minnesota late last spring. Selection for the CECM scholarships are made on the basis of academic excellence and character.

George Kewin, a third-year graduate student at the Harvard Graduate School of Design, will share $5,000 with his school for his design of an "extruded" aluminum ferry terminal for Woods Hoole, MA, which won first place in the 1979 Reynolds Aluminum Prize for Architectural Students.

conferences

TWENTY-NINTH CONCRETE CONFERENCE, November 29
Earl Brown Center, St. Paul Campus. Fee: $40.
Design, construction, repair of concrete structures.

TWENTY-FIRST U.S. SYMPOSIUM ON ROCK MECHANICS, May 1980
University of Missouri, Rolla, MO.
Rock fragmentation, ground support, coal mining, rock instrumentation and analysis, explosives, geothermal conditions, tunneling, drilling, earthquakes, subsidence. Abstracts and papers accepted. Contact David A. Summers, c/o University of Missouri-Rolla, rock Mechanics & Explosives Research Center, Rolla, MO, 65401. Deadline for abstracts, 30 November 1979.

NEW APPROACHES TO NONLINEAR PROBLEMS IN DYNAMICS, December 9-14
Asilomar Conference Grounds, Pacific Grove, CA
Mathematical techniques, applications in ME, AE, ChE, EE, Civil and Envionrmental Engineering. Contact the Engineering Foundation, 345 East 47th Street, New York, NY 10017.

Books and Film

McGraw-Hill Dictionary of Scientific and Technical Terms, 1,814 pp., $39.50. Over 8,000 definitions with more than 3,000 photographs and line drawings. Outlines processes, methods, reactions; gives capsule explanations of theories, laws, and rules; describes technical equipment; includes acronyms, abbreviations and synonyms. Also covers SI conversion tables, mathematical notations, energy conversion factors, and much more.

Cyril M. Harris, Ph.D., **Handbook of Noise Control** (2nd edition), 720 pp., $39.50. Discusses noise production and transmission; OSHA, EPA and HUD regulations; environmental impact of noise. Features contributions of 53 experts.

Nathan Walker, LL.B., et al, **Legal Pitfalls in Architecture, Engineering, and Building Construction,** 321 pp., $17.50. Written for the professional. Discusses construction management, arbitration proceedings, new forms and contracts, with legal analyses.

Aluminum Association, **Aluminum Standards and Data,** 208 pp., free. Basic reference to mechanical, physical and other properties of aluminum. Sections include general information, industrial nomenclature, and standards. Single copies available from the Aluminum Association, Publications Department, 818 Connecticut Ave., NW, Washington, D.C. 20006.

David McCullough, **Civil Engineers Are People,** reprint, free. Reprinted from **Civil Engineering,** September 1978. Asserts that there are engineers "who read, who paint, who grow roses and write poetry, who fall asleep at lectures. Civil engineers have been known to go to the theatre; they have taken pleasure in good music and fine wine and the company of charming women. There is even historical evidence of the existence among a few civil engineers of a sense of humor." Copies available from the American Society of Civil Engineers, 345 East 47th Street, New York, N.Y. 10017.

Bell Laboratories, **Fundamental Scientist,** 25-minute film, $125 or rental fee. Features Philip W. Anderson, co-recipient of the 1977 Nobel Prize in Physics. Awarded a CINE Golden Eagle Award. Discusses the scientific environment and the benefits of scientific knowledge. Contact Larry Chase, Bell Laboratories, 600 Mountain Ave., Murray Hill, nj, 07974.

Seminars and Colloquiums

CHEMICAL ENGINEERING AND MATERIAL SCIENCE
RM. 240 AMUNDSON HALL—1:15 PM

November 13
"The Interaction of Flow and Kinetics in the Refining of Pulp Fibers"
Dean Harry Cullinan, Institute for Paper Chemistry

November 20
"Use of H+ to Pump An Ion Across a Supported Liquid Membrane"
Prof. Maurice M. Kreevoy, Department of Chemistry

December 4
"New Concepts in Process Synthesis and Their Industrial Application"
Dr. Bodo Linnhoff, ICI

AEROSPACE ENGINEERING AND MECHANICS
RM. 225 AERO ENGINEERING—2:15 PM

November 2
"Computing on Non-orthogonal Grids in Three Dimensions"
Prof. Jack Moran, Department of Aerospace Engineering and Mechanics

November 16
"Recent Developments in Aero-acoustic Research"
Prof. David G. Crighton, Department of Applied Mathematical Studies, University of Leeds, England

COMPUTER SCIENCE
RM. 305 LIND HALL—3:30 PM
COFFEE AND COOKIES, 114 LIND HALL—3:00

November 19
"An Approach to Data Types and Data Abstraction"
Dr. James Morris, Department of Computer Science, Purdue University

November 26
"On the Simplification and Equivalence Problems for Straight-Line Programs"
Mr. Brian Leininger, Graduate Student, Department of Computer Science

CONTROL SCIENCE AND DIGITAL SYSTEMS (EE 8290)
RM. 108 MECHANICAL ENGINEERING—2:15 PM

November 1
"Algorithms for Computer Control of Urban Traffic"
Prof. Willliam S. Levine, University of Maryland

November 15
"Freeway Surveillance and Control System Design Via Modern Control Theory"
Dr. Harold J. Payne, ESSCOR, San Diego

MECHANICAL ENGINEERING (ME 8773/8774/8775)
RM. 108 MECHANICAL ENGINEERING—3:15 PM

November 7
" Military Enterprise and the American System of Manufacturing"
Prof. Merrit R. Smith, Department of History of Technology, MIT

November 14
"Energy Conservation in Buildings: Are Efforts Designed to Increase It Effective?"
Eric Hirst, Research Engineer, Oak Ridge National Laboratory

November 21
"Pattern Recognition in Walking"
Prof. Maxwell Donath, Department of Mechanical Engineering

November 28
"Diesel Exhaust Aerosols"
Prof. David B. Kittelson, Department of Mechanical Engineering

ARCHITECTURE AND LANDSCAPE ARCHITECTURE
RM. 125 ARCHITECTURE—4:30 PM

November 7
Beyond Theory and Perfection in Architecture
Edward Frenette, Director of Design
Setter, Leach & Lindstrom

November 14
From the Bedroom to the Drawing Board
John and Rae Baymiller, Baymiller Studio

November 20
Invention and Convention
Prof. Fred Koetter, Department of Architecture
Harvard University

MISCELLANEOUS

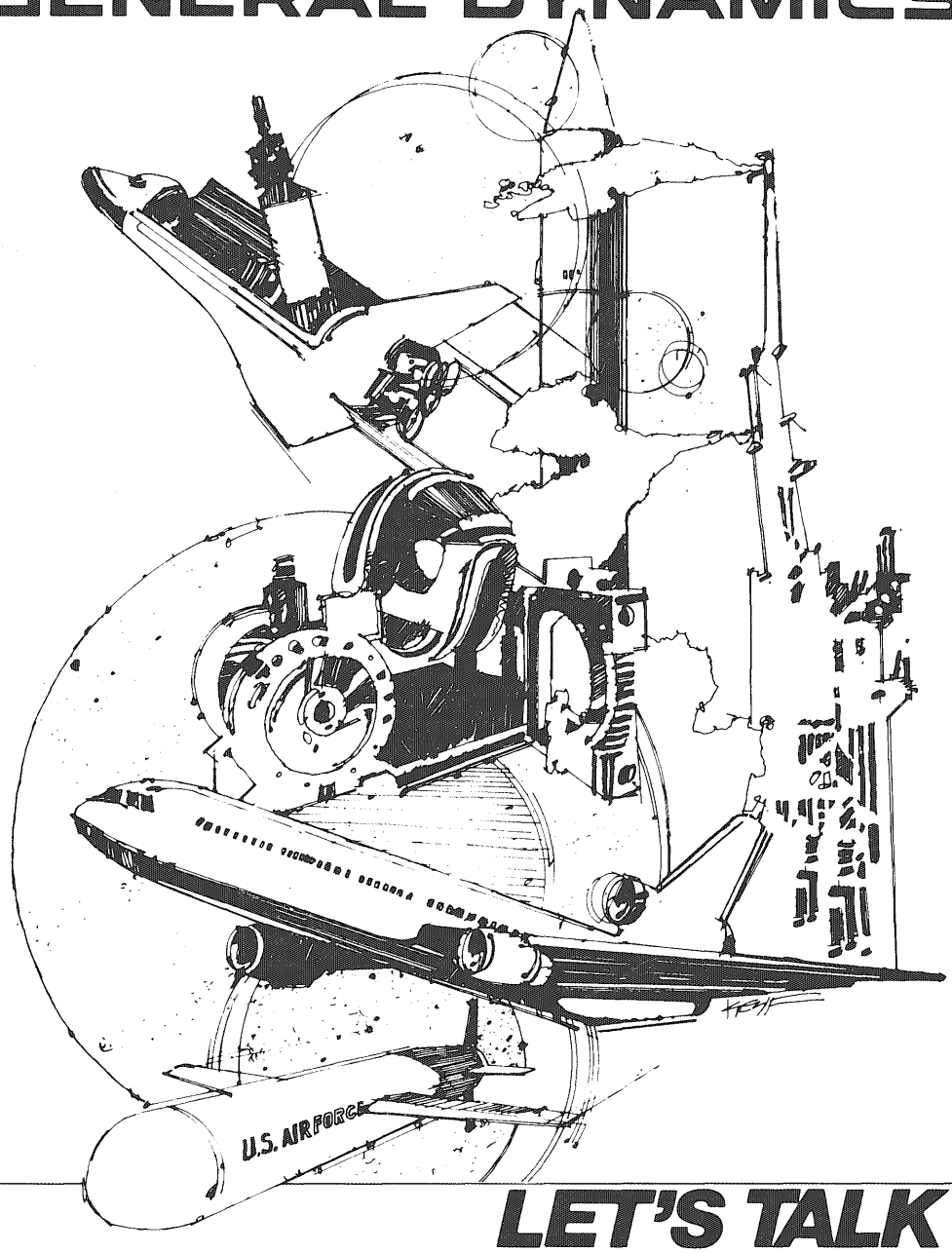
November 1
"Demetallation of Metalloporphins"
Dr. Warren Reynolds, Department of Inorganic Chemistry
Rm. 168 Kolthoff Hall— 12:15 PM

"Is F(2P3/2, 2P1/2) + HBr – HF + Br (2P3/2, 2P1/2) an Adiabatic Process?"
Dr. Kopin Liu, Department of Chemical Dynamics
Rm. 224 Smith Hall—8:00 PM

November 2
"Financing for Public Transportation Programs"
Dr. Alice Kidder, North Carolina A & T, State University, Greensboro
Rm. 110 Experimental Engineering—2:15 PM

November 14
Alvar Aalto and Finnish Architecture
Three visiting lecturers sponsored by Northwestern National Bank. Rm. 125 Architecture—8:00 PM.

GENERAL DYNAMICS



LET'S TALK TECHNOLOGY

The General Dynamics Convair Division, located in San Diego, wants to talk to engineering students about the diverse work assignments in such engineering areas as: Research, Test, Design, Quality Control/Assurance and Manufacturing. Currently there are major, long-term contracts that involve work in Advanced Space Structures, Energy, Commercial Airframes and the Cruise Missile Program. Excellent growth opportunities exist for these programs in the following engineering fields: **Industrial, Electrical, Mechanical, Aerospace, Engineering Technology,** and **Manufacturing**.

Also, let's talk about our excellent educational assistance and management development programs, tuition reimbursement for furthering your college education, and our liberal relocation allowance.

To learn more about General Dynamics Convair Division, contact your Placement Office today. Or, if you prefer, send your resume to: *Mr. Earl Bailor, College Relations Administrator, GENERAL DYNAMICS Convair Division, Mail Zone 11-1306-1114, P.O. Box 80847, San Diego, CA 92138*

Convair Division

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After Graduation

by Steven M. Deyo

"What? Five weeks into the fall quarter and you're already talking about graduation?"—Well, yes; but, to tell the truth, it's never too nearly to start pondering your future. If you haven't already begun, you ought to start mulling over your options now, and do some serious self-evaluation. What are your practical interests? What are your marketable skills? Or, getting down to brass tacks: What can you offer an employer so that he feels justified in paying you ten, twelve, fifteen thousand dollars a year?

The conventional method of job hunting has been to decide on a career that seems interesting, go to college for a degree in that field, and somehow get a job upon graduation—where you learn the specific skills and tasks that job requires. Unfortunately, some people find their inherent skills are poorly matched for the job they do manage to get. Problems like this can sometimes be remedied by changing jobs, but often more drastic action is needed, or career dissatisfaction results. Why do you think there are so many family-supporting workers in entry-level positions nowadays?

We, on the other hand, are going to do just the opposite. We will determine our inherent and proven skills, notice particular groupings of skills, pair them with interest and curiosity, and come up with several jobs we can competently perform within a particular career field. After this, job-changing becomes a deliberate fine-tuning of our career goals, a natural part of our career development, and not a random, almost frantic rummage for a job, any job, to tide us over until we get sick of it. The graduate who knows exactly what he can do is rarer than you think—and employers will sit up and listen when you start telling them how you can solve their problems.

So, some evening when you don't feel like studying, take out a sheet of paper. It's reflection time.

Think about your past work experience, hobbies, and community involvement. Find ten specific achievements which gave you particular satisfaction, whether great or small. Next, think them over. What was it about them that you enjoyed? That you did particularly well? Perhaps, that other people complimented you for? What **results** did you bring about? (Employers think in terms of problem-solving and task-achieving—**results.**) Then compare each accomplishment with the following skills inventory.

Keep in mind that elements of some or all of these groupings will be important in whatever field you choose; it's not strictly black-and-white. The point of this exercise is to help you determine for yourself, so you know as thoroughly as possible, exactly what each of your skills and strong points are. With a handle on these, you will know what you can do well—borne out by past experience, only diffusedly—and concentrate these elements to gain experience and demonstrate effectiveness, all the while honing your skills and fine-tuning your career path into precisely what you do and enjoy best.

I. DEXTERITY Did you like model-building or shop when you were young? Do you work well with tools? Which ones? Can you drive? Can you do precision work with your hands? Are they steady and firm? How's your hand-to-eye coordination? Are you good at fixing things? People who have these skills could be carpenters, typists, artists, surgeons, watchmakers or mechanical engineers.

II. COORDINATION Are you the athletic type? Active? Coordinated? Love the outdoors? Into exercise? Physically demanding jobs require these skills.

III VERBAL Can you summarize essays or articles succinctly? Do you have a colorful vocabulary? Can you express yourself clearly to others? How is your spelling and pronunciation? Can you create vivid images with words? Are you an interesting conversationalist? How is your memory? Many of these skills are vital for salesmen, politicians, (technical) writers, or advertising personnel.

IV. SENSUAL are you a keen observer? A thorough inspector? Can you make judgments based on your testing/observation? How are you with details? Doctors, surveyors, and chefs (among others) use these skills.

V. NUMERICAL Are you one for planning ahead? How is your foresight? Are you able to size up people or situations accurately? Has your insight into situations proven fruitful? Are your first impressions generally valid? Can you visualize three dimensions out of two, add details to diagrams, "see" the finished product while it is still being constructed? You may even have some degree of photographic memory. Administrators, architects, politicians and diplomats, artists, and engineers need these valued qualities.

VII. LOGIC How are your research skills? Are you proficient at mental dissection and analysis? Can you order parts, organize groupings, classify wholes? How's your problem-solving ability? Can you pick out the pithy from the **passe,** decide on the best possible solution, review all positive and negative factors objectively? Do your evaluations and suggestions bring improvements? Can you perceive contrasts in similarities and differences, construct theses and antitheses, synthesize and perform dialectics? These are the everyday tasks of scientists, engineers, academicians, critical writers and managerial personnel, to name a few.

VIII. ORIGINALITY Do you like to tell stories? Do you have a vivid imagination? Do you often come up with new and better ways of accomplishing some task? How's your talent at "making do" when you're missing that essential ingredient? Have you ever been complimented for an appealing turn-of-phrase, quip or remark?

IX. SERVICE How effectively can you see and meet others' needs? Are you sensitive to others' feelings? Can you listen? How are you at small talk or striking up a conversation? Do you convey warmth, understanding and concern to others? Can you put yourself in others' shoes, see what they see, feel what they feel? Can you encourage others, show them appreciation, or improve their self-image? Does your counsel usually help others choose the right path? Anyone who works with people uses these qualities every day.

X. ARTISTIC Have you ever written a

Continued on page 30

"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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Fall Quarter Recruiting Schedule

Representatives from the following companies will be on campus for interviews on the dates specified. For a list of other interview dates contact the Placement office, 373-2922.

Wednesday, October 31
American Cyanamid Co. (2nd Day)
Black & Veatch Consulting Engineers
Burroughs Corp.
Caterpillar Tractor Co.
Deere & Co. (2nd Day)
Gulf Oil Corp. (2nd Day)
Modine Manufacturing Co.
Shell Companies (3rd Day)
Wisconsin Power & Light Co.

Thursday, November 1
Aluminum Company of America
Chevron Companies
Dana Corp/Industrial Group
▪▪ Fisher Controls Co.
S.C. Johnson & Son (Johnson's Wax)
Pratt & Whitney Aircraft Group
Rexnord Inc.
Shell Companies (4th Day)
Shell Companies (PhD)
TASC (The Analytic Sciences Corp.)

Friday, November 2
Chevron Companies (2nd Day)
▪▪ Fisher Controls Co. (2nd Day)
Ford Aerospace & Communications Corp.
IBM Corp.

Monday, November 5
Eastman Kodak Co.
McDonnell Douglas Corp.
Motorola Inc.
Northern Indiana Public Service Co.
United States Steel Corp.

Tuesday, November 6
American Hospital Supply Corp.
General Motors Corp.
Eastman Kodak Co. 92nd Day)
McDonnell Douglas Corp. (2nd Day)
Motorola Inc. (2nd Day)
Raychem Corp.
Union Carbide Corp. (PhD)

Wednesday, November 7
American Hospi8tal Supply Corp. (2nd Day)
General Motors Corp. (2nd Day)
Eastman Kodak Co. (3rd Day)
Union Carbide Corp. (2nd Day) (PhD)
United Computing Systems
Whilpool Corp.

Thursday, November 8
General Motors Corp. (3rd Day)

Friday, November 9
AMAX Extractive Research & Development
Amoco Production Research
Burlington Northern Inc.
Dairyland Power Cooperative
FMC Corp.
General Motors Corp. (4th Day)
E.F. Johnson Co.
MIT/Lincoln Laboratory

Monday, November 12
Boeing Co.
Bucyrus-Erie Co.
Cities Service Co. (PhD)
Digital Equipment Corp.
Maytag Co.
Micro Control Co.
Ohio Medical Products
Parker Pen Co.
Sqaure D Co.
Trane Co.
Westvaco, Laurel Research Lab

Tuesday, November 13
Avco Lycoming Division
Boeing Co. (2nd Day)
Duval Corp.
Electro-Craft Corp.
Litton Guidance & Control Sytems
Minnesota Valley Engineering
Standard Oil Co. (Ohio)
Trane Co. (2nd Day)
United States Air Force (2nd visit)

Wednesday, November 14
Data General Corp.
Donaldson Co. Inc.
Intel Corp.
Oscar Mayer & Co.
NASA/Lewis Research Center
Natural Gas Pipeline Co. of America
Std. Oil Co. (Ohio) (2nd Day)
Trane Co. (3rd Day)
Union Carbide Corp.

Thursday, November 15
Ford Motor Co.
International Harvester Co.
Intel Corp. (2nd Day)
Northwestern Bell Telephone Co.
Sperry Univac (Roseville)
Trane Co. (4th Day)
Union Carbide Corp. (2nd Day)
Western Electric Co.

Friday, November 16
Cargill Inc./Process Equipment Group
Dresser Industries
Engraving, Bureau of
Graco Inc.
Hercules Research, Inc. (PhD-ChemE)'
ITT Business Communications Div.
Northwestern Bell Telephone Co. (2nd Day)
Ottertail Power Co.
Trane Co. (5th Day)
Western Electric Co. (2nd Day)

Monday, November 19
Albany International
Bell Laboratories
Cray Research Inc.
Granite Construction Co.
Harris Corp.
Al Johnson Construction Co.
Northern States Power Co. (MN)
Nothern States Power Co. (WI)
Occidental Research Corp.
Peace Corps/Vista
Soil Testing Services Minnesota, Inc.
▪▪ Texas Instruments, Inc. (Sherman, TX)
US Army Materiel Development and Readiness Command

Tuesday, November 20
American Hoist & Derrick Co.
Analog Devices/Semiconductor
R.W. Beck & Associates
▪▪ Bell Laboratories (2nd Day)
Burroughs Corp. (A.M.)
Champion International
Cray Research Inc. (2nd Day)
Northern States Power Co. (MN) 2nd Day)

Monday, November 26
Camp Dresser & McKee Inc.
Fermi National Accelerator Laboratory
Fruin-Colnon Corp.
Hutchinson Industrial Corp.
Seismograph Service Corp.
Stauffer Chemical Co.

Tuesday, November 27
American Electric Power Corp.
Boise-Cascade Corp.
Eaton Corp.
Fruin-Colnon Corp. (2nd Day)
Naval Weaons Center
Northern States Power Co. (MN) (2nd Visit)
Nortronics Co. Inc.
Reed Rock Bit Co.
Upjohn Co.

Wednesday, November 28
Boeing Co. (Wichita, KA)
Conkey & Associates
Corning Glass Works
Dow Corning Corp.
Eglin Air Force Base/Florida
Koch Refining Co.
Moorhead Machinery & Boiler Co.
Northern Natural Gas Co.
Polaroid Corp. (PhD-ChemE)
Reclamation, Bureau of
State Farm Insurance Co.
United States Navy
Wang Laboratories Inc.
Western Gear Corp.

Thursday, November 29
Boeing Co. (Wichita, KA) (2nd Day)
Carrier Air Conditioning Co.
Davy-McKee Corp.
Dow Corning Corp. (2nd Day)
Hanna Mining Co.
Lubrizol Co.

Friday, November 30
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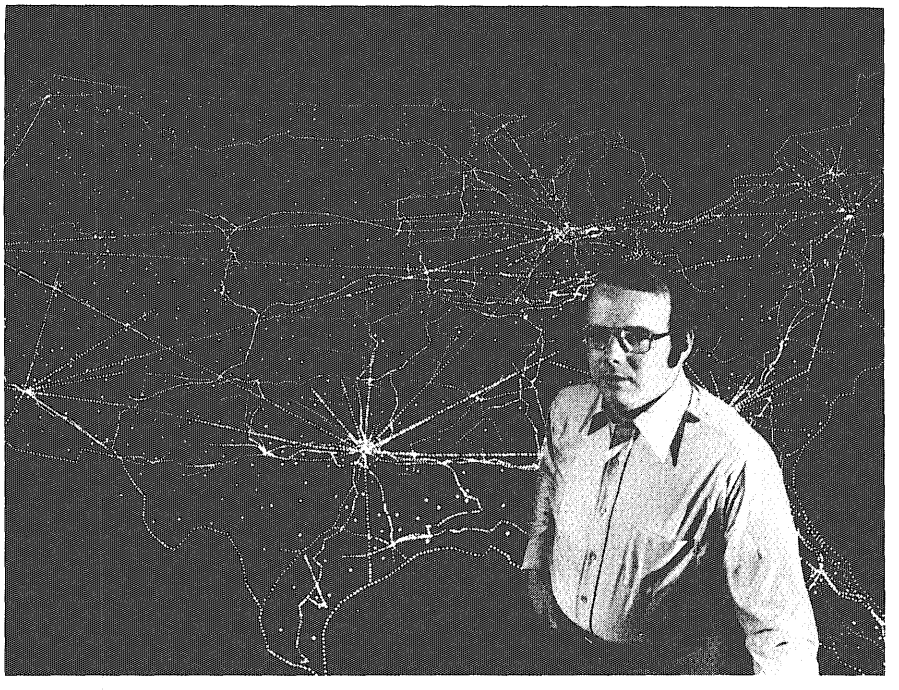
Don Hartman found a "model" way to troubleshoot the network.

The nationwide telecommunications network carries over 515 million phone calls on an average business day. Only a small number of them run into trouble, such as failing to go through the network, getting noise on the line, or being disconnected prematurely. Craftspeople in Bell telephone companies fix most of these problems quickly. But the causes of some can be difficult to find among one-billion-plus miles of circuits and thousands of switching offices.

For several years the Bell System used its computerized Network Operations Trouble Information System (NOTIS) to try to pinpoint those causes by analyzing trouble reports from all over the country. NOTIS was good. But Bell System managers wanted it to be better, more precise in identifying possible trouble spots. And they wanted the data in compact, easy-to-use form.

We assigned a new employee, Don Hartman, to improve NOTIS. Don came to us with a B.S. from the University of Texas and an M.S. and Ph.D. from Massachusetts Institute of Technology. He and his associates developed a second-generation system (NOTIS II) that does the job superbly.

For the new system, Don developed a mathematical model of the telecommunications network, including 28,000 local and long-distance switching offices and nearly a half-million circuit groups. Don also designed the system software and served as a consultant to the team of Bell System programmers assigned to the project.



Each day trouble reports from the entire country are sent to the NOTIS II center in Atlanta. Overnight, the system analyzes the reports, processes them through the network model, and discerns trouble "patterns" which help identify potentially faulty equipment. By 8 a.m. the next day, via data links, analysts at phone company service centers receive information on troubles traceable to circuits or switching equipment in their territories. Result: Better equipment maintenance. And better service.

With NOTIS II up and running, Don has moved on to other projects. Today he's a supervisor with broad responsibilities for planning the telecommunications network of the future.

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From Science: Service

The I.T. Auto: Biograp

Who would have thought that several University of Minnesota engineering students and faculty members would take a concept—that a standard gasoline engine could be combined with a hydraulic system to produce a more efficient automobile—and design a car that turned a lot of heads at the fifth Student Competitions on Relevant Engineering (SCORE) near Detroit last August? They proved their concept and walked away with top honors in their category. To Wallace Erickson, a student involved in the project, it was "a classic example of several University students and faculty members working together to achieve a common goal."

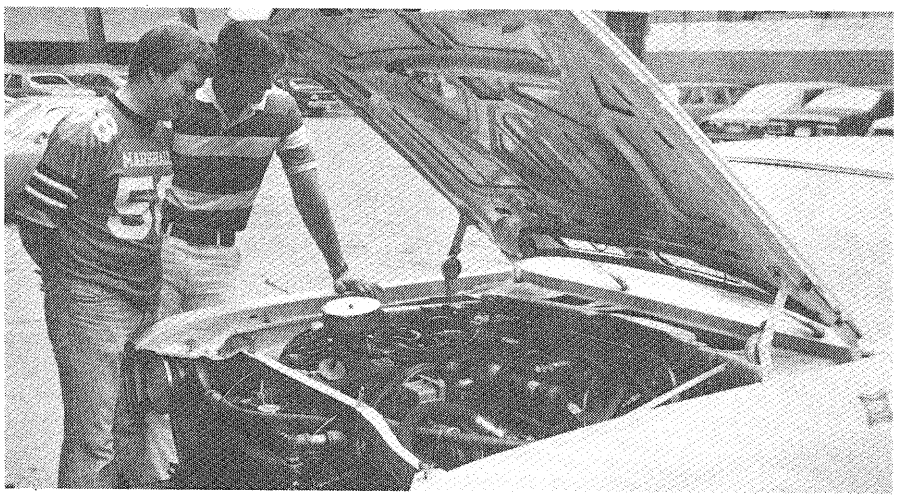


Photo by Glenn Fiekke

A year and a half ago, the Mechanical Engineering Department decided to enter a hybrid car, one that uses a double power system, in the SCORE contest. Professor Thomas Murphy suggested they try designing a car that combined a gasoline engine and a hydraulic system. They discussed the possibilities with John Miller, an engineer at Honeywell Corporation who had been interested in this type of system for quite some time.

Miller became an adjunct professor and the SCORE project was integrated into a senior design project course. "I guess the novelty of the class drew a lot of interest," Erickson said.

From the project's conception, the people involved knew that this would not be an ordinary design project course. Because the project involved so much time, the professors could not be there at all times to watch over the students' shoulders. The students would also have to find ways to raise money for the project. "Fortunately we had good leadership among the students. They took the ball and really ran with it," said Professor Arthur Erdman of the Mechanical Engineering Department.

"The Students did the ground work for the fund raising," Erdman said. "They came up with about $26,000 in financial and equipment contributions. That's a real credit to the students."

"We showed companies that we really wanted it," Erickson said, "and that sparked a lot of corporate involvement in the project."

They had an older car at the start of the project. "But we didn't have time to take a junker and bring it up to par," said David Larson, another student. Still, they needed a model to begin designing the car. A computer provided this model.

"The computer simulation started out to be very simplistic, but as time went on, it got closer and closer to the real systems," Erdman said.

When Chrysler Corporation donated a Volare to the project, the students began using the equations used in the computer simulation in designing the actual car. "Simulation was duplicated in the real world—that's why it worked so well," Erickson said. The final design actually called for a computer right in the car.

"What we were designing was a city car," Larson said. "At low speeds you don't need all the power of an engine designed for quick acceleration and highway speeds. Our design would be most practical for things like city buses and taxi cabs."

The huydraulic system stores energy that is usually lost in the braking process. Therefore the car is most efficient in the city where the car is forced to stop often.

"We wanted to prove that you can drive through an entire city without turning on the engine," Erickson said.

The project moved on fairly smoothly, but there were a few rough spots. For instance, the group realized that the equipment at the University was not sufficient for work on the hydraulic system in the car. Eaton Corporation

ohy of a Breakthrough

offered the students use of their facilities, so the car was moved to their building in Eden Prairie during the last few weeks before the contest.

"You plan for everything, but you always miss something," Larson said. "But every time we had a crisis, the guys came through and we solved it. That's what we were doing at Eaton from four in the afternoon until midnight the last few weeks before the competition."

Larson's feelings seemed to be unanimous. Erickson agreed. "There were a lot of long, sleepless nights, especially the week before the contest. It was the people who kept coming back and saying 'Let's get going again' who stuck it out and made it work."

"The greatest triumph was to see it work," Larson said. "We got it going at midnight about a week before the contest and drove it around the parking lot at Eaton. The way we were acting, I'm sure the security people thought we were crazy."

The students had completed a difficult assignment. The fact that out of about 130 schools that entered SCORE two years earlier, only 30 percent were present to compete in Detroit and the fact that of those 30, several were not ready when they got there, exemplifies that difficulty.

"There were a lot of people at the testing grounds that were just as talented as we were," Erickson said, "but we turned a lot of heads out there."

The University of Minnesota's car stood out for several reasons. "Six or seven of the cars in the competition had computers in them, but the University of Minnesota had the only one with a working computer," Erickson said.

"We shocked each other and we shocked ourselves that we could make it work," Erickson said. But they never stopped trying to think of ways to improve the design. "There are so many things we could change," Larson said. "I'd like to see how we can work things out."

"The contest brought a lot of renewed interest and a lot of exposure to the project," Erickson said. "Hopefully we will be able to continue the project."

"General Motors engineers were really drilling Wally about the computer," Erdman said. "He'd done things that they hadn't been able to do."

The University of Minnesota also had the only medium-to-full-size car in the competition. "We had gone into the contest with the spirit of competition," Erdman said, "and I feel it's a credit to our stick-to-itiveness to go out with a six-seater."

Fig. 1. Microprocessor function diagram.

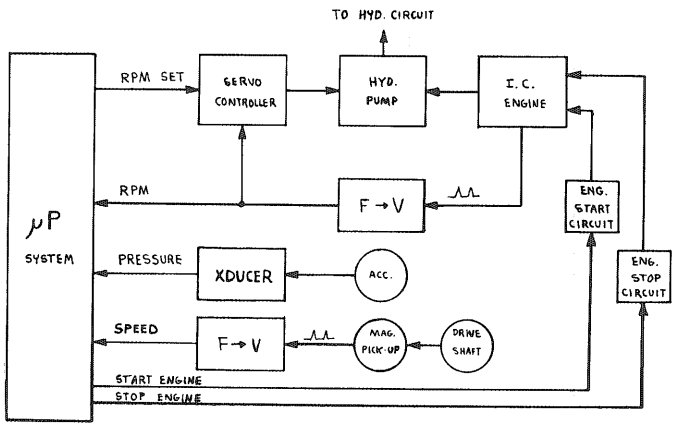
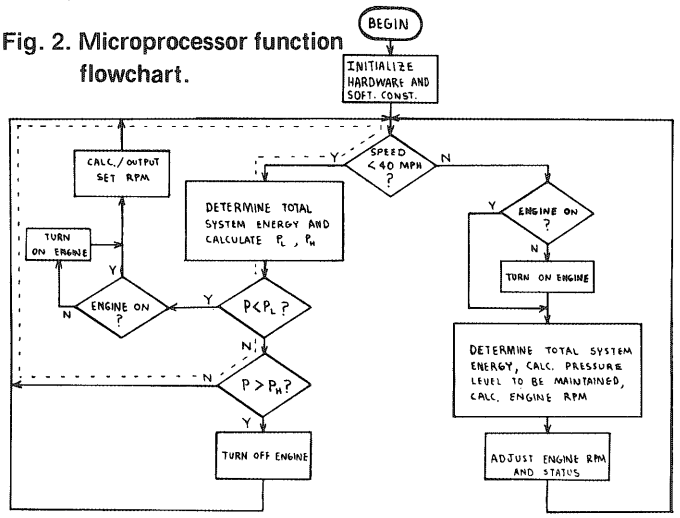


Fig. 2. Microprocessor function flowchart.



The microprocessor interprets converted electrical input as speed, pressure, and rpm, then starts or stops the engine as a function of rpm within preset limits by a failsafe (servo-controller). The hydraulic pump stores braking energy in two psi accumulators. These, when full, once powered the car from B. Dalton Bookseller, down University Avenue, around the stadium, and halfway to Washingtom Avenue—a distance of one kilometer—without turning on the engine!

The project will be continued this fall. Although 90 percent of the students who worked on the project have graduated, Professor Erdman expects about five percent to return. "We plan to continue this fall to fix the things that went wrong," he said. "The concept is proven, it just needs more engineering to refine it and make it easier to drive. We may be able to provide much of that this fall."

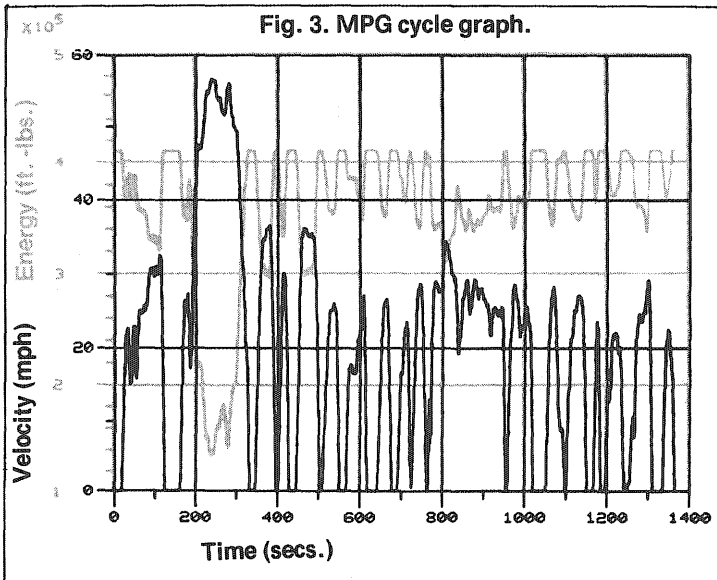
When asked whether the project was worthwhile, Erickson said, "It was incredible to see how well a group of engineers in different fields could come together and work toward a common goal. We had different people with special talents. We needed each one and each one made a contribution we couldn't have done without."

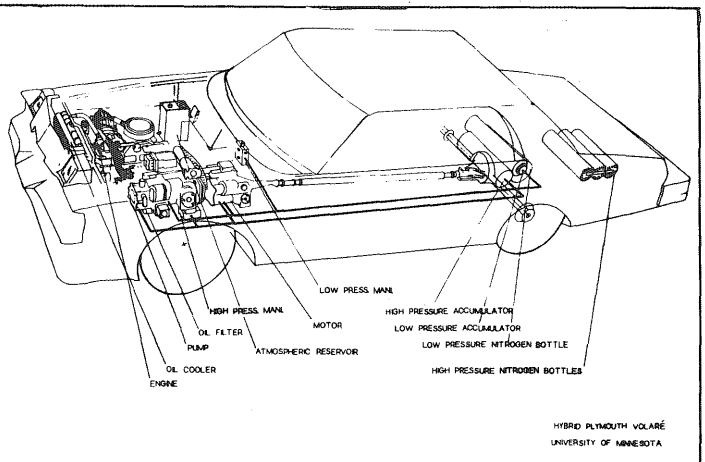
Larson proudly said, "The professors took a back seat and let us take over. The students took the initial idea and designed the system. The students made it work."

"It was so rewarding to be a part of an effort where the students just wouldn't let it die," Erdman said.

Terri Levy is a journalism major.

Fig. 3. MPG cycle graph.





Black lines indicate engine energy output; grey lines, hydraulic energy output. Notice complementary cycles.

A car needs only about an 18 horsepower engine to run efficiently at 55 miles per hour. Most cars, however, employ 150-250 horsepower engines to provide enough energy for rapid acceleration. The University's hybrid car uses a smaller, thus more efficient engine and draws energy stored in the accumulators for accleration.

In braking, the energy that is usually lost is stored in the accumulators in the form of pressurized nitrogen gas. When the pressure in these accumulators is insufficient to run the pump motor, a microprocessor tells the engine to kick in. By powering the hydraulic pump, the engine brings the pressure in the accumulator back up to the proper level.

The Institute of Technology's hydraulic car took 145 students and faculty, eighteen months and nearly $27,000 to build. It also took first place out of six in the "hybrid car" category of the SCORE tests at the General Motors' Proving Grounds outside of Detroit last August. Called "the most expensive and technologically advanced car on the field," it sported a dual propulsion system comprised of an internal combustion engine and a hydraulic pressure accumulator which stored braking energy as governed by a plug-in microprocessing computer in the glove box.

Early CYBER simulations gave an EPA estimate of 22-35 mpg for city driving. And even with several system malfunctions, the IT car was rated at 19 mpg during SCORE's EPA cycle tests—and that with an extra 1,000 pounds added on to the original Volare's 4,500-pound, 18-mpg hulk. The car is most efficient in city driving because the hydraulic system eliminates the energy waste of start-and-stop driving. Authur Erdman, a Department of Mechanical Engineering professor, feels he and his students can up the car's mileage to 36 mpg this year.

The tasks of the hydraulic system and the microprocessor are "fairly complicated," said Erdman, and operate basically as a function of rpm, or speed (see Figures 1, 2, and 3).

The car did have some problems at the SCORE competitions. For one thing, the accumulators were only storing one-seventh of their expected energy, due what has now been discovered to be a storage orifice which was too small. Also, the fuel injection system quit two days before the end of the competitions, and the only recourse was to revert to the old (and nearly useless) carburator. There was also a velocity governor malfunction; a solenoid failure; and an overflow safety valve popped off, causing a minor fire over the manifold, which was quickly extinguished.

Prof. Erdman and the students of his seminar course will be spending the fall quarter repairing and retuning the car, rethinking the schematics, and praying they can receive enough aid to bring them out of the red and continue to develop this truly innovative automobile.

Prof. Erdman said that, mass-manufactured, such a car could be marketed "possibly cheaper" than conventional vehicles today. The hybrid engine could optimally be used for city buses and taxis. But, he added, the University's task is education; any move beyond his seminar course must come from industry.

Still, Prof. Erdman commended the University's administration and faculty —especially the Dean—for their support and encouragement. Virtually none of the "big schools" were at SCORE, he said, because professors need tenure, and are discouraged by their administrators from working on such unconventional schemes.

"We demonstrated a very feasible concept," said Erdman proudly, "and all the credit goes to the students."

The Toobee: Frisb

By Steven M. Deyo

What throws like a curveball, soars like an eagle, looks like a beer can and is as fun as a Frisbee? It's the Toobee, and it's not only as fun as a Frisbee, but it's every bit as contagious.

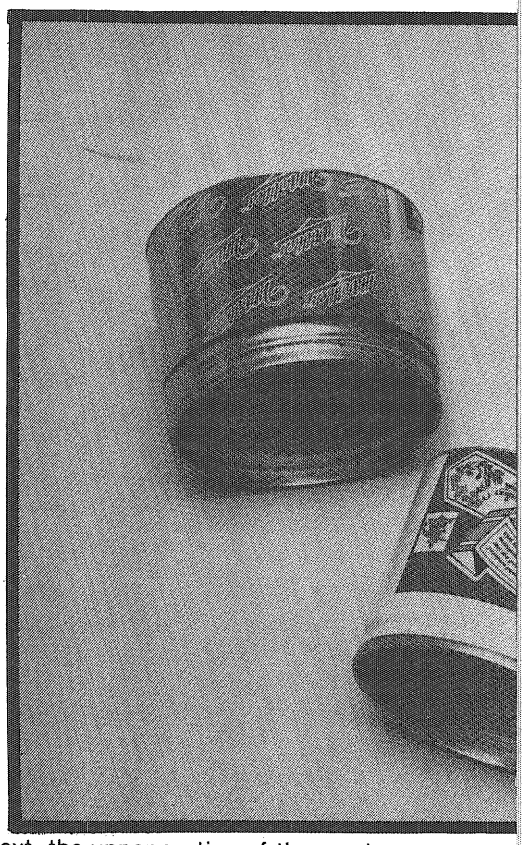
Toobee fever has struck California, and it's spreading. On the campus, at the beach, in back yards and living rooms, Toobees are floating, wafting, swooping, gliding, and just generally doing some impressive aerobatics. What is a Toobee? Where do they come from? For these answers and more, read on.

The Toobee is a toy—and an aerodynamical marvel—made from the top two inches of aluminum cans by Toobee Toys, Inc. The Toobee was "discovered" in 1975 by Dr. Dale Klahn, who has an M.A. degree in aeronautical engineering and a Ph.D in metallurgy from the University of California, Berkeley. And it operates on the ancient aerodynamic principle of the annular wing.

At least six full-scale airplanes have been constructed on the principle of the annular wing—not to mentiion kites, gliders, paper and model airplanes—including those built by Ellehammer, Bleriot, and the French tail-sitting jet of the 60's. But when a mechanical engineering lab partner showed Klahn a paper version in 1964, Klahn became fascinated with the idea. Using the paper version as a model, Klahn began to improvise with cardboard, plastic, and plastic-metal combinations. His best results came by cutting a cylindrical wing from a plastic bottle and weighting its leading edge with solder. But it was not until 1975 when the idea to use aluminum cans was discovered by Klahn and Gary Upham, now president and vice-president of the two-man company, Toobee Toys, Inc.

At least six full-scale airplanes have been constructed on the principle of the annular wing—not to mention kites, gliders, paper and model airplanes—including those built by Ellehammer, Bleriot, and the French tail-sitting jet of the 60's. But when a mechanical engineering lab partner showed Klahn a paper version as a model, Klah version in 1964, Klahn became fascinated with the idea. Using the paper version as a model, Klahn became fascinated

Klahn and Upham had to design and build four machines to handle the delicate, precision work required to manufacture the Toobee. First, uncrushed aluminum cans are bought for a penny a piece. Next, the top lid is removed and the cut edge is flattened against the inside of the rim. This nearly eliminates the aerodynamic drag and makes the Toobee's leading edge smooth and safe.



Next, the upper section of the can is cut off—precisely 2.001 ± .002 inches of it. (Just to give you an idea, this page is about .001 inches thick.) The cut edge is curled over and crimped, lending structural stability and back-edge safety.

And finally, the Toobee is cleaned and stamped with the Toobee name, address, and throwing instructions. For this step, a special machine had to be designed to print on the inside of a curved surface.

It took three years of experimentation and testing for Klahn and Upham to ar-

ee of the Eighties

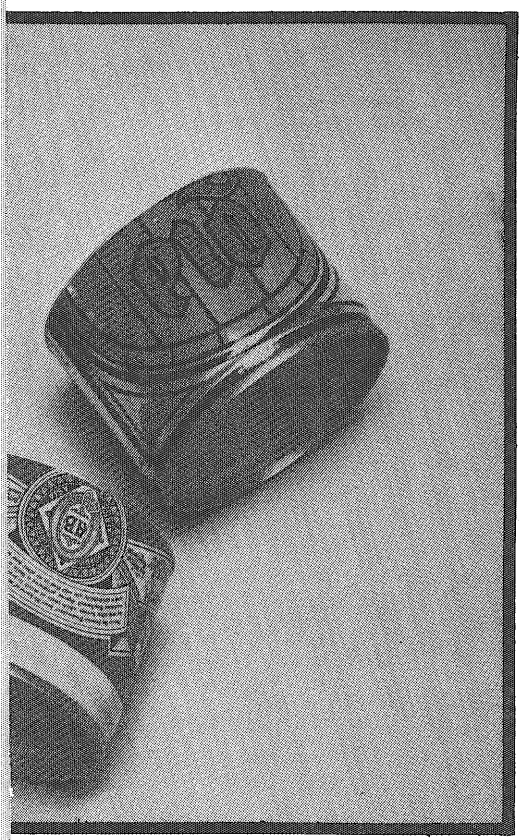


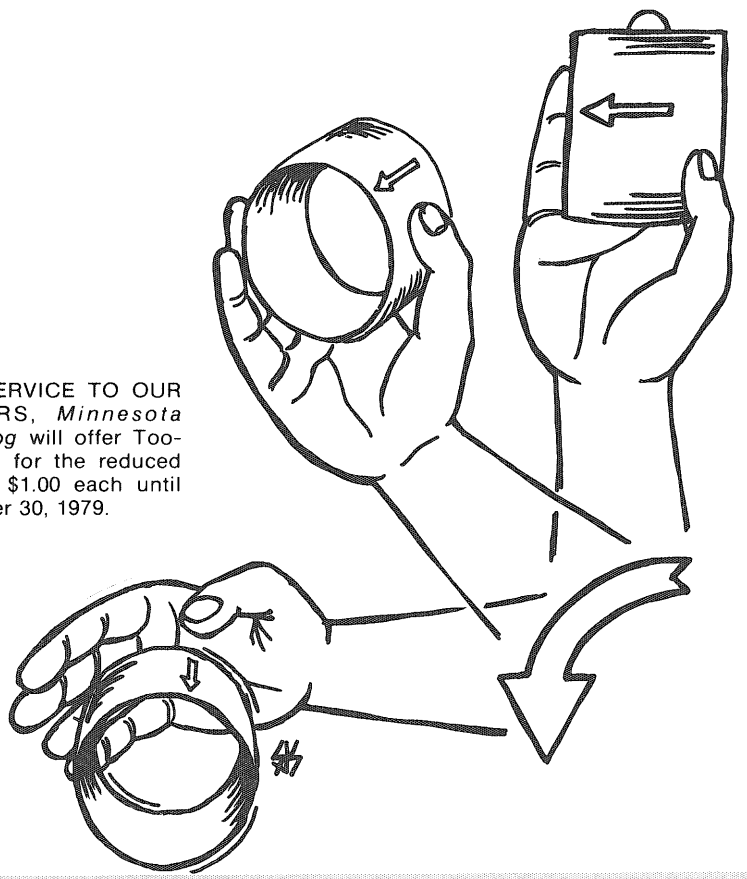
Photo by Charles Frizzel

rive at the optimum design specifications for the Toobee. But how does it work?

Klahn explains that, when you first throw the Toobee, you impart an initial linear thrust and angular velocity (spin). In flight, thrust increases and drag increases, although drag is minimal because the Toobee is so thin—.005 inches thick, for the most part—aerodynamic friction is almost negligible. Lift forces acting upon the Toobee overcome its extremely low mass much in the same way as with an airplane when it lifts off. The Toobee's angle of attack creates a more rapid airflow over the topsides of its upper and lower surfaces; faster airflow means lower pressure. Thus the net higher pressure of the undersides of the Toobee's surfaces boosts the Toobee upward in a vector angle normal to its axis of spin (see Figure 1). Also, the spin imparts a gyroscopic stability to the linear momentum, insuring a straight, stall-free flight without the use of fins or rudders. But the unique feature of the Toobee is that the center of gravity has been designed to coincide *directly over* the center of lift. "If this were not done," says Klahn, "a (pitch) moment would be generated and the Toobee would go unstable and tumble." (Try throwing a Toobee backwards.)

Several questions as to the precise aerodynamics of the Toobee are still hanging in the air. Dr. Roger Arndt, Director of the St. Anthony Falls Hydraulics Laboratory, noticed a "definate yaw to the right," independent of the angle of attack, and wonders if this is necessary for flight stability. The *Technolog* staff noticed the same pulling to the right, and wonders if it might be due to the spin torque of the Toobee. A propeller plane will pull to one side as soon as it leaves the ground due to that same principle, pointed out aeronautical engineering junior Steve Smith. And Prof. Theodore A. Wilson of the Department

AS A SERVICE TO OUR READERS, *Minnesota Technolog* will offer Toobee toys for the reduced price of $1.00 each until November 30, 1979.



of Aeronautical Engineering hinted at the complexities of the Toobee's fluid mechanics, suggesting wind tunnel studies to determine airflow currents. But that would take a lot of time and effort, he said. "and that means money."

In the meantime, Dr. Klahn sold over 40,000 Toobees by last spring, with sales increasing. Toobees are sold by mail through Toobee Toys, Inc., at the price of two for $3.00, and in hobby shops in the Berkeley area. National television promotion is planned for the spring of 1980. Kids of all ages—even those at the U.S. Patent Office—go nuts over the toy. They play catch, throw for distance and accuracy, and do trick shots just as with a Frisbee. "In a little wind," says Klahn, "the Toobee darts and dances like a bubble. . . In fact, people seeing it from afar for the first time often think it's a soap bubble that flies almost as if on a string." And it can fly up to fifty yards.

How did the Toobee get its name? A conflation of "tube" and Fris*bee*. And here's something ironic: our photo editor, Mike Dorn, says there is a Japanese word, *tobi*, which means "kite" (artificial or avicular).

The Toobee has been mentioned in *Sports Illustrated* (Nov. 27, 1978), *The New York Times* (Aug. 27. 1979), and *Popular Mechanics* (September, 1979). *California Engineer* also did an article called "The Toobee Story" (April 1979). Slowly, the Toobee is gaining popularity. Enthusiasm follows this aeronautical toy wonder wherever it flies. And we ask ourselves: Will the Toobee be the Frisbee of the eighties?

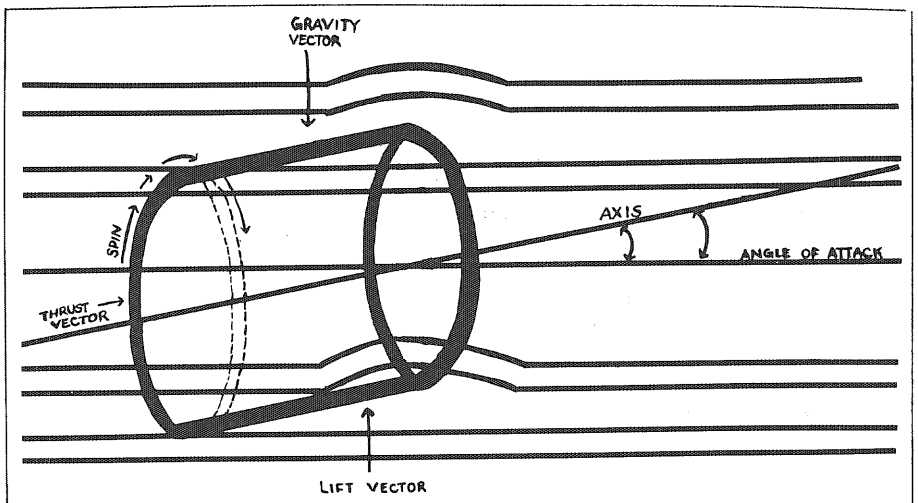


Figure 1. *Toobee in flight, side view.*
Thrust and drag acting on the Toobee relative to the angle of attack. Center of gravity directly over center of lift. Airflow currents travel further distance over topsides of Toobee surfaces, creating less pressure and allowing net upward lift force.
Diagram modified from that of *California Engineer*.

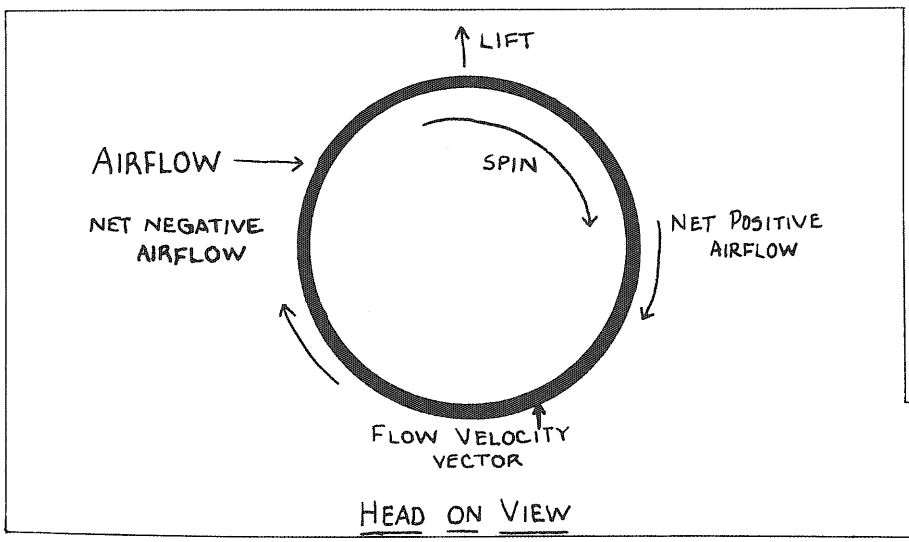
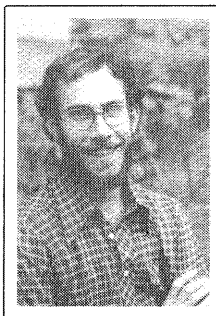


Figure 2. *Toobee in flight, frontal view*
Spin creates net positive and negative airflow with net upward lift vector.
Courtesy of Dr. Roger Arndt.



Steve Deyo is a journalism graduate and associate editor of *Minnesota Technolog*.

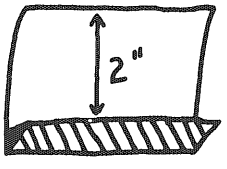
TECHNOWING

DIRECTIONS FOR TOOBEE TOY

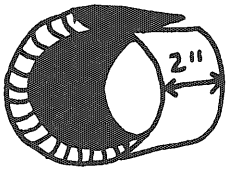
1. CUT THIS PAGE OUT FROM THE CENTER ON THE DOTTED LINE.

2. START WITH A FOLD OF ABOUT $\frac{1}{2}$" AT THE BOTTOM OF THE PAGE.

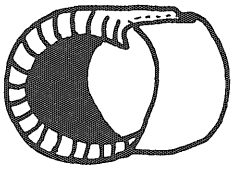
3. CONTINUE FOLDING IN SAME DIRECTION UNTIL APPROXIMATELY 2" ARE LEFT.



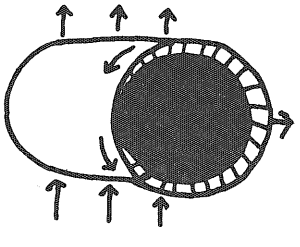
4. HOLDING FOLDED PORTION, BEND A TO B SO THAT FOLDS ARE ON INSIDE OF CYLINDER.



5. PUSH ONE END BETWEEN FOLD AND TOP OF PAPER AT OTHER END UNTIL PROPER DIAMETER IS REACHED. TAPE RESULTING SEAM WITH PLASTIC TAPE. ROUND CYLINDER OUT.



6. THERE IS A CLOCKWISE SPIN AND THE CYLINDER IS FALLING. THE AIR FLOW IS UP. GREATER AIRFLOW ON LEFT [SUBTRACTION OF FLOW ON RIGHT SIDE] CAUSES LOWER AIR PRESSURE ON LEFT SIDE. THE CYLINDER MOVES LEFT.



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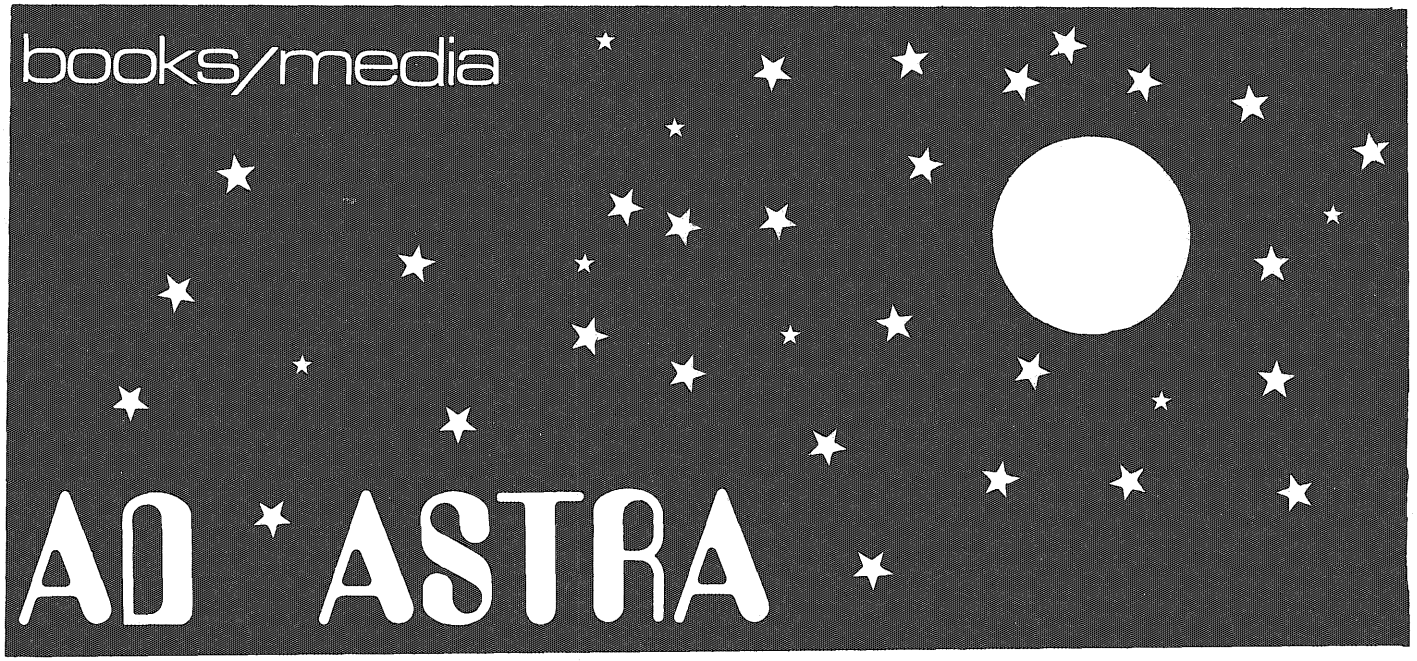


by Bruce Kvam

The Fountains of Paradise, by Arthur C. Clarke, Harcourt, Brace, Jovanovich.
Jem, by Frederik Pohl, St. Martin's Press.
Roadmarks, by Roger Zelazny, Del Rey Books.

When a man who has been writing some of the best science fiction of the past forty years says that he's not going to write any more, it's a little bit of a shock. But that's what Arthur C. Clarke claims: he's written his last book. It's called **The Fountains of Paradise,** and it is a fitting farewell from a man with a long and distinguished career.

The hero of **Fountains** is an engineer in the old sense, a builder of bridges. But not ordinary bridges: His accomplishments link continents. Now he has a project in mind that dwarfs anything ever built, something on the same scale as planets.

Consider the wastefulness of rockets. They expend so much energy to transport so little mass. They pollute extravagantly. They are used once and cast away. And besides the practical aspects, they're downright **dangerous.** In a phrase, rockets are the epitome of poor design.

If you could build a bridge (call it a Tower) between the Earth and space, why, that would solve all the rocket's problems. Ridiculous, you say? Not so! If our materials science progresses at the same rate it has been for just a few more years, we'll soon have the wonder fiber to build such a bridge. And that is what **The Fountains of Paradise** is all about. •

The basic idea is not Clarke's own. Several researchers have conceived of it independently, the first commentary on it being published by a Soviet scientist in the early 1960's. A number of novels and stories about these 'skyhooks' and 'beanstalks' have appeared almost simultaneously with Clarke's book. And why not? It's an ideas whose time has come.

Fountains is much like Clarke's other works in tone: not a rip-roaring adventure, but a thoughtful story that rolls on majestically in Clarke's style of understatement. It has a curious structure to it, which parallels the history of Sri Lanka (Clarke's adopted island homeland) with the construction of the Tower. And, like many of Clarke's other works, **Fountains** has that special perspective that leaves the mundane troubles of our insignificant planet for the greater concerns of the universe.

I hope Clarke was joshing us when he said this was his last book. It is good enough, but the next one could be better!

While Arthur C. Clarke is threatening to leave us forever, Fred Pohl is writing at a greater rate than he had been for a good portion of his equally long career. His latest is **Jem,** which shows no signs of Pohl slowing down.

Jem is a planet more formally known as N-OA Bes-bes Geminorum 8246. However, most of the characters in the book call it Klong, or son of Kung. But somehow, "KLONG, by Frederik Pohl," doesn't sound quite right.

Jem's parent sun is a red dwarf which radiates almost no light in the visible spectrum, which makes for consistenly gloomy days on the planet. Jem itself is populated by three separate, sentient, mutually antagonistic races—that is, until the humans come. Then there are four.

Jem takes place between forty and sixty years in the future. The world has become divided into three camps: the Fats, the Greasies and the Peeps; respectively, the Food producers (USA, USSR), the Fuel producers (UK, Saudi Arabia) and the People producers (China, India). Each bloc, of course, has the capability to wipe the others completely off the face of the globe, but, of course, no one would be so stupid as to actually use that capability. Or would they?

Each faction sends its own expedition to Jem, to claim the planet as its own; to start a new life on a new planet, with peace and brotherhood, where there is no rape of the earth, or poisoning of it, or war or hatred or . . . With these righteous aims in mind, the explorers proceed to kill and maim the native species of Jem, as well as themselves.

I find a number of things I don't like about **Jem.** For a book that is set a number of decades in the future, everything is disturbingly similar to today. The affluent drink Perrier. The Arabs waste gas like we waste water (as if even **they** are going to have any oil left in fifty years!). And everyone is still shivering in fear of the nuclear umbrella.

Jem paints a rather dismal picture of the future. The characters make the

same mistakes we are making now, use the same rationale for their errant behavior and make the same excuses for their blunders. Everything is then as it is now: circular history triumphs.

I hope that Fred Pohl is no prophet.

Both **Jem** and **Fountains** are prime examples of hard science fiction. Roger Zelazny's newest book, **Roadmarks**, stands in stark contrast with them, with its marvelous contortions of the fantastic.

Roadmarks is a time-travel novel, but a very unorthodox one. In it, time is like a freeway—literally. To go into the future or into the past, you simply hop into your vehicle (be it pickup truck, hovercraft, whatever), get on at the nearest entrance ramp and cruise up and down the centuries.

Red Dorakeen has been searching the Road incessantly for a time he once knew. Somehow, it's disappeared; the ramps have been overgrown, and no one can remember it, save Red. He's been changing history to see if the on ramps for his lost time will reappear, with no luck. Someone doesn't approve of his efforts, though, so much that they want him dead.

Roadmarks is a strange book. It is filled with allusions, references, quotes, symbology, and intellectual tennis: things that drive literary analysts into a state of pure ecstasy. Although it has all these things, **Roadmarks** is definitely **not** a dry philosophical novel. It is so full of action that all the literary references could slide right by you and you wouldn't feel you'd missed a thing.

So, no matter what your intellectual preferences are, **Roadmarks** is not likely to disappoint.

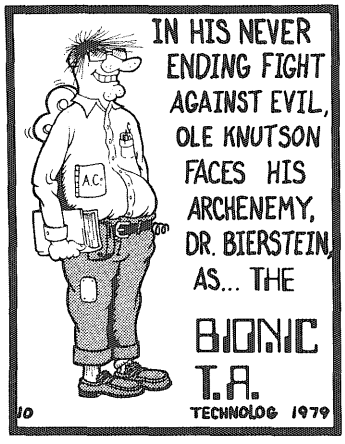
Bruce Kvam is a computer science major in IT and a regular contributor to *Technolog.*

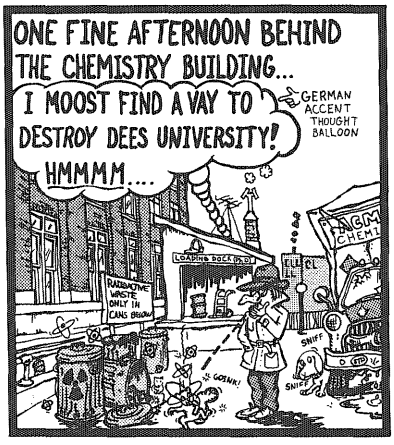
Institute of Technology Student Board

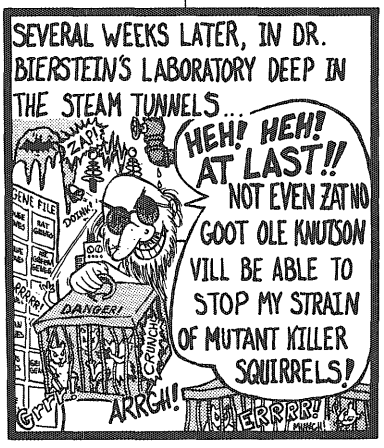
What is the Institute of Technology Student Board (ITSB) about? Well, it consists of one representative from each of the twelve IT departments, three at-large representatives, and two freshman representatives. The Board's purpose is to promote and advocate the interests of IT students and to act as a liaison between the administration and the IT student body. The Board also provides a forum where matters of student concern may be presented and discussed, courses of action decided upon, and the necessary funding made available to implement such decisions.

The Board holds a one-hour general meeting every week, open to all interested persons who wish to attend, in room 305 Aeronautical Engineering. At the meeting, new program ideas are presented, and discussion of current student issues or progress reports on recent committee work takes place. This fall quarter, we meet every Thursday at 1:15 PM. ITSB has bulletin boards in a number of departments throughout IT listing the most recent meeting's minutes, the names of all Board members, and upcoming activities or new programs. The main board is in first-floor Lind Hall, near the Unclassified Majors Office.

Institute of
Technology
Student Board

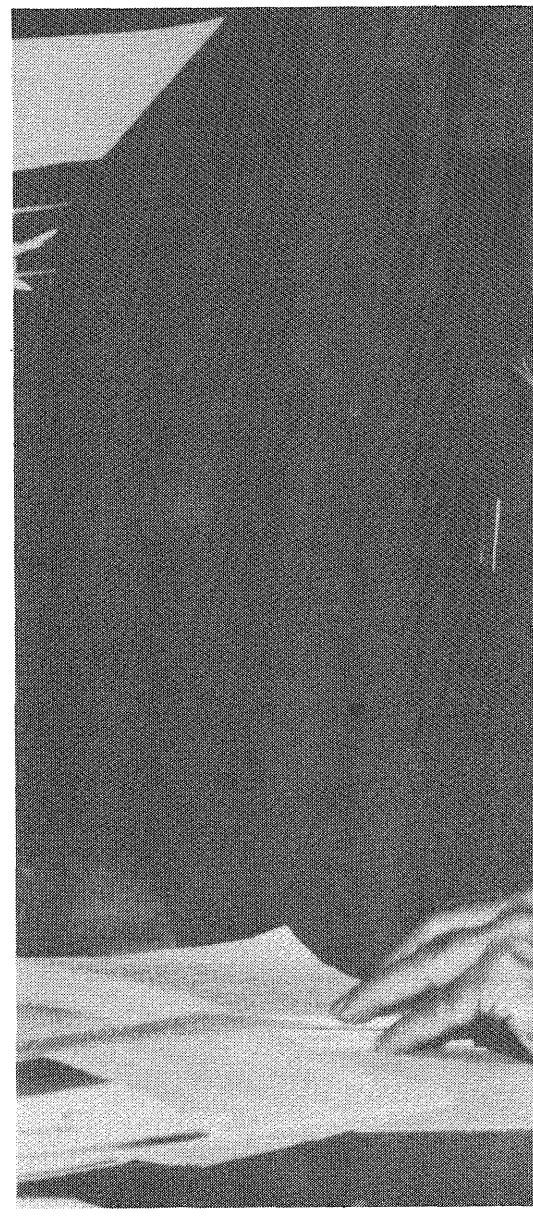







THE SQUIRRELS ATTACK...
HEEYAH!
GRR!
CHOMP!
AT THE DOILY OFFICE THE NEXT DAY...
ELMO!!
GO OUT AND DO A STORY ON THOSE SQUIRREL ATTACKS! WE'VE GOT TO REGAIN OUR CREDIBILITY!
home of the minny-so-duh daily
"ALL THE RUMOR THAT'S FIT TO PRINT"
SPECIAL CLOSE OUT ON ALL ADULT BOOKS ½ PRICE MUST GO!
VICE SQUAD
AWW!! I DON'T WANNA DO NO ★☆#! STORY ON NO @☆*@!★ SQUIRRELS!!
SQUIRRELS! I AIN'T DOIN' NO #*@ STORY ON DUMB SQUIRRELS!
KIOSK
HEY!! NOW FOR SOME FUN!
EEEK!
SURPRISE!!
THE SQUIRRELS ATTACK ELMO...
RARGH!
MUNCH!
BURP!
RIP!
AAIIEE!
AS THE SQUIRREL TERROR DARKENS THE CAMPUS...
THERE'S ONLY ONE PERSON ALIVE WHO CAN SAVE US, THE BIONIC T.A.!
BBRATT!
ROTC
WHILE OLE EATS HIS LUNCH...
BZZZT!
YEEPERS! IT'S A CALL ON A MY SEE-CRET RADIO!
NO SMOKING!
OLE!?
GLUK!
GLORT!
TED WAS HERE!
JA, CHIEF?
OLE! YOU'VE GOT TO FIND A WAY TO STOP THESE SQUIRRELS!!
THEY'VE THROWN EVERYTHING AT US BUT THE KITCHEN SINK!!
ERRG!
DANGER MINE FIELD
HMMMMMM! I MUST T'INK OF AH A SALUTION!
MUNCH!
ACME ICE COMPANY
CRUNCH!
SKRIT!
GORF!
GULP!
WE HAVEN'T GOT MUCH TIME-
SKRACK!
OLE DOES SOME QUICK RESEARCH...
SKRTCH!!
SKWK!
ZAP
FWIP!
THUNK!
THAT OLD IDEA LIGHT BULB
JAH-UMPIN' LUTEFISK, THAT'SA IT!
FAIRY TALES
SHORTLY...
PLEASE! I MUST A BORROW DA GO-PHER SUIT AND A PIC-PIC-PICCOLO! QUICK!
GRUNT?
SNIFF?
A MOMENT LATER...
I YUST A HOPE DIS VERKS!
ZOOOT
ON THE MALL...
SO FAR A SO GOOD! NOW IF A I CAN LEAD A THEM TO A THE BRIDGE...
WEEEEE!
GRAWK!
ERP!
SNIFF SNIFF!
ON THE BRIDGE...
AND A INTO THE RIVER - WHA?
NO!!
MISSISSIPPI RIVER 13.4 ft
ZO! YOU HAFF FOILED ME AGAIN, BUT HOW DID YOU KNOW VAT TO DO TO STOP MY SQUIRRELS?
OLD HOUND DOG BEER
THE DRIED DROPPINGS OF HAMSTERS
HAMMERS '79
SIGH!
ANY CHILD COULD HAVE THOUGHT OF IT!
THE END

NIER GOES FAR



by Mary Jo Hannasch

It is a long road from the University of Minnesota to New York, to the Manhattan Project, to the atom bomb, and to the Mars Viking Project, but this is precisely the path traveled by Dr. Alfred O.C. Nier, a distinguished scientist and professor in the University of Minnesota Physics Department.

Along the way, Professor Nier isolated U-235, designed instruments used for space missions, modified many instruments now used by the science community, and received many honors, which include election to the National Academy of Sciences and recognition as a University Regents' Professor.

"I started out in electrical engineering at the University of Minnesota, with the intent of becoming an engineer, which is not precisely the branch of science I ended up in," explained Professor Nier. "My ending up in physics is something that just accidentally occurred."

Nier, taking physics courses required for engineering, caught the attention of one professor when Nier received 100's on the first few quizzes. The professor recognized Nier's natural talent, urged him to go into physics, and gave him a job in the physics department.

"I received both my B.S. and M.S. degrees in electrical engineering. At that time, a master's degree was the highest degree you could receive in engineering. So, many of the students who might have gone on in engineering went into physics," recalled Nier. After working in the physics department, it seemed logical for Nier, who felt at home there, to begin his physics career in graduate school.

When he was a beginning graduate student at the University in 1933, the most important research being done was with the "electron impact of gases." This research involved bombarding atoms and molecules with electrons and studying the results. The University laboratories had a very good reputation, Nier recalled, because Professor Tate had instigated some very progressive research programs.

"Eventually," Nier said, "I realized that with the equipment I had built or inherited from others, I could do what many of the nuclear physicists couldn't do. I was able to look for rare isotopes and isolate them, so I began to work in this area. As a graduate student, I discovered potassium-40, which no one had yet been able to identify. I was very fortunate in this area, and decided to continue to work with rare isotopes, which brought me to nuclear physics." After Nier received his Ph.D. in physics in 1936, he spent two years at Harvard as a postdoctoral fellow, returning to join the Physics Department's faculty in 1938.

While Nier was at Harvard, he worked with uranium and lead in connection with geological age measurements, with the aid of a mass spectrometer. A short time later, this knowledge of uranium would prove valuable. In 1939, nuclear fission was discovered in Germany, sparking widespread interest in this country.

In the spring of 1939, Nier went to a meeting of the American Physical Society, where he met John Dunning, a professor at Columbia University. Dunning, who was very enthusiastic about nuclear fission, introduced Nier to Professor Fermi, who also taught at Columbia. Fermi impressed upon Nier the importance of knowing which of the isotopes of uranium were responsible for the fission reaction which had been observed.

"Since few people in those times had a mass spectrometer, Fermi and Dunning urged me to try to isolate U-235," said

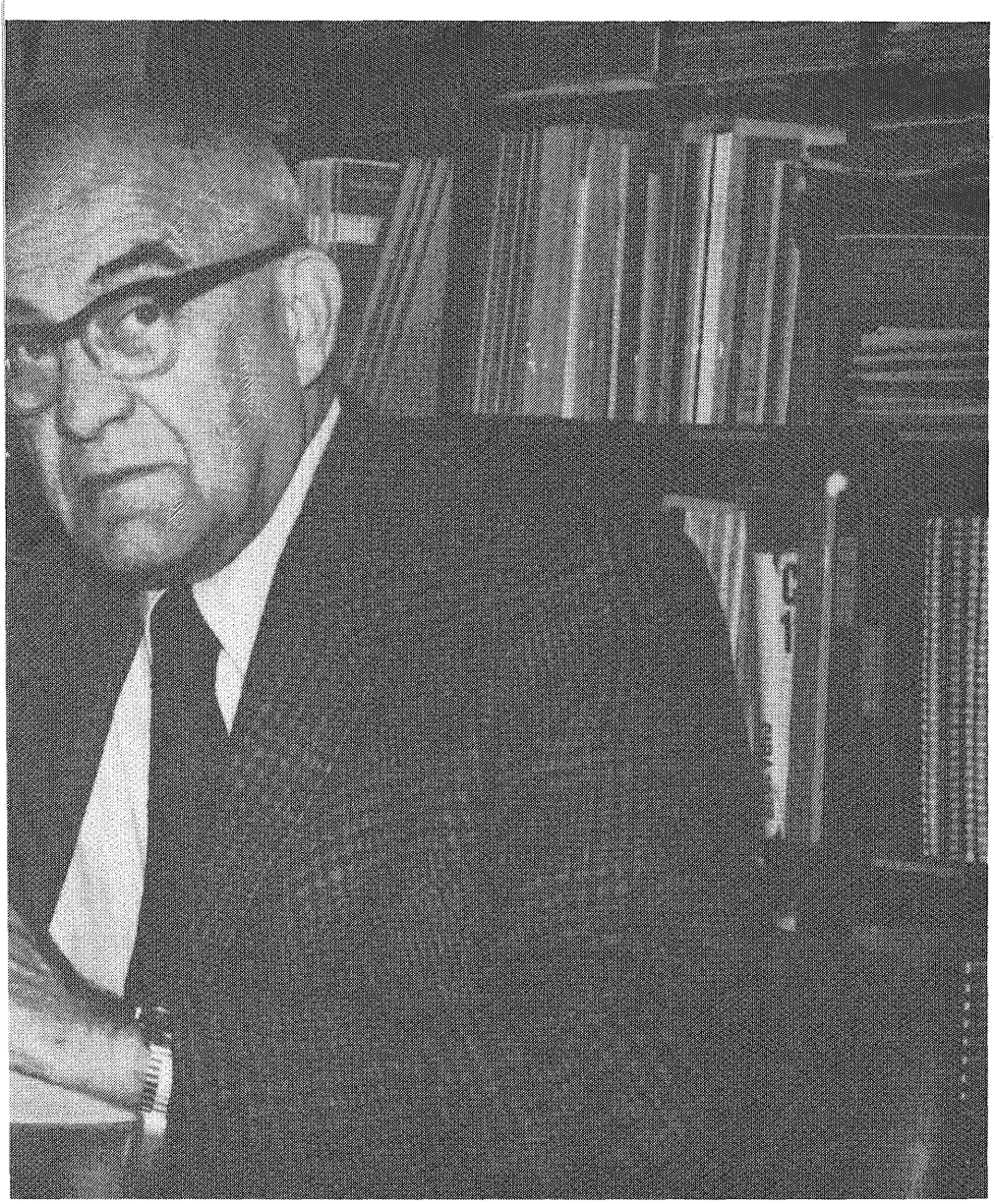


Photo by Wayne Asp

Nier. "By souping up the performance of the spectrometer, it seemed plausible that I could get a sample large enough for them to bombard with neutrons in the Columbia University cyclotron.

"In the fall of 1939, I started to isolate U-235, but because of a few false starts, it wasn't until after January 1940, when I built a new apparatus, that the tests became successful. On February 29th, I finally isolated enough to send on to Fermi at Columbia."

The science community, Nier noted, recognized the significance of finding the right isotope which would provide this strong chain reaction. Although they realized that the nuclear reaction could have many applications, the idea of producing a nuclear reactor or bomb was such a remote thought that most people had doubts it would occur within their lifetime. It was only the result, Nier pointed out, of the war escalating at that time which prompted the government to spend huge sums of money to accelerate this project and develop it decades ahead of its time.

"By 1940, this country was already becoming involved with the war, because the feeling was that, in the long run, we would also be in the war," Nier explained. "Many of the scientific people were drawn off to work in government laboratories. By late 1940, most of the Physics Department was gone.

"I started doing analyses of materials for people isolating U-235 because we had the only mass spectrometer in the world which could tell if they were succeeding. There were no rivals to the apparatus we had here at the University because we had been doing this kind of isotope and electron impact research."

Various methods were tried, Nier recalled, to isolate U-235. Research in gaseous diffusion methods went on at Columbia, research in chemical exchange methods at the University of Minnesota, and research in centrifugal isolation of U-235 in Virginia. Their results were brought to the basement of the Physics Building for analysis by Nier.

"From 1943 to 1945, I went to work for the Kelex Corporation, which was building the big gaseous diffusion plant at Oak Ridge, Tennessee," Nier continued. I was head of the laboratory which developed the instruments which analyzed the plant's performance.

"I spent a great deal of time on trains traveling between my New York lab and Schenectady, where General Electric was building equipment; on alternate weeks, I went to Oak Ridge where the equipment was being installed.

"In November 1945, I came back to the University. In a sense, the clock had stood still for me because I was so busy doing development work and troubleshooting for the Manhattan District—a term used to describe the army engineers involved with this project—so I really didn't learn any new science. However, this was true for most scientists who worked on development projects for immediate problems. When I came back, I wanted to pick up where I had left off, so I once again continued to look for isotopes. In one program with graduate students, we found helium-3."

In 1949, Nier became more interested in nuclear structure, so he found a way to refine his instruments to make more accurate measurements of isotope masses. Nier commented that one of the students who contributed greatly to the project was Dr. Walter Johnson, a graduate student at the time, who was acting dean of IT last year.

Nier's interests are as varied as his experiences. In later years he became interested in space-related problems. Programs for taking measurements of rare gases in meteorites, finding the composition of the Earth's atmosphere past 100 kilometers, and designing instruments for three satellites are among some of the projects Nier has participated in.

"In 1968, there was an 'announcement of opportunity' by NASA where you could apply for membership on the Viking Project, which was a mission to Mars," Nier recounted. "I was already

connected with NASA because of the rockets and satellites, so I applied for membership. I was chosen as head of the Entry Science Team, which designed the instruments that studied the atmosphere as the landers went down to the surface. It turned out to be very successful, and in the actual mission, the instruments worked beautifully."

Areas of current research which Nier finds progressive are high-energy physics, solid-state physics, nuclear energy, and superconductors. Although Nier believes that basic research is starting to receive better funding, he also believes that basic research has suffered because of the recent difficult economic times.

"I am greatly concerned about the energy problem," Nier expounded. "I am a proponent of nuclear energy, and feel it should be pursued. It is most unfortunate that many of its opponents are misinformed. I find it hard to understand why those people interested in preserving our environment oppose nuclear energy, because it is actually less damaging to the environment than alternative forms of energy.

"I feel that more public education in this area is needed. The whole question of radiation is a mystery to them. I think a great deal of facts are misunderstood.

"I have had a very satisfying life, but whenever I'm in the middle of a project. I don't have time to think about what is happening, so I always look forward to the next project. I'm happy that many of the projects have been successful, although not all of them have been. It's been fun."

Mary Jo Hannasch is an electrical engineering major in IT and a regular contributor to *Technolog*.

minnesota TECHNOLOG

The same magazine that brings you "The Bionic T.A." is also expanding your scientific horizons.

Surprised?

You can laugh. You can think. You can learn. Because we at **Minnesota Technolog** bring you technology as it is today—and as it may be tomorrow. The controversy, the crisis, the innovation, the humor. Because in a matter of years you're going to be part of it all.

Look for us on campus. We're the ones who brought on the "Do I.T. With An Engineer" T-shirt epidemic last year. We're the ones who calculated that Skylab would drop dead center in the **Technolog** office and were busy selling box-seat tickets in Experimental Engineering at $4.50 a crack. And, if our calculations were correct, by the time you read this, there should be approximately 3,566 Techno-Toobies fwhizzing about the IT campus.

You may even have one of us in your classes. Denny Sullivan is our editor-in-chief. Besides being over-all policy-maker and overseer of the magazine's format and advertising, Denny is especially committed to the professional quality of **Technolog**—making it and keeping it a magazine you will be proud to read. Look for Denny in your journalism or chem engineering classes.

Steve Deyo is **Technolog**'s associate editor. Steve works with the writers. They may have a story idea they want to develop themselves, or they are given an assignment in a field of their strenth. Steve is making **Technolog** a magazine you'll be glad to have read. He's also pullikng together a wide range of writers to give as many IT students as possible the valuable career experience of writing for a technological publication. Writers are needed, and writers are paid—so if you don't have Steve in one of your classes, look him up. And if you don't think you're a good writer because you're not an English major, don't worry. Correcting spelling and punctuation is **his** job.

Our photo editor is Mike Dorn. He's the fellow with the self-designed blaster. (This is true!) He needs photographers, and he'll get them one way or another. Also, we are still looking for art production people. So if you can draw or take pictures, and would like to earn extra money, stop in or call.

Or, if you mean business, **Technolog** needs an advertising sales person, an office manager, and promo personnel. The contacts you make with business firms and corporations locally and nationally could land you a job on graduation—besides making impressive experience for your resume.

And now a note from Denny and Steve:

Hello, everyone! Hey, we're really excited about this year. We've got lots of new ideas for increasing readership, advertising, and student involvement, besides improving production quality. All this, plus a few surprises. The only thing that could hold us back is lack of personpower. We want to be your magazine. Read us. Talk to us. Give us a call at 373-3298, or stop in at room 2, Mechanical Engineering; someone's almost always there. Let us know what you like, don't like, or would like to see. Come join our team. We hope you're as excited as we are.

Stop in or call for details on the time and place of our staff Team Party this November.

With best wishes for the coming year . . .

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THE lighter side OF TECHNOLOGY

A regular feature advancing the notion that technology can be serious and funny at the same time.

...IS THAT ANOTHER SKYLAB JOKE?

Yes, I'm afraid it is. But I just couldn't pass up the chance to discourse upon the most widely-publicized and attention-getting scientific event since Kohoutek's comet. (Only a bionic test-tube baby could supersede that.)

Seriously, though: as engineers, we know that into every technological or mechanical gizmo that comes forth from the mind and hands of man—be it a car, an electric can opener, or Skylab—is built a peculiar essence, almost a parallel to the soul, called the "margin of error". Much as we humans have our own quirks, frailties and snafus, so do machines run a certain risk of unpredictably going haywire. It's sad but unavoidable, unless we are willing to allow the cost of the thing to disporportionately outweigh its value. We can't keep asking ourselves "What if. . .? What if . . .?" Everything has its risk; that's life. The point is to live life to the fullest without being constantly preoccupied with the "what-if's."

In the case of Skylab, we saw a "margin of error" crossed—and its fiery results. Some panicked, some worried, some didn't care. Others laughed in the face of the 500-odd "what-if's" hurtling down to Earth. That's what Gordon R. Dickson was saying about the human spirit in his story "Danger—Human."

Many people made light of what could have been a grave situation. (No pun intended.) You may have heard of:

- "Skylab missed me" T-shirts;
- a poster: "Why get hit by Skylab when you're alone? Come to the Skylab Party!";
- the newborn twins christened Sky and Lab;
- Skylab repellent spray ("guaranteed or your money back");
- T-shirts with a target and the caption "I'm wearing this because NASA has never hit one";
- the man who wore his "Official Skylab Colander" to work;
- and, of course, WCCO's offer of a free dinner for two if you-know-what hit you on the head.

Well, America has survived Skylab. I guess my only concern is if, as though in mimicry of the Civil War, we start to see "Skylab veterans" popping up at parades, fairs and civic events. Or, in our imminent recession, a whole new meaning could develop for the slogan, "Don't forget—hire a vet."

Thanks to Bruce Brand, Civil Engineering

After Graduation continued

song or "thought up" a melody? Do you like to sing? Can you either play an instrument or sing well? How's your creativity with clay, paints, metal, glass, etc.? How's your sense of form and balance with regards to photography, painting, or architectural design? Do have an eye for colors? Can you convey ideas or feelings through how you express yourself in words, actions, or pictures? Can you create images or induce emotion with words?

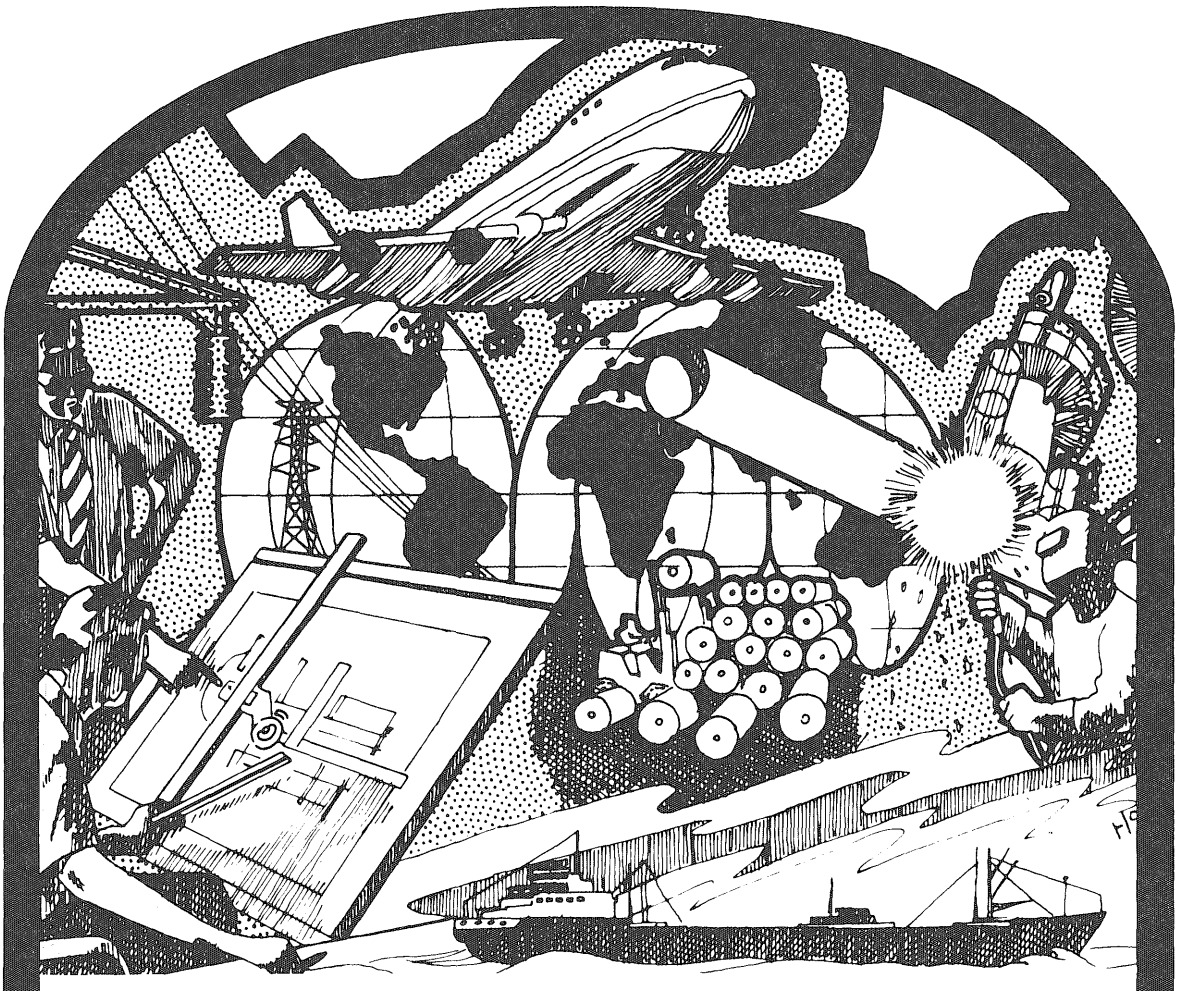
XI. LEADERSHIP Are you usually the one who takes initiative in starting a task, project or friendship? Are you an organized person? Can you organize events, details, or functions? Do you often find yourself leading or directing others? Will you stand up for what is right? Can you make firm decisions? You're not afraid to take risks, are you? Or to get up in front of a group of people? How well do you persuade people? Promotion, negotiation and diplomacy are also essential leadership skills.

XII. APPLICATION This last group includes ability to file, record, classify, follow instructions, and attend to details.

After asking yourself these and other questions, you may find a tendency in yourself to prefer working with people, ideas, or things. Keep this in mind. If you're an inveterate conversationalist, you probably wouldn't want some lonely graveyard shift monitoring instruments.

Well, think through your skills and interests and we'll work with them some more later on. For further reading, see Richard N. Bolles' **What Color Is Your Parachute,** John L. Holland's **Making Vocational Choices: A Theory of Careers** (not available through MINITEX), and **The Dictionary of Occupational Titles (DOT),** fourth edition.

Next issue: "Sizing up the Job Market"



GRADUATING ENGINEER

NRC offers you nationwide exposure to hiring companies at absolutely no cost. NRC recently announced its national recruiting data bank for subscribing companies all over the United States. There is never any charge for employment to the engineer or the company.

The only reason not to get into the system is because you do not want to start your career.

To receive more information and the materials needed to enter the system please call the toll free number:

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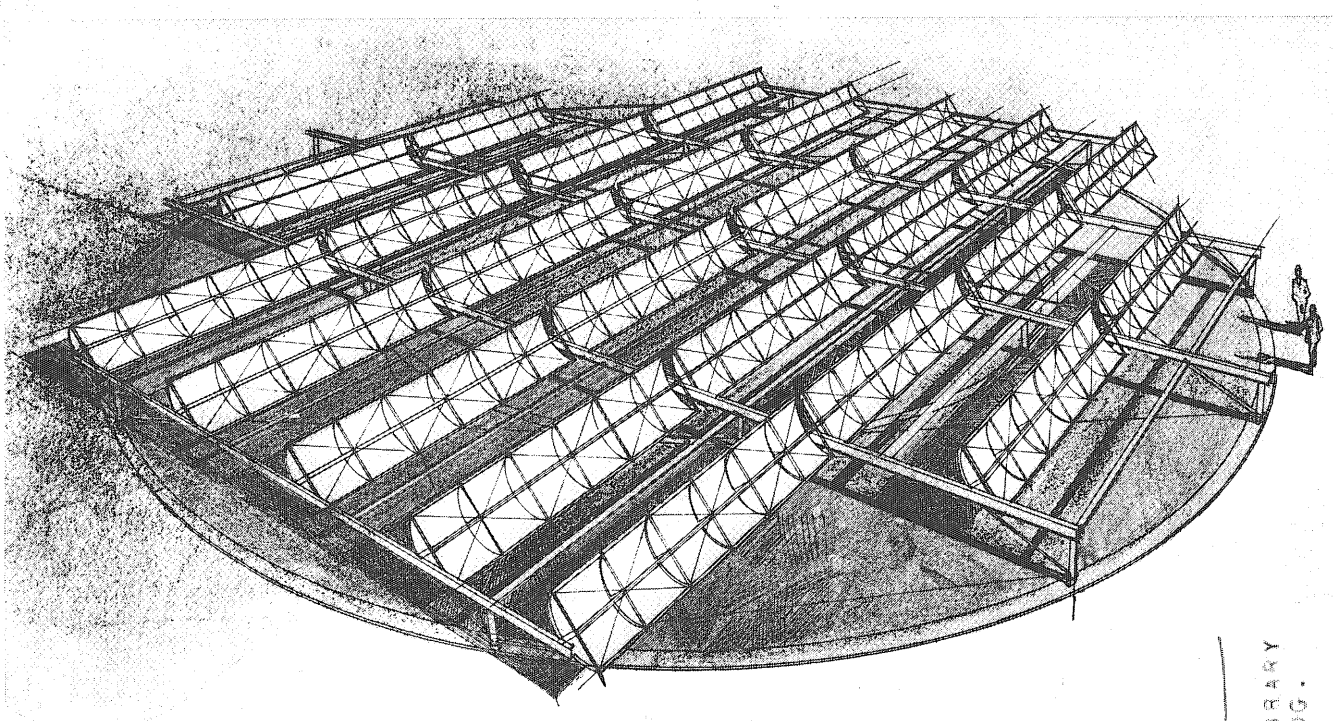
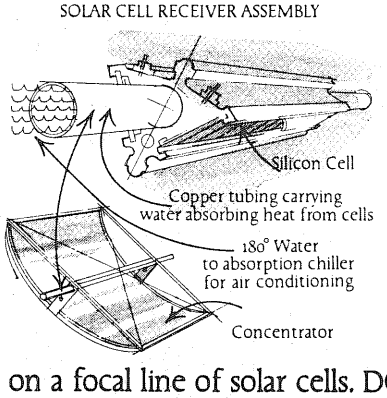


8 years ago, we designed turntables to track records. Today, we're designing turntables to track the sun.

What you're looking at is a turntable that measures 146 feet in diameter — a turntable programmed by computer to track the sun's azimuth while concentrators track the sun's elevation. Nine of these turntables are being designed to power marine-mammal life-support systems at Sea World in Florida.

The photovoltaic concentrator system uses high-intensity silicon solar cells to convert sunlight into electric power and is under study by General Electric for the U.S. Department of Energy. Parabolic troughs on each turntable are formed of aluminum sheets covered by a reflective film laminate. They are angled to concentrate energy on a focal line of solar cells. DC power generated by the photovoltaic cells will be converted to AC power providing up to 300 kw of peak electricity—enough power to service about 40 average homes.



Water circulated through copper coolant piping in the solar cell assembly and carried to absorption chillers would be used to air-condition a shark exhibit. The generation of electricity and simultaneous ability to air-condition makes the GE system unique.

Our Sea World application is a test project. It will include researching ways to reduce costs to make photovoltaic systems practical for commercial or industrial-scale use.

Looking for new and practical energy sources is just one example of research in progress at GE. We're constantly investigating new technologies, materials and innovative applications for existing technologies — in such areas as medical systems, transportation, engineered materials.

This takes talent — engineering talent — not just in research and development, but in design and manufacturing, application and sales.

If you'd like to know more about engineering opportunities at GE, send for our careers booklet: General Electric, College Communications, W1D2, Fairfield, CT 06431.

Progress for People

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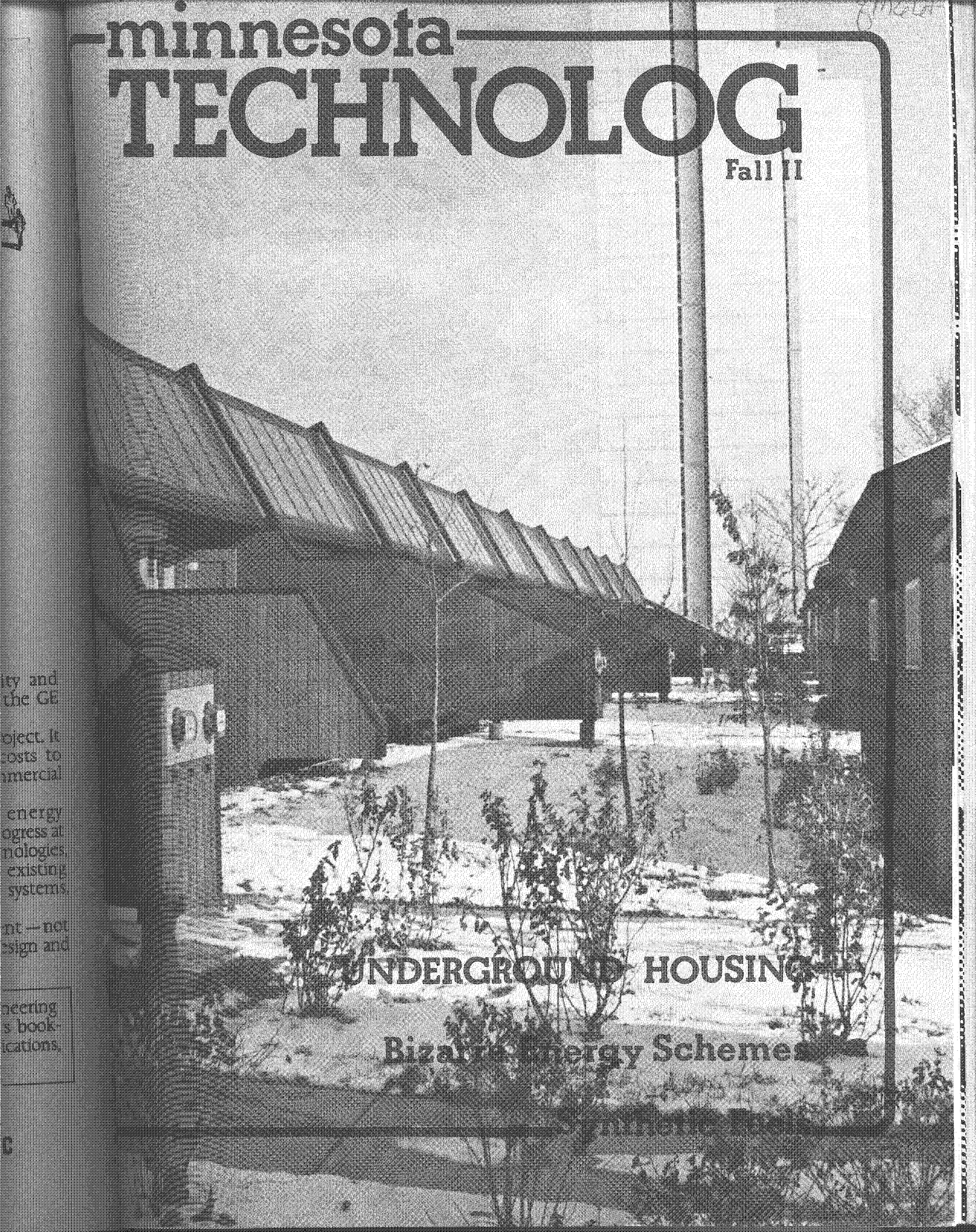
minnesota TECHNOLOG

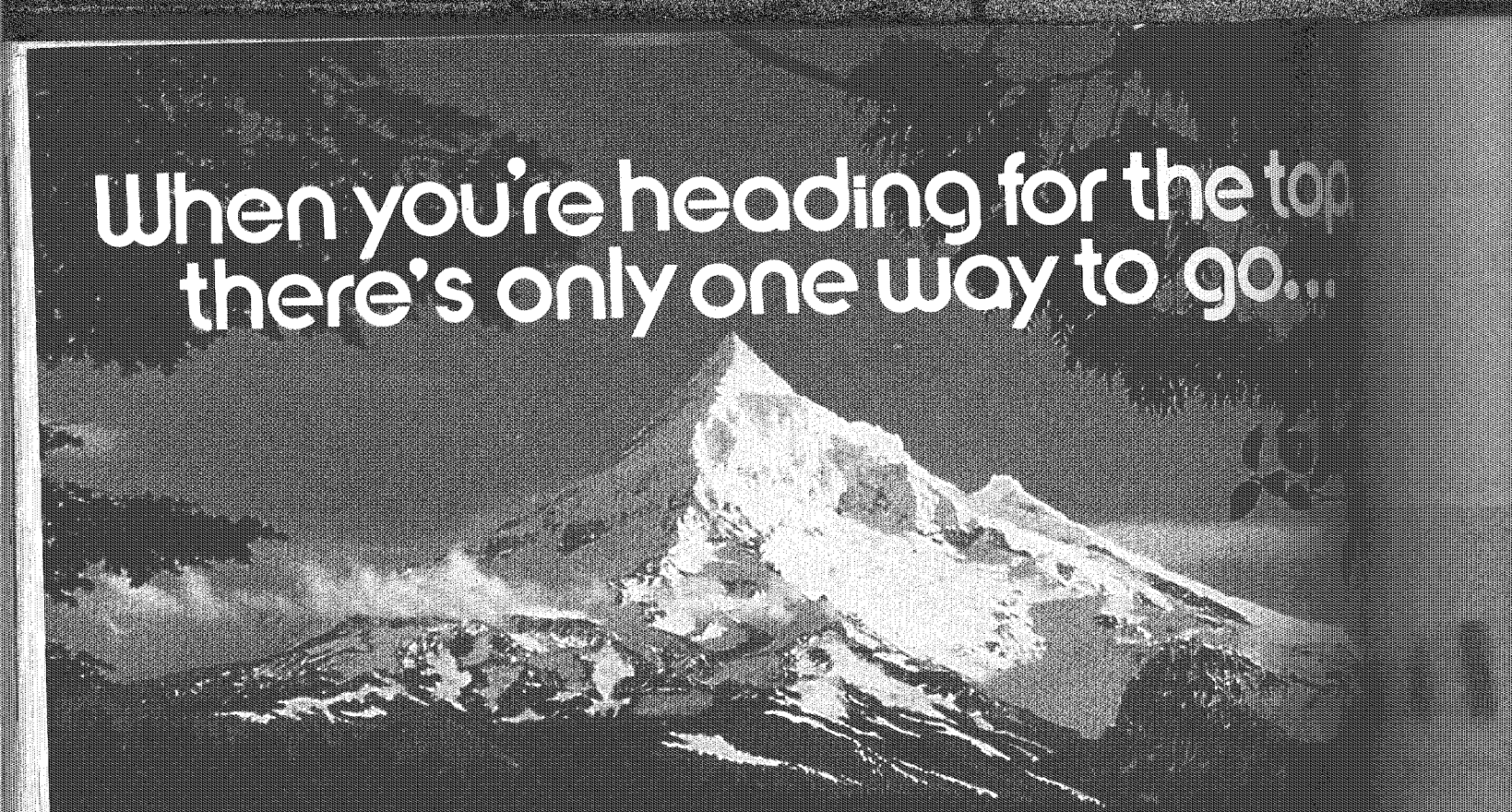
Fall 11



UNDERGROUND HOUSING

Bizarre Energy Schemes

When you're heading for the top there's only one way to go...



Anheuser-Busch

Engineers, you really can reach the top when you climb with a leader. And no doubt about it, Anheuser-Busch, the world's largest brewer and maker of Budweiser, Michelob, Michelob Light, Busch, and Natural Light beers, is out in front.

If the only thing higher than your lofty aspirations is your potential, we'd like to talk with you.

We'll be on campus looking for Engineers to join our Engineering and Operations Department on **Tuesday, January 8, 1980.**

CENTRAL ENGINEERING

B.S.M.E. - M.E.'s will gain experience in such diverse fields as material handling, equipment layout, piping system development, steam generation, compressed air systems, ventilation, heating and air conditioning, and high-speed bottle and can packaging.

B.S.E.E. - E.E.'s can expect to be working in such areas as electrical machine design and application, power distribution, sub-station layout as well as industrial and commercial lighting, electrical control circuits, and systems control.

INDUSTRIAL ENGINEERING

Our Corporate Industrial Engineering Department presently has openings for Industrial Engineering Trainees at the B.S. and M.S. degree levels. These positions will be project-oriented and will include assignments in operations control and improvement, facilities revision, plant design and layout, and development of operation standards for cost control.

CORPORATE MANAGEMENT TRAINING PROGRAM

Opportunities exist in our Corporate Management Training Program for individuals with leadership ability and Engineering degrees. This 12-month course is designed to give the individual exposure to all areas of Operations and Administration and to prepare trainees for a career in Production Management, Quality Control or Engineering.

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—David A. Dindinger BS, Chemical Engineering

...interviewed companies ...ous and off. About ...mpanies in all. And I ...Pont offered me the ...portunity in terms of ...elopment, outstand- ...ects and, best of all, the ...to some traveling. ...e been getting ...ut since I joined the ...in 1973 out of the ...of Illinois-Chicago. As ...surance engineer in the Engineering Department, I inspected equipment vendors fabricated for Du Pont. I worked in 10 states in the U.S. and four states in Mexico. My job now is reviewing equipment specs and writing procedures for our inspectors. It's been a good learning and growing experience."

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

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Editor's Log

Energy is of great concern to almost everyone. As students of technology, the solutions to many of the world's energy problems are our responsibility. In this issue of the *Technolog* we take a look at a few of these energy issues.

To pretend that one issue of any magazine could address all of the possible energy problems and solutions would be ridiculous. Instead we chose several certain, rather specific, topics that are of particular interest to engineers today. Our purpose in doing this is not to answer all the questions concerning these topics, but, instead, to stir more movement towards a better energy future by raising questions about what is being done today.

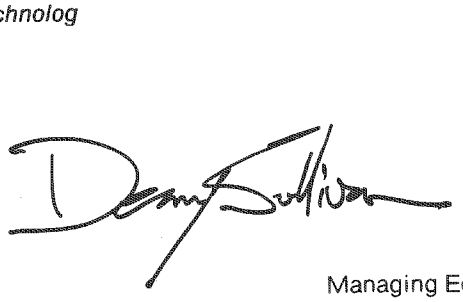
Underground housing, our cover story, has come to Minnesota in a big way. As we all know, the university is heading underground with the Civil and Mineral Engineering Building; but just across I-94 from campus is a complex of underground apartment buildings that demonstrate some very innovative energy-saving concepts. Underground family dwellings are fast becoming practical. Terri Levy will tell us how this is happening in "Where Earth Meets Sun."

Germany, during the reign of the Third Reich, faced petroleum problems similar to the ones we will face in the 1980's. Forty years later we are looking back to discover how Hitler's Germany dealt with that problem. Synfuel was part of the answer. While foreign oil prices continue to climb, the relative cost of synthetic fuels are not. In "Synfuel: Keeping Us In Fuel" Renee Valois explores several synfuel options.

Mary Daly takes the view that energy changes happen too slowly due to political, social and economic factors. She will outline this viewpoint in "Energy and America: Convention vs. Change."

The energy crunch has also brought out a lot of "nuts;" some of them have very good ideas. Dan Freeborn looks at a few of these in his article on "Bizarre Energy Schemes."

Our regular features, "Ad Astra," "After Graduation," "The Bionic T.A." and "The Lighter Side of Technology" are, of course, back again in this issue. "Ad Astra" should be of particular interest, however, because one of the books Bruce Kvam reviews was written by Jim Young, a former IT student and past editor of the *Technolog*



Managing Editor

Staff

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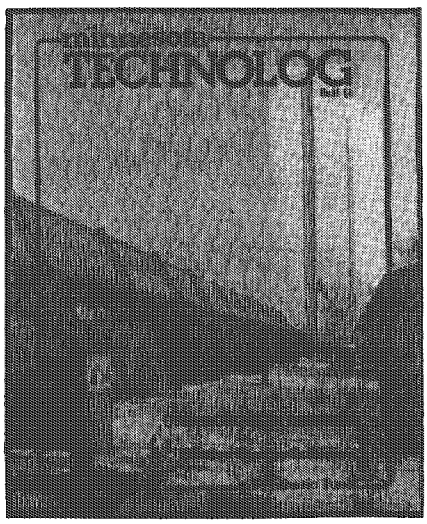

COVER:
Underground
apartment complex
2500 Franklin, Minneapolis

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log Ledger

...stronger involvement in energy ...ment and water conservation ...ed by President Carter, the **U.S. ...of Reclamation** is about to be ...the Water and Power Re... Administration.

...SA's **Jet Propulsion Laboratory** is ...ing low-cost, point-focusing solar ...ntrators for rural energy use. The ...rator project was commissioned ...eral Electric. Each concentrator ...twelve meters in diameter and ...ude a sun-tracking mechanism.

...world's first large-scale heating ...ing demonstration using a solar ...rator system is now in operation ...amson Hall. The system, de... by former mechanical engineer... ...essor Thomas Bligh, will help ...temperatures in the award-win... ...derground building. Project cost ...0,000.

...University Physics Department ...to confirm Einstein's Unified ...—the hypothesis that gravity, ...gnetic waves, atomic attractive ...and radioactive decay induction ...one—in the old Tower-Soudan ...on the Iron Range. Physicists ...ive million gallons of water into ...ndoned mine, calculating that, ...ch volume, the probability of ...ing one decaying proton—sub... ...roof of the theory—will be in... ...about once a year. The pro... ...ast at least five years, at the ...million a year.

...last quarter, about one-third of ...00 University students taking ...courses were enrolled in remedial ...that is, "high school math." ...y students are arriving at the University with the mistaken impression that they can get along with only elementary school mathematics," said Willard Miller, head of the University's School of Mathematics. "(There is) a greatly increased need for mathematics training in a society based on high technology," he said. "Lack of sufficient high school math is impeding the progress of these students toward degrees, and severly draining the resources of the School of Mathematics." Emphasizing the rapid pace of college mathematics, the tedium of college remedial courses and the inefficient use of college professors to teach lower math at the expense of college math, Miller recommends more math preparation at the high school level.

IT and CLA have received joint grants of $150,000 from 3M and $100,000 from the Donaldson Company. Money will go to the Business and Technology Partners Program over the next three years to support curriculum and faculty development, fellowships, planning.

Westinghouse Electric Corporation has received a $6.5 million contract for the design, construction and testing of one of the world's largest superconducting electromagnets for the Department of Energy's Oak Ridge National Laboratory. The 32-ton, 18-foot magnet is unique in its use of superconductors made of niobium-tin alloys.

Such magnets can produce magnetic fields strong enough to produce fusion reactions—fields with peak strengths of eight tesla and higher, more than five times stronger than the largest electrical generator, and about 150,000 times stronger than the Earth's magnetic field.

The three miles of superconductor in the coil will circulate 17,600 amperes without resistance at -452 degrees Fahrenheit.

It's winter on Mars again, and this photograph taken by Viking Lander 2 at its Utopia Planitia landing site on May 18, 1979, shows it. A thin coating of frost covers the rocks and soil. Scientists believe the frost forms around dust particles in the atmosphere which then, weighed down by frozen carbon dioxide, sinks to the surface. Sublimation of the carbon dioxide by the heat of the Sun leaves behind only water and dust. The frost coating seen here is extremely thin, perhaps no more than one-thousandth of an inch thick.

The five-year-old experimental Applications Technology Satellite-6 was retired to a higher orbit by NASA on August 6th. The 1,402-kilogram satellite outlived its planned life span by three years, although three of its four thrusters had by then failed. The spacecraft will stay in its higher orbit indefinitely. It was boosted to prevent potential hazards for present and future space vehicles.

Satellite-6 was used in the first educational course taught via satellite television in 1974, the first successful satellite-to-satellite communications experiments, and direct TV support for the Apollo/Soyuz Test project mission in July 1975.

News—cont.

The first industrial use of landfill methane gas in the U.S. began August 29 at Hoeganaes Corporation of New Jersey. Capable of providing up to an estimated one million cubic feet of gas per day, the system will be used to heat 30-ton ladles in the manufacture of metal powders.

At the same time, Westinghouse Electric Corporation is testing the economic feasibility of **methane extraction from unmined coalbeds.** Using a process known as hydro-fracture, a high-pressure mixture of sand and water is forced into the well. Cracks thus form in the coal deposits, held open by the sand after the water is removed. The cracks then serve as "micro-pipelines" which allow gas to flow to the wellhead for collection. The well, now capped and operated as a conventional natural gas well, measures about 30,000 cubic feet of 99.2-percent pure gas per day.

The Solar Research Institute (SERI) is negotiating with private contractors Martin-Marietta to build **the world's largest photovoltaic power system** to supply two small villages in Saudi Arabia. The proposed system will deliver a peak output of 350 kw DC. It includes an energy storage subsystem with the necessary power conditioning to provide electricity for the 3,500 inhabitants of Al Uyaynah and Al Jubailah, 30 miles northwest of the Saudi Arabian capital.

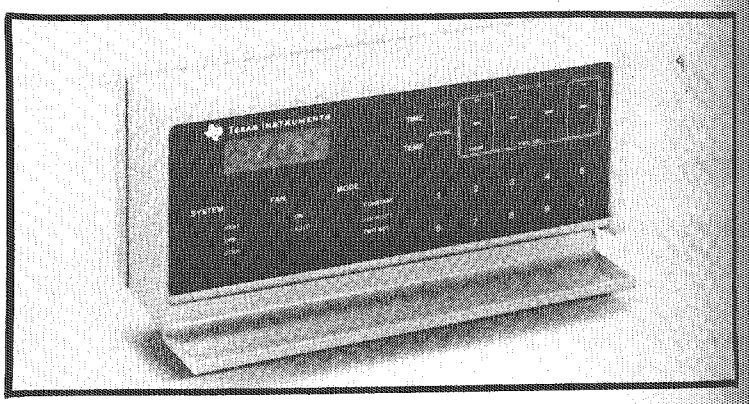
SERI is also negotiating with Honeywell, Inc. of Minneapolis and three other firms in a **solar cooling project** to be tested in southwestern U.S.A. Systems tested will deliver between 10 and 18 tons of refrigeration for light commercial buildings, using evacuated-tube or concentrating-type collectors.

The 107-ton superconducting electromagnet built by Argonne Laboratory for the Stanford Linear Accelerator Center has finished its 2,248-mile trek from Chicago to Palo Alto. It was the heaviest load ever carried on U.S. highways.

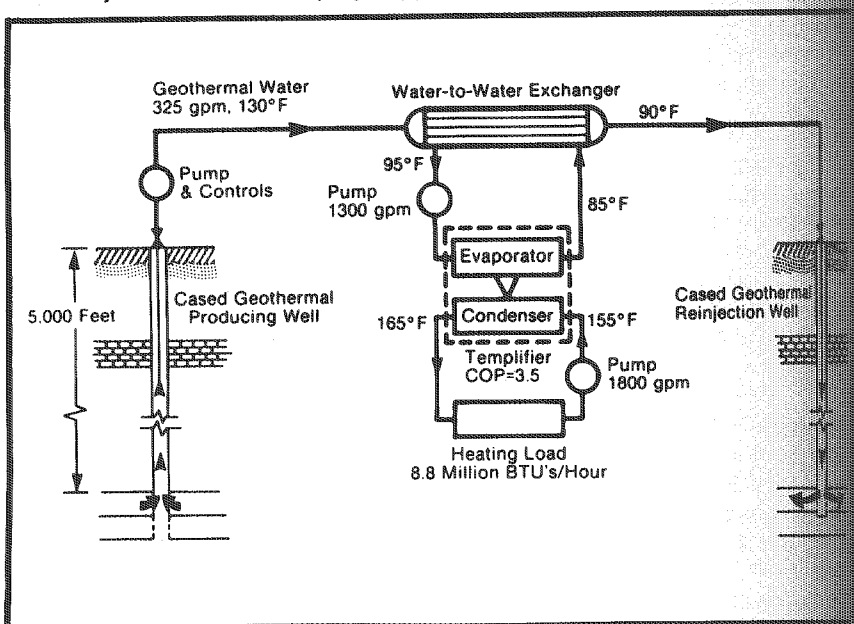
A new stack heat reclaimer has been developed for use with oil-, gas-, coal- or wood-burning stoves and furnaces by Gateway Industries Inc. of Bloomington. It can recover 57,000 BTU per hour from a flue temperature of 1,000 degrees Fahrenheit, using a blower that produces 200 cubic feet per minute of air movement. For more information, call toll-free 1-800-328-2935.

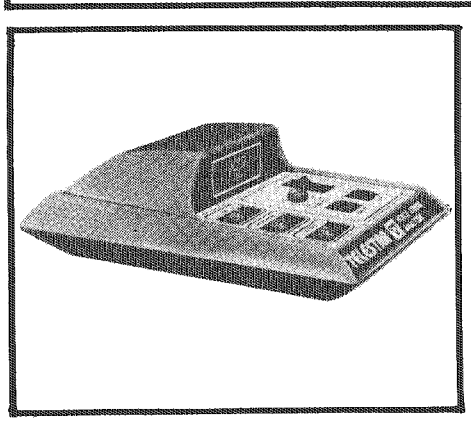
New Products

An electronic digital thermo... was introduced by Texas Instrum... this summer. It offers a day/night ... program revisability, and is easy to ... stall.

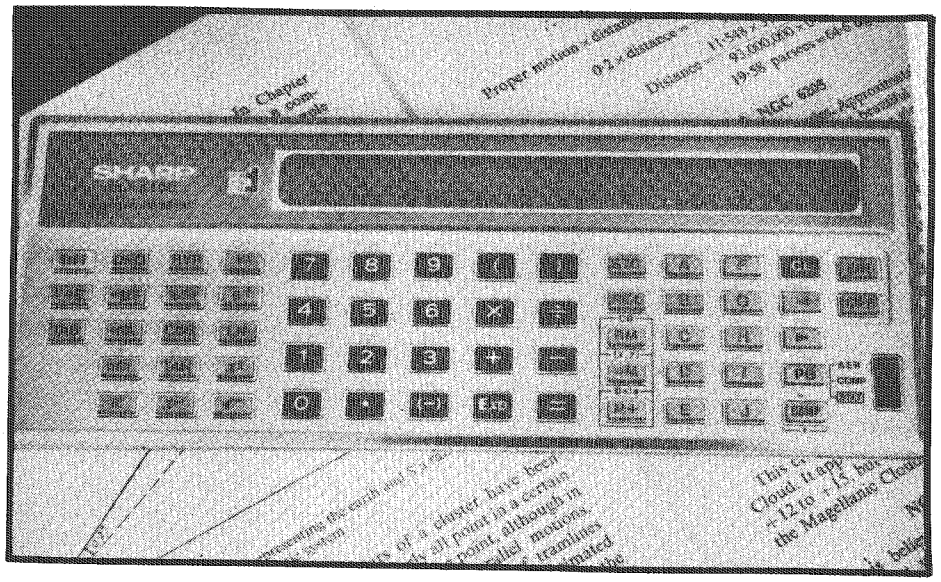


Westinghouse Electric Corporation has developed the Templifier, **a high-temperature heat pump** intended to augment geothermal and solar energy collection systems. It can amplify tapped heat to the 140- to 220-degree ... heit temperatures required ... industrial processes, space heating ... water heating applications.





Telestar Inc. of Pennsylva... developed **a microcomputer "voice analyzer"** (lie detector) availa... public use. The Truth Machine ... inaudible microtremors in the ... voice.



...first programmable LCD calcula... ...priced for under $40.00 has been ...ced by Sharp Electronics. The new ...s an 8-digit mantissa, 2-digit ... calculator with a 30-step ... memory. It performs 37 func... ...has seven memories, all safe... ...Up to 15 levels of parentheses ...nput, and 6 levels of pending ... Includes automatic power-off ...

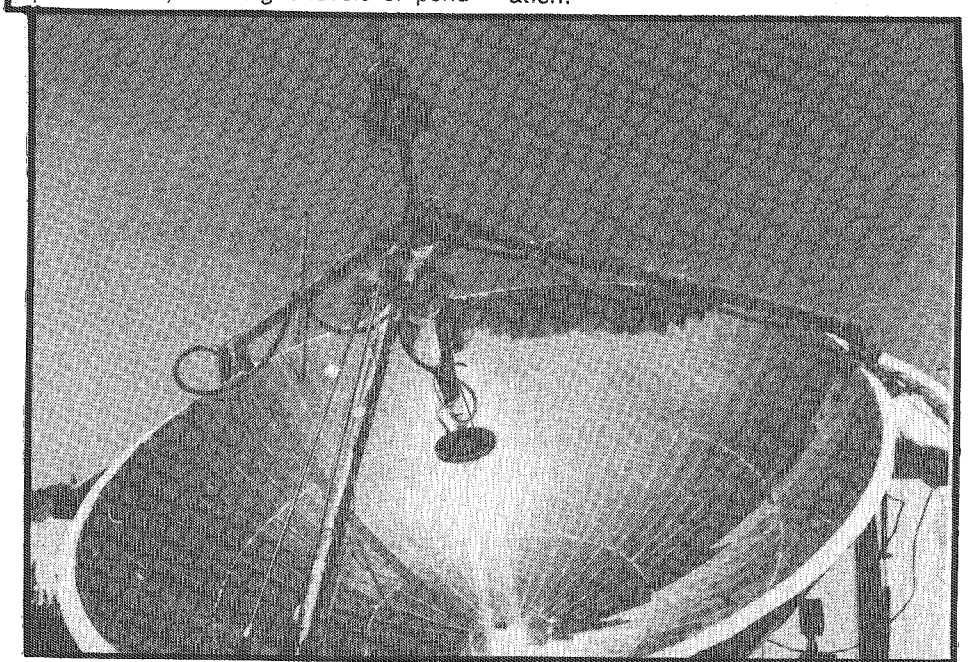
...handheld scientific calculators ...ich alphanumeric formulas can ...ered as written have been dev... ...by Sharp Electronics. The two ... the EI-5100 (suggested retail ...95) and the EI-5101 (suggested ...e $79.95) are now available at ... bookstores. Formulas may be ... into the calculators without ...slated into machine language ... the use of a rolling writer LCD display. Up to 80 steps may be keyed into the EI-5100, which has 61 functions, ten data memories, a memory safeguard and automatic power-off. The data stored in the memories can be retrieved even after a power-off. The EI-5100 accepts up to fifteen levels of parentheses, with eight levels of pending operations. Up to five formulas with up to 80 steps each can be stored as long as needed and recalled at the touch of a key. Formulas can be recalled and edited with up to ten variables.

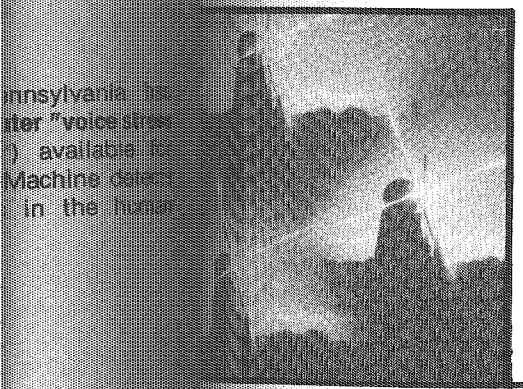
Both calculators operate on silver oxide batteries with 1,000 hours' operation.

...gy in Israel

...the largest per capita user of ...gy in the world. Twenty per... ...raeli homes are fitted with solar ... refrigerating systems. Dr. ... Arad, Director-General of ... Energy Authority, is optimistic ... energy use can be increased ... current 2 percent of the coun... ...consumption to between 8 and ... by the 1990's.

... 20 to 25 percent of all house... ...gy needs—predominantly for ...ting and hot water—could be ... passive systems design and ...rgy applications," said Dr. ...cent Israeli developments in... ...ow-temperature solar energy ... capable of powering solar air ...ing in summer, heating in win... ...taining mechanical energy for ... and a new solar cell with its ...mal storage system that can ...electricity after sundown.





Israeli scientists have also made headway in modernization of the windmill as an alternative energy source. At the Israeli Institute of Technology (Technion), Professor Anthony Peranio has developed a new "rotary viscous friction" device. It consists of a paddle wheel enclosed in a tank of water or oil which is rotated mechanically by the wind. The liquid is thus heated, providing power.

Israel has also been at work developing such energy alternative sources as "solar ponds" which operate on a greenhouse principle, trapping solar energy and producing heat at temperatures between 90 and 100 degrees Celsius; methane gas production; a Dead Sea species of algae which produces glycerol, a possible raw material for natural gas or gasoline; wind turbine enhancement by installation of turbine shrouds; and sea wave kinetic energy conversion devices.

Awards

The National Space Club is awarding **a $2,000 scholarship** for students intending to pursue undergraduate or graduate studies in science or engineering during the 1980-81 school year. Deadline is January 18, 1980. Information is available in the Technolog office.

The Hartford Insurance Group and the National Safety Council have announced **an awards competition to the total of $75,000** for winners who propose schemes to reduce accidents in America's workplaces. For materials, write: The Hartford Loss Prevention Awards Competition, The National Safety Council, 444 N. Michigan Avenue, Chicago, IL 60611.

The American Consulting Engineers' Council (ACEC) announces its **1980 undergraduate engineering scholarship program.** For details contact ACEC, 1155-15th Street NW, Suite 713, Washington, DC, 20005.

The Solar Energy Research Institute (SERI) of Colorado has awarded **$2 million** to 321 individual and team researchers nationwide **for academic research** in solar energy.

University researchers have been awarded more than $1.4 million by the National Science Foundation to set up a surface analysis center, and $650,000 by the U.S. Department of Energy for a corrosion center. Robert Hexter of the Department of Chemistry and Lanny Schmidt of the Department of Chemical Engineering and Materials Science, with the Department of Electrical Engineering, will be primarily involved in research at the surface analysis center. They will study the microscopic structure of surfaces with an eye to further miniaturization of medical implants. The corrosion center will collaborate in providing this region with up-to-date surface science equipment, seminars and workshops.

News Cont.

Miller Brewing Co. and three nutritional experts have asked the FTC to rule use of the term "natural" with respect to **Budweiser, Natural Light, Busch and Michelob** by their manufacturer, Anheuser-Busch, to be "false and deceptive." While Anheuser-Busch defines "natural" as "produced only with natural ingredients using traditional processes," the experts claim the beers do not even fill their own definition. The experts cite such "non-natural" and "non-traditional processes" as: use of the additive tannic acid produced by a chemical solvent extraction process in the beers as a chill-proofing agent (to prevent haze); use of chemically treated beechwood slats during the fermentation of Budweiser; mechanical injection of carbon dioxide into the beers; brewing of Budweiser, Busch, and Natural Light under the modern technique of "high gravity"—brewing the beers "too heavy" for commercial consumption, then diluting them with carbon dioxide-injected water; and shortening of Budweiser's brewing cycle by nearly 25 percent in recent years.

A brick passive solar heating system employing a Trombe wall heats MIT architecture student Mark Crosby's home near Royal Oaks, MD. A 28-page brochure is available for $2 from the Brick Institute of America, Old Meadow Road, McLean, VA, 22102.

Publications

The Role of Government in the Development of Solar Energy
By Michael Yokell, a senior economist at SERI. Free. Send orders to: National Technical Information Service, 5285 Port Royal Road, Springfield, VA, 22161.

Low Temperature Thermal Energy Storage: A State-of-the-Art Survey
By Frank Bayline of SERI. Analyzes research, development and demonstration activities in current TES technology. Available at above address for $6.50 a copy, $3.50 for microfiche copies.

Solar Energy Technical Training Directory
Lists 91 post-secondary [illegible] offering training in solar technical [illegible] Free. Call toll-free 1-800-523-2[illegible]

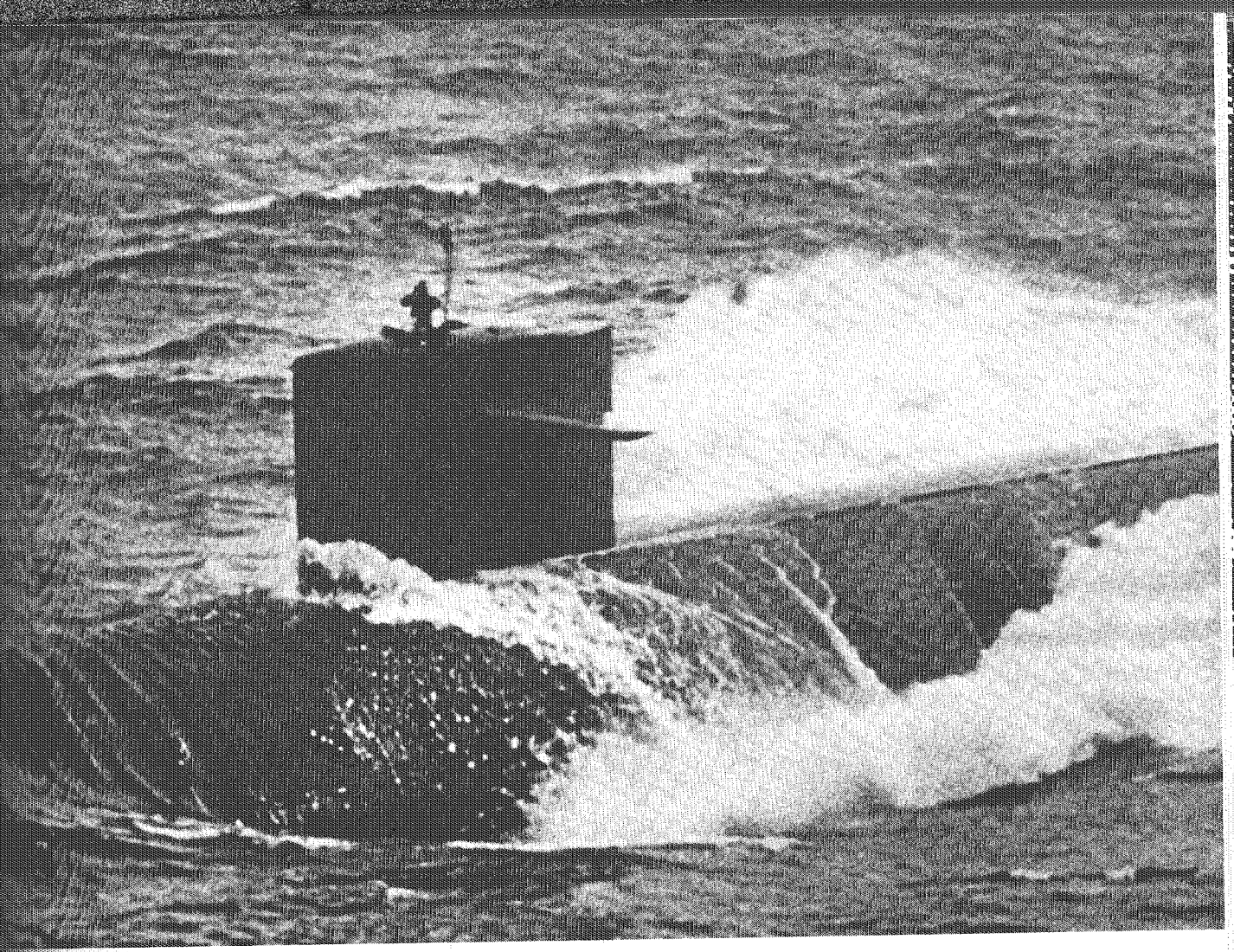
Wind Machines, Second Edition
By Frank Eldridge, Van Nostrand Reinhold, 232 pp., $17.95. Covers technical, economic, environmental, social and institutional aspects of wind power and gives full historical coverage.

Solar Energy Utilization
By Timothy Michels, Van Nostrand, [illegible] pp., $18.50. Discusses passive and active solar systems and costs and benefits of each system type depending on climate, dwelling size and structure.

The Solarex Guide to Solar Electricity
Includes charts, graphs, diagrams, drawings of solar cell applications, discusses parallel and series connections with capacitors, current limiters, [illegible] pp. Write to: Ed Robertson, Solarex Corp. CPD-Dept. L100, 1335 [illegible] Drive, Rockville, MD, 20850. Cost $[illegible] (includes shipping).

Sun Up to Sun Down—Understanding Solar Energy
By Shawn Buckley, McGraw-Hill. This renowned professor and [illegible] presents a conceptual framework and practical applications for solar energy use, primarily heating systems.

Satellite Power System Concept Development and Evaluation Program Reference System Report
Free. Presents DOE geosynchronous power satellite proposal for the year 2000. Write: Fred Koomanoff, Satellite Power Satellite Program, [illegible] Massachusetts Avenue NW, Washington, DC, 20545. Also available are other reports dealing with economic, demographic issues, financial arrangement scenarios, international agreements, military implications, environmental assessments, public acceptance, siting studies, resource requirements and student participation.



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WHERE EARTH MEETS SU

by Terri Levy

"Earth-sheltered housing." What do those words bring to mind? A damp, dimly-lit home? An inhabitant squinting as he comes outside into the sunlight? A tour through the new earth-sheltered townhomes off of Interstate 94 on 25th Avenue will change those conceptions.

From the sidewalk you will see a long mound of sod about ten feet high. There are a dozen doors lined up:the entrances to these strange mole homes. You open the door and find—a regular townhouse! It seems disappointing at first. The living room is large; the floor-to-ceiling windows allow for a bright, cheery atmosphere and a nice view of the back yard. You walk down the stairs to find the bedrooms. From the broad windows you see a fairly large, handsomely terraced garden area that inclines like a large staircase up to the ground level. There is plenty of natural lighting down here, too. These homes are amazingly reminiscent of hundreds of other townhouses.

But these homes *are* different. "It's interesting to watch people's reactions as they walk in," Ron Duty of Seward West Redesign, the developer of the homes, said. "They forget there is anything unusual at first. Then, as they remember that there is earth above them, they all start to look up at the ceiling."

The homes are covered with earth on three sides. The south wall is almost completely windows. The earth does not serve as an insulator, but rather provides a large heat mass.

"At a certain point, underground temperature stabilizes," Duty said. "We're taking advantage of that principle." This decreases daily and seasonal temperature changes.

With an average winter temperature of minus 30 degrees Celsius, a conventional home would have to be heated 50 degrees. An earth-sheltered home needs to be heated only 10 degrees.

Underground construction can save from 25 to 30 percent of the fuel costs of a conventional home. In addition to fuel savings, earth has proven to be a very effective sound insulator. This feature will enable builders to reclaim land next to freeways, such as the lot on

which these homes are built.

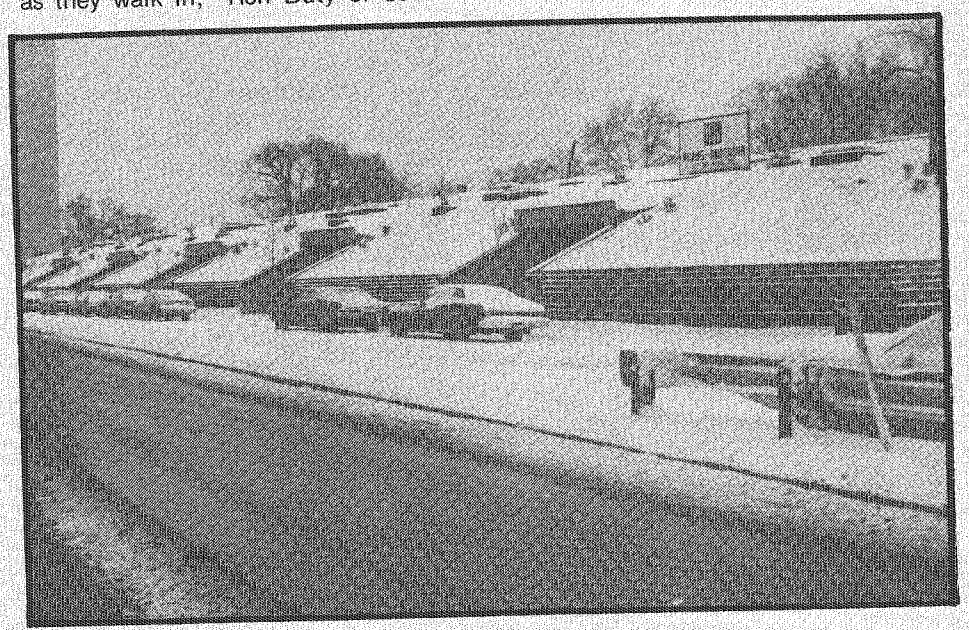
These townhouses comm[unity] fits of an earth-sheltered [home] passive and active solar heat[ing] that add to the energy savings.

The windows, all on the s[outh] the building, maximize so[lar] minimize heat loss. A three- to four-foot overhang sh[ades] summer to prevent overheat[ing] winter, when the sun's posit[ion] in the sky, the overhang [allows] the sun, allowing sunlight to [enter] rectly into the windows.

The windows also employ [exter]ior rolling shutters which [prevent] heating in the summer and [heat] loss in the winter and at [night] shutters can raise the R [value] double-paned window s[ystem] two or three increments.

Concrete is not an insul[ator] sorbs heat. The walls, floor[s] ing of the townhouses form a [mas]crete mass that absorbs and [stores] and will release it when [room] ture drops.

Buyers are also offered an [extra] passive solar option. Ceramic [tile] installed instead of carpet [on the floor] near the window. The tile [absorbs] which is passed on to the [concrete]. The heat can then be [transferred] flowing beneath the floor and [circulated] throughout the home.



passive solar features alone may ute from 25 to 35 percent of the space heating required for the use.

homes also employ an active, solar system. Each townhouse given solar panels. The heat collec- these panels runs through the where heat is transferred from lector to the air. This air then goes ock storage area where transferred to the rock. This area can store enough heat to the home for two cloudy days.

upper-level floor is constructed precast, hollow concrete panels. heat is fanned from the storage these panels, moving across and distributing itself to the This enables builders to omit ducts. Some of the heat ab- by the concrete radiates after turned off.

combination of passive and active systems provides about 45 percent annual space heating needs of a room townhouse, and about 37 the needs of a three-bedroom

solar system is backed up by a conventional gas heating system. The systems are coordinated electrically the gas system kicks in automat- when it is needed. The current annual cost for heating in townhouses is $47.

of the water for domestic use is heated by the solar system. There is in the air return duct. Water is through the coil and is heated by the air in the duct. In the summer, usually be heated to 120 to 140 Fahrenheit—a normal range for hot water—by the solar system winter, especially on cloudy solar system will only heat the 80 or 85 degrees Fahrenheit. A conventional water heater is used to the temperature to the proper

estimates say that the solar will contribute sixteen million of hot water per year.

homes are designed in a way makes them very marketable. surveys have shown that there segment of the multiple-family- market that is interested in efficient homes," Duty said.

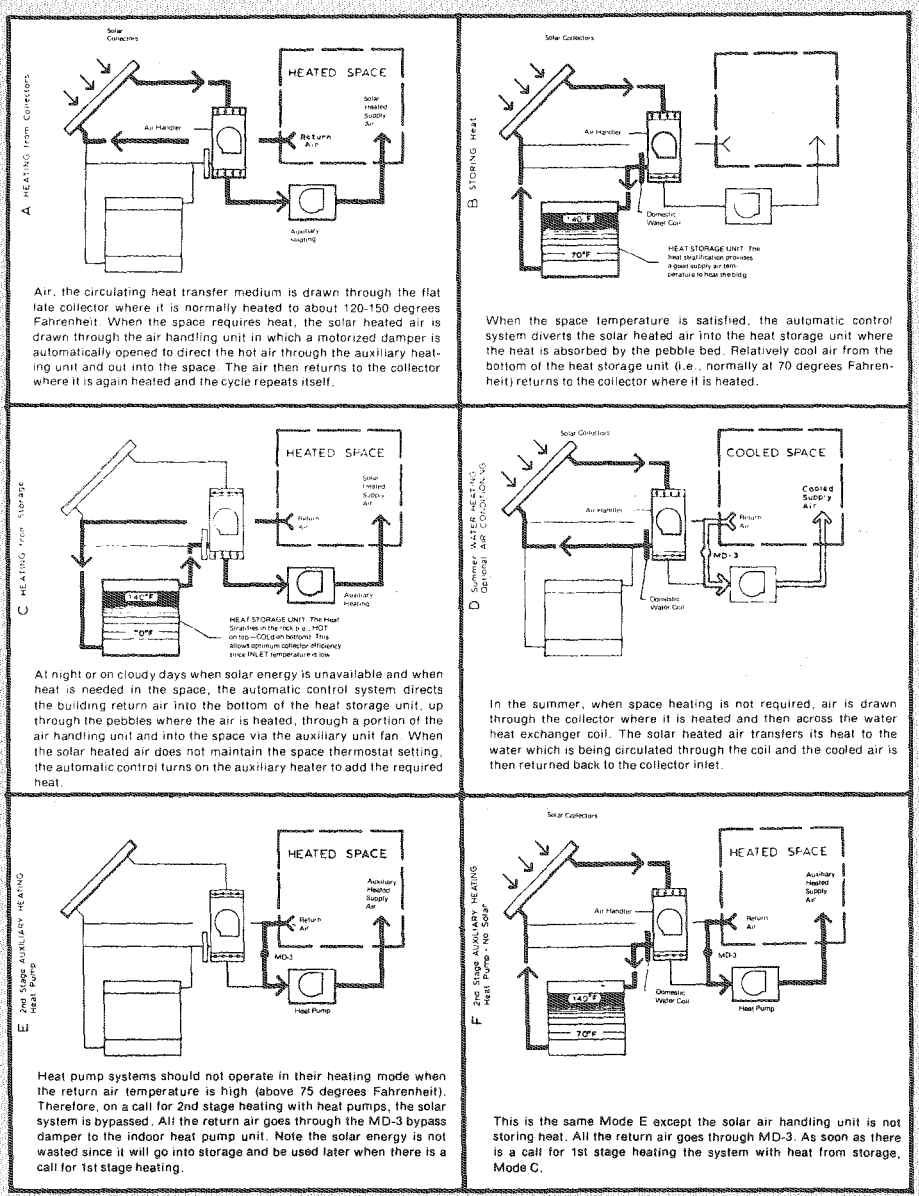
is an important factor. "We re- the building twice in order to within a feasible price remarked. A two-bedroom with a total of 1,054 square feet sells for $66,419. A three-bedroom unit, with 1,387 square feet, sells for $76,419.

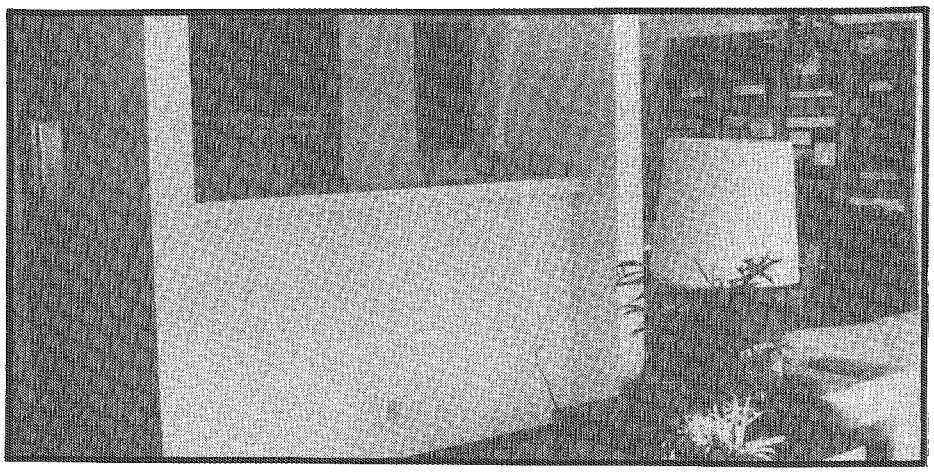
The homes are designed to bring in as much natural light as possible. This also gives them an appealing marketability. The living areas—the living room and the bedrooms—are on the south side, with all the windows. No wall separates the living room and kitchen, so the light from those windows carries across the home. Downstairs, the laundry room and heating systems are on the side opposite the windows.

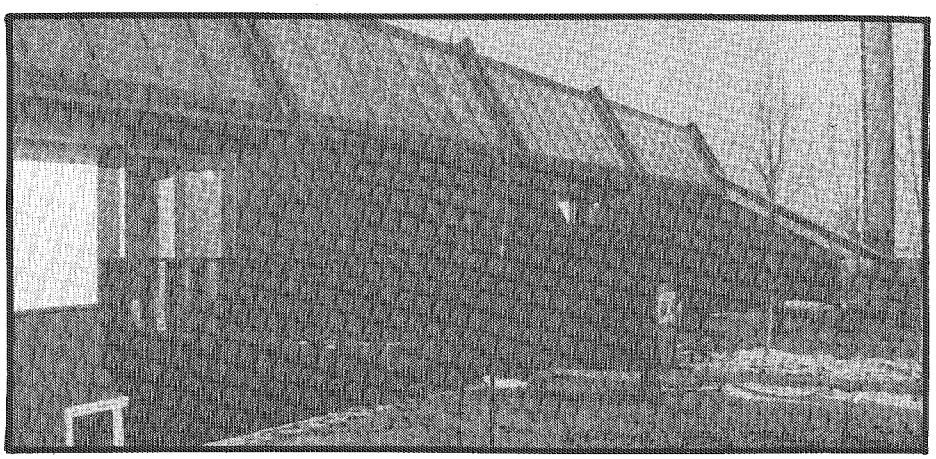
There is also a skylight in the dining area, which brings additional sunlight into the north side of the upper level.

The south side of the upper level is completely above ground. "If the whole structure was below ground level, there would be additional mechanical costs to pump waste water and sewage uphill," Duty said. "Besides, we wanted to give more than just a natural light, we wanted to give them a view."

The setting of the earth-sheltered homes proves that innovative, energy-efficient housing is not limited to the

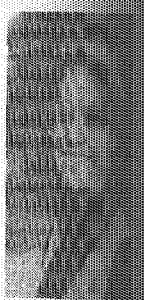




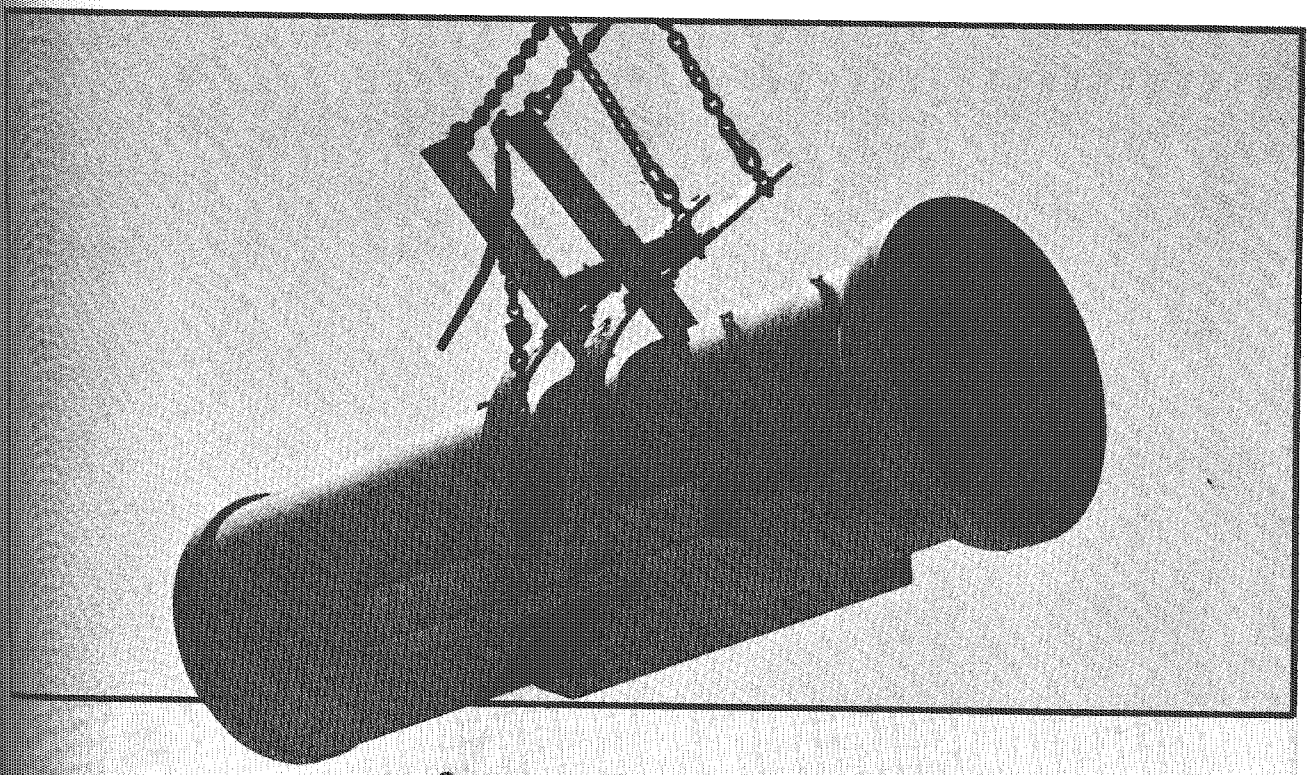


suburbs or the country. "We want to show that earth-sheltered housing has urban applications as well," said [illegible].

Owners are moving into their homes now. Earth homes are open to continue to be open to the public Saturday and Sunday from 1-5 p.m. until all the units have been sold. Visitors are welcome.



Terri Levy, a journalism major at the University, contributes regularly to Minnesota Techno[illegible]



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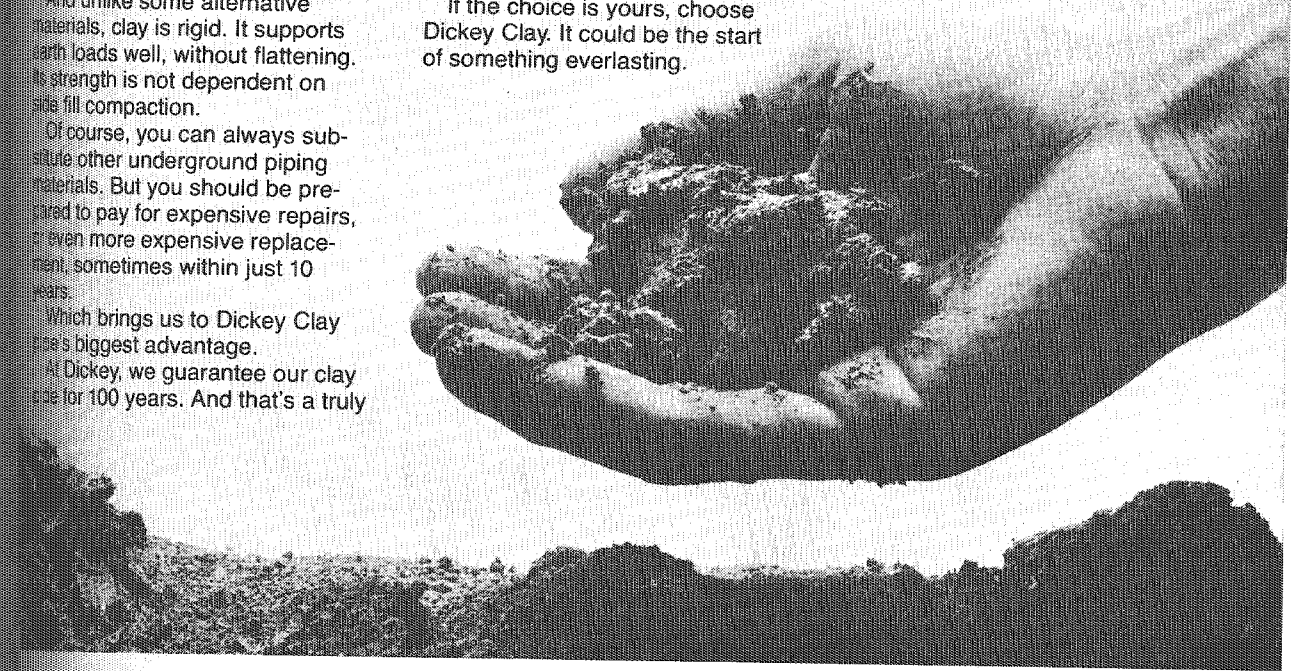
Dickey Clay.



SYNFUEL
KEEPING U

by Renee Valois

How will the Minnesotan of 1990 fuel his car and heat his house? Oil prices seem to be rising every day—even when oil is available.

Spiraling costs and the summer's long gas lines prompted President Carter to outline a new energy plan which calls for the development of "America's own alternative sources of fuel." About two-thirds of the $140 billion allocated are earmarked for the development of "synthetic fuels." So, if Mr. Carter has his way, the future Minnesotan will be driving a car run not on natural gas, but on one of the "synthetic fuels."

"Synthetic fuels," as defined by the Administration, include both the liquids and gases that can be derived from coal, as well as the alcohol and gaseous fuels which are derived from biomass (timber, animal and timber waste, municipal and industrial waste, sewage, sludge, oceanic and terrestrial plants, and other organic matter).

Each type of synthetic fuel has its proponents and opponents, for good reasons. Let's take a look at some of the most important forms of "synfuel" and see why.

Coal Liquefaction

Coal liquefaction is not a new process. The conversion of coal into synthetic crude oil was first achieved in 1912 by a German chemist, Friedrich Bergius. For this he was awarded the Nobel Prize in 1931. During World War II, Germany was dependent on a synfuel [illegible] which produced about 18.5 [illegible] rels a year. This fuel output pro[illegible] percent of Germany's military [illegible] gasoline as well as 68 percent [illegible] for civilian and other military [illegible] There has been speculation [illegible] Germany had not had its synfu[illegible] bilities, World War II would ne[illegible] begun.

Today, South Africa leads the [illegible] synfuel production. Because that [illegible] has no oil reserves, and has be[illegible] cotted by most of OPEC, it [illegible] Sasol (South African Coal, Oil [illegible] Corporation) provides almost [illegible] of the oil South Africa needs [illegible] plant. More plants are being bu[illegible]

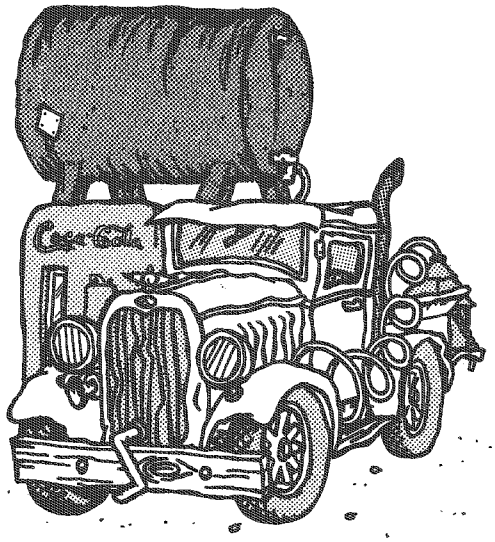
But what is America doing?

There are five rival coal liqu[illegible] processes being developed in the [illegible] States today. Two, the Mobil O[illegible] South African methods, use [illegible] liquefaction. These methods are [illegible] on the Fischer-Tropsch proces[illegible] veloped in the 1920's. Coal is tur[illegible] a gas which is then converted to [illegible]

The other three methods be[illegible] oped by Exxon, Gulf, and Dy[illegible] are direct coal liquefaction [illegible] These methods are similar to the [illegible] Bergius process, the main [illegible] being that each company uses [illegible] patented solvent to dissolve the [illegible]

In the Bergius process, coal [illegible] ground into a powder and mix[illegible] natural or synthetic oil. This [illegible] mixture, or slurry, is pumped [illegible] vat (a paste pump) into a reac[illegible] the coal liquefaction takes plac[illegible] lyst is used to transform [illegible] molecular structure. (Molybde[illegible] tungsten sulfide were used as [illegible] by the Germans.) Coal is [illegible]

IGUS IN FUEL



d fuel hydrocarbons through the tion of hydrogen into the reactor. peratures of 400 degrees Celsius pressures of 6,000 to 7,000 pounds square inch are applied within the r which, along with the catalyst, the coal to break down into a This liquid is synthetic crude oil, can be refined much as is natural

ful components of the syncrude removed through distillation. The from the distillation is made to with hydrogen. The resultant liquid blended (like natural petroleum) octane levels. The synfuel is now to be used in an automobile or

iquefaction may seem easy, but problems. Estimates of the cost of barrel of synfuel run from $25 The cost of a barrel of natural is about $20. Still, if the cost eum keeps rising (as seems likeel will someday be economicalce. But the government wants eveloped now. A few test plants built, but few companies are is building a large plant.

problem is that coal reserves so coal liquefaction as a obtaining fuel is also limited, has been estimated that ore oil contained in coal right all of the OPEC countries.

the worst problem with coal is pollution. Scientists are the government that more dioxide is released in the comsynfuels than from burning are afraid that an increase in carbon dioxide could warm the world by 2 to 3 degrees people, such as Frank Carter's science advisor, agree that carbon dioxide would increase, and have a warming effect, but that the effect might be small or even beneficial.

But carbon dioxide is not the only pollutant released in the liquefaction process. Strong cancer-causing hydrocarbons, including 3,4-benzo(a)pyrene (first noted to cause cancer in chimney sweeps in 1933) are produced. Coal dust, sulphur dioxide, nitrogen oxides, and carbon monoxide are also emitted. Large amounts of water are needed for cooling, and some toxic chemicals appear in the waste water. Toxic ash must be carefully disposed of. Liquified coal is perhaps not as good a solution to the gas shortage as it first appears to be.

Gasohol et al

Alcohol fuels are another alternative to petroleum. Two of the most important alcohol fuels are ethyl alcohol (ethanol) and methyl alcohol (methanol). The first is derived from starch or sugar products such as grains, distressed (wet, mouldy) grains, or food processing wastes. The second is derived from cellulose materials, including crop residues, timber wastes, and special energy crops, like cattails. Two slightly different processes are used to produce these alcohols.

The most popular form of alcohol fuel today—gasohol— is actually made up of 90 percent gasoline, and 10 percent alcohol. This fuel mixture can be safely used in any automobile engine. Tests have shown that higher mileages may be obtained by using gasohol instead of gasoline. Gasohol also is high-octane fuel. Race cars frequently run on pure methanol.

Brazil leads the world in gasohol production. Gasohol made from sugar cane surplus and manioc is widely used in a 20-percent alcohol, 80-percent gasoline mixture. Brazil plans to fill 20 percent of its automobile fuel requirements with gasohol in the next few years. Millions of gallons of gasohol have been sold in the United States, but this is only a very small fraction of total gasoline sales. **(Editor's note:** Olivia, Minnesota was the first locality to sell gasohol for public consumption.)

One of the advantages of alcohol fuels is that almost any organic material can be made into alcohol. Substances high in carbohydrates, such as grains, are first converted to glucose, which is next broken down into simpler organic compounds through yeast fermentation. The resultant mixture then yields ethanol by distillation.

High-protein materials are by-products of this method when used for methanol production. Called distiller's dried grains plus solubles (DDGS), they can be used as animal feed, and may be suitable for human consumption as well. Further research is being carried into this possibility.

Cellulose materials, such as cattails, milkweed, crop residues, and forest product wastes, can also be converted into glucose, and then alcohol. But cellulose materials are harder to break down into glucose than carbohydrate materials; the right enzymes are rare.

In the acid hydrolysis method, milled cellulose is soaked in a strong sulfuric acid solution for several hours, while the temperature is raised. Between 35 to 50 percent of the cellulose is broken down into glucose by this method. After the acid is neutralized or removed, the glucose can be fermented like the glucose obtained from carbohydrate materials.

An advantage of this methanol-producing process is that not only DDGS,

but fertilizers may be obtained from its residues. This process is not as energy-efficient as the ethanol process. However, the *Trichoderma viride* fungus has a cellulose enzyme that is currently being studied. The use of this enzyme may increase glucose yields, and hence fuel output, in just a few years.

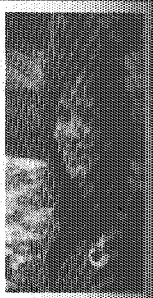
There are several advantages to using alcohol as a fuel. The technology to convert sugar and starch materials into alcohol already exists, and alcohol is a renewable energy source.

But opponents say that more energy may be consumed in the production of alcohol than is actually produced. Others are afraid that grain which should be used to feed starving people will be used instead to fuel cars.

It is uncertain whether fuel alcohol will be as important a solution to the energy shortage as its proponents argue, or as useless or immoral as its opponents claim. Only the future will decide.

Another process known as "bioconversion" may not only provide an energy source, but dispose of garbage as well. In bioconversion, biomass can be burned to produce heat, steam, and electric power. Another method of bioconversion uses bacteria, which consumes treated biomass and generates methane gas. If the solid wastes from every American were processed, the energy produced would be equal to 225 million barrels of oil per year, which is almost a full month's quantity of imported petroleum.

So it seems that there is no end to the possible future sources of synthetic fuel. No doubt fuels we haven't thought of yet will provide energy in the far future. But for the Minnesotan of 1990, synthetic fuels will be more conventional [illegible] car may run on alcohol or synthet[illegible] while his house may be fueled by m[illegible] ane. We'll see. . .



Renee Valois is a senior in English and theatre at the University. She has a strong interest and background in science.

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ople join TI for love of technol- They stay for a lot of reasons. ere are no artificial barriers to nitiative at Texas Instruments. erybody's on a first-name even up to the president of ompany.

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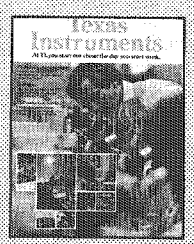

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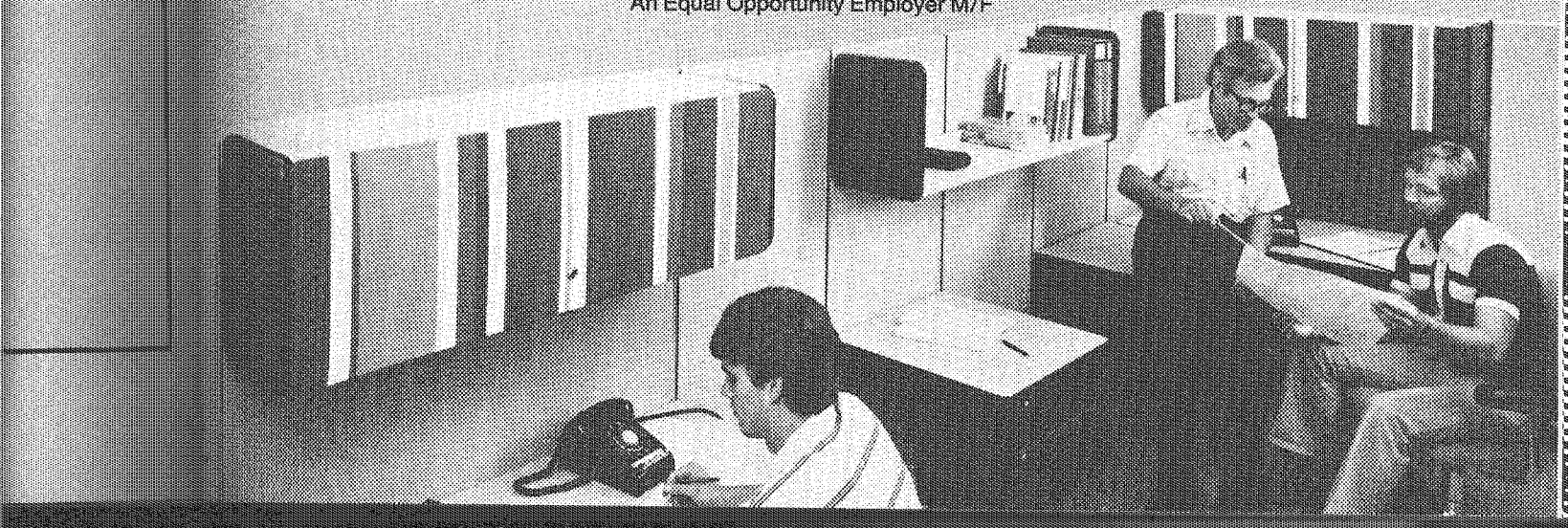

Winter Quarter Recruiting Schedule

Representatives from the following companies will be on campus for interviews on the dates specified. For a list of other interview dates contact the Placement office, 373-2922.

Monday, January 7
Edwin Cooper, Inc.

Tuesday, January 8
▪ Anheuser-Busch Inc.
Micro Control Co.
Stone & Webster Engineering Corp.

Friday, January 11
E-Systems/ECI Div.
Westinghouse Electric Corp.

Monday, January 14
Burlington Northern, Inc.
Hercules Inc.
Hewlett-Packard Co.
Paper Converting Machine Co.
United States Navy

Tuesday, January 15
American Can Co.
Hewlett-Packard Co. (2nd Day)
Oscar Mayer & Co.
Sta-Rite Industries, Inc.
York Div./Borg-Warner Corp.

Wednesday, January 16
Dana Corp./Industrial Group
Dresser Industries
Geo. A. Hormel & Co.
Standard Oil Co.

Standard Oil Co. (Indiana)
Texas Instruments Inc.

Thursday, January 17
Abbott Laboratories
National Semiconductor Corp. (CA)
Rexnord Inc.
Standard Oil Co. (Indiana) (2nd Day)
▪ Texas Instruments, Inc. (2nd Day)
Union Oil Co. of California

Friday, January 18
Analog Devices/Semiconductor
Cargill Inc./Process Equip. Group
Cooperative Power Association
Mobil Oil Corp.
Northern States Power Co. (MN)

Monday, January 21
Graco Inc.
Intel Corp.
Miller Brewing Inc.
Ottertail Power Co.
Storage Technology Corp.

Tuesday, January 22
Atlantic Richfield Co.
Brunswick Corp.
Chicago & North Western Transportation Co.
Kimberly-Clark Corp.
Intel Corp. (2nd Day)
Schlumberger Well Services

Wednesday, January 23
Allen-Bradley Co.
Beloit Corp.
Burroughs Corp.
Control Data Corp.
Gard Inc.
Onan Corp.
Penzoil Oil Co.
Pillsbury Co. (R&D)

Thursday, January 24
Chevron Companies
Control Data Corp. (2nd Day)
Cray Research
Diamond Shamrock Corp.
E.F. Johnson Co.
National Steel Corp.
Nekoosa Papers Inc.
Pillsbury Co. (R&D) (2nd Day)
Soil Testing Services of Minnesota, Inc.

Friday, January 25
Chevron Companies (2nd Day)
Gould Inc.
Litton Guidance & Control Systems
Scientific Atlanta Inc.
Sperry Flight Systems
Warner Electric Brake & Clutch Co.

Monday, January 28
R.W. Beck & Associates
Carrier Corp.
General Mills, Inc. (Corporate)
Northern State Power (WI)

Tuesday, January 29
General Dynamics Corp.
IBM Corp.

Wednesday, January 30
Bucyrus-Erie Co.
Electro-Craft Corp.
General Dynamics Corp. (2nd Day)
Northern Indiana Public Service Co.
Northwestern Bell Telephone Co.
Philips Industries, Inc.
RTE Corp.
Wisconsin Public Service Corp.

Thursday, January 31
Corps of Engineers/St. Paul District
Data General Corp.
Fisher Controls Co.
▪ Eastman Kodak Co.
Northwestern Bell Telephone Co. (2nd Day)
Ohio Medical Products
Procter & Gamble Co.

Friday, February 1
Corps of Engineers (2nd Day)
Fisher Controls Co. (2nd Day)
FMC Corp.Packaging Machinery Div.
Al Johnson Construction Co.
▪ Eastman Kodak Company (2nd Day)
Procter & Gamble Co. (2nd Day)
Sargent & Lundy

Monday, February 4
▪ E.I. du Pont
FMC Corp. Northern Ordnance Div.
3M Co.
Motorola Inc.
Rosemount Inc.
Trane Co.
Wisconsin Natural Gas Co.

Tuesday, February 5
Deere & Co.
Federal Highway Administration
International Harvester Co.
3M Co. (2nd Day)
Modine Manufacturing Co.
Motorola Inc. (2nd Day)
Trane Co. (2nd Day)
Wisconsin Electric Power Co.

Wednesday, February 6
Deere & Co. (2nd Day)
Detroit Edison Co.
Employers Insurance of Wausau
Ford Motor Co.
Interstate Power co.
3M Co. (3rd Day)
Outboard Marine Corp.
Trane Co. (3rd Day)

Thursday, February 7
Conwed Corp.
Ford Motor Co. (2nd Day)
Honeywell Inc.
S.C. Johnson & Son/Johnson's Wax
3M Company (4th Day)
Trane Co. (4th Day)

Friday, February 8
Central & South West Services
Conwed Corp. (2nd Day)
Daniel Construction Co.
Honeywell Inc. (2nd Day)
S.C. Johnson & Son (Summer) (2nd Day)
3M Co. (5th Day) Minnesota Power &
Trane Co. (5th Day)

Monday, February 11
▪ General Electric Co.
McDonnell Douglas Corp.
Minnesota Valley Engineering
Sperry Univac (Roseville)
United States Steel Corp.

Tuesday, February 12
Conoco Inc.
Consolidation Coal Co.
Exxon Corp. & U.S.A. Affiliates
General Electric Co. (2nd Day)
McDonnell Douglas Corp. (2nd Day)
Sperry Univac (Roseville) (2nd Day)
Wisconsin Power & Light Co.

Wednesday, February 13
Brown Boveri Turbomachinery, Inc.
Exxon Corp. & U.S.A. Affiliates (2nd Day)
Harris Corp.
Sperry Univac (Roseville) (3rd Day)
Vought Corp.
Whirlpool Corp.

Thursday, February 14
Cutler-Hammer Inc.
Exxon Corp. 7 u.s.a. Affiliates (3rd Day)
Factory Mutual Engineering
Parker-Hannifin Corp.
Procter & Gamble (International Div.)
Shell Companies
Union Carbide Corp.

Friday, February 15
Exxon Corp. & U.S.A. Affiliates (If
Inland Steel Co.
Northern States Power CO. (MN) (2nd
Shell Companies (2nd Day)
Union Carbide Corp. (2nd Day)

Tuesday, February 19
American Hospital Supply Corp.
Archer Daniels Midland Co.
Cleveland-Cliffs Iron Co.
Corning Glass Works
Eaton Corp.
Dairyland Power Cooperative
Johnson Controls Inc.
Naval Weapons Center

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"Scientific Method"

Three scientists were asked to determine the veracity of the statement "all odd numbers are prime."

The Physicist: "Well, let's see. . .three is an odd number, and that's prime, too. . .five is odd, and that's prime, too. . .seven. . .nine is —no, wait a minute, nine isn't prime. . .hmm. . .eleven is prime. . .thirteen is prime. . .

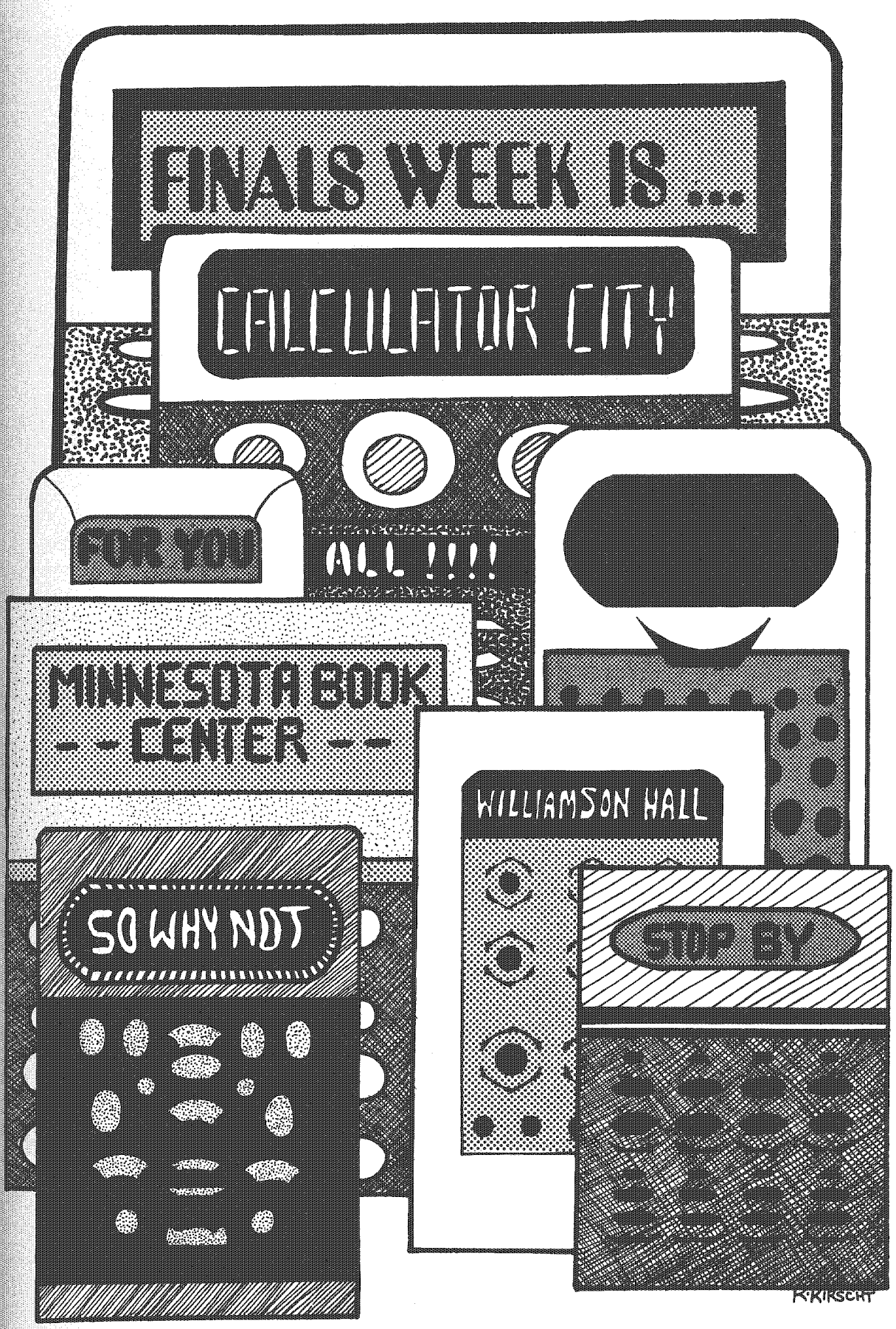
"I can hereby state that all odd numbers are prime; nine was an experimental error."

The Chemist: "Hmm. . .three is odd and prime. . .five is odd and prime. . .seven is odd and prime. . .

"That should be enough data to prove beyond a doubt that all odd numbers are indeed prime."

The Engineer: "Um. . .wait a second, I'll get my calculator. . .Uh, three is prime. . .five is prime. . .seven is prime. . .nine is prime. . .eleven is prime. . .

Acknowledgements to the Chicago Museum of Science and Industry



MINNESOTA BOOK CENTER
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Energy and America:

EDITORIAL

Convention vs. Change

An editorial opinion
by Mary Daly

A family in Canada cut their fuel consumption by two-thirds, using cold river water as their primary source of heat energy. (A glycol refrigerant system chills the water even further and draws off eight degrees Fahrenheit of heat for home use.)

The Honeywell corporation has developed energy saving devices that could cut the amount of oil imported by 73%, if used on a large-scale basis.

Many researchers in the field of energy have stated that the possibility of synthetic fuels could become a reality by 1990, provided research isn't hampered by a lack of funds.

So why aren't there more federally-funded programs to develop these projects and others like them?

Politics play a major role in this energy standstill. Governmental officials, Congress in particular, are not as interested in satisfying the long-term energy needs of the country as they are in satisfying the short-term needs of special interest groups and other political manipulators. The problem these groups most concern themselves with today is the cost and availability of gasoline and heating fuel, with little concern about the availability of these fuels in the future. Price controls on gasoline could keep prices down; a greater emphasis on mass transit could cut fuel consumption slightly; but these measures would only prolong the inevitable death of oil. It is apparent that new fuels must be developed, and, as stated before, these could play a significant role in our society by 1990. Although ten years is a relatively short period of time to change a lifestyle, it is a long time for anyone who wishes to continue to hold a political office. If the American public can't see the results of energy legislation right away, it is unlikely that they will be supportive of such legislation, therefore making Congress wary of passing long-term energy bills.

An example of the Government's need to satisfy the public is seen in the Federal Government's subsidizing of Amtrak. In order to make trains more financially attainable to the public, the Federal Government developed a program where they would pay a part of each fare. It was soon discovered that on some trains the government was paying more towards the cost of each ticket than the entire cost of an airline ticket for the same route. Train transportation is not as fuel-efficient as buses or airlines (which are not subsidized), and their ridership accounts for an extremely small percentage of public transportation; but the American people love trains, so the Federal Government decided to keep them alive.

Also, because so many special-interest groups are represented in Congress (rather than the American public), the ability of Congress to pass any type of legislation is all but totally ineffective. Last June the House did pass an energy bill providing subsidies for synthetic fuels, but only after two years of debate, and in the wake of the current gasoline shortage. Even then, the amount was considerably less than originally hoped for.

It is apparent that solutions to the energy problem must materialize faster. President Carter has proposed the development of an Energy Mobilization Board, which would be primarily responsible for allocating funds for energy development. These funds would come from a 50 percent tax on the windfall profits of oil companies. If the board was allowed total control of these funds it is less likely that they would be tied up in red tape, and since they would be allocated by persons with experience in the energy field, it is more likely that they would be put to the best possible use. Politics would not play as great a role, since officials would be appointed rather than elected.

Unfortunately, whether or not the board materializes will ultimately be up to Congress, so its chances of passing without compromise in the near future are very slim.

Mary Daly is a mechanical engineering major at IT.

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BIZARRE ENERGY SCHEMES

by Dan Freeborn

Eighty-seven beer cans, peanuts, grass, and ice.

What sounds like the necessary elements for a highly self-indulgent weekend are actually components of various alternative energy schemes. Whimsical as it seems, these items have been either tested for, or actually applied in energy producing or storing applications.

Beer Can Solar Collector

Eighty-seven beer cans are the principal collectors of solar heat energy in a forced-air heater which supplements the conventional home furnace. The cans are cut in half lengthwise, painted flat black inside, arranged concave-side-out in rows and suspended on fishline and wire within a four-by-eight-foot open plywood box. The front of this box is covered with glass and sealed so the air trapped within cannot escape. An air intake duct in the back of the box channels air from the house into the box, and a small blower in the exhaust duct forces the heated air into the dwelling. The box is placed against the house at a sixty-degree angle (this angle varies with the location of the house within the continental United States and the angle of the winter sun); the area between the back of the box and the side of the building is then closed with plywood.

Although designer A. Lebens specifies aluminum beer cans for the collectors, he makes no mention as to how the cans should be obtained, and certainly more enjoyably, how they should be drained. This is a very appealing project from nearly every aspect.

Peanut Power

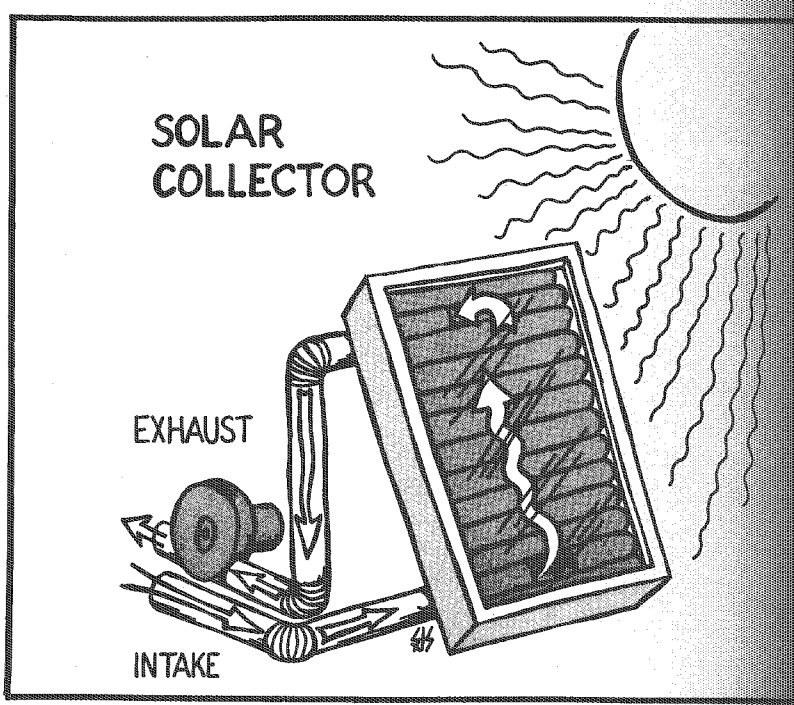
As peanuts make a fine side dish to a main course of beer, they also work well in solar energy collecting applications. According to the American Society of Agricultural Engineers, test results show that peanuts have a relative solar-collecting efficiency of 80 percent or better when compared to flat black paint. Corn, beans, and white rice were also tested as a part of a study on solar power drying systems. Of all the crops tested, peanuts ranked highest.

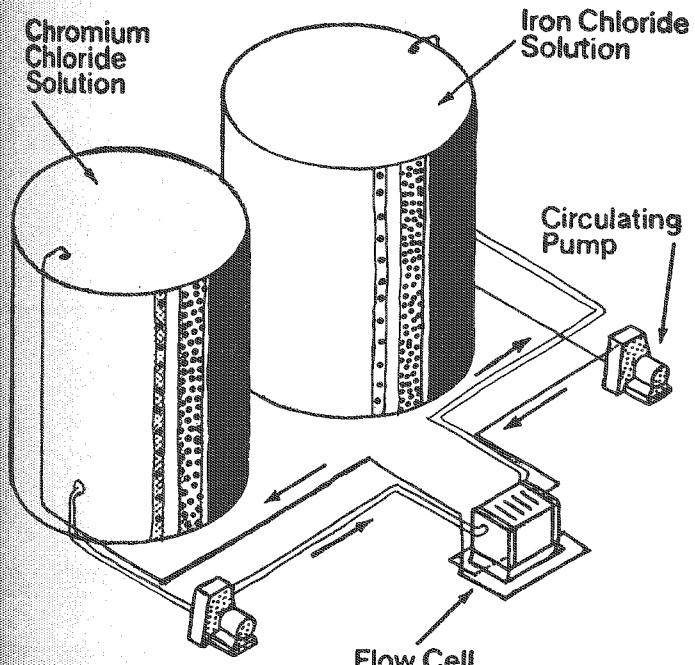
Grassohol?

The Institute of Gas Technology is currently studying a method to [illegible] from grass. Bermuda grass [illegible] through an anaerobic digest[illegible] duce methane. Because [illegible] harvested more than once a [illegible] quickly reestablishes itself [illegible] ing, its advantages are [illegible] According to the Institute, [illegible] duces as much methane [illegible] sources, most notably sewage [illegible] Besides being more appealing [illegible] and nose than sewage sludge, [illegible] yield can be increased dramat[illegible] simple treatment with nitrog[illegible]

Snow Job

The Argonne National Lab[illegible]





NASA's Redox System

...n for cooling dwellings during ...er by using large underground ...l ice. According to the plan, heat ...ding to a large buried storage ...e exposed to winter air, causing ...rm at the bottom of the water ...hen enough ice forms on the ...tending into the tank, the ice ...would break off and float to the ...tank. Over the winter, the tank ...ll with ice. In summer, the ice ...used to cool a home by pump... from the tank to a cooling ... the house.

...heat pipes allow heat to travel ...e direction, and since there is ...ation of heat, water in a well-... tank stays cold all summer, ...constant cooling.

...ealing Brrreakthrough

...nother cold water scheme, icy ... used to heat a dwelling rather ...l. The system is currently in ...ome along the Rideau River in ... Canada. It uses 350 feet of copper tubing placed at the river bottom to act as a heat exchanger. Glycol antifreeze runs through the tubing and leads to a glycol-refrigerant heat exchanger inside the house. There, eight degrees of heat is drawn off, and the cooled glycol is circulated back to the river.

In the winter, the river bottom temperature is about 42 degrees Fahrenheit, while the glycol is about 28 degrees when it reaches the heat exchanger. It's returned to the house at about 37 degrees. The house is kept at 72 degrees Fahrenheit with no night setback.

Glycol can work in temperature colder than that found in water, so freeze-up is not a problem. Also, because the system is sealed, there is little chance for water to enter the line and cause problems.

System owner, Bob Laidley, estimates his heating bill without the system would be approximately $850. With the system, his heating bill came to $427.30 last year. He is now making plans to install solar panels on the roof and run the same glycol through them as he uses for the heat pump.

NASA's Redox System

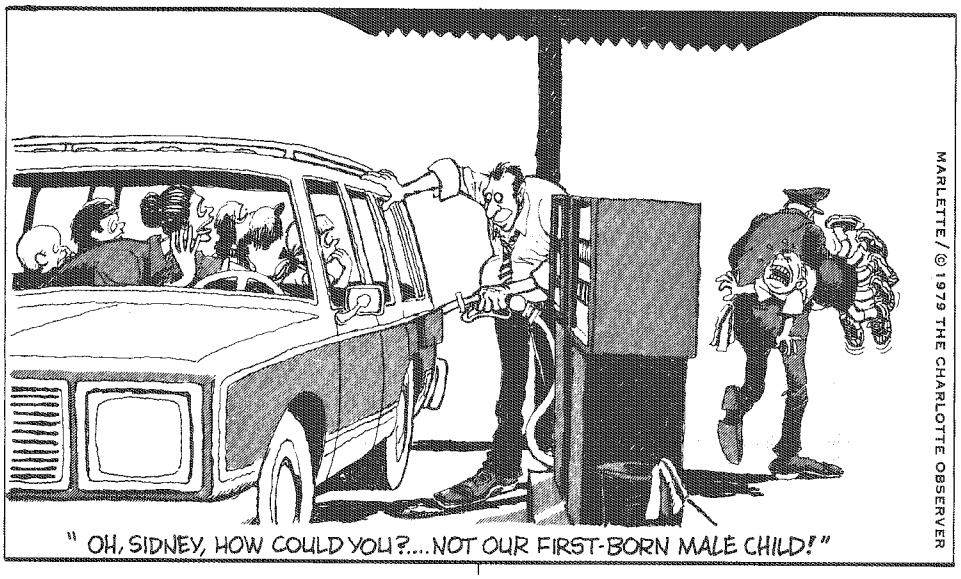
Methods for obtaining energy from alternative sources are widely varied. However, a problem common to all is the storage of that energy. NASA has recently developed a method for storing large amounts of electricity that costs about one-fourth the cost of typical lead acid battery systems, and is more reliable. The system is called Redox (for "reduction oxidation") and converts chemical energy into electrical energy.

The system works like this: solutions of chromium chloride and iron chloride are pumped through flow-cell stacks. The fluids don't touch each other, but transfer a charge through membranes as they react with their respective inert electrodes.

This storage system is ideally suited for solar and windpower electrical generators. It could also be used to level loads for utilities, storing power during off-hours for use during peak demand times. A one- to two-kilowatt test unit will be ready by next year, NASA says.

Undoubtedly more, and more bizarre, energy schemes will appear in the years to come. This is merely a small sample of those under examination by researchers, designers, and inventors.

Dan Freeborn is a senior in the science journalism sequence of the Department of Journalism and Mass Communications.



minnesota TECHNOLOG

The same magazine that brings you "The Bionic T.A." is also expanding your scientific horizons.

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You can laugh. You can think. You can learn. Because we at **Minnesota Technolog** bring you technology as it is today—and as it may be tomorrow. The controversy, the crisis, the innovation, the humor. Because in a matter of years you're going to be part of it all.

You may even have one of us in your classes. Denny Sullivan is our editor-in-chief. Besides being over-all policy-maker and overseer of the magazine's format and advertising, Denny is especially committed to the professional quality of **Technolog**—making it and keeping it a magazine you will be proud to read. Look for Denny in your journalism or chem engineering classes.

Steve Deyo is **Technolog**'s associate editor. Steve works with the writers. They may have a story idea they want to develop themselves, or they are given an assignment in a field of their strenth. Steve is making **Technolog** a magazine you'll be glad to have read. He's also pullikng together a wide range of writers to give as many IT students as possible the valuable career experience of writing for a technological publication. Writers are needed, and writers are paid—so if you don't have Steve in one of your classes, look him up. And if you don't think you're a good writer because you're not an English major, don't worry. Correcting spelling and punctuation is **his** job.

Our photo editor is Mike Dorn. He's the fellow with the self-designed blaster. (This is true!) He needs photographers, and he'll get them one way or another. Also, we are still looking for art production people. So if you can draw or take pictures, and would like to earn extra money, stop in or call.

minnesota TECHNOLOG

FINANCIAL AID EACH YEAR

AD ASTRA

by Bruce Kvam

The Face of the Deep, by Jim Young, Pocket Books, 223 pp., $1.95, released Dec. 1.
Beyond the Blue Event Horizon, by Frederik Pohl, Del Rey Books, 336 pp., $9.95, to be released Feb. 18.

Getting started is the hardest thing. Whether it's on a new job, a term paper, taking out the garbage, (writing an article for *Technolog,*) asking someone for a date—the first step, goes the old saw, is always the most difficult.

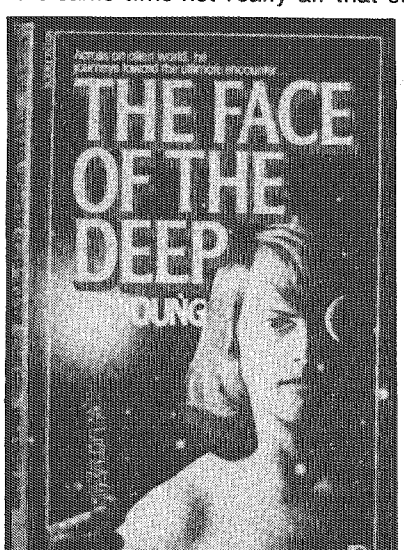
So it is with writing. As an unpublished writer you can beat your head against the editorial wall for years before achieving even minimal response; perhaps a personal rejection letter that says more than "We found your manuscript unsuitable for one or more of the following reasons. . ."

But the day that phone call or letter comes announcing that you've just sold your first story—that is a day to be never forgotten. You, the unpublished writer, enter the ranks of the professional, and, though not guaranteed success, you've got your foot in the door.

New writers are found this way all the time; it is not a totally uncommon phenomenon. But when it happens close to home, it's something special.

Jim Young was managing editor of Technolog in 1973-74. The summer of 1978, he wrote a book. Last winter David Hartwell, sf editor at Pocket Books, bought it. This winter it is being published.

It seems so simple, told that way. And yet so strange, that someone you know, have talked to, who knows you, has sold a book that you can hold in your hands and read, and there is his name, right there on the cover. It's astounding, but at the same time not really all that surprising (and it makes me jealous!).



Young's first is called *The Face of the Deep,* and it's a good book. Let me tell you about it.

Raphael O'Sullivan is a translator with the UN expedition to Bok II, the first planet mankind has found bearing intelligent life (or the second planet, if you deem *Homo Sapiens* intelligent). The cultural and technological level of the natives are on a par with that of Renaissance Europe, except for one anomaly: they have radio.

Rafe's party has two objectives in contacting the natives. The first is to warn them that their sun will soon explode. The second is to investigate an alien structure on the planet, which is obviously not local handiwork. The natives, unfortunately, do not plan to greet the alien humans, whose appearance fits the descriptions of their miscreants and monsters quite well. The contact party is attacked, Rafe is kidnapped and dragged on a journey across mountain and desert to find a radio to call his ship.

Young does a good job with the natives. They have their own beliefs and traditions, religion, customs and practices that are internally consistent. They have their own language, which Young evidently worked out in fair detail. He has fully avoided the temptation to bombard the reader with alien phrases and words on every page to enhance the "alienness," a mistake that many science fiction writers make.

The Face of the Deep is an adventure novel. It is fun, it doesn't drag, something is always happening or there is the anticipation of something happening.

There are problems with the book. There always are, with first novels. Relationships between certain characters were stereotypical. Some descriptions failed to convince. The ending seemed a little too pat to me, but it is in the spirit of

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Pictures of juniors and seniors to be taken January 7-11, 9am-3pm, in the Architecture Court.

nstitute of Technology Student Board

...e your student rights being vio-...d but you don't know how to re-...the issue? Then the Student ...s Committee (SCC) of the IT ...t Board (ITSB) can be your ... You needn't even involve ...lf in the mediation process if ...r reprisal from the instructor. ...problem, class and instructor ...n SCC at the ITSB office, 305 ...trical Engineering, or call Lee ..., SCC Chairman, at ... during the evening.

...r organization sponsoring a ...program promoting the wel-...education of IT students? ...you may qualify for ITSB's Small Grants Program. During its first year, $1,000 in IT student fees were distributed to such IT organizations as Plumb Bob, Sigma Pi Sigma (SPS), the American Society of Agricultural Engineers (ASAE), and the Student Competitions on Relevant Engineering (SCORE). Small Grant funds went towards E-Week festivities, initiation of an SPS honorary physics chapter, ASAE national convention attendance fees, and funds for construction of SCORE's energy-efficient car. (See "I.T. Auto" in the Fall I issue of *Technolog.*) Small Grant application forms and information are available from the ITSB office. To receive priority consideration for this year, applications should be submitted by Friday, January 18, 1980.

Plumb Bob and the ITSB Projects Committee are working together to make this year's E-Week the best ever. We are challenging student chapters of professional organizations to sponsor activities for their student members—specifically, demonstrations, workshops, lectures, or even some form of departmental contest (e.g., the paper airplane design contest, a toothpick structure building contest, and so on. ITSB welcomes feedback concerning activities you would like to sponsor or see happen during E-Week this spring.

Before you buy your textbooks for next quarter, be sure to check the ITSB Book Exchange Board outside room 5 Lind Hall. You just might find your books at bargain prices.

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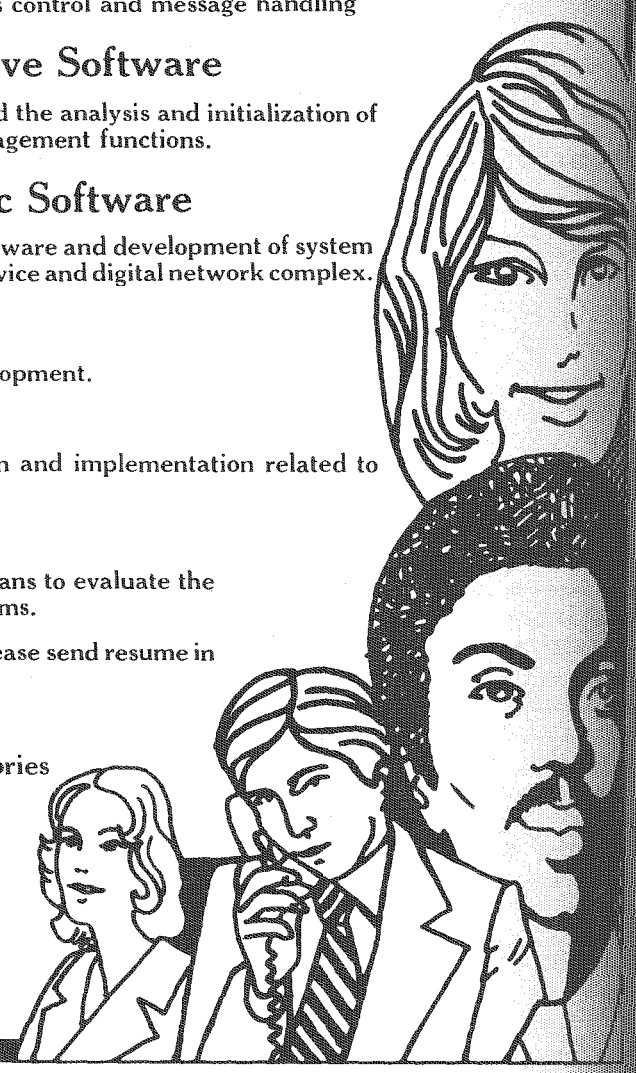


...the book. (Reviewers frequently ... such cryptic comments, but if ... to explain them, it would ruin ... for you!) But not everything ... believe. Some live, some die. ... always the evil ones who lose the ...

...face of the Deep is a local success ... around. The cover painting is by ...edge, the St. Paul artist who did ...*chnolog* cover illustrating *Ring-* ... the Spring I 1978 issue. It is ... first bookcover sales.

...face of the Deep is a good leg to ... Hopefully we'll see more from ... the future.

...gratulations, Jim, and good luck!

...a brand new author, we turn to ...and in the field.

...Pohl has been doing a lot of writ- ...ly, now that he's gotten all those ...duties off his shoulders. In the ...ur years he's written the same ...r of books: *Man Plus, Gateway,* ...d his newest, *Beyond the Blue* ...*orizon,* to be published by Del ...ks this coming February.

...a lot of writing, but the quality ...tput has been consistently high, ...*n Plus* taking a Nebula and *Gate-* ...ugo. *Jem* isn't up the awards ...gh it is expected to be a top con-

...found Pohl's work to be good, ...s disturbing qualities in it. The ...re always set in very negative ...s, with grimy surrounds and ...ople. All of which is true to ...but it grates on the nerves after a ...

...*the Blue Event Horizon* ...rth referred to as *BBEH)* is ... It is set in exactly the same ...e as *Gateway,* but the tone is ...y different, somehow. There is ...versity, but the bad taste that ... in my mouth reading Pohl's ...nt work just wasn't there.

...gh it is a sequel to *Gateway,* ...n stand on its own. It starts off ... characters, reintroduces the ...pts and characters in a non- ...y, and brings in new ideas as ...

...gan with the Heechee.

...Heechee were a space-faring ...could travel between stars in a ... days. A million years ago they ...st network of shipping lanes ...e galaxy. And then they van- ...l like that.

...mankind finally dawdled into ...found the remains of Heechee technology on Venus, then an asteroid (Gateway) that was really a spaceport, with which hundreds of Heechee ships were docked. The clincher was that all this stuff still worked. Mankind could have the stars.

Except it wasn't all that easy. Sure, people could get into Heechee ships, take off and get rich off the Heechee treasures found at the star at the other end. But they couldn't pick *which* star. Flying a Heechee ship out of Gateway was like Russian Roulette.

In *Gateway,* Robinette Broadhead played the game three times. The third time he thought he won, at least his bank account said so, but he had lost something else. . .

In *Beyond the Blue Event Horizon,* Broadhead has used the profits from his third mission to finance a normal-space expedition to the Oort comet cloud, where the semi-mythical CHON-food factory is suspected to be. Broadhead wants the food factory to help feed an ever-starving world, as well as fatten his wallet.

But it would be a deserted hulk, like all the other Heechee relics. Broadhead hoped it would be still functional, or at least intact enough for humans to copy its design. What they found there, though, was a little more than they expected.

Stylistically, *BBEH* is very different from *Gateway. Gateway* was filled with many sidebars and flashbacks, and sometimes that made it confusing and irritating to read. *BBEH,* on the other hand, is linear. There is, however, backtracking in time, due to the different sets of characters and the fact that the cometary halo is some 5,000 AU's, or 25 light days, from Earth.

One thing I greatly appreciated about the book is that Pohl manages to squeeze a lot of science into the story—and make it live there as a relevant and vital part of it. This is especially pleasing to me, because this is the way science fiction started; trying to educate people in science, while entertaining them. That went out of style for a while, but Pohl is infusing the practice again, avoiding the pitfalls the sf writers of yore (among which Pohl should be numbered, by the way) fell into.

I found *BBEH* to be quite enjoyable. Pohl did everything with it that I like, and didn't do the things that I don't like. Except for the infernally long title. . .

Remember the *Technolog* science fiction contest! (See this issue for details.)

Jim Young didn't start at *Technolog;* winning the short-story contest was one of the steps along the way for him.

Bruce Kvam is a computer science major in IT and a regular contributor to Technolog.

> "I have found Pohl's work to be good, but it has disturbing qualities in it."

After Graduation

Sizing Up the Job Market

by Steven M. Deyo

No job is just a job.

Almost 90,000 hours of your life will be spent working. That's almost half of your waking hours from now until age 65. And, basically, your career planning and preparation now will determine whether those 90,000 hours result in fulfilling, useful service—or merely wasted time.

That's why I had you examine your skills in our last issue. Unless you make some rational judgments and informed decisions about what you do best and enjoy most, and where you can best do it while adequately supporting your family, you are going to lose the job contest by default. Not making a decision, or putting one off, is actually a decision in itself; one that can only sell you short of your potential. A little extra effort and thought now, before you commit yourself to one particular path, will reap extra long-term benefits all around—in your attitudes, in your self-concept, in your sense of responsibility and financial security, and in your place of service to the community. Don't wait like 20 to 30 percent of any given senior class does—like I did—until the month before graduation to start considering where you might work, whether your field pays enough to keep you alive, whether there is an increasing or decreasing demand for people in your specialty. At least put more time into preparing your career than you do in selecting a scientific calculator.

From this point on, I assume you have decided on your major, and thus your career field (that's why you're in IT); that you have arrived at a firm self-knowledge (i.e., your skills, strengths, abilities, and weaknesses); and that you have made some initial attempts at finding a job on graduation, or at least some part-time experience while you're here (e.g., registering at the Office for Cooperative Education and the IT Placement Office, signing up for interviews, contacting alumni and professional organizations, etc., and taking their suggestions as far as you can).

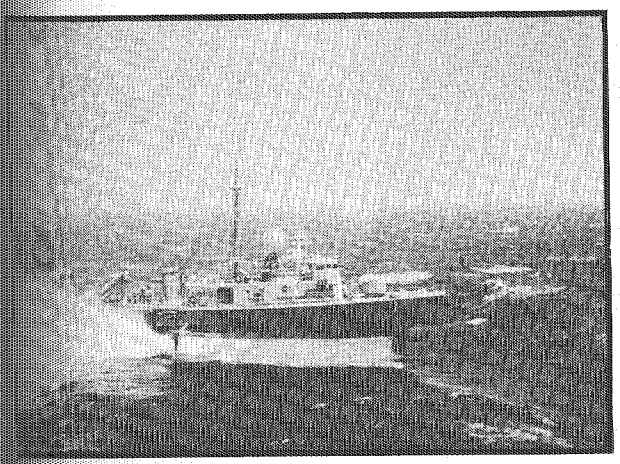
I strongly urge you, if you haven't done a number of the things suggested above, to do them. Especially the skills inventory and self-analysis given in Fall I, 1979 of *Minnesota Technolog*. And after that, study a copy of the *Dictionary of Occupational Titles (DOT)*, fourth edition. The *DOT* will help you form a good skills configuration once you have determined what your skills are. Don't read on unless you've done all this.

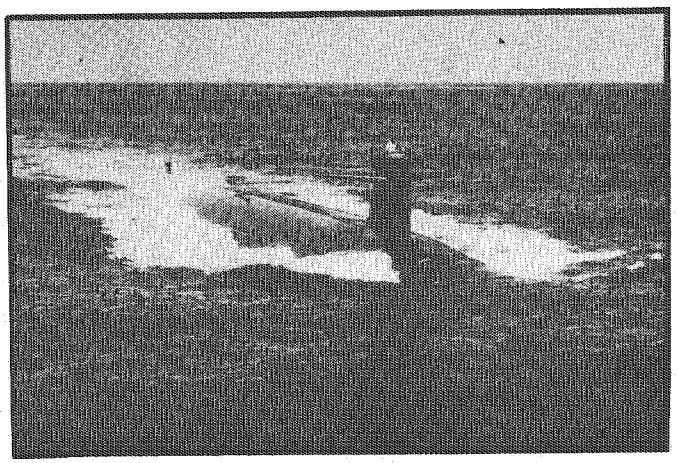
So; you're narrowing your options. Fine and good; a concentrated laser beam burns cleanly, while a diffuse one lacks intensity. (Lesson: Don't spread yourself too thin.) What you need now is flexibility. Versatility. Adapting a skills configuration that will land you a job. That may mean starting small. It may mean beginning in an overlooked aspect of the field, where job opportunities are not as competitive for the unproved beginner. It may mean thinking a bit. Being original. Using the grey matter. No problem for a college student. Right?

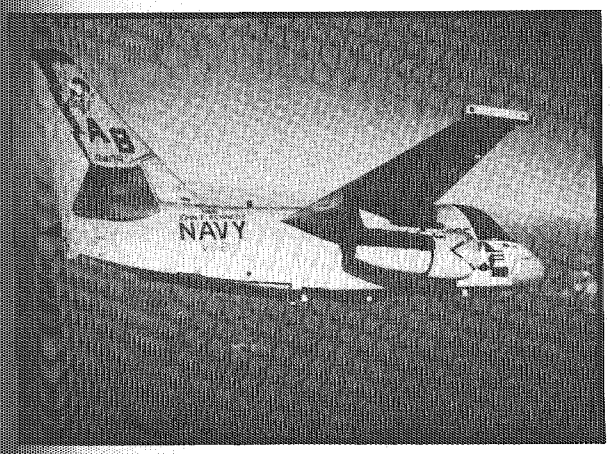
If you're in architecture, you should that the opportunities for landscape and commercial architects are stronger than those for residential architects. Or, find out if the government is opening up any new departments where you could be needed. Talk with your professors—they often have "real world" contacts—and discover where engineers are needed most, where the innovative research is being done, where the field is geoning. You're graduating from ege. Don't be set on getting exact field you're going to spend of your life in, for now. You You have the privilege to try field, that specialty, to test and prove yourself, first here The important thing for now experience.

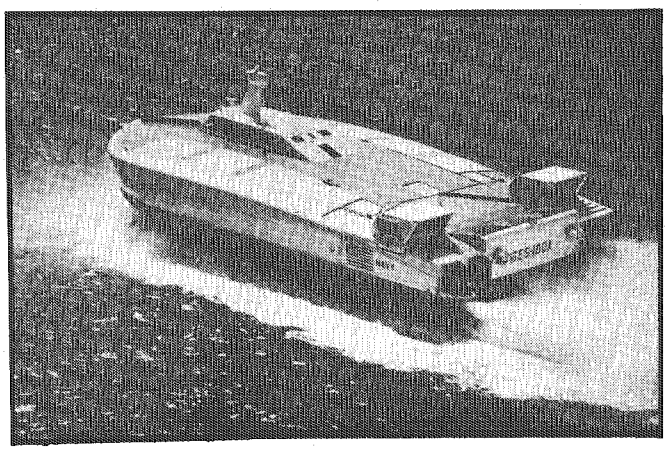
A year or so before you contact various local figures field—as "high up" as poss make an appointment to discuss developments in his specialty, responsibilities would be if working for him, and what he gest to help you accomplish you have set for yourself. Do for a job, or bring a *resume*— you dress impeccably (but not carrying an air of self-assur responsibility, who knows? certainly remember you if you contact him later, for a job might even call you if you leave phone number and express a keep in touch (on a professional course). Such men and wom discussing their work and helping graduates-to-be get off to a good in their company, if the gradua is responsible and intelligent.

The important thing is to exp self. Know yourself and let oth it. Get leads on contacts from your friends, relatives, teach visors, co-workers, your dentis neighbor, your pastor. Follo every lead you get. Either it bum steer, or bull's-eye. And f lead that comes through, get the at least one more contact per aside a handful of hours each make appointments. Look at it vestment in your future. There









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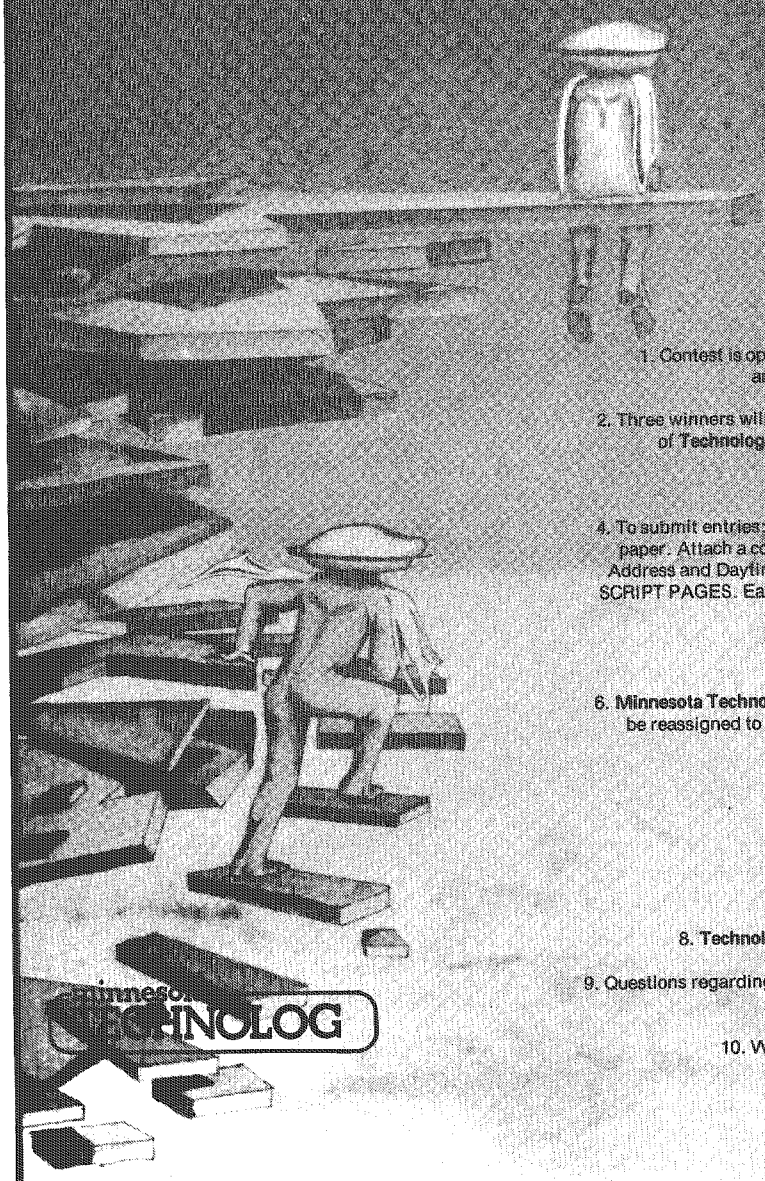
THE NAVY

Science Fiction Contest 79-80



ENTRY RULES

1. Contest is open to all U of M students registered Winter Quarter 1979. Writers must have amateur status; not have been previously published for payment [illegible].

2. Three winners will be named in February with manuscripts published in the last issue of **Technolog**. The first place will be awarded $75, second place $50 and third place [illegible].

3. Writers may submit more than [illegible].

4. To submit entries: Manuscripts must be typed, double-spaced with 1" margins on [illegible] paper. Attach a cover page on each entry submitted, including Title, Name of Author, Address and Daytime Telephone Number. DO NOT TYPE NAME OF AUTHOR ON MANUSCRIPT PAGES. Each entry must be submitted with three additional photocopies of the script. All entries must be original [illegible].

5. Entries must not exceed [illegible].

6. **Minnesota Technolog** retains first publication rights to all manuscripts. However, rights will be reassigned to authors upon request. All manuscripts will be returned after publication in Winter [illegible].

7. Deadline for entries is January 31, 1979. Send entries to:
1979 Science Fiction Writing Contest
Minnesota Technolog Magazine
Rm. 2, Mechanical Engineering Building
University of Minnesota
Minneapolis, MN 55455

8. **Technolog** and Technolog Board of Publications staff past or present [illegible].

9. Questions regarding the above rules for entry should be directed to Bruce Kvam [illegible] at the **Minnesota Technolog** [illegible].

10. Winners will be notified by mail upon completion of the judging [illegible].

...here. But being in the right place, at ...ght time is awfully difficult. Getting ...ame out isn't (relatively). And it's ...xpensive and tedious than a bulk-...*sume* mailing project. Besides, ...learning about what actually goes ...your specialty and establishing ...ble relationships with established ...leads in your field, which can only ...e good. Devote as much time to ...ch as your other commitments ...

...thout printed information, too. Get ...mailing lists. They spread. Sub-...a couple technical or trade jour-...tone, where the field is bur-...You're graduating from col-...be set on getting into the ...organizations for job and ...ch material. And no matter ...specialty, there's a govern-...partment for it. Find out who it ...write. For public employment ...write: Employment and Train-...nistration, U.S. Dept. of Labor, ...C. 20213. The *College Place-...Manual* is an invaluable compend-...corporations and contact per-...service. It is offered free of ...students of most colleges, but ...at IT. The IT Placement Office ...copy for perusal, and the library ...a copy on reserve. Hit the ...reference stacks for the *Thomas ...of American Manufacturers,* ...*Poor's Register of Corpora-...Dun & Bradstreet's Million Dollar ...Directories,* the ...*Trade Directory,* Chamber ...registers—even the *Yellow ...*pages that interest you. ...Government prints sheaves and ...material on vocational out-...look for a quire or so. Check ...books for job-search man-...and don't be afraid to shell out a few clams for an up-to-date title (they're much more practical) from your bookstore's selection. Such self-help books, however, should always be taken with a grain of salt. Don't ever follow one particular book to the letter. Read several and apply common sense together with the recommendations of Federal, State, City, County, Placement Offices, Civil Service, private, professional, or fee-paid employment service agents—and then apply it only as warranted by your circumstances. If nothing else, such books generally provide an extensive bibliography.

Several books I recommend for this phase of your job search are:

David P. Campbell, *If You Don't Know Where You're Going You'll Probably End Up Somewhere Else,* Argus, $1.95.

David Noer, *How to Beat the Employment Game,* Ten Speed Press, $4.95.

John Shingleton, *College to Career: Finding Yourself in the Job Market,* McGraw-Hill, $5.95.

Kirby W. Stanat, *Job-Hunting Secrets Tactics,* Follet, $4.95.

> "Such self-help books, however, should always be taken with a grain of salt."

Steve Deyo is a journalism graduate and associate editor of Minnesota Technolog.

Next issue: "Selling Yourself in the Job Market"


ORIGIN OF THE BIONIC T.A.
ORPHANNED AT A YOUNG AGE, OLE KNUTSON EXCELLED IN ACADEMICS, SOON OUTSTRIPPING ALL THE SCHOOLS OF EUROPE. HE DECIDED TO LEAVE HIS NATIVE SCANDANAVIA AND DO GRADUATE WORK AT THE U.
9
TECHNOLOG 1979
SEPTEMBER 1976.... OLE HAS BEEN STAYING AT HIS AUNT LENA'S IN FRIDLEY...
SMORGASBO
I TINK SO!
JA TINK YOU'LL GET DA YOB, OLE?
BYE LENA! BYE KNUT!
LATER... WELL, YOU'VE GOT A GOOD RECORD HERE, OLE; GRADUATED UNIVERSITY OF OSLO, DID RESEARCH AT THE SWEDISH SCIENCE INSTITUTE...
LIND HALL (MAIN E.)
WEEEEE!
..HOWEVER, WE DON'T HAVE A "TEACHING ASSISTANT" JOB OPEN, BUT YOU COULD SUB FOR ONE OF OUR T.A.'S WHO'S SICK TODAY.
P. FLUNCH
JA, SOUNDS GOOD...
* T.A.
BRIEFLY...
ST. PAUL CAMPUS
I'M A SUPPOSED TO TEACH A MATH CLASS ONNA DA WEST BANK!
HEY! DIS GUY LOOKS LIKE DOZE "ENGKINEARZ!"
..AN' YOU KNOWZE WUT WE DO TO "ENKINEERS" ?!!
GTTT!
AHH!
SPLAT!
WHACK!
KRUNCH!
CRASH!
CHOP!
STOP JEEVES!
YES, SIR!
HAR/HA
SPLAT!
Skreeeeee
WHAT IS IT?
ERGH!
IT IS...ER.. WAS A...(ICK!). STUDENT!
HE'S ALIVE! I'LL CALL AN AMBULANCE!
CHAUFFEUR
MOMENTS LATER...
MAYO MEMORIAL AUDITORIUM
MAYO GA AND EMERGEN ENTRAN
POST ANGEL OF MERCY
CLONG!
Plink!
Doink!
INSIDE...
WE CAN REBUILD HIM, WE HAVE THE TECHNOL... HEY!! SOMEBODY RUN OVER TO THE ENGINEERING BUILDINGS AND GET SOME BIONIC PARTS!
SSSSSSS
IN THE BASEMENT ELECTRICAL EN
WAIT! WE CAN USE THAT!
TORSION
AFTER THEY COLLECT THE NEEDED PARTS...
LEG BONE'S CONNECTED TO DA KNEE BONE... KNEE BONE'S CONNECTED TO DA THIGH BONE... THIGH BONE'S...
SCREWDRIVER! SOLDERING IRON!
BUBBLE
FOOSH!
BASH! BASH!
WHEN OLE RECOVERS...
WELL OLE, I SEE YOU'VE DISCOVERED YOUR NEW POWERS!
JA!! I YUST TRIED TO PICK UP MY PENCIL FROM UNTER DA BED AND UFF DA!
HMM
DIT-DIT-DIT
TWIP!
YOU'VE GOT A JOB NOW TOO, OLE, AS "THE BIONIC T.A."!
OLE THEN DEDICATED HIS LIFE TO THE CAUSE OF JUSTICE AND THE ADVANCEMENT OF SCIENCE.
HAVE A NICE CHRISTMAS, OKAY?

There's more to the Kodak picture than snapshots

Look closer at some of the diversity that can mean outstanding career opportunities for you. More than 30,000 products and processes carry the Kodak name, testimony to many achievements by Kodak engineers.

Our origins in photographic technology started us on a wide-ranging assortment of imaging products—from copying equipment for business systems to health-care products. Plus a completely separate array of fibers, textiles, and dyes for apparel and home furnishings. All for an extremely wide range of assignments for technically trained individuals who want to help develop, design, manufacture and market these products.

But there's more. Kodak's record as an innovator has frequently made it necessary to design unique facilities or complex production processes to make all of this progress possible. And that creates more choices for talented graduates with chemical, electrical, industrial, or mechanical engineering backgrounds. Those who prefer to help expand our stockpile of ideas might consider opportunities in research.

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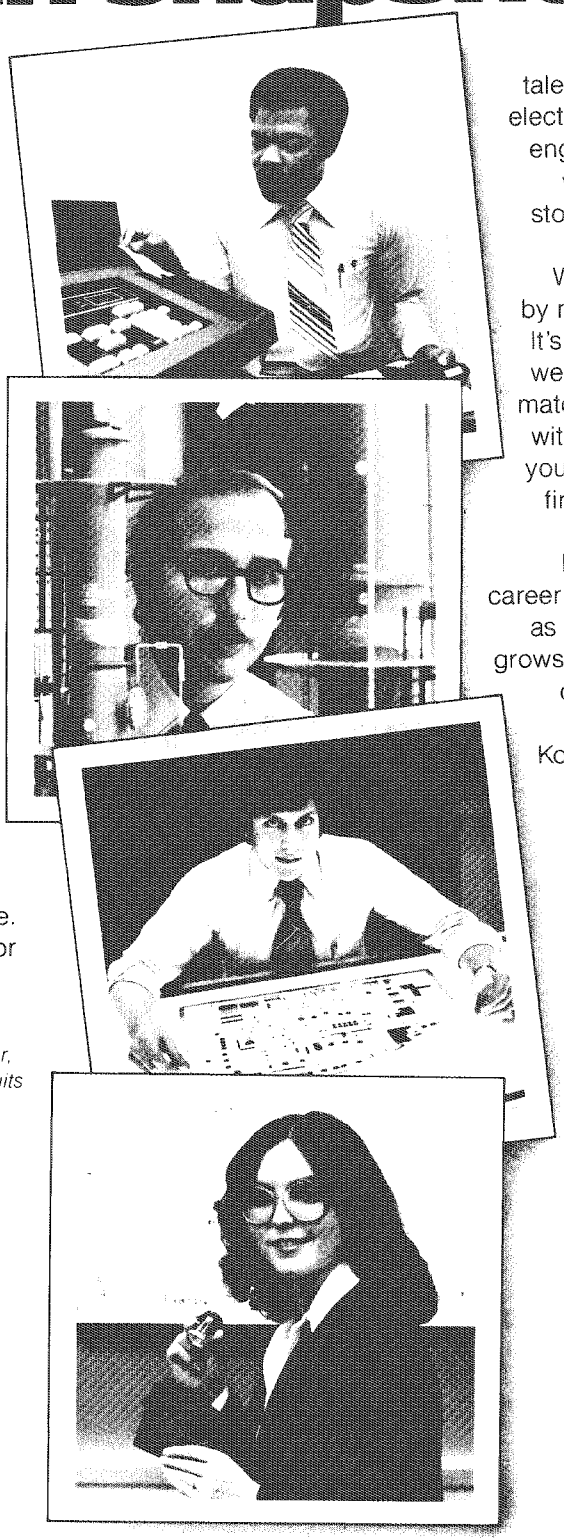
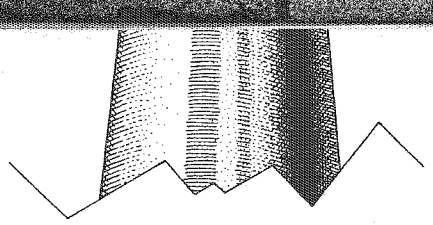
Get more information. Visit a Kodak recruiter on your campus. Or contact: Business and Technical Personnel, Eastman Kodak Company, Rochester, N.Y. 14650.



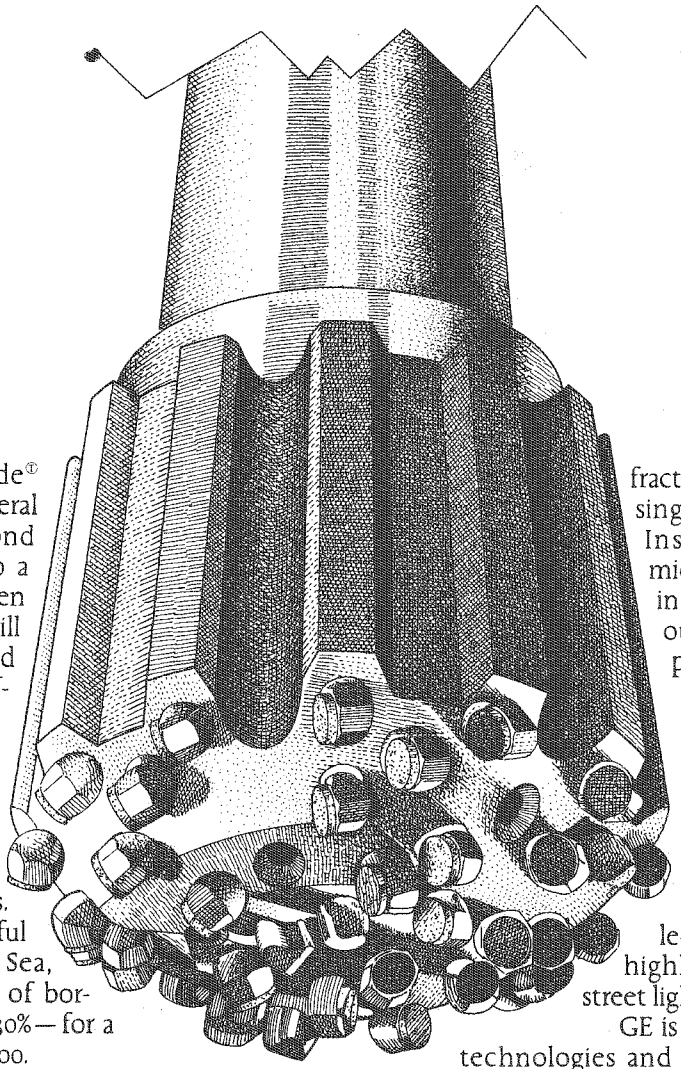
From top to bottom:
ME—development engineer, medical products. ChE—process design engineer, solvent recovery. EE—integrated circuits design engineer, consumer products. Quality control systems engineer, management services.

1880 Kodak 1980

A 100-year start on tomorrow



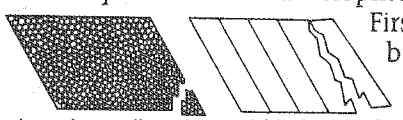
With this drill bit, GE is putting diamonds back into the earth.



The diamond is Man-Made® diamond developed by General Electric. Man-Made diamond crystals are pressed into a polycrystalline "blank." When this blank is attached to drill bits like the one pictured here, it provides a highly efficient cutting tool to probe deep into the earth.

Drill bits which include diamond blanks can as much as double the penetration rates of steel bits in drilling for oil and gas. In one of the most successful applications in the North Sea, these drill bits cut the cost of boring through shale by nearly 30%—for a total saving of close to $300,000.

Two remarkable engineering breakthroughs were required for the development of these drill bits.



The polycrystalline diamond blank microfractures because of its structure. Natural cleavage planes of mined diamond (right) cause it to break off in larger pieces.

First came the synthesis by GE of Man-Made diamond itself. Pioneering the technology of heating and pressurizing carbon established GE as a leader in superpressure science.

Then GE invented the technology which compacts the small, powdery Man-Made diamond into far larger disks (as large as 12 mm. in diameter by as much as 1 mm. thick). Since these disks are composed of many nonaligned crystals, they resist the massive destructive fracturing which occurs in single-crystal natural diamonds. Instead, these disks tend to microfracture, constantly creating new cutting edges without destroying the diamond product.

Creating new engineered materials is an important example of research in progress at GE. Recent developments include a proprietary epoxy coating that's cured by ultraviolet light. GE work in ceramics led to the Lucalox® lamp, a highly energy-efficient form of street lighting.

GE is constantly investigating new technologies and innovative applications of existing technologies—in such areas as electrical distribution systems, electronic components, environmental systems. This takes talent—engineering talent—not just in research and development, but in design and manufacturing, application and sales.

If you'd like to know more about engineering opportunities at GE, send for our careers booklet. Write: General Electric College Communications, Box 2, Fairfield, CT 06431.

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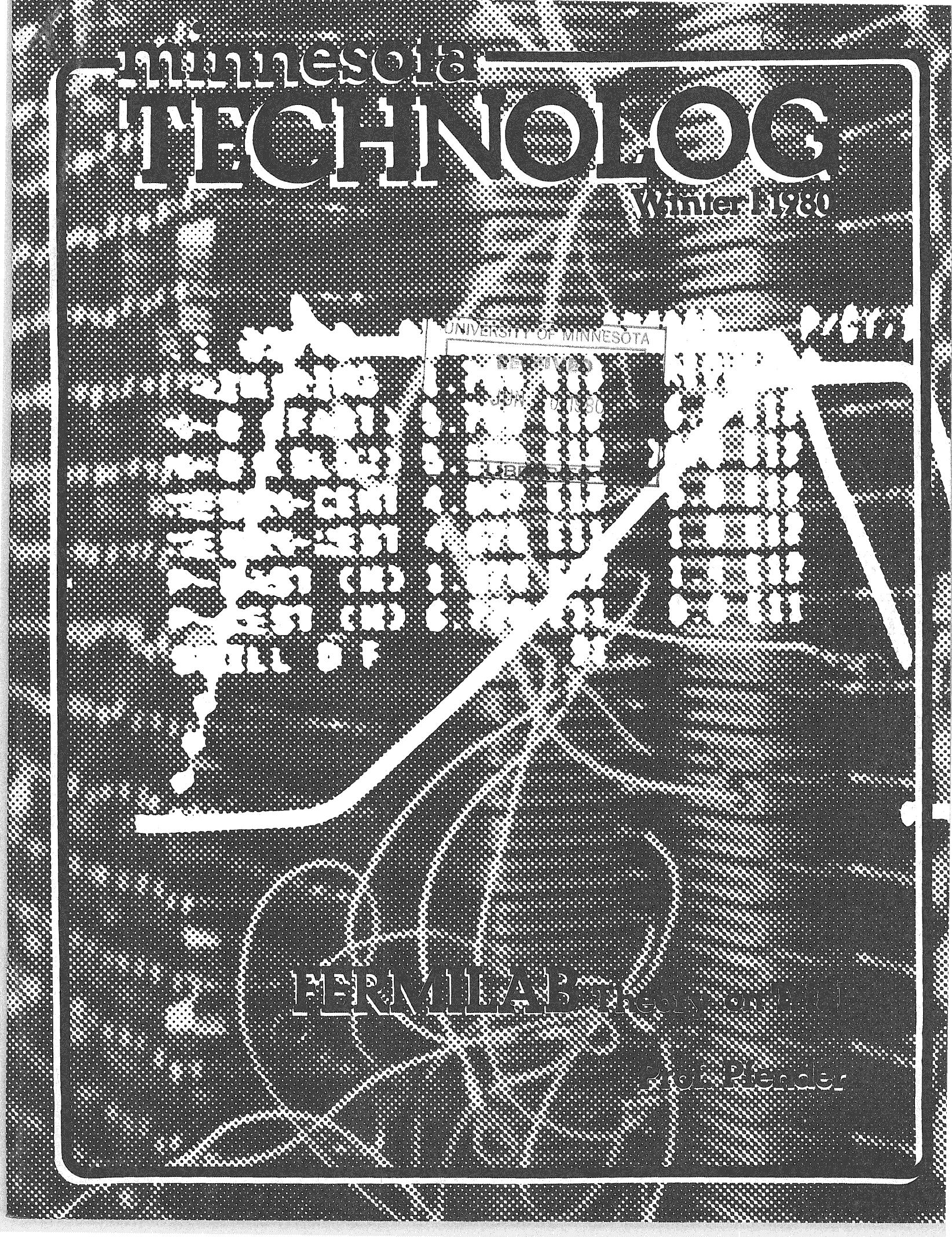
Minnesota TECHNOLOG

Winter 1980



FERMILAB

Prof. Pfender

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(Please refer to this magazine when corresponding with our office.)

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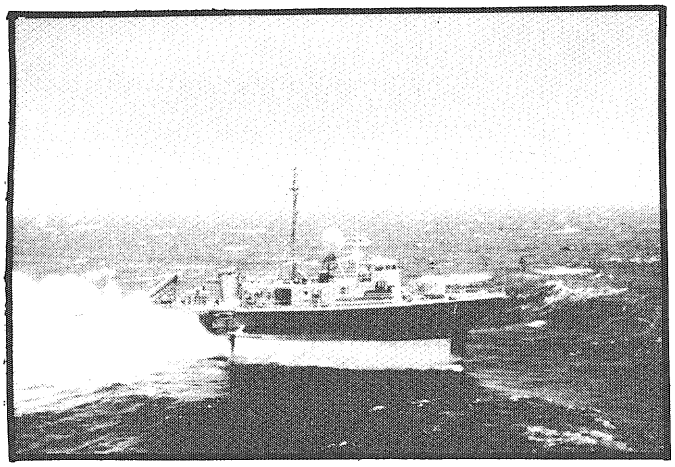

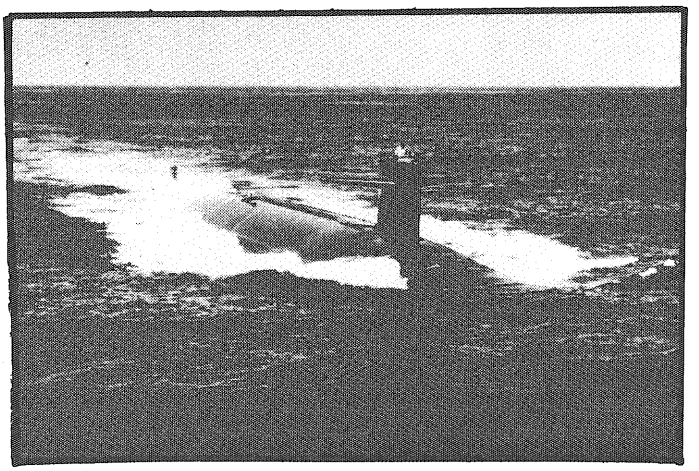

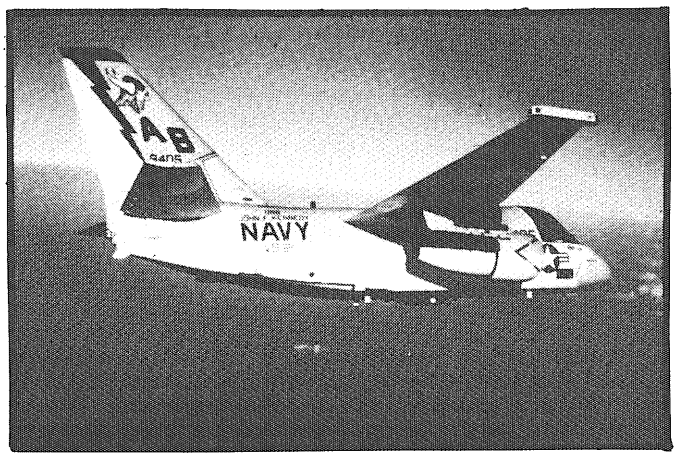

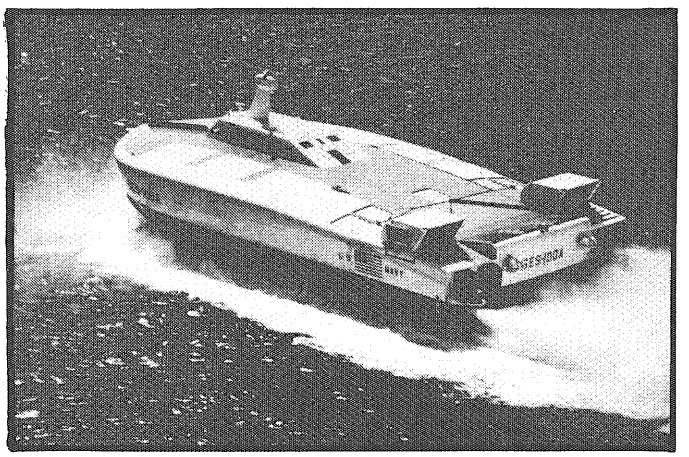

Current technology and its influence on the United States Navy is creating a demand within the fleet for technically qualified line officers. Because of this demand, the Navy is offering a two-year scholarship program through Naval ROTC designed for college sophomores and juniors pursuing engineering and hard science curriculums. This program allows qualified students to obtain a commission in the United States Navy and continue on in surface line, aviation, or nuclear power. Let your last two years of college prepare you to be someone special! If you are interested in applying for this opportunity please call (612) 373-2230, or write to:

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THE NAVY

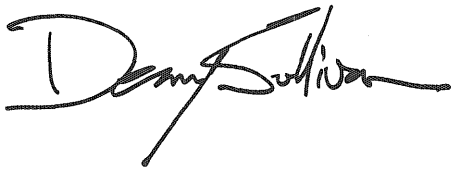
Editor's Log

As students preparing to enter technical fields, we will soon have the privilege of entering a world where our talent is in great demand. Even more important than the "marketability" of a technical degree will be our ability to meet the technical demands of America. As Dean Staehle pointed out in a recent meeting with IT student leaders, the technical knowledge of the United States will soon be matched by other world powers. This is exemplified by certain indexes showing spending on research and development, building of technical schools and governmental support in technical fields. In this issue we will attempt to provide some insight as to what we are doing in response to this trend.

At Fermilab, Illinois, scientists from many different disciplines are using a high energy, 400,000,000,000 eV, proton beam to study the structure of matter. This allows resolution down to 1/500 of the diameter of a proton. John Bartelt, an IT senior in the physics department, spent nearly five months at Fermilab. In the article "Fermilab" he describes some of his experiences there as well as some of the more fascinating facts about the world's largest proton accelerator.

Professor Pfender talks about his philosophy towards learning and students in "Keeping in Ion Things," by Mary Jo Hannasch. Pfender also sees a need to concentrate on the basics of technological learning in order to insure a secure tomorrow. He points out the possibility of a materials crunch in the United States.

In this issue, Bruce Kvam's "Ad Astra" is back as well as "After Graduation," by Steven Deyo and the continuing adventures of "The Bionic T.A.," by Steve Smith.

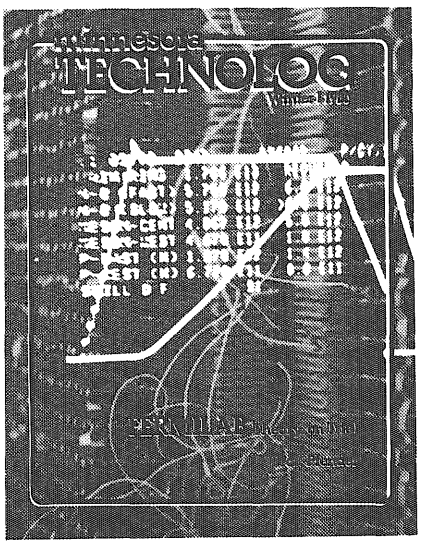


Managing Editor

minnesota TECHNOLOG

Official Undergraduate magazine of the Institute of Technology, University of Minnesota

Staff



Cover: A close-up of the Liquid Argon Calorimeter. Superimposed is a picture from the television monitors scattered throughout Fermilab showing the status of the Main Ring. One line traces the number of protons in the Main Ring—injected in bunches, the number is steady during acceleration; when up to full energy they are extracted—first gradually, them in a final bunch.
The other line traces the current in the Main Ring magnets. It increases steadily during extraction. The current drops again to prepare for the next cycle. Each pulse takes less than 5 seconds.
The numbers indicate how many protons were sent to each experimental area.
The time exposure lacks clarity, because the size of the TV picture varies a little during the pulse—due to the huge amount of current drawn by the Main Ring magnets.

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LETTERS
To the Editor

I appreciate your invitation to offer constructive criticism of the *Technolog*. I think that, by and large, it's a splendid publication; I especially enjoyed reading the article on Al Nier (Fall I, 1979). I do sense, however, that over the years the Chemistry Department has not contributed very much to the *Technolog*, possibly because we're in such a remote corner of the IT complex. Of you do, however, wish to put in an article featuring the Chemistry Department, we'd be happy to help you with it.

Sincerely,

John Overend
Professor and Chairman, Chemistry

Technolog *appreciates your offer of assistance. We are aware of past oversight of the Department of Chemistry, and are planning one article (possibly two) for this year.*

We look forward to reading *Minnesota Technolog.*

Bob Maas,
Astronomy **magazine**

In my view, [*Technolog's*] most important articles refer to activities currently going on in the Institute of Technology at the University of Minnesota. Particular features such as the articles on the IT auto (the ME Department's SCORE project) and on Dr. Nier of the Physics Department are very *a propos*. I suggest that there be more articles on individuals, research groups, and activities which would be of value to our undergraduate students. These could point out current directions in engineering education and research at the Institute.

I wish the staff of *Technolog* well. We would be happy to cooperate in any way we can.

Sincerely yours,

R.J. Goldstein
Professor and Head, ME

Technolog *agrees with Prof. Goldstein but does not want to limit itself to this only.* Technolog *will include at least one article per issue that deals with current research at IT. Coming topics are bionics and the Unified Field Theory.*

Correction

Due to an oversight, **Technolog** neglected to give Jerome Brandt credit for his photo of the "I.T. auto" on pp. 14-15 of the Fall I issue.

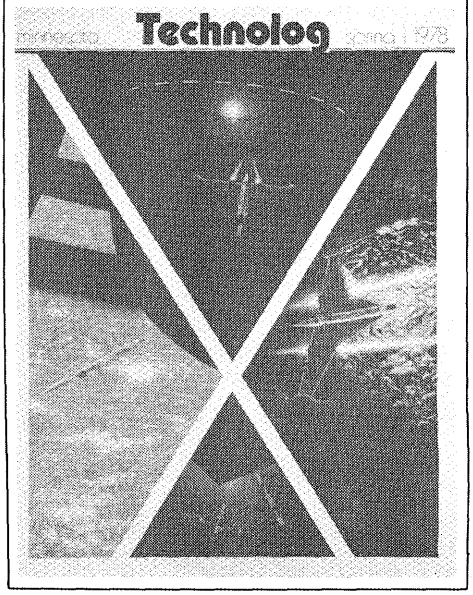
Technolog Awards

Minnesota Technolog took awards in five separate categories of the Engineering College Magazines Associated (ECMA) Competitions last spring.

Technolog topped out at first place for Best Single Cover with its four-color Egge illustration (Spring I, 1978). *Technolog* also won second place for Best Layout, All Issues; second place for Best Layout, Single Issue (Spring I, 1978); third place for Best All-Around Magazine, All Issues; and an honorable mention for Best Single Issue, Biquarterly Publication (Spring I, 1978).

Technolog has submitted its entries for this year's ECMA Competitions in Boulder, Colorado, April 11-12, 1980. ECMA comprises about fifty American engineering magazines.

Technolog was also given an "honor rating of First Class" in an Associated Collegiate Press evaluation of its Fall 1978 issues.



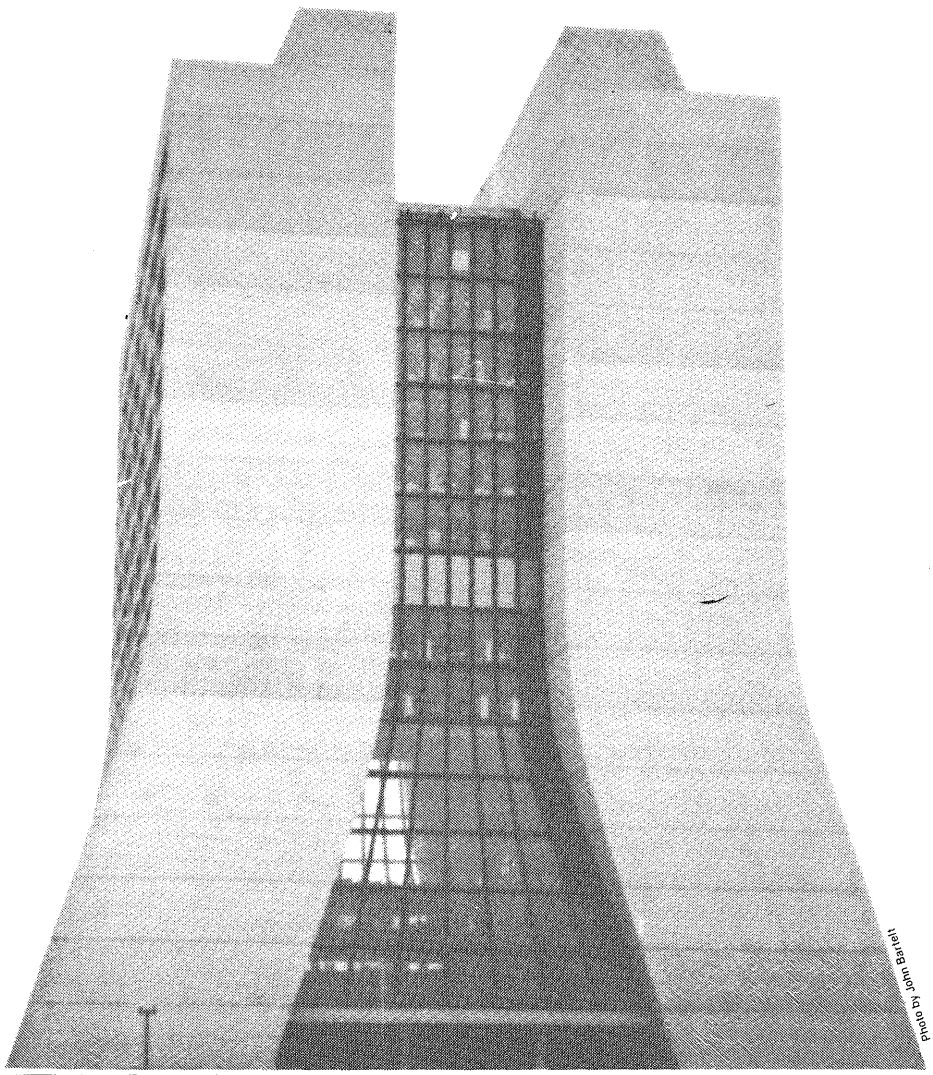


photo by John Bartelt

FERMILAB
Theory on Trial

by John Bartelt

Rising high above the surrounding plains of Illinois, visible for many miles around, is the Central Laboratory of the Fermi National Accelerator Laboratory (Fermilab). In all, Fermilab covers nearly 10 square miles among the far western suburbs of Chicago. Its heart is the world's largest proton accelerator—in effect, the most powerful microscope in existence. I spent the better part of five months there during the summer and fall of 1979, working on an experiment with two dozen physicists from the University of Minnesota, the University of Rochester, and Fermilab.

Why is such a large installation necessary?

To learn about the structure of matter you bounce particles off of it, and study how they are scattered. In the most common example, light bounces off something, and your eye detects the light. But it is a rule of nature that the finer the detail you want to see, the more energy your projectiles must have. The particles of light that you see have an energy of a few electron-volts (abbreviated eV; 1 eV equals 1.6 x 10-19 joules or about 40 billionths of a trillionth of a calorie). Light, therefore, can't resolve detail any finer than about a thousandth of a millimeter. X rays, with an energy of about 1000 eV (or 1 keV) can be used to probe finer structure, as in crystals. Or electrons can be accelerated to an energy of several keV in an electron microscope, producing resolution and magnification far greater than can be obtained with a light microscope. From there, it is simply a matter of scale and energy.

The Fermilab accelerator regularly produces a beam of protons with 400 billion electron-volts energy (or 400 GeV; GeV is an abreviation for giga-electron-volt, and is pronounced "jev"). A proton is about 1 Fermi (or femtometer) in size (1 Fermi = 10-15 meters). At an energy of 400 GeV, we are able to "see" detail at a scale of a few thousandths of a Fermi, and thus capable of probing the structure of the protons themselves.

To accelerate the protons to such high energies is a task requiring a complicated piece of equipment, to say the least. First, hydrogen atoms are stripped of their electrons, leaving bare protons. These are accelerated to low energies by the pre-accelerator, a Cockcroft-Walton device, which uses an electric field to propel the protons, much like the picture tube in a TV accelerates electrons. Then the protons go through the linear accelerator, or linac, which, as the name implies, accelerates them in a striaght line, using an oscillating electromagnetic field. From there they go into the Booster, a circular accelerator, where they are pushed to a speed very near that of light. When they have achieved an energy so high that they can't easily be maintained in the small circle of the booster, they are injected into the Main Ring. The Main Ring is about two kilometers in diameter (over four miles in circumference). The protons will circle it roughly 140,000 times in about three seconds. When the electromagnetic fields have finished their work in the Main Ring, the protons are traveling at 99.9997 percent of the speed of light. The whole cycle is completed in less than five seconds. Thus, from six to ten times each minute, a pulse of about 20 trillion protons, each with 400 GeV, is produced, extracted and sent to the experimental areas. This is, in effect, the source of the "light" which is used to "see" the structure of subatomic particles.

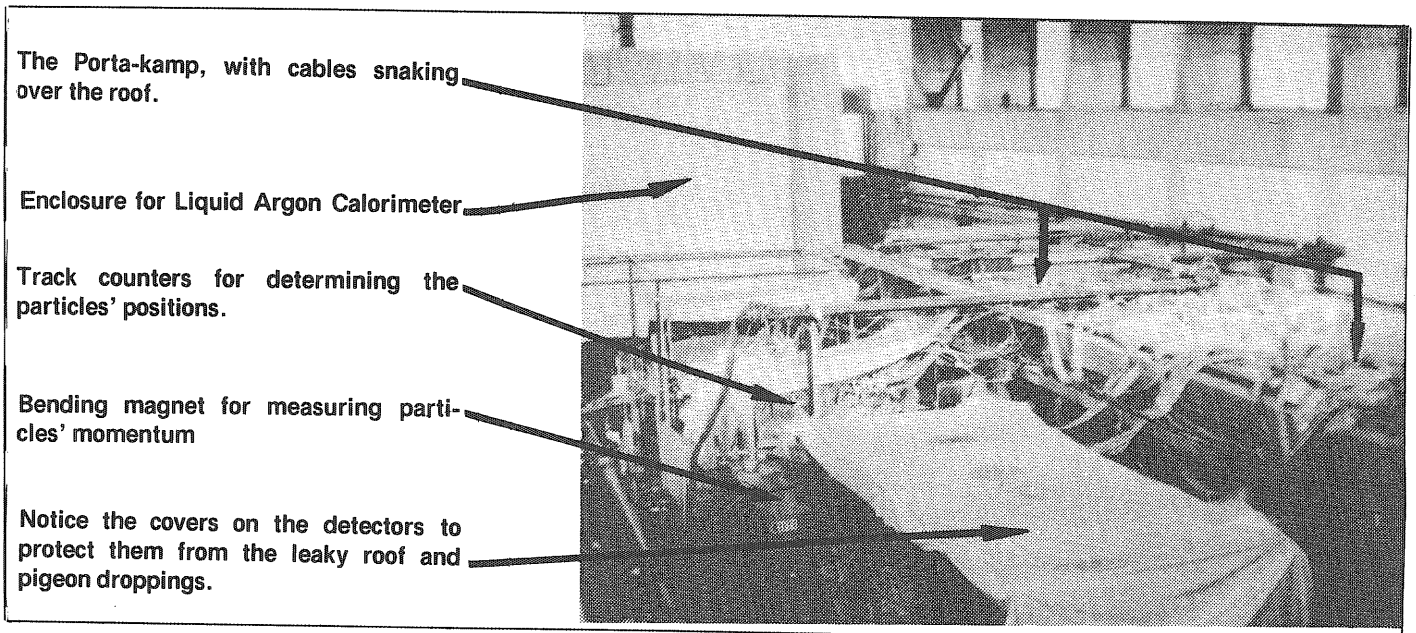


Photo By John Bartelt

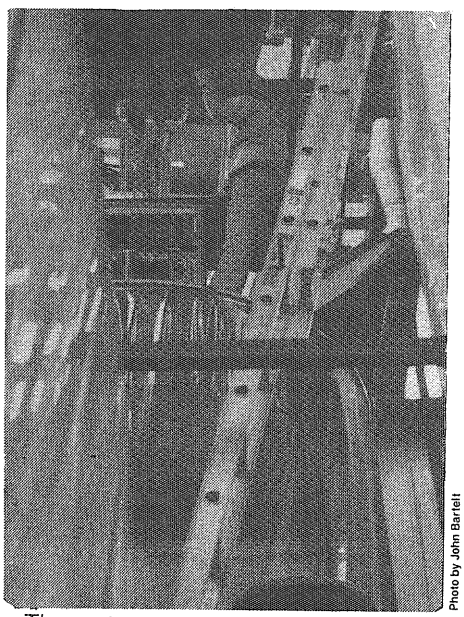


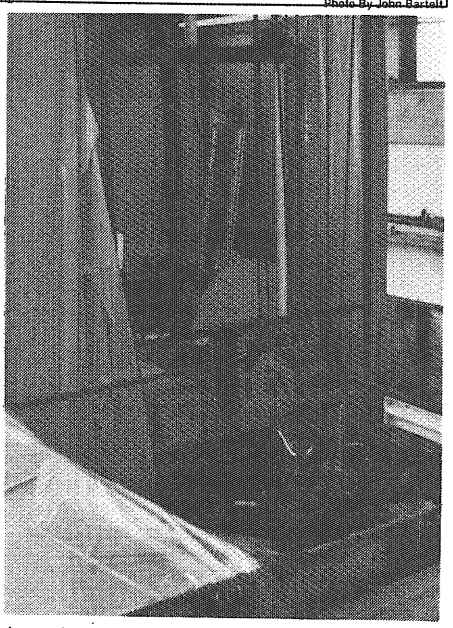
Photo by John Bartelt

The protons are split into three beams. One is sent to the Proton Area where the 400 GeV protons are themselves used on experiments. To get neutrinos for the Neutrino Area, the protons are made to collide with matter. There they interact, producing other particles, including neutrinos. While the other particles are absorbed, most of the neutrinos pass through the matter, because they interact with it only weakly.

The third group of protons is sent to the Meson Area. The lightest and most common mesons are pions and kaons (contractions of "pi-meson" and "k-meson"); they are lighter than protons, though still much heavier than electrons. Pions, in fact, are the lightest particles that feel the strong nuclear force, and kaons are the lightest particles which have the property called "strangeness." They can carry either an electric charge of +1 or -1, or be neutral. They are produced by letting the protons slam into the "meson target," a block of beryllium. The particles that come out are directed by magnets through evacuated pipes to the meson experimental areas, in a beam about one inch by three inches. The Meson Detector Building has room for up to six experiments, each getting its own share of the meson beam.

The "M1" beam line is the location of Experiment 272, one of two experiments in which physicists from the University of Minnesota are participating. Data had been taken almost a year ago, but the experiment was shut down for changes in the meson area. Many of the dozens of detectors employed in the complex experiment had been moved, modified, or disassembled, and it all had to be put back together again. This involved tasks as varied as surveying the positions of the detectors to within a thousandth of an inch, to taking some rough lumber and knocking together a stand to support a bag of helium (that was my first job; helium bags are used in the spaces between some detectors to decrease the amount of matter in the particles' way). Hundreds of cables had to be strung, taking current to the detectors or bringing signals from them—not to mention the hundreds more in the "logic" controlling the data-taking.

The control center for the experiment is the "Porta-kamp," a 12-meter-long trailor inside the Meson Detector Building. It is highly air-conditioned, a requisite for the operation of the electronics filling most of the trailer. The



data is funneled into a computer in a nearby room. Only a computer is capable of collecting the data fast enough to be practicable.

For this experiment, magnets near the meson target pick out particles which have an energy of 200 GeV. (Such pions move at 99.99998 percent of the speed of light.) These particles are then directed into a small block of material, the experimental target. Many of the particles go right through; but some interact with a nucleus in the target, either via the electric force or the strong nuclear force. The particle may also be changed into a different particle because of the interaction. Or a pion may be scattered by an electron in an atom in the target, resulting in the electron being knocked out and flying "downstream" along with the pion. Down-

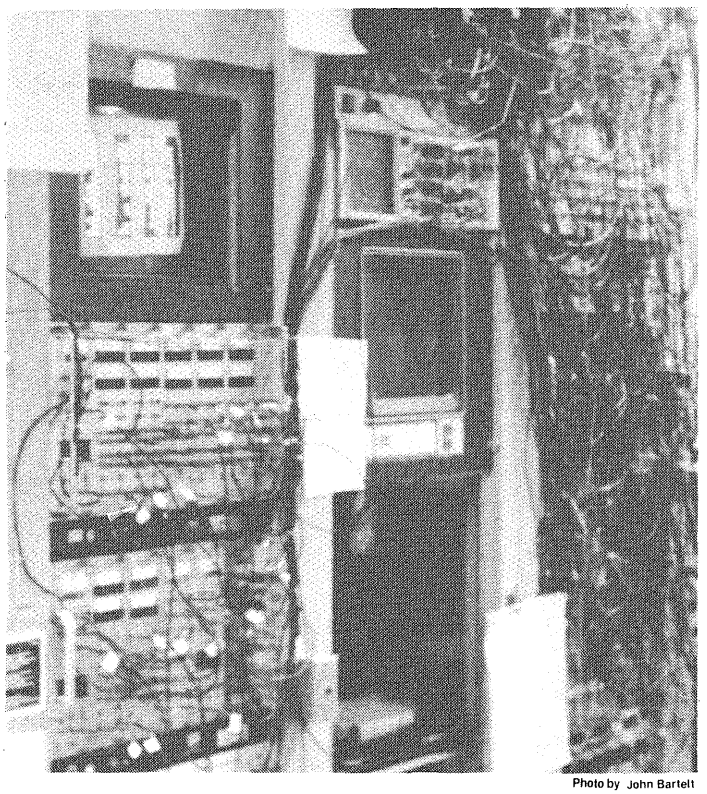


Photo by John Bartelt

Inside the Porta-kamp—the control center for the experiment.

Neatness counts when wiring.

Photo by John Bartelt

Experimenters work meticulously to move the massive Liquid Argon Calorimeter from its tank into a clear working area

stream of the target are several types of detectors with which the particles' paths can be determined. The last and most complex detector is a liquid argon calorimeter, which accurately measures the energy of the particles entering it. It is also capable of detecting neutral particles (such as gamma rays), which most of the smaller detectors can not. All of these measurements can be pieced together to yield new information about the particles and their internal structure. This requires more computer work, analyzing the hundreds of tapes of raw data—a process that will take several months.

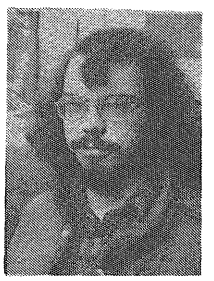
The experiment runs 24 hours a day, usually 6 days a week. About one day a week is set aside for accelerator maintenance; there are also unscheduled shut-downs when something breaks. The last run for Experiment 272 started in September and went all the way into early December—a schedule that was rather hard on the experimenters.

When not working on the experiment, or using the computing facilities in the Central Laboratory, experimenters may relax in the Users' Center's bar, play tennis, or go swimming. All these are "possible in the Village," the residential area at the east side of the Fermilab site. The Village also has dozens of houses and dormitories used by visiting scientists.

And while different members of the group work on different shifts, some working at the Porta-kamp and some in the Central Lab, the Minnesotans try to get together for dinner almost every day. It provides time for socializing and camaraderie which is highly valued when spending a month or more away from home.

Altogether, there are a few hundred experimenters at Fermilab at any one time. Fermilab employs well over a thousand people. Right now, the lab is working on upgrading its facilities. In particular, a second ring of superconducting magnets is being constructed in the Main Ring. These magnets will enable the accelerator to produce protons of up to 1000 GeV (or 1 TeV). At the same time, it will use less electricity; currently the Fermilab electric bill is about $1,000,000 per month. The "Tevatron" will give us an even closer look at the structure of matter—and that has always been Fermilab's goal.

(For More information on accelerators, see the January, 1980 issue of Scientific American.)



John Bartelt, an IT senior in physics, contributes regularly to Minnesota Technolog.

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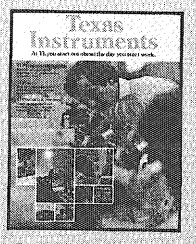

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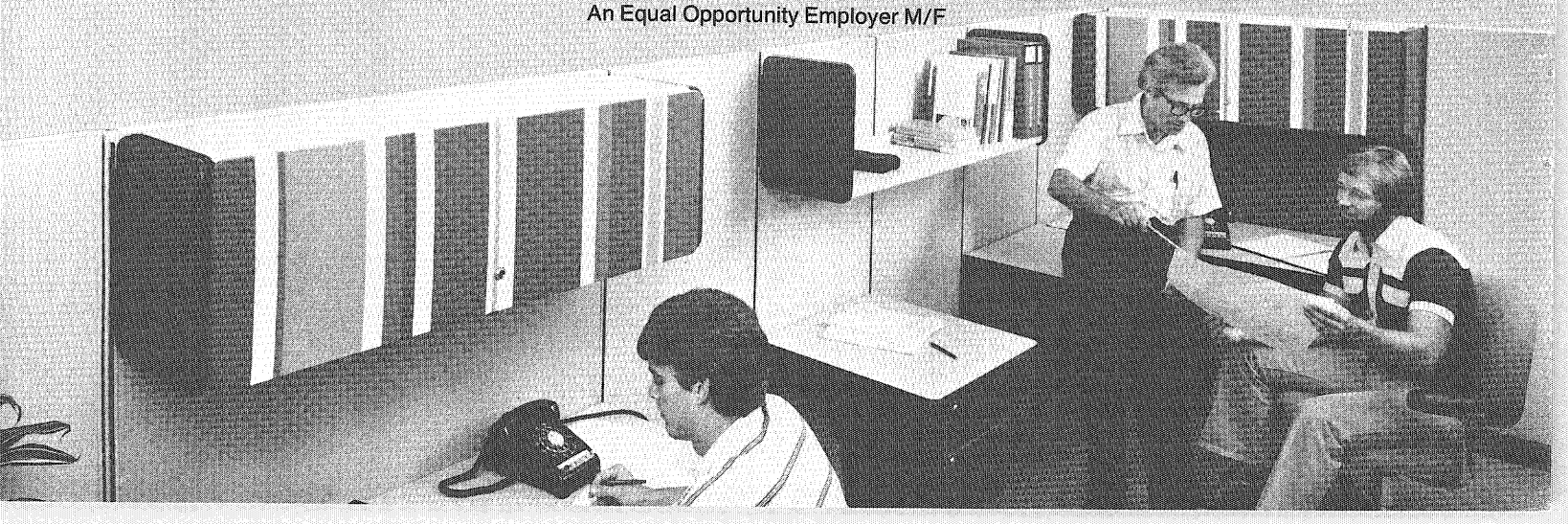

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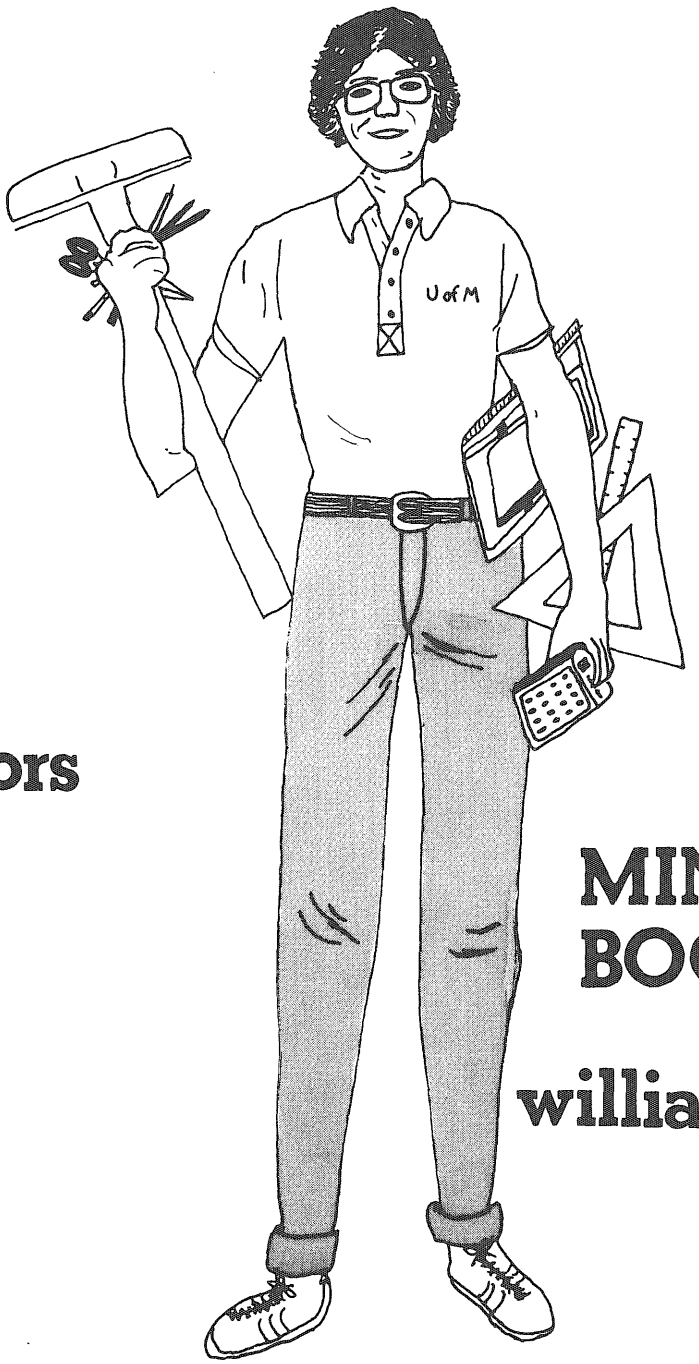

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News

Dr. Robert Lent, a recent Ph.D. graduate of Ohio State University, is heading up **the IT Counseling Office**. Appointments can be made in 105 Lind Hall, or call Robin at 373-9753.

More than thirty engineering organizations with memberships totalling to more than a half-million engineers have joined to form **The American Association of Engineering Societies** (AAES) in an effort to unify the voice of the engineering community.

American unmanned probes of Jupter and Saturn have turned up a moon orbiting Jupiter (now the fastest natural satellite known) and three more moons orbiting Saturn, bringing the count up to thirteen. Also, the Saturnian rings have been measured more precisely: the F ring at 1,300 miles wide, the outermost G ring at sixteen times that width.

IT Dean Roger Staehle told regents recently that, if IT were allocated needed money for faculty, staff and equipment expenses, IT could become "equal to or better than any scientific and technical organization in the country."

The American Society of Civil Engineers has rejected a Soviet offer to exhange engineering delegations in 1980 "until the USSR ends its occupation of Afghanistan."

Earthquakes in Minnesota? Ten recorded earthquakes have occurred in the past century, according to University physicist Harold Mooney. Mooney and members of the Minnesota Geological Survey are monitoring earthquakes to arrive at guidelines for the location and construction of nuclear power plants, and to set up standards for building codes in areas prone to tremors.

"Bench-warmer Bob" Lurtsema, former Minnesota Viking, has a degree in mechanical engineering and mathematics.

General Electric has built **the world's largest wind turbine generator.** Its 350-foot turbine has two 100-foot steel blades which, in 25-mile-per-hour winds, can supply up to 500 average homes with electricity.

The United Nations nas recently negotiated **a "moon treaty"** to maintain orderly and safe development of the moon's resources by all nations.

On a cumulative basis, **about half of all electrical engineering students** took first jobs within the state of Minnesota.

The Department of Energy is inviting qualified university faculty members to spend **a year of sabbatical leave** to do research with the Argonne National Laboratory staff.

Four aquifers, **layers of porous rock** that absorb and hold precipitation, have been discovered under the Twin Cities. According to the Minnesota Geological Survey, a heat storage system might be put in use under the St. Paul campus. Cold water would be pumped from the aquifers, passed through a heat exchanger, and returned as hot water to the aquifers to be stored until needed.

The students and staff of the Department of Astronomy have prepared a taped phone message—**Minnesota Starwatch**— which gives information on the seasonal night-time sky and brief explanations of different aspects of the Universe. Call (612) 376-5587. The message is updated every two weeks and is available 24 hours a day.

U.S. engineering colleges awarded 52,598 bachelor degrees in 1979, the largest number since the peak of 1950.

The Graduate School will use **a $625,000 grant** from the Northwest Area Foundation **to hire six young faculty members** to fill positions in the physical sciences whose departments have a high percentage of older faculty, said Dean Warren Ibele.

In order **to continue the space program** as planned, private industry will have to involve inself on a larger scale, says Boeing Space Marketing Manager Gilbert Keyes. The electronics and nuclear industries evolved in this way, said Keyes, and such action would allow NASA to concentrate on space research.

The New York District Army Corps of Engineers has an unusual problem—it **can't get enough engineers**. For more information, write: Personnel Office, 26 Federal Plaza, Room 1909, New York, NY, 10007.

Control Data has given the University **a $2 million grant** to establish a midwest regional center for microelectronics and information systems, and a $300,000 endowment for a visiting professor in computer science.

The Minnesota Geological Survey will be covering about 60,000 flight miles to map variations in **the magnetic fields of five Minnesota counties**. Maps should be ready by August, 1980.

The American Society of Civil Engineers' **Rose Bowl Float** took first prize among business association floats at this year's Rose Bowl Parade.

ABC will use fiber optic cables when (or if) it broadcasts the Winter Olympics. Fiber optic cables are subject to less interference, take up less space, and are now cheaper than copper wire.

According to University Department of Astronomy professor Vincent Icke, **a predicted 1982 superconjuction of planets** in our solar system will not cause earthquakes or other problems on Earth. Icke criticized such claims as put forth by John Gribbin and Stephen Plagemann in their book, **The Jupiter Effect**, published in 1974.

Control Data is offering **a short course in microprocessors** on the PLATO system. Call Control Data or visit the *Technolog* office for more data.

Awards

The Student Assistance Council of America offers **a computerized scholarship search** system. More information is available in the *Technolog* office.

Department of Electrical Engineering professor Aldert van der Ziel was awarded the 1980 IEEE Education Medal recently.

Asst. Professor **Wayne Gladfelter**, new member of the Department of Chemistry faculty, received the American Chemical Society's Nobel Laureate Signature Award for outstanding performance as a graduate student in chemistry.

Awards totalling $23,000 are offered for papers by graduate or undergraduate students working on design, engineering or fabricating problems of a structure, machine or mechanical apparatus. Deadline is July 1, 1980. For more information and entry forms, write: The James F. Lincoln Arc Welding Foundation, Cleveland, OH, 44117.

Publications

Peterson's Annual Guide to Careers and Employment for Engineers, Computer Scientists, and Physical Scientists. 540 pp. By Peterson's Guides. Who's hiring, how much they're paying, what kinds of specialists are in demand. Write to: Peterson's Guides Book Order Department, P.O. Box 978, Edison, NJ, 08817. Cost: $13.25 (includes shipping).

Water Treatment for HVAC and Potable Water Systems. By Richard T. Blake. 181 pp., $16.50. Discusses chemical and physical treatment of water for effective operation of steam boilers, recirculating water systems, cooling towers for air conditioning and potable water plumbing systems.

Advanced Analysis with the Sharp EL-5100 Scientific Calculator. By Jon M. Smith. 160 pp., $6.95. Demonstrates applications of the calculator for engineering, design, advanced mathematical analysis and scientific research. Available where Sharp products are sold.

Planning and Creating Successful Engineered Designs. By Sidney Francis Love. 272 pp., $17.95. Includes calculating worth, defining objectives, projecting time and cost estimations for design projects, etc.

Western Division of Sylvania Systems Group Career Opportunities. Describes opportunities for engineering graduates. Free. Write: Division College Relations Coordinator, Sylvania Systems Group, 100 Ferguson Dr., Mountain View, CA, 94942.

Publications cont.

Minnesota Geological Survey Subsurface Geology Base: Water Wells. Classifies subsurface rock and materials encountered by Minnesota water-well drillers. Available from Minnesota Goelogical Survey, 1633 Eustis St., St. Paul, MN. 55108. Cost: $2.08 plus postage (tax included).

Radiation Protection—Concepts and Trade Offs
By Hymer L. Friedell, M.D. Lecture given at the annual meeting of the National Council on Radiation Protection and Measurements. Write to: NCRP Publications, P.O. Box 30175, Washington D.C. 20014. Cost: $7.00.

Sourcebook for Programmable Calculators
By Texas Instruments, Inc. 408 pp., $16.50. Goes beyond the owners' manual to show possible applications of programmable calculators.

Metalcutting: Today's Techniques for Engineers and Shop Personnel. By the editors of **American Machinist Magazine.** 244 pp., $19.95. Covers equipment and techniques from the fundamentals of drilling to the newest electrical-discharge and laser-cutting technology.

Program of Home Study Courses in Preparation for the April 1980 Engineering Registration Examinations
By Engineering Registration Studies. Write: Engineering Registration Studies, P.O. Box 24550, Los Angeles, CA, 90024.

World Demand For Raw Materials in 1985-2000
By Mining Informational Services and Wilfred Malenbaum. 126 pp., $12.50. Analyzes projected future demand for a variety of strategic metals and crude steel.

Stimulating Technological Progress
Asserts that excessive goverment regulations and uncertain economic policies have increased risk for would-be investors in innovative opportunities. Write to: The Research and Policy Committee of the Committee for Economic Development, 477 Madison Ave., New York, NY 10022. Cost: $5 paperbound, $6.50 hardbound.

Engineering Formulas.
By Kurt Gieck. 433 pp., $11.95. Contains more than 1,500 technical and mathematical formulas and 300 diagrams.

Social Values and Solar Energy Policy: The Policy Maker and the Advocate.
By Solar Energy Research Institute. 58 pp., $5.25. Write to: The National Technical Information Services, 5285 Port Royal Rd., Springfield, VA. 22161.

Seminars

CHEMISTRY
RM. 325 SMITH HALL—8:00 P.M.

February 19
"Light Scattering By Suspensions of Lead Sulfide"
Prof. Edward J. Meehan, Department of Chemistry

February 26
"Analytical Methods For Plant Hormone Analysis"
Prof. Mark Brenner, Department of Horticultural Science

March 4
"Recent Advances in Paired-Ion Chromatography"
Prof. Larry Bowers, Department of Laboratory Medicine

March 10-14
Kolthoff Lectures
Prof. A.J. Bard, Department of Chemistry, University of Texas

March 18
"HPLC For Trace Organic Analysis"
Prof. Roland Frei, Department of Analytical Chemistry, Free University of Amsterdam

ELECTRICAL ENGINEERING
RM. 108 MECHANICAL ENGINEERING—4:15 P.M.
TEA, RM. 136 ELECTRICAL ENGINEERING—3:45

February 21
"Synthesis of Low Roundoff Noise Digital Filters"
R.A. Roberts, Department of Electrical Engineering, University of Colorado.

March 6
"Prospects of Gigabit Logic For GaAs FET's"
R. Zuleeg, McDonnell Douglas Astronautics Company

PHYSICS AND ASTRONOMY
RM. 131 PHYSICS—4:00 P.M.
REFRESHMENTS, RM. 130 PHYSICS—3:30

February 20
Topic to be announced
Dr. James Bjorken, Stanford Linear Accelerator Center and Fermi National Accelerator Laboratory

February 27
"Acoustic Spectroscopy of the Violin"
Prof. Gabriel Weinreich, University of Michigan

March 5
"The Aether Drift Revisited"
Prof. John Broadhurst, Department of Physics

SURFACE SCIENCE
RM. 102 MECHANICAL ENGINEERING—4:15 P.M.

February 20
"Initial Oxidation of Single Crystal Metal and Binary Alloy"
Dr. C.R. Brundle, IBM Corporation

March 5
"Electrochemistry of Well-Defined Surfaces"
Prof. Arthur T. Hubbard, University of California-Santa Barbara

COMPUTER SCIENCE
RM. 305 LIND HALL—3:30 P.M.
COFFEE AND COOKIES, RM. 114 LIND HALL—3:00

February 25
"Parallel Matrix and Graph Algorithms"
Mr. Eliezer Dekel, Graduate Student, Department of Computer Science

March 3
"Approximations to Combinatorially Hard Problems"
Prof. Shlomo Moran, Department of Computer Science, Technion IIT, Haifa, Israel

MECHANICAL ENGINEERING (ME 8773-8774-8775)
RM. 108 MECHANICAL ENGINEERING—3:15 P.M.
February 20
"Diesel Oil From Renewable Feed Stocks"
John E. Sanderson, Program Director, Dynatech

February 27
"Cattails, A High-Yield Renewable Energy Feedstock"
Douglas C. Pratt. Department of Botany

March 5
"Plasma Metallurgy"
Donald R. MacRae, Bethlehem Steel Corporation

March 12
"Mathematical Modeling of the Human Control Function"
Prof. Tarald O. Kyalseth, Department of Mechanical Engineering

Seminars cont.

MICROELECTRONICS
RM. 305 LIND HALL—3:15 P.M.

February 22
"Process and Device Simulation"
Dr. A. Ellis, Honeywell

February 24
"Tunable SAW Devices Using Magnetostrictive Thin Films"
Prof. W.P. Robbins, Department of Electrical Engineering

CONTROL SCIENCE AND DIGITAL SYSTEMS
RM. 102 MECHANICAL ENGINEERING—2:15 P.M.

February 14
"Signature Analysis"
James E. Smith, Control Data

February 21
"Performances Evaluation of Bus-Oriented Multicomputer Systems"
S. Vicay Iyengar, University of Minnesota

February 28
"Nonlinear Analysis of Missile Systems"
Dr. J.K. Mahesh, Honeywell

March 6
"Parallel Processors"
Howard J. Siegel, Purdue University

March 13
"Design Automation"
Hillel Ofek, IBM Corporation

CHEMISTRY
RM. 325 SMITH HALL—7:30 P.M.

February 20
"Flash Vacuum Pyrolysis, Carborane-Siloxanes, Synthesis of Modified Polymers, Reactive Intermediates"
Dr. Hedeya, Union Carbide Corporation

March 5
"Nuclear Magnetic Resonance Spectrscopy, Conformational Analysis, Organic Reaction Mechanisms, Applications of Analytical Chemistry to Archaeology"
Prof. Joseph Lambert, Northwestern University

Miscellaneous

February 28
Topic to be announced
Prof. Harold Stone, Department of Electrical and Computer Engineering, University of Massachusetts
Rm. 198 Mechanical Engineering—3:30 P.M.
Coffee and Cookies, Rm. 114 Lind Hall—3:00

March 11
"Reactions of Nitric Oxide on Platinum"
Dr. John Gland, General Motors Corporation
Rm. TBA—1:15 P.M.

TOOBEE UPDATE

You may have read our article on the Toobee toy in the Fall 1 issue of *Minnesota Technolog*. If you didn't, it's too late; we ran out of all 4,000 issues within five days. (A *Technolog* first.) We also sold 250 Toobees at a discount price to our readers in the same amount of time.

That first week, a southpaw stopped in and confirmed our spin-torque theory; he said his Toobee flew to the left when he threw it. Our staff tried some left-handed experiments too, and got the same results.

Also, we've come up with some exciting Toobee throws, each with several subtle variations of its own.

Method # 1 ("Standard") Grasp Toobee in hand, leading (heavy) edge forward. Throw like a football, rolling off the fingers to impart spin. Strong spin gives slow-motion flight. The Toobee can fly directly into a headwind due to its low drag coefficient; the firm leading edge lends imperviousness to collision damage as well.

Method # 2 ("Side-arm") Throw in a long, sweeping side-arm, holding Toobee between thumb and two forefingers. Good for throws in low-turbulence areas.

Method # 3 ("Roll") Denny came up with this one. Throw Toobee over-arm on its side, imposing strong downward spin, but snap out into the standard throw at the last moment. This is the most difficult throw, methodologically, but easiest on your arm physiologically, and really imparts "phwhizz."

Method # 4 ("Trick Shot") This is the fun one. Grasp Toobee between thumb and two forefingers, *directly over* leading edge, which must be facing away from your body and perpendicular to its normal direction of flight. Throw as in the roll shot, but don't bring it out; just throw on its side, forward, slightly downwards, and **hard**. The Toobee will shoot off to the side at as much as a 60-degree angle from the direction of thrust—and that including a net initial forward distance before banking!

Toobees should be on the Minnesota market this spring.

Winter Quarter Recruiting Schedule

Representatives from the following companies will be on campus for interviews on the dates specified. For a list of other interview dates contact the Placement office, 373-2922.

Wednesday, February 13
Exxon Corp. & U.S.A. Affiliates (2nd Day)
General Mills, Inc. (Consumer Foods Group)
Harris Corporation
Mostek Corporation
Nortronics Company Incorporated
Sperry Univac (Roseville) (3rd Day)
Vought Corporation
Whirlpool Corporation

Thursday, February 14
Cutler-Hammer Incorporated (Central & Southwest Services)
Exxon Corp. & U.S.A. Affiliates (3rd Day)
Factory Mutual Engineering
Parker-Hannifin Corporation
Procter & Gamble (International Div. - P.M.)
Shell Companies
Union Carbide Corporation
General Mills Tech. Ctr. (3rd visit)
Chrysler Corporation

Friday, February 15
Consolidation Coal Company (CONSOL)
Exxon Corp. & U.S.A. Affiliates (4th Day)
Inland Steel Company
INRYCO Incorporated
ITT Business Communications Division
Northern States Power Company (MN) (2nd visit)
Shell Companies (2nd Day)
TSI Incorporated
Union Carbide Corporation (2nd Day)
Pacific Gas & Electric Company (CompSci)

Monday, February 18
President's Day

Tuesday, February 19
Albany International
American Hoist & Derrick Company
Archer Daniels Midland Company
Corning Glass Works
Dairyland Power Cooperative
David Taylor Naval Ship Research and Development Center
Eaton Corporation
Johnson Controls Incorporated
Naval Weapons Center
St. Paul Insurance Companies

Wednesday, February 20
American Hospital Supply Corp. (2nd Day)
Archer Daniels Midland Co. (2nd Day)
Burroughs Corporation (A.M.)
Donaldson Company Incorporated
Kohlor Company
Peace Corps, Vista

Thursday, February 21
Boeing Company (The)
R.R. Donnelley & Sons
Falk Corporation (The)
Illinois Department of Transportation
MTS Systems Corporation
Pratt & Whitney Aircraft Group
Rockwell International

Friday, February 22
Boeing Company (The) (2nd Day)
Minnesota Power & Light Company
Rockwell International (2nd Day)
3M Company (Staff Marketing Services)
Potlatch Corporation / Northwester Paper Division

Monday, February 25
Chicago Board of Trade
California Dept. of Transportation
Schlumberger International Coordination
Buckbee-Mears Company
Modine Manufacturing Company
Energy & Environmental Analysis, Inc.
Hughes Aircraft Company
Occidental Research Corporation
Westvaco, Laurel Research Lab
SRI International
U.S. Air Force

Tuesday, February 26
American Electric Power Service Corporation
Geo. A. Hormel & Company (2nd visit)
Minnesota Valley Engineering
Public Service Company of Colorado
Sperry Univac Defense Systems Division
Western Gear Corporation
Information Exchange System (2nd visit)
H.B. Fuller Company
Ohio Medical Products
Nekoosa Papers Incorporated

Wednesday, February 27
Black & Veatch Consulting Engineers
Caterpiller Tractor Company
Sperry Univac Def. Sys. Div. (2nd Day)
ADC-Magnetic Controls Co. (2nd visit)
Minnesota Waste Control Commission
Sandia Labs
Kato Engineering
Standard Oil Company (Indiana) (CompSci)
Northrop Corp.

Thursday, February 28
Sperry Univac Der. Sys. Div. (3rd Day)
Advanced Micro Devices Incorporated
Edwin Cooper Incorporated
Kearney & Trecker Corporation
Sandia Labs (2nd Day)
Bermo Incorporated

Friday, February 29
Argonne National Laboratory
Digital Equipment Corporation
Fiat-Allis Incorporated
Navy, Department of (CAPSO-N)
Tektronix
Nat'l Semiconductor Corporation (CT)
MCI Telecommunications
Owens-Corning Fiberglas Corporation
Bedford Industries

Monday, March 3
Raychem Corp.

These companies support Technolog through their advertising dollar

Keeping in Ion Things

by Mary Jo Hannasch

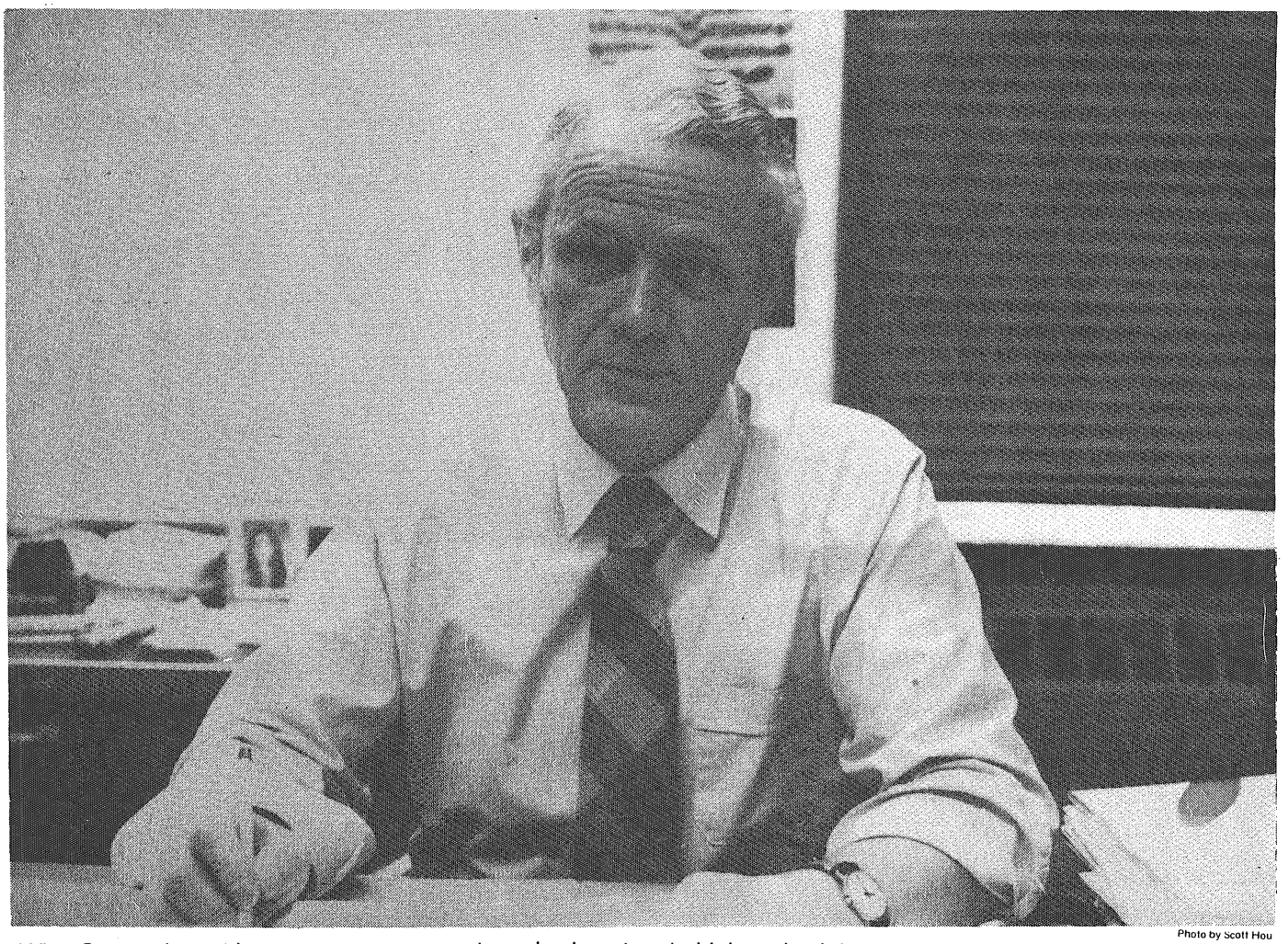


Photo by Scott Hou

What German import has more energy than a Volksvagen? Emil Pfender, of the Department of Mechanical Engineering.

Professor Pfender, who has taught at the University since 1964, was born and educated in Germany. He received his undergraduate degree in physics from the University of Stuttgart, Germany, and earned his Ph.D. there in 1959 in Electrical Engineering.

The German educational system is quite different from America's, Pfender explains.

"When I went to school," he said, "only 5 percent of those who entered grade school entered high school," due to a rigorous entrance exam. For college, there was another comprehensive exam. The students who did not pass went on to vocational or trade schools. "With this system," said Pfender, "the students' abilities were much more uniform."

After teaching several years at the University of Stuttgart, Pfender came to the United States and joined IT's Mechanical Engineering faculty, because their work most closely resembled his own research work. That is, plasma heat transfer, electric art technology, plasma chemistry and energy conservation.

Lately, Pfender has become more involved with plasma chemistry, which is concerned with the synthesis of carbides and nitrites. By injecting powders, tungsten, for example, into a high temperature plasma (which is a more or less ionized state), scientists are able to instantly heat, evaporate, chemically react, and cool the powder.

With this process, Pfender and others found they were able to produce a high-temperature form of tungsten carbide which cannot be made easily any other way.

"We ultimately hope to make new materials with unusual properties," Pfender said, "which would alleviate the materials shortage that is right around the corner. Next to the energy crunch, the next crunch I think we will be facing is in materials. Much of our materials are imported, and with the unstable situation in South Africa and Iran, it is not certain that we will always get the materials. We will have to become more dependent upon man-made materials."

Pfender beamed sincerely as he admitted he found high-temperature work a great challenge. Among other applications his work, Pfender is now involved with the University's Plasma Chemistry Center, which involves electrical, chemical, and mechanical engineers.

"It is a very loosely organized unit, allowing people to follow their particular interests," Pfender explained. "However, joint proposals have been made to the Office of Naval Research, which has given us funding. We have also received funding from the American Science Foundation."

Pfender's philosophy of research and teaching influences his work and reflects his liberal mind. "I like teaching. I am a strong believer in the combination of research and teaching. I would not like to do one without the other. It would not contain the same challenge or excitement.

"I think the wrong approach is to do my research alone. Sometimes you may feel inclined to that because you can do it faster, and you know precisely what to do. However, we are here at the University mainly to educate the students.

"I feel strongly that you have to develop your students. This can be a painful process. I can watch a student doing something wrong, but I let him proceed because I know that the next time the student will remember how to do it correctly."

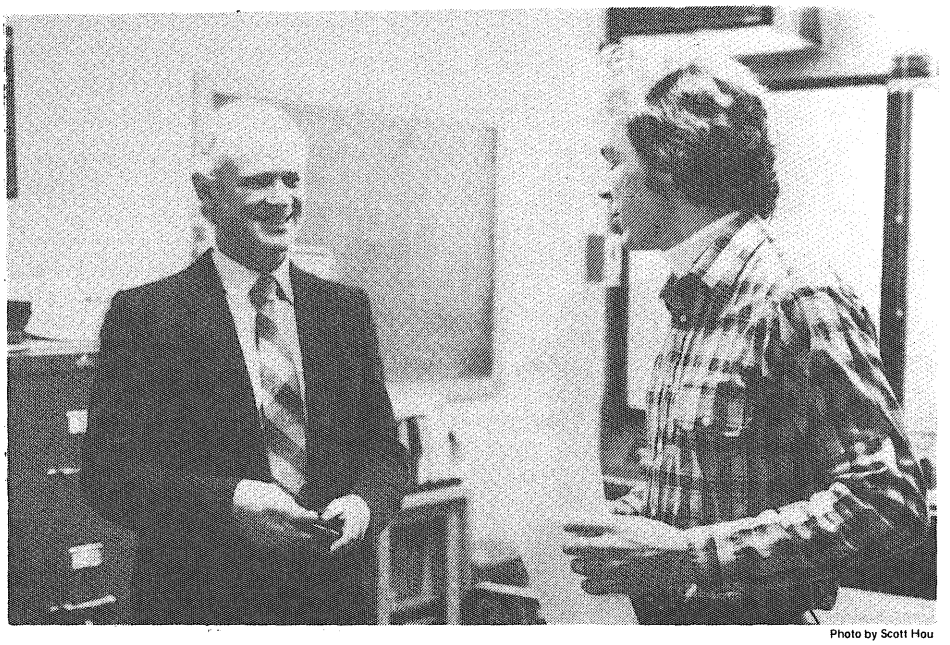


Photo by Scott Hou

> "I like teaching. I am a strong believer in the combination of research and teaching."

Pfender's concern for students is evident throughout his student interactions. He has served as advisor for 12 Ph.D. candidates and 21 M.S. students.

"I keep my students on a relatively long leash. I simply mean that I don't want to step on their toes. Students need the room to develop and work on their own projects. If a student says 'I want to go in this direction,' I let him do it even if I am convinced it is a dead-end street. This is the type of development a student has to undergo to become a well-rounded person. On the average, it takes a little longer for my students to get their Ph.D., but I haven't really heard any complaints."

This free-thinking philisophy extends even to the curriculum which he believes the student should follow.

"We shouldn't try to mold the students into one direction," said Pfender. "One of the first things that stunned me was how rigid the engineering program was, and how few choices the students actually had."

The advice that Pfender gives most students is to look around and see what is going on. The major pitfall that he sees is in becoming too involved too quickly, without seeing the broader perspective.

"Stopping to look around" consists of maintaining interests in different areas, and active participation in a wide variety of hobbies, a philosophy which

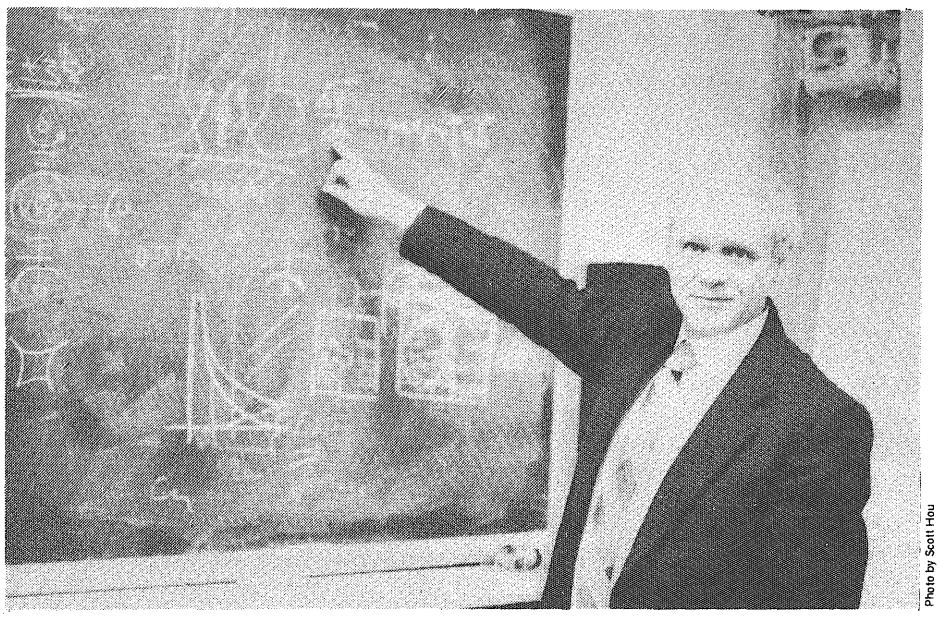


Photo by Scott Hou

Pfender himself adheres to.

"I feel very strongly that I really like what I am now doing," said Pfender. "If I was given the opportunity, I might not do anything differently."

His future plans include continuing work in plasma chemistry. There are two main branches of plasma chemistry. One deals with plasma that has high electron temperatures but low heavy-particle temperatures. The second is called thermal plasma, which is Pfender's area. Thermal plasma deals with plasma of both electrons and heavy particles at high temperatures, where the thermal dynamic state is close to equilibrium.

Pfender sees himself moving towards materials and corrosion synthesis. One high-temperature plasma application in corrosion is to untie surface corrosion coatings with a plasma spray.

"I'm really not trying to discover a new process," said Pfender, "but I am trying to gain a basic understanding of what is happening in these situations. From that point of understanding, industry can then do a much better job of developing processes."

This emphasis of basic research is not only found in Pfender's work, but, according to Pfender, it is the trend of the future.

"One trend I definitely see is that engineering is going toward the basics," said Pfender, a trend he says he thinks is due to America's lagging in competitive technology. "Here at the University, we are geared toward basic research, and we should stick to this. We have devoted far too much energy to the applied aspects in the past.

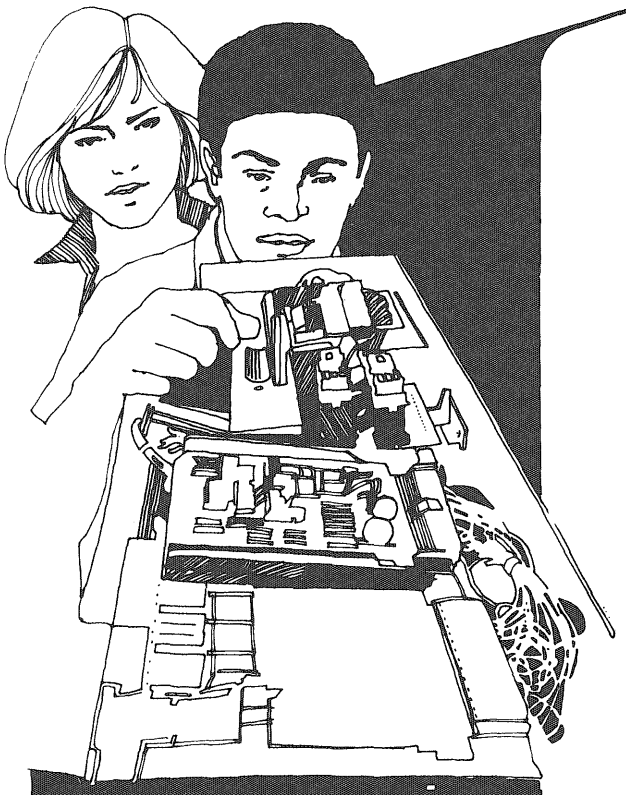
"However, there was a pressing need at that time for applied research, and there was money available for it.

"In the end, though, it is basic research which provides developmental opportunities, jobs, and exports. These are the things which we need. I now see all the signs that we are changing toward basic research. This pleases me very much."

Pfender's open mind and broad philosophy will undoubtedly remain an asset to the Department of Mechanical Engineering as he continues his teaching and research.

"I am very anxious to involve young people into the type of work I am doing, because I feel that the younger generation eventually has to carry the torch."

Mary Jo Hannasch, an IT junior in mechanical engineering, contributes regularly to Minnesota Technolog.



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After Graduation

SELLING YOURSELF IN THE JOB MARKET

by Steve Deyo

Let's face it. No one is going to get you a job except *you*. Now, if you follow the established system—on-campus interviews, Placement Office counseling, and so on—and you land a job by graduation time, excellent! But some students run this bureaucratic gamut only to dead-end for one reason or the other. This shouldn't be a problem for most engineering graduates; still, it is for some. What do you do when you've graduated and you still don't have a job?

When conventional means fail, what then?

You can anticipate the possibility and move to prevent it. Hopefully the suggestions you find in this column, supplementing the guidance of the IT Placement Office, will help you secure a job by the time you do graduate.

Finding a full-time job could be your first and toughest full-time job. Don't worry about finding the "perfect job" first off. You're just entering the job force; you can afford to be flexible for a while.

You do need to know two things, though: the points we've discussed in the past two "After Graduation" columns, and yourself. Gauge your strong and weak points. Know what you can do, can't do, and want to do—specifically, in particular job situations. Can you make quick, accurate decisions? Is patience one of your qualities? (Be honest.) Do you produce or collapse under pressure? Do you resent or assimilate criticism? How do you weigh job satisfaction against salary (and what will your salary needs be)? Do you want to work in a large or small company, in a large or small urban area? Employers will expect you to be in touch with these areas. They will also check you for responsible appearance, clear self-expression, maturity, enthusiasm, and general "togetherness." Be prepared to be asked questions such as "Where do you see yourself in five, ten, fifteen years?" and "How will you be an asset to our company?" (Generally, "Why should we hire you instead of *X* over here?") If you can offer what they want and show them so, you'll most likely get the job.

> "Let's face it. No one is going to get you a job except *you*."

This doesn't mean you're on the defensive. After all, the company is looking for engineers; it can't afford to pass up any reasonable hiring prospects—provided you don't putz out the interview. You're offering them a service they're looking for. Unless you make it clear to them you're going to be a waste of time, they'll give you a fair break. They need to hire new engineers, or fold up their business. They need you. In a sense, they're almost at your mercy. Use, but don't abuse, that advantage.

If you have been following this column's suggestions, you should by now have a) decided on at least three job settings or career lines in which you can combine or adapt your skills configurations; b) identified potential employers within any restrictions (geographical, etc.) you may have set; and c) contacted supervisors in these companies to acquaint yourself with the company and its work. (*Not* to arrange a job interview, yet.)

Let's assume you've come this far. You've exposed yourself to the professional atmosphere of your employment hopefuls, and acquainted yourself with supervisors and employees in each company. You've already got a head start on the person who's only mailed in a resume and is waiting for a call. Your contacts are going to remember your visit and all that enthusiasm you radiated. (Right?)

Now you do your homework: preparing for your interview.

First of all, *never* go into an interview cold. It impresses the interviewer no end if you've taken the time to bone up on his or her company. It says you really mean it when you say "I want to work for you." (That's why you're interviewing, remember?) Plus, it safeguards you from a "loser" job.

Find out if the company shows consistent growth, for one thing. Who are its competitors? How are they doing? Is their company "out front" technologically? What do the employees say about their jobs?

If you've been able to secure information like this, you can probably find out what one of the company's major problems is, too, in an area relevant to your field. (Ask an employee or supervisor.) If you can come up with a plausible recommendation or solution to the problem, you've won an invitation to interview. Moreover, the interviewer will be

very interested in whatever you have to say regarding his or her company. And they will most likely want to have you around on a permanent, paid basis. That means a job.

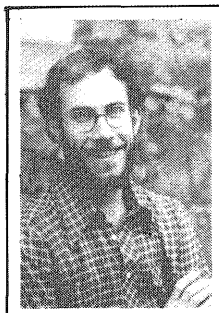
In the next issue, we'll talk about resumes, cover letters, and associated strategies.

Books you might want to read for now are:

Charles Guy Moore, *The Career Game* (Ballantine, $5.95)

Tom Jackson, *Guerilla Tactics in the Job Market* (Bantam, $2.50)

Next issue: "Resumes and Cover Letters Revisited"



Steve Deyo, a graduate student in journalism and English at the University, is associate editor of Minnesota Technolog.

AD ASTRA

By Bruce Kvam

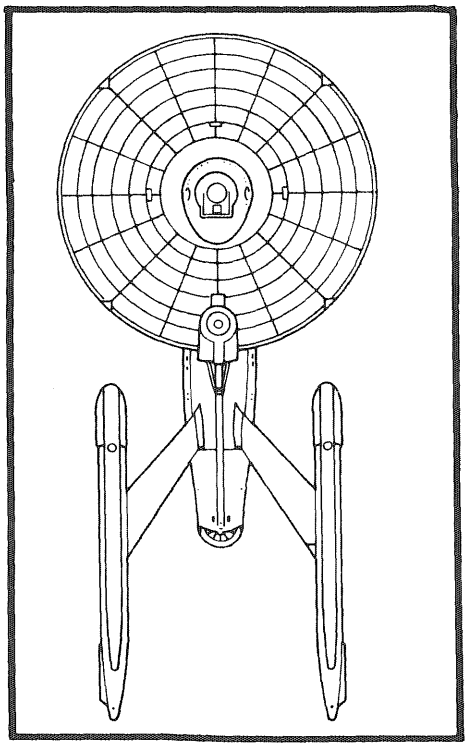
It all started with *Stars Wars*. George Lucas had an idea for a movie that would be big, splashy, fun, mindless, action-packed, and visually stimulating—a space opera in the style of Flash Gordon. The public was in the right frame of mind for an escapist science fiction thriller; the rest is multi-million dollar history.

Other Hollywood executives, a breed especially adept at bandwagon-jumping, opted for a piece of the action. A plethora of BIG sf movies was soon announced: *Alien*, *Meteor*, *Star Trek: The Motion Picture*, *The Black Hole*. *Alien* was a horror flick in outer space. *Meteor* was an atrocity with no redeeming virtues whatsoever, except that they did their Russian homework. Here we will concern ourselves with the latter two films, which are still running in local theaters.

The *Star Trek* television series was declared officially dead the summer of 1969 in its third season. NBC canned it because of poor ratings, which were attributable to its extremely poor time slot and the admittedly declining quality of scripts. The show had nearly been cancelled the year before, but was saved by an unprecedented viewer write-in campaign that brought literally millions of letters cascading down on the desks of network executives. *Star Trek*, it seemed, had a following. Nontheless, the next year the axe fell.

The funny thing was, the show wouldn't die. Fan groups were formed. Conventions were held. Reruns were shown, again and again. Today, after eleven years in the grave, *Star Trek* still maintains that tremendous following.

Hollywood knows big bucks when it smells them, so *Star Trek* wasn't forgotten. Reviving the series was out of the



question because it would be impossible to keep the actors together in one place long enough—they had become too sucessful in their own rights. So it had to be a movie.

This idea was kicked around for years. First it was on, then it was off, then on again. They couldn't get Nimoy. They couldn't work out a script. But finally, on Pearl Harbor Day of 1979, they dropped it on us: *STAR TREK: THE MOTION PICTURE*.

And everyone was aboard! Kirk, Spock, McCoy, Scotty, even good ol' Yeoman Rand. It was old home week.

First, the good things about the movie.

This is the first picture I've seen in which the widely-touted Dolby stereo actually *works*. You can place things spatially (most of the time) by the sound.

Now the bad things.

This film has tremendous flaws in characterization, plotting, acting, scripting—and on and on. This is a bad movie.

When we hear about a new "sci fi *(sic)* movie," the first question that pops into our minds is, "How are the special effects?" Well, *Star Trek*'s are okay, as good as *Star Wars*' or *Close Encounters*'; maybe a little better. But so what? I take good special effects for granted now—I want more than pretty colors and zooming spaceships in a movie.

In *Star Trek* the effects were overdone. There were so much of them, it got boring. For example, Kirk spent a solid ten minutes looking at the outside of the *Enterprise*. I was bored absolutely stiff with minute after minute of staring at a screen filled with cobwebs and sparkling lights which represented the huge invading *thing* that the Enterprise is sent out to fight.

Which brings us to the plot. Well, there's this BIG thing (How big? Eighty-seven AUs across! Gee whiz!) coming right at Earth, destroying everything in

its path. Kirk, who's been an armchair admiral for several years now, must take command of the *Enterprise* away from the new captain, Willard Decker. For a brief moment there is a flicker of personal conflict between Kirk and Decker, and it seems there might be *some* substance to the film. But that quickly subsides, and we are back to looking at a screen filled with people looking at a screen.

The characters are etched in stone. No one says anything or does anything much. They all look like the old *Enterprise* crew, but that is a deception. They are nothing but automatons filling in. Infrequent attempts are made to resuscitate them, but even the vivacious McCoy, to coin a cliche, is a mere shadow of his television self.

Incidentally, the plot was lifted from one of the TV episodes. I won't say which one; I wouldn't want to spoil it for you.

Star Trek: The Motion Picture had quite a few people from NASA working on it as technical advisors and actors. (Nichelle Nichols, who plays Uhura, is now a P.R. person for the Space Administration.) I think this had a definite effect on the film. The same people who managed to stultify the conquest of space—perhaps mankind's greatest endeavor—also helped to make *Star Trek* a very dull and uninspired film.

> "Why is it that the makers of these movies insist on turning their actors into machines and the machines into people?"

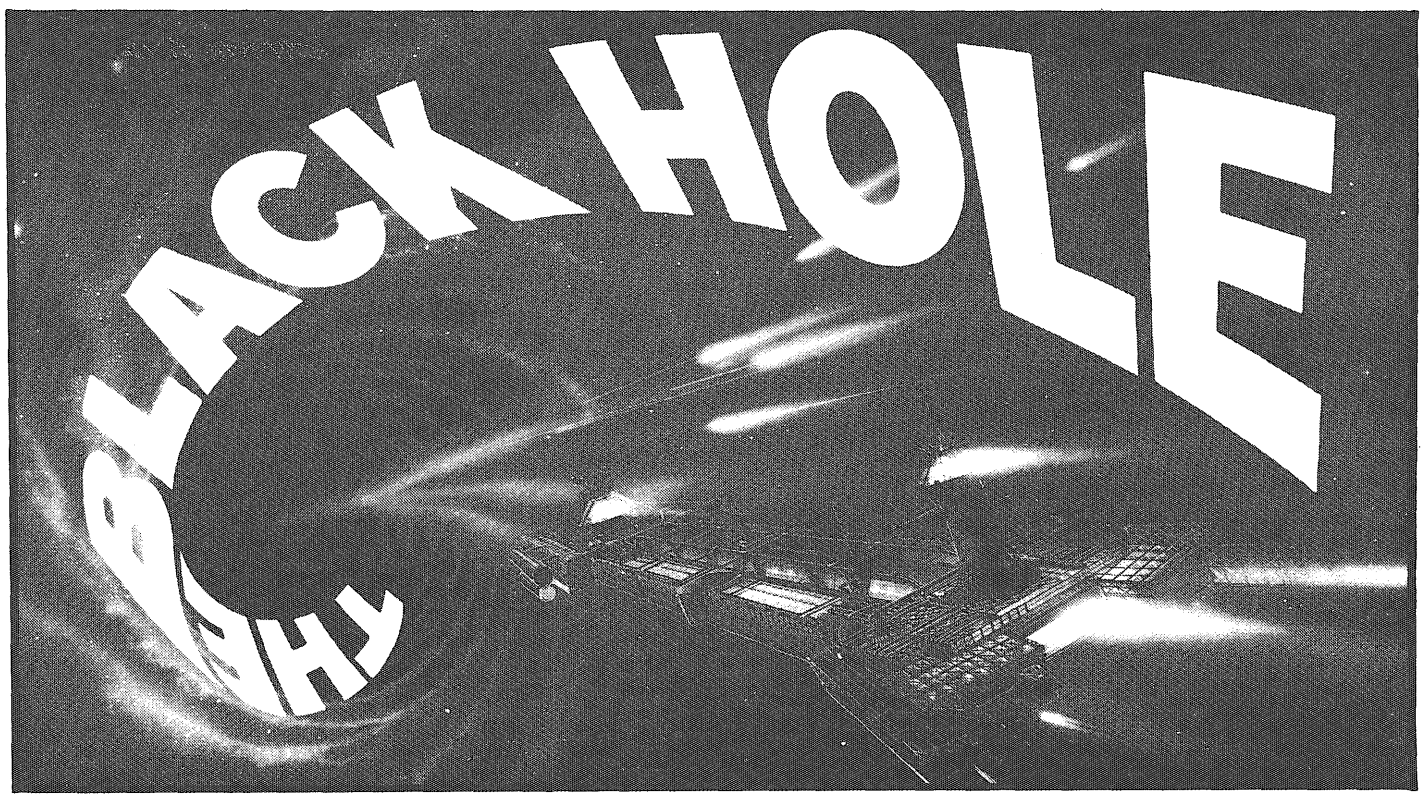
Of course you'll want to see it—just to *see*. To see how old Kirk and Spock and McCoy and Scotty and Sulu and Uhura and Chekov and Chapel and Rand have become. To see the sleek new *Enterprise*. To see the great special effects. To see the funny bald lady.

What the hell? It's only money!

The Black Hole was a big step for Walt Disney Productions. It was their first PG rated movie. The rating stems from a few "damns" and "hells" placed at choice moments, quite a bit of *Star Wars*-type shoot'em-up violence, and the demise of a ninny scientist with a rotary hedge clippers affixed to the arm of a demonic robot.

Fortunately, *The Black Hole* has more of a plot than *Star Trek*, even though it still is of the mad-scientist subgenre of sf films.

The good ship *Palomino* is heading



back to Earth from its mission to search the universe for "habitable life" (Yvette Mimieux's words), when it encounters the lost ship *Cygnus* perched, curiously motionless, above a black hole. They board and find only a single human aboard—(the evil) Dr. Hans Reinhardt. His entire crew has been lost, but he has replaced them with what appear to be robots.

His life study is the black hole. He tells us of its immense power, how not even light can escape its grasp. And he reveals his dream: to enter into the black hole!

Somehow the black hole acquires attributes of evil (I don't understand why; are asteroids evil? planets? quasars?) and the crew of the *Palomino* are convinced that this guy is really wacko.

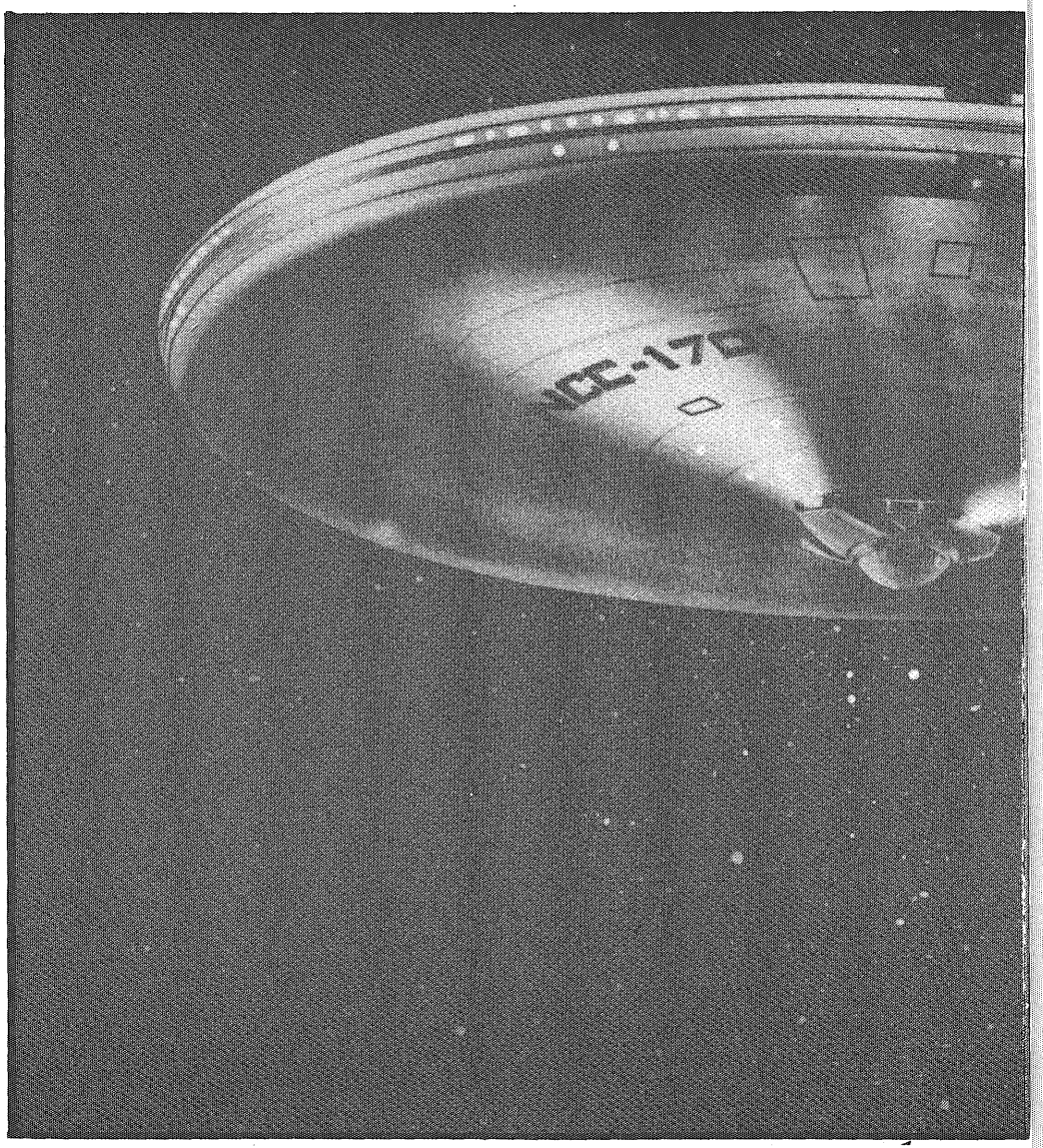
Don't mention plot or characterization. You'll find none. Maximilian Schell, who plays Reinhardt, hit the nail squarely on the head in an Associated Press interview. He said, "In science fiction films, what is important are the surroundings, the special effects, the scenery. The human beings tend to disappear.

"Take *Star Wars*," Schell continued. "To me, the most appealing character was R2D2. I don't remember much about the human actors."

So too with *The Black Hole*. The only interesting character was a robot called VINCENT (*Vi*tal *In*formation *Cent*ralized). He always made snappy cracks, had duels with Nazi-like robots highly reminiscent of *Star Wars* storm troopers, and befriended a downtrodden robot with a Texan accent.

Why is it that the makers of these movies insist on turning their actors into machines and the machines into people? (This exact thing occurred in *Star Trek*, too—Ilia, the bald woman, is made into a robot.) All sf movies seem to suffer from this, stretching back to *Metropolis*, *Forbidden Planet*, *2001*, *Alien*, *Star Wars*—producers have very powerful one-track minds!

There's no reason why science fiction movies should be so consistently bad. Within sf there is a wealth of interesting, well-written, well-plotted, well-characterized fiction. It sorely amazes me that Hollywood has been able to ignore it for so long.

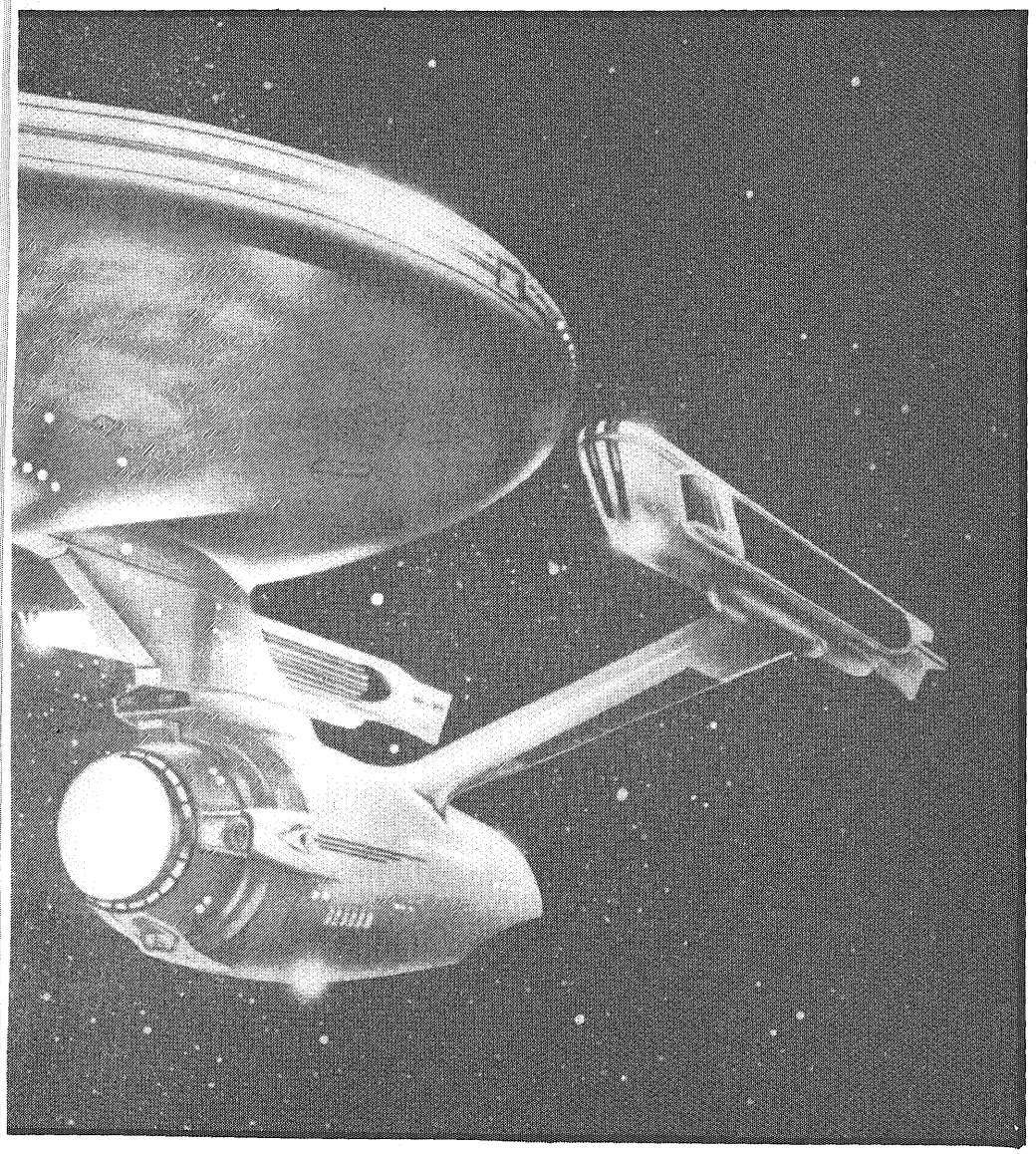


I digress.

Despite the PG rating, *The Black Hole* is definitely Disney. There is a highly moralistic thread running throughout which culminates in a scene stolen directly from *Fantasia*, the animated Disney journey through the standard classical musical repertoire.

Hole's ending confuses a great many people with its emulation of a similar sequence in *2001: A Space Odyssey*. But the rest of the movie is straightforward good-versus-bad hackery. It's kind of fun. See it if you must, but I told you so.

Any movie these days is a multimedia propaganda blitz, with simultaneous releases of novelizations, sound tracks, calendars, dolls, guns and assorted paraphernalia.



Gene Roddenberry, *Star Trek*'s executive producer and creator, is the author of *Star Trek: The Motion Picture—A Novel*.

This book is a complete travesty. It suffers from the same faults the movie suffers from, and introduces a multitude of stupid ideas for which Roddenberry can blame only himself.

One of the most frustrating technical errors in the writing is the lack of dialogue. Rather than have people say things aloud to each other, Roddenberry has one character hear what the other has said, and then repeat it in his mind. It is a very monotone narration. If you're interested, it's a Pocket Books/TOTAL RELEASE/$2.50.

And of course you can get the official *Star Trek:The Motion Picture* blueprints of the modified *Enterprise*, which include the plans to the Klingon warship (now how did Star Fleet get hold of those?) right down to the captain's foot rest! ($6.95, Wallaby Books).

And then there's the *Star Trek Spaceflight Chronology*, by Stan and Fred Goldstein, illustrated by "the Brilliant Artist of the Space Age, Rick Sternbach." This is the "future history" of spaceflight, covering the field from Yuri Gagarin's Vostok all the way up to the uprated *Enterprise* and beyond. In it, we find that the new *Enterprise* can accelerate from 0 to .99*c* in 19 seconds flat!

This is another of those fictional nonfiction large format paperbacks which the publishing industry has thrust upon us as of late. The *Chronology* is also a Wallaby release at only $8.95. The art is all quickie airbrush stuff, added with nonsense about how dilithium technology has improved starship design, and the educational prospects of time travel.

But wait! There's still more to come! Lucas is currently doing the *Star Wars* sequel, *The Empire Strikes Back*. And there will be a film called *Saturn 3* out soon starring Farrah Fawcett with this sexually psychopathic robot...

If I seem slightly negative about the current state of affairs in sf movies, then I have made my point. At $450,000 a minute (Star Trek ran 132 minutes and cost, including publicity, $60 million), I expect more than just enough light and noise to keep me from falling asleep in my four-dollar theater seat.

Bruce Kvam, an IT gradute student in computer science, regularly writes the "Ad Astra" column for Minnesota Technolog.

THE lighter side OF TECHNOLOGY

"IMPURE E.E."

Once upon a time ($1/t$) when t equals zero, there lived in a small cavity in a dielectric medium a poor, struggling dipole by the name of Eddie Current. He was deeply in love with a beautiful coil by the name of Ann Ion, the daughter of an influential force in town, "Cat" Ion.

Eddie's first contact with her came at time equals a. As he passed by a beauty parlor on his periodic orbit, he saw her having a standing wave induced in her filaments. He made a fine sight in his beautiful doublet and it was a case of mutual polarization. *"You shock me,"* he thought.

By a coincidence they met at a dissipation function the following night. After a few oscillations to the strains of a number (n) played by Mo Mentum and his Incandescent Tuning Forks, the couple diffused into the field outside.

"Gauss, Ann," he said, "you're acute angle. I am d (termined) that U shall marry me, for I sphere that I shall never be happy without you."

"Oh, Eddie," she replied, "don't be so obtuse. Integrate out here in the alpha rays."

"Ann, are you trying to damp my osculations? Can't you see I'm in a state of hysteresis over you?" (He couldn't resistor.)

"Now, Eddie, be a discrete particle. What will father say?"

Alas, there was also in this cavity a mean dipole who was resolved to marry the beautiful Ann, using coercive force if necessary. Hearing these murmurings of love, he went i'd with fury. He crept stealthily upon the couple with velocity u, his joules drooling with the vestigial erg that moved him.

"What in the infrared are you doing here, you flat-footed, vial villain?" demanded Eddie. The situation grew tensor.

Schmidt advanced to choke the beautiful coil; Eddie offered resistance R. His capacity C for absorbing the charge Q was low, and Schmidt suffered little lost work content in knocking him out to infinity with a severe blow on the negative charge. Eddie made a quick comeback with acceleration a, stripping off Schmidt's outer electrons. This so upset the villain's equilibrium that he was converted into cosmic radiation and vanished into the realms of space, leaving Eddie the resultant vector in combat.

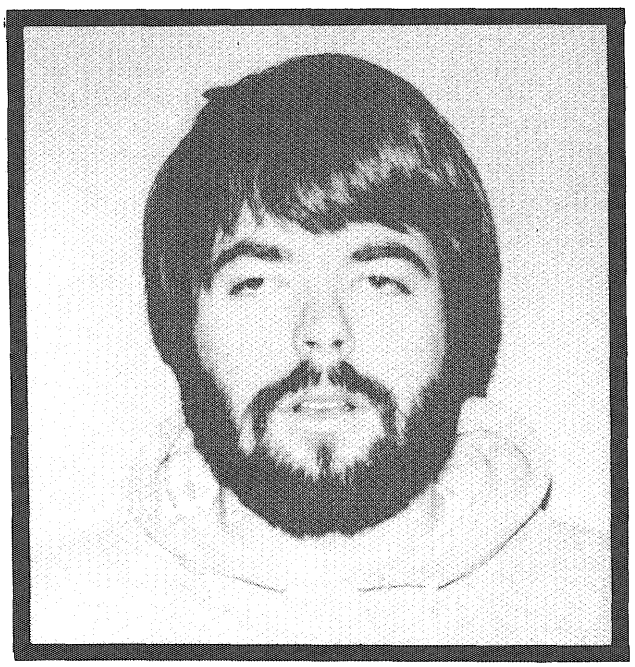
"Our love will not be transient," said Eddie as he formed a closed circle around her.

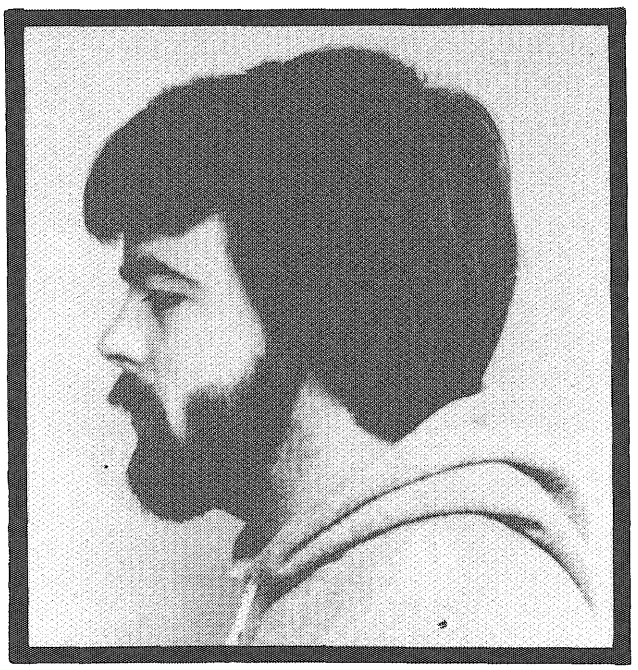
"Darling, we will raise a one-parameter of second-order infinitesimals," murmured Ann happily.

And as time t approached infinity, they lived happily ever after.

Reprinted with minor revisions from *Plumbers' Pot*, McGill University, Montreal, Quebec, March 30, 1977.

WANTED





Editor

We are now taking applications for the 1980-81 **Technolog Editor**.

This position is open to all full-time University of Minnesota students. Preferential treatment will, of course, be given to IT applicants. This is an excellent opportunity to gain practical communications experience, which is very marketable upon graduation.

For more information please contact: Denny Sullivan, Room 2 Mechanical Engineering.

Although the $500-per-quarter-plus bonus salary isn't the most important part of the reward, it doesn't hurt!

$1500 Reward

The Society of Women Engineers (SWE) is planning their second Annual Career Fair and Banquet for February 22, 1980.

The Career Fair will be open to all students and held in Architecture Court. Approximately thirty companies from around the nation will have information booths at the Fair—for example, Texas Instruments, Pillsbury, and Honeywell. The Career Fair will run from 10 a.m. to 4 p.m.

That evening will be the SWE reception and banquet. Guest speaker will be Dr. Julie Prager, a 3-M organic chemist.

Anyone wishing more information may call Virginia Pitterle, 373-7125 or Mitzi Crawford, 722-6821.

Can you identify the chemical engineer in this group?

You're right if you said all of them. And you're right again if you conclude that Kodak offers a wide choice of career paths for individuals with strong technical skills. So it shouldn't be a surprise that our top management team is predominantly individuals with engineering backgrounds. At Kodak plants in Windsor, Colo.; Rochester, N.Y.; Kingsport, Tenn.; and Longview, Tex., you'll find chemical engineers in hard hats performing vital production staff functions and others deeply involved in design and development. Other chemical engineers are more often in business suits, calling on customers all over the country as Technical Sales Representatives. And some don't stray too far away from the satisfactions they find in the research labs. Incidentally, it would be very easy to find this kind of occupational variety among mechanical, industrial, or electrical engineers at Kodak.

Some of the members of this group found a bachelor's degree was all that was needed to prepare them for a challenging job. Other positions are better suited for someone who has completed a master's degree. If you prefer to work now and study later, the Kodak Educational Aid Program offers opportunities for full- or part-time learning. Those bent on a career in research usually apply to us with Ph.D in hand.

At Kodak, the emphasis is on technical innovation as a blueprint for keeping pace with our changing world. It's taken us—and it can take you—far from our photographic origins. For example, our basic expertise in photographic emulsion coating was the springboard to the development of a new clinical blood analysis system for health care. Our need for chemicals in photographic manufacturing led to the development of a multiplicity of products including fibers, textiles, and dyes for apparel and home furnishings. And our imaging abilities gave us an opportunity to make and market quality business equipment like microfilmers and copier-duplicators.

When a company is open to new directions, the people who work for it should expect changing horizons in their individual roles as well. Where the future can take you at Kodak depends on a lot of things—like personal preferences, performance on the job, and available openings. What we can promise is the opportunity to explore many conventional engineering choices plus a lot of other vital professional options.

Begin by contacting Personnel Resources, Eastman Kodak Company, Rochester, N.Y. 14650.

1880 Kodak 1980

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 sales offices throughout the U.S.A.

This electric car is plugged into the electronics revolution.

The electric car you see here is one of a pair of experimental vehicles GE is developing for the Department of Energy.

With a projected range of 100 miles at a constant 45 mph, it's so much better than previous models that there's hardly any comparison.

What's made this big difference is electronics. A GE-designed microcomputer manages energy flow throughout the propulsion system, regulating power demand to extend the car's range.

The power-conditioning unit contains another major GE innovation: special high-power transistors.

They're the world's most efficient high-power transistors, capable of switching 400 volts and 350 amps on or off in less than a millionth of a second. Yet the silicon chip that contains them is less than half the size of a postage stamp!

These high-power transistors have three important functions.

They regulate the speed, torque and acceleration of the car's DC motor.

Their high-frequency characteristics also make them ideal as components for the car's overnight charging system.

Finally, the transistors play a big role in the car's regenerative braking system. They help change the motor automatically into a generator, supplying braking power to the wheels and producing current to partially recharge the batteries.

What's coming down the road after this advanced vehicle? GE engineers are developing one that's even more advanced. It's a hybrid that will burn far less fuel than an all-petroleum-powered car and have even greater range and power than the all-electric. It too will feature microelectronic controls...but of even greater sophistication.

Looking for new and practical solutions to transportation problems is just one example of research in progress at GE. We're constantly investigating new technologies, new materials and innovative applications for existing technologies — in such areas as energy sources, motors and drives, aerospace systems.

This takes talent — engineering talent — not just in research and development, but in design and manufacturing, application and sales.

If you'd like to know more about engineering opportunities at GE, send for our careers booklet. Write to: General Electric, College Communications, W1D2, Fairfield, CT 06431.

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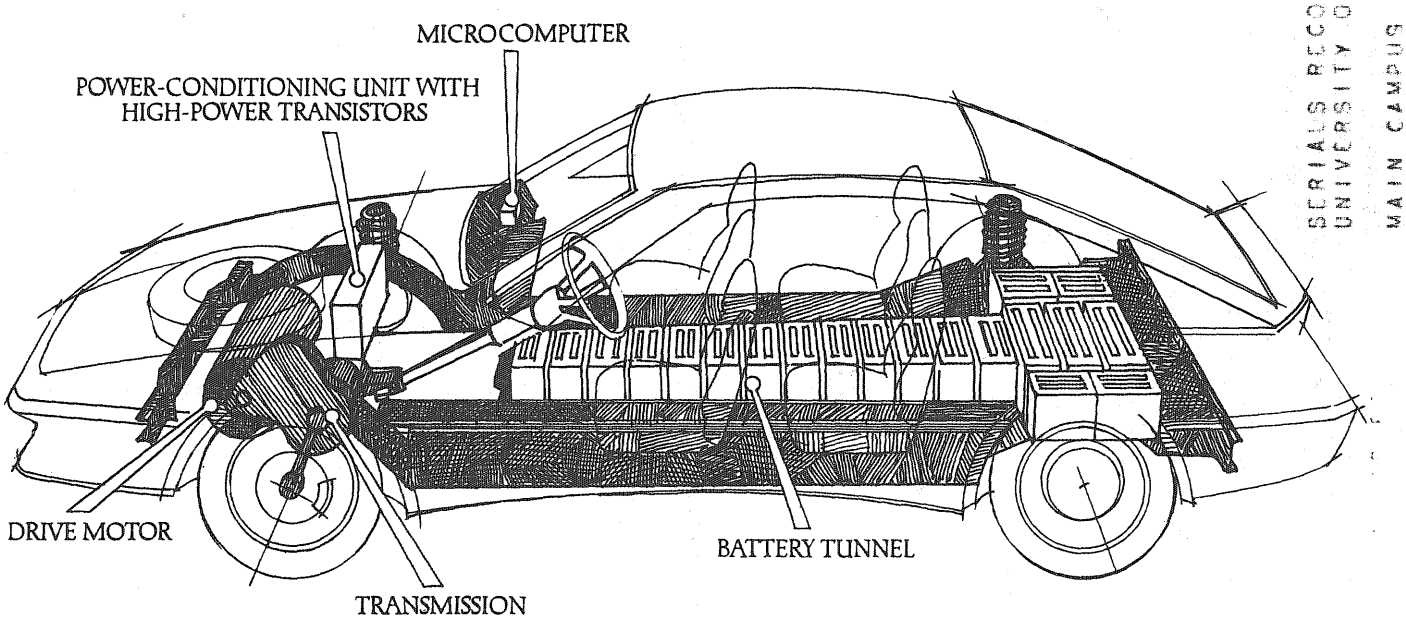

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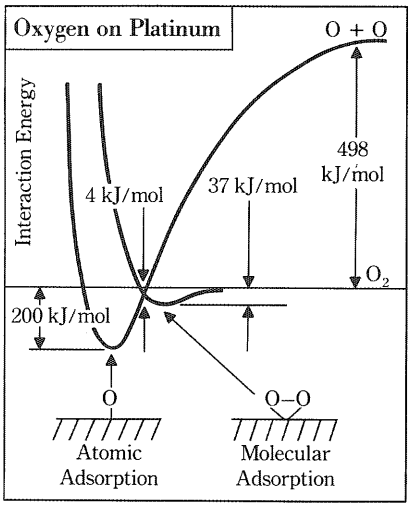
The Atomic Arrangement

In a recent experiment, scientists at the General Motors Research Laboratories studied changes in chemical bonding during the dissociation of oxygen molecules on platinum. Preliminary surface work has explored an interesting new phenomenon: the mechanism of oxygen dissociation over a wide range of temperatures.



A simplified schematic illustrating the reaction potential energy surface for oxygen-adsorption on a close-packed platinum surface.

An electron diffraction pattern which shows diffraction patterns from an oxygen-covered hexagonally close-packed platinum surface at 0° C.

UNDER what conditions will oxygen molecules dissociate into single atoms on a platinum surface? What is the mechanism for oxygen dissociation? Those are the kinds of questions that Dr. John Gland and his colleagues at the General Motors Research Laboratories are investigating to get a better understanding of the chemistry behind catalysis.

Their work has valuable practical implications for the automotive field, where catalysis is used to remove harmful emissions from automobile exhaust. Most cars built in the U.S. use catalytic converters filled with beads containing platinum to chemically transform carbon monoxide and unburned hydrocarbons into harmless CO_2 and water.

While it has long been known that catalysts are an effective way to convert these gases, little is known about precisely why and in what order the basic atomic reactions occur.

In seeking answers to these questions, surface chemists study the elemental composition and geometric arrangement of atoms in the first few atomic layers of the surface and the means by which atoms and molecules from the gas phase bond to the surface.

In his most recent work, Dr. Gland has been studying the adsorption and desorption of oxygen on platinum single-crystal surfaces. This is important because oxygen is the agent that must be adsorbed on the surface to react with carbon monoxide and hydrocarbons to convert them to CO_2.

The experiments were conducted in a stainless steel ultrahigh vacuum system equipped with an electron energy analyzer and a mass spectrometer. The electron energy analyzer allows one to measure the concentration and character of the oxygen adsorbed on the platinum surface. The mass spectrometer is used to measure the desorption of O_2 as the platinum surface is heated. Mathematical analysis of the desorption process allows one to characterize the chemical bond between the oxygen and the platinum surface.

In these experiments, the platinum surface is covered with oxygen at the extremely low temperature of −179°C (almost the temperature of liquid nitrogen) by exposing it to gaseous O_2 molecules. The oxygen remaining in the gas phase is pumped away, and then the desorp-

tion of oxygen from the surface is observed as the platinum crystal is gradually heated to 1000°C.

The oxygen was found to desorb from the surface in two distinctly different temperature regimes—part at −125°C and the rest at about 425°C. By using the oxygen-18 isotope, it was established that the low temperature desorption represents oxygen that was adsorbed on the surface in a molecular form while the higher temperature desorption corresponds to oxygen adsorbed in the atomic form. From an analysis of the desorption process, it was possible to establish the complete energetics. Oxygen molecules from the gas phase strike the surface and are weakly bound (37 kJ/mol). The adsorbed oxygen molecule can either desorb into the gas phase (37 kJ/mol) or dissociate into atoms (33 kJ/mol). The atoms are bonded very strongly (200 kJ/mol) to the surface.

FROM the desorption analysis, it was also possible to deduce the mechanism for the dissociation process. The interesting conclusion that results is that the formation of O atoms on platinum is a two-step process—oxygen is adsorbed in a molecular state and then dissociates to form atoms.

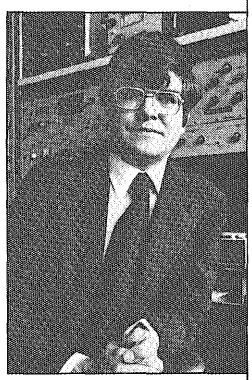
The GM scientists were most interested in learning how this adsorbed molecular species is bonded to the platinum surface. Fortunately, another technique was available to determine the bonding. The technique is called electron energy-loss spectroscopy and is quite new—there are only six or seven such instruments in the world. The measurements not only confirmed the existence of the adsorbed molecular oxygen but showed that it was bound by the transfer of two electrons from the platinum surface into the antibonding π_g orbitals of oxygen. "This was most exciting" said Dr. Gland, "because this is the first time that this type of oxygen bond has been observed on a metal surface.

"We're getting closer and closer to a more specific understanding of catalysis," says Dr. Gland. "The more we learn about simple chemical systems, the better we'll be able to control more complicated systems. That has excellent implications for protecting the environment."

THE MAN BEHIND THE WORK

Dr. John Gland, 32 years old, is a Senior Research Scientist in surface chemistry at the General Motors Research Laboratories. He heads a group of 7 investigators, 4 with Ph.D.s, all involved in work relating to the basic surface chemistry of catalysis.

A graduate of Whittenberg University in Ohio, Dr. Gland received his Ph.D. in physical chemistry at the University of California, Berkeley, in 1973 and joined the General Motors staff that year.



Dr. Gland comments: "I came to GM Labs because I wanted to get in on the ground floor of an exciting new field. The atmosphere here is very open, with lots of cross-pollination among departments. With several hundred people with Ph.D.s here, we've got a lot of human resources to draw on in all the basic sciences.

"Typically, management defines a broad problem, then we're free to tackle the solution in any way we choose. They give us the freedom, equipment and support to get the job done correctly."

In addition to his research, Dr. Gland enjoys backpacking in Wyoming and in the Sierra Nevada Mountains in California.

Editor's Log

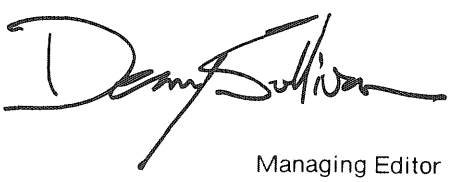
Man may never learn to control the future, yet we may try anyway. The future holds many promises and to be able to grab it is to touch immortality. As people interested in technology this feeling of future has special meaning. To many the question of future *is* the question of technology. To satisfy this desire to control our destiny we try to mentally project ourselves forward in time. This is done in different ways by different people. Some believe our future lies in another present. Some dream about the future. Others are trying to plan it.

In this issue the associate editor, Steve Deyo, takes an indepth look at UFO phenomena in "What About UFOs?" Are these beings developed to a point where they can travel throughout the universe at will, or do they just reflect our need to believe in the future? This article, along with an interview with UFO expert Dr. J. Allen Hynek, will look at this question and raise several others.

Science fiction is the stuff technology's dreams are made of. Thirty-four of these "dreamers" wrote down their fantasies and entered the 1980 **Technolog** Science Fiction Contest. Four winners have been selected and the third place winner was Perry Heyda's "The Number of the Beast." Perry's story is a new twist on one of the older methods to predict the future.

This year a team of University architecture students planned the future and won. "The Les Halles Competition" is the story of how they did it.

Also in this issue we have "After Graduation," "The Lighter Side" and, by Steve Smith, the all-new adventures of "Jake Starduster," an intergalactic busybody and close relative of the "Bionic T.A."



Managing Editor

minnesota TECHNOLOG

Official Undergraduate magazine of the Institute of Technology, University of Minnesota

Would you buy a used UFO from this alien?

Staff

The Minnesota **Technolog** is published six times yearly by the University of Minnesota Technolog Board of Publications; twice each academic quarter during the periods from October through December, January through March, and April through June. **Technolog** is produced by and for students of the University of Minnesota Institute of Technology, Twin Cities campus. Editorial offices: Room 2, Mechanical Engineering Building, University of Minnesota, Minneapolis, MN 55455. Telephone: 612-373-3298. National Advertising Representative: Littell-Murray-Barnhill, 60 West 42nd St., New York, N.Y. The Minnesota **Technolog** is a member of Engineering College Magazines Associated. Subscription rates: $5 per year, $1.00 for single copies. Advertising rates available upon request. Opinions expressed in the **Technolog** do not necessarily reflect those of the Institute of Technology or of the University of Minnesota. Printed in U.S.A.

Science Fiction Contest

1980 Winner

Is fiction the mirror of reality? Or is it the other way around? The 1980 *Technolog* Science Fiction Contest didn't set out to answer such questions, but the results of the annual short-story competition may provide some ammunition for both sides of the argument. But before we get mired in deep, philosophical discussion, first let me announce the winners.

First place in the *Technolog* SF Contest was awarded to Paula Reed for her story "Youngsters." This is a first-contact-with-aliens story, although it isn't exactly the *first* contact. Besides publication of her story in the Spring II issue of *Technolog,* Paula will receive $75.

Gordon Plorin, one of last year's winners, has done it again with his story, "Slow Descent." Gordon's story poses some interesting questions about the desirability of certain ecological niches. "Slow Descent" will be published in the Spring I issue. For his labors, Gordon will receive $50.

Third place goes to Perry Heyda, for his " The Number of the Beast." Perry's prize is $25, and his story will be found in this issue.

Honorable mention goes to Robert P. Crofford for "The Mists of Valmar."

The stories will be printed in reverse of their placement, on the theory that we're saving the best for last. The judges for the contest were John Bartelt, Steve Deyo and Bruce Kvam.

Congratulations must be given to all who submitted the 34 entries this year. It takes a lot of guts to put down your thoughts, your feelings, your*self*, on paper. If you didn't win this year, try again next year. All contestants may pick up their manuscripts at the *Technolog* office until March 31, when those remaining will be discarded.

Returning to what was said at the onset, I must remark about the common thread that ran through so many entries: war. War figured in fully half of the stories (and in all of the top four), either in the foreground or in the background. In addition, in half of those stories the war was with the Soviet Union. In contests of previous years there were always stories with war in them, but never such a high percentage.

What is the cause of this? Are writers responding to events around them, or are we just becoming more militant as a people?

I don't claim to know. I just hope we relegate the subject to fiction, rather than fact.

— Bruce Kvam

Science Fiction Contest 3rd Place Winner

The Number of the Beast

by Perry Heyda

"*Yes*!" screamed the old man.

So, he had finally broken. I was surprised he had held out so long; electric current torture can be rough — especially on an older man. And especially with someone like the Lieutenant pushing the buttons. I walked over to the chair where the old man was strapped in. He just sat there, completely limp, with his head hanging down.

From behind the control console, the Lieutenant spoke. "All right, then. Where is it?" There was no response; the old man didn't even lift his head. "Old man," the Lieutenant continued, "we can keep this up all day. Now where's the printing machine?"

I reached out, put my hand under his chin, and lifted his head. His skin was weathered, dry. And his eyes — they were a lifeless grey, greyer than the hair that hung in tangled disorder about his head.

"Fifteen," he whispered. "Fifteen . . . seventeen. Oakridge." I let his head drop. "Fifteen-seventeen," he repeated, "Fifteen-seventeen Oakridge."

The Lieutenant stepped out from behind the console. "All right, Harper," he said to me. "Get a driver, get out there, and clean it out."

I looked at him with surprise. "Alone?" I asked.

"Nobody else available," he said curtly. "Anyway. Just a couple of old men. You can handle it."

"But we don't know what they're printing," I protested. "My security rating's only Four. That doesn't clear me to be alone with some kinds of propaganda, even to destroy it."

He set his hand on my shoulder and

E-WEEK '80

E-Week is fast approaching. This year, the fun begins on Monday, May 5th, and carries on through E-Day, Friday, May 9th.

A $25 prize is awarded for the best entry in the E-Week Button Design Contest. Watch for posters giving further details. Entry deadline is April 4th.

The following list of events features the Solar Collector Design Contest and the great American Alarm Clock Car Race, both which offer monetary incentives for early entries. Rules on the various events will be posted on the Blarney Board in first-floor Mechanical Engineering.

Car Rally
Paper Airplane Contest
Calculator Race
Tricycle Race
Bed Race
Wheelbarrow Race
Picnic
E-Week Button Design Contest
Solar Collector Competition
Chess Tournament
Backgammon Tournament
Softball Tournament
3-Man Basketball Tournament
Foosball Tournament
Pin Pong Tournament
Shamrock Hunt
Blarney's Castle
IT Dinner Dance
Great American Alarm Clock Race

For more information, call Plumb Bob at 331-8078.

said, "There's nobody rated Five to go along. Besides, you're a smart kid. And I trust you. Handle this okay, and maybe we can get you that number Five security rating."

Well, that made my day. I'd been wanting a security promotion for months. So I just nodded my head and smiled. As his hand dropped away from my shoulder, I noticed the new tattoo on the back of the Lieutenant's hand. Then I remembered.

"Aw, Lieutenant," I said. "I can't go. I'm scheduled for marking in half an hour."

He turned to leave the room "I'll reschedule you," he said. I followed him out.

"But I've been waiting for this ever since they announced it."

"Another day won't hurt," he said. "It's still a week before we start enforcing it."

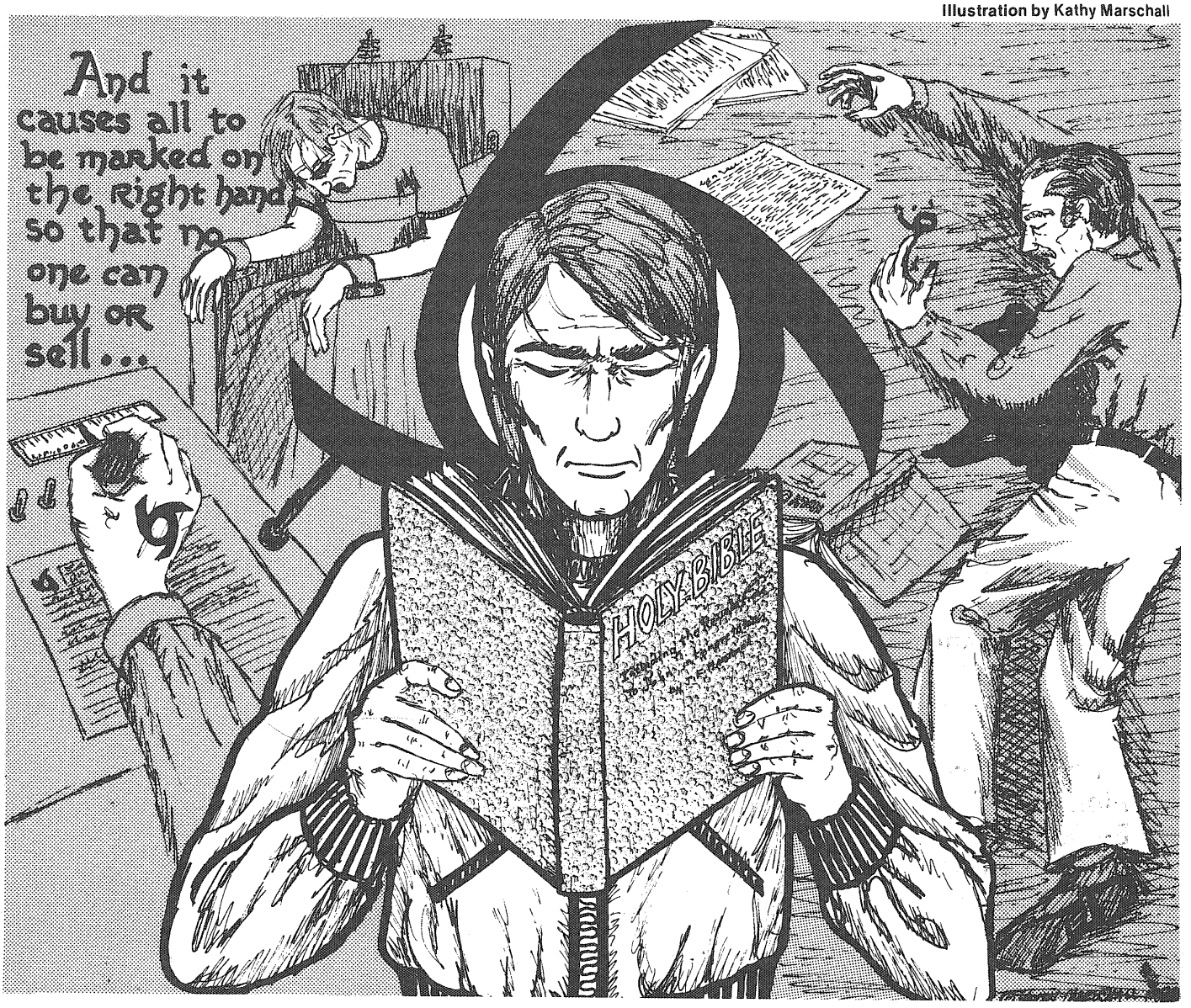
He was right, of course. For the rest of the week we could still buy food, withdraw and deposit at banks, check into hospitals, all without Dolan Leander's mark tattooed on our hand. But it wasn't only that I'd soon need the mark just to get by. The whole purpose of the thing was to display our allegiance, a token of our faith. And I believed in Leander. He had been sent by God, no question about that. I had seen his powers myself. No magician's tricks. He was the real thing; I would be proud to show my belief. It was easy for the Lieutenant to say "another day won't hurt." He had already gotten Leander's tattoo. Still, no point in arguing with him. So, I'd have to wait another day.

I stopped off at the armory and picked up a case of explosive cartridges to replace the old lead-nosed ones I usually carry in my '45. If I did meet any resistance, an exploding bullet in the gut would sure slow it down. I shoved the case into my jacket pocket and stepped out of the stationhouse.

There was a light mist blowing through the air, and it burned my skin as I walked. I muttered a sarcastic "thank you" to the days of industrial development. Still, it could be worse. The acids in the water claimed fewer lives every year.

On the street, an unmarked car sat waiting for me. She had the hull of an ancient, pre-War patrol car. But underneath she carried the latest Police-issue electric drive, and she'd top 180 miles per on a smooth straightaway. She sure looked like a junker, through, painted-on rust spots and all. A most convincing dception. I climbed in.

Illustration by Kathy Marschall



"Lieutenant tell you where I'm headed?" I asked.

"Somewhere on Oakridge," said the driver.

"Fifteen-seventeen," I replied. The car's hum changed pitch, and we accelerated away. I looked back to the Ecumenical flag flying in the stationyard: a circle with three outwardly spiralling arms. Then I looked back to my hand, imagining it written right there, a declaration of my faith for the world to see. Sure, anyone willing to lie about their allegiance could get the tattoo too, but at least this would weed out the radicals who wouldn't lie on their loyalty oath. Without signing the oath, they couldn't get the tattoo. Without the tattoo ... it would be difficult to get by. If they tried to buy food, to buy anything, without the mark, we'd pick them up. The Tribunal would deal with them.

I dug the case out from my pocket and started loading the new shells. Actually, I didn't like to kill. But we were under martial law. I was a cop; enforcing the law was my job. And there were just certain things that martial law would not allow. Like the filthy, stinking propaganda these old creeps were printing up. That kind of stuff could cause big trouble in times like these. The War had wiped out almost everything that had been; Dolan Leander was starting to pull us back into a nation again. But he would need a free hand to do it. Then you get these fools screaming about censorship. Well, it was only temporary, and necessary until this new nation that Leander was forging had settled. I gave the last shell an angry shove into place and snapped the gun closed. The penalties for disobedience were stiff. For distributing or reading anti-government propaganda, the jail terms were long and unpleasant. In some cases the penalty was death, like with the Bible.

Not that the Bible was outlawed! No, not by any means. But some of these people were trying to add another portion to it, full of blasphemies and lies. Reading that carried a sentence of death. It seemed mighty stiff, but we had Leander's assurance that it was necessary. Leander's word was the word of God, and that was all we needed.

The car rolled to a stop at the corner of Oakridge, and that cut my musings short. I had justified to myself what I might have to do in there; now it was time to go do it. I climbed out and started walking along the sidewalk. The car hummed past me, turned the corner, and parked out of sight. I was just walking past fifteen-twenty-three. Counting ahead, I spotted the house. A nice house; cheap, but nice. A little one-level job. One garage. Liveable. A nice neighborhood, too. Down the street, a couple of houses flew Leander's Ecumenical flag, the circle with three spiralled arms. Christianity, Judaism, Islam. The Ecumenical movement. Leander was bringing it all together. He would do it, too, if we could just give him enough time. Freedom of the press would come after we had order.

Fifteen-seventeen. I turned into the yard. Just act natural — that was the trick. Act like you belonged there. Then, if any of the neighbors were in on it too, they might not think anything of me. I just had to hope that the door was unlocked. I reached out and grabbed the knob.

Locked. It figured. I tried to look surprised, then reached into my jacket like I was going for my keys. My fingers wrapped around one of my three EVB's. Hiding it in the palm of my hand, I reached out and touched the metal end against the knob. A quick squeeze, and the little package let loose its electrical charge; the lock mechanism was burnt open in a second. I pushed the door open, slipped in, and closed the door behind me.

Drawing my gun, I looked around. At least there was no one waiting for me.

As an afterthought, I dropped the EVB to the floor — it was useless for anything now. I blinked my eyes a few times; some of the acids from the air were still burning. My vision had to be clear, especially since I was handling this one alone. There was nobody else to see what I might miss.

Sliding along the hall, I came to the first room. I flicked the knob and pushed on the door. As it swung open, I aimed my gun and got ready to blast . . .

The toilet. And empty, too. I smiled a little. It had taken the edge off my nerves.

I pushed open the next door down the hall. It opened into a library. But not a library of microfilm. A library of books! The whole room was filled with them, all over the walls. I just stood there and looked. I hadn't seen so many books in one place in years. No time for browsing, though; I had to keep moving. Stay in one place and someone's bound to find you; better to find them first.

There was one more door in the hall. I gently pushed the door aside with my foot — and there it stood, along the far wall: the printing machine. An old one, at that; but operable. Had to be some kind of variation of a photocopier. But how it worked didn't matter. The fact was simply that it did work, and it was obvious what it was being used for. The walls were covered with it: pamphlets, leaflets, posters. Anti-Leander, anti-Ecumenical trash.

I walked over to the table standing beside the machine. There they were . . . a whole stack of those biblical sequels. Beside the stack lay a thicker book, freshly printed. The title read "Holy Bible," and it was subtitled "including the Revelation to John, interpretation by R. F. Hartman." Revelation, that was it. I remembered hearing the name. So now they were even printing up copies of the Bible with this "Revelation" thing right in it. I slid the book off the table, and it fell open-faced onto the floor. Across the table, there was another Bible, a little paperback copy, and I picked it up. The title read simply "Holy Bible." I smiled. None of this "Revelation" garbage. And opening it to the back, what did I find? "The Revelation to John"! Printed right there, as if it belonged. I flipped back to the front, looking for a copyright . . . a printing date . . . anything . . . 1977.

My mind took off. 1977. Before the War, before Leander; like the old man had said. Leander had said that this last chapter was a forgery, an attempt at slandering him. But this printing date said it existed before anyone had even heard of Dolan Leander. Running my fingers over the pages, I shook my head. If the book were a fake, if it really were printed *after* the War, they had done a good job of making it look old. An awfully good job.

I looked up from the book; someone was coming down the hall. Dropping the book back on the table were I'd found it, I crouched down behind the printer and listened. He was coming this way, all right. He must have come in through a back door; if he'd come in through the front, he would have seen the doorknob fried open. But it was obvious from how much noise he was making that he thought everything was safe. That put all the odds on my side.

> "Dolan Leander," he said to me, "has come to us as a fulfillment of prophecy."

I heard him come into the room, so I poked my head around the corner of the printer. It was another old man, like the one at the station. He stood there, looking at the newly-printed bible I had dumped on the floor. He shook his head and went over to it. When he was stooping to pick up the book, I stepped out from my hiding place, aimed, and cocked my pistol. The *click* was plenty loud, and he froze; didn't move an inch. Then he straightened up and carefully laid the book back onto the table. He turned and faced me.

"You're from the Police?" It was more a statement than a question.

I nodded. "Party's over, old man," I said, trying to hide my nervousness. His eyes wandered across the walls.

"Do you intend to kill me now?" he asked matter-of-factly.

"No," I said, studying him over the sights of my pistol. "No, I'll leave that to the Tribunal." Then I decided to sound forceful. "Unless you try something stupid, in which case I'll blow you away right here and now."

"Yes," he said distantly. "And the Tribunal will most certainly execute me." His eyes met mine. "You're using explosive cartridges, young man?" I stared with confusion into those tired old eyes. He had me worried.

"Yeah . . ." I finally said.

He just stood thinking for a little while. "Then either way death will come swiftly, and—relatively—painlessly." I didn't like his tone, not one bit. I tightened my grip on the pistol.

"So," he said abruptly, "I may as well make my passing useful. I shan't be able to say these things to the Council. I'll be gagged if I try. So I'll say them to you." His expression had changed. I knew the look. It was the look of a man prepared to die.

"Dolan Leander," he said to me, "has come to us as a fulfillment of prophecy."

"Huh?" I said in astonishment.

"His near-fatal injury in the War was foretold in the book of Revelation."

I leveled my gun on his stomach. "Shut up, old man!" I yelled. Still he kept talking, as if he hadn't heard me.

"That he would require his mark to be placed on us was foretold also . . ."

"Last warning, old man! Shut up or I blast you."

"Let him who has understanding reckon the number of the beast . . ."

"Old man!" I screamed. "I mean it!"

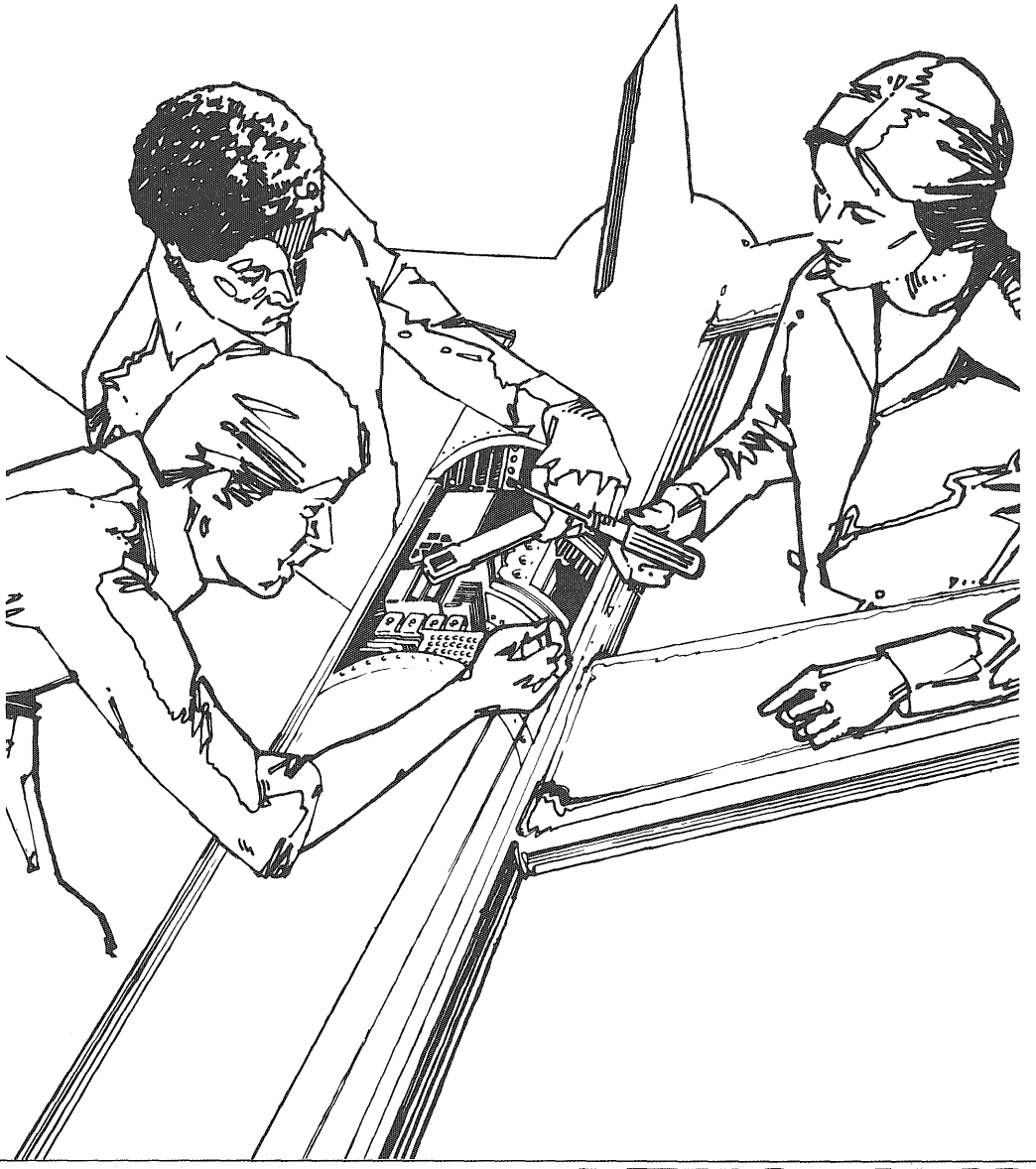
"For it is a human number; its number is six-hundred and sixty-six."

I blasted away — three shots into his gut. He slammed back against the wall, then slid to the floor in a sitting position. I lowered my gun. I couldn't even remember hearing the shots.

Somehow, he was still able to move. He slid his hand up to the holes in his stomach. They were small holes; they belied the extent of the damage. Three exploding shells . . . there was nothing left together inside his belly. And yet, for a last few seconds, he lived. As he slid over onto his side, he reached out his bloodied hand and wrote, in blood, on the floor. As I walked over to his side, he died. He had drawn a symbol, like a six. I recognized it. He had been trying to draw Leander's Ecumenical symbol.

"A little late, old man," I whispered. Leaning against the table, I holstered my gun. I was empty; just completely empty inside — like someone pulled a plug inside me and let me all drain

GENERAL DYNAMICS



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away. This wasn't the first time I had had to kill, but it never changes. When it hits you just what you've done, the effect is always the same. So I just sat there resting.

I suppose I should have gotten out of there right away, but I didn't. What the old man had said kept coming back to me, about how all this stuff about Leander was foretold in this "Revelation." Even something about a fatal injury. Leander had almost died in the War from metal fragments when his wing man's reactor overloaded and blew. And about having people marked. That one gave me a chill. But then I shrugged it off; the old man had said something about it being a number . . . six hundred sixty-six? Leander's mark was the Ecumenical symbol. I looked down to what the old guy had written in his blood. And then I saw it. The symbol — I realized what it was. The circle, with three curved arms; three sixes, blended together!

I started to feel sick. Leaning back against the wall, I tried staring at the ceiling. But I kept on seeing the symbol, kept on seeing those three sixes the old man had talked about, coming together into that shape.

Things started to fall into place for me. Reading anti-government literature carried a heavy sentence, but reading that last book meant the death sentence. Of course. If the book really said all that, if Leander was who they said, he would have to outlaw the book, and destroy it, to get into power.

So it all came down to one thing: Did the book, the Bible printed before the War, before Leander came to power, really say those things? The paperback Bible lay right beside me on the table. And suddenly, I didn't care about the risk of being caught; I had to know. I flipped to the last book again, and started skimming.

It didn't take long. Chapter thirteen, verse twelve: ". . . the Beast, whose mortal wound was healed." And, at the end of the same chapter: ". . . and it causes all to be marked on the right hand so that no one can buy or sell unless he has the mark . . . of the Beast."

I closed the book in my hand. From every wall of the room, the posters were screaming the truth. I walked slowly to the door. Turning back, I looked over what I had done.

Time to call in to the Lieutenant. I wouldn't be able to tell him all of what had happened, of course. I'd be shot for reading what I'd read. I held up the tiny Bible again. There was something important going on here. Something really important. Maybe I could change it, maybe not. In any case, I had to know what was going on. And tomorrow I was scheduled for marking.

I looked to the back of my hand . . . to the spot where, earlier in the day, I had so eagerly wanted the tattoo. Tonight I was going to have to do some reading. So I buried the old book deep in my jacket pocket, turned again, and walked out.

Perry Heyda, a junior in psychology at the University, won third place in the 1980 Technolog Science Fiction Contest.

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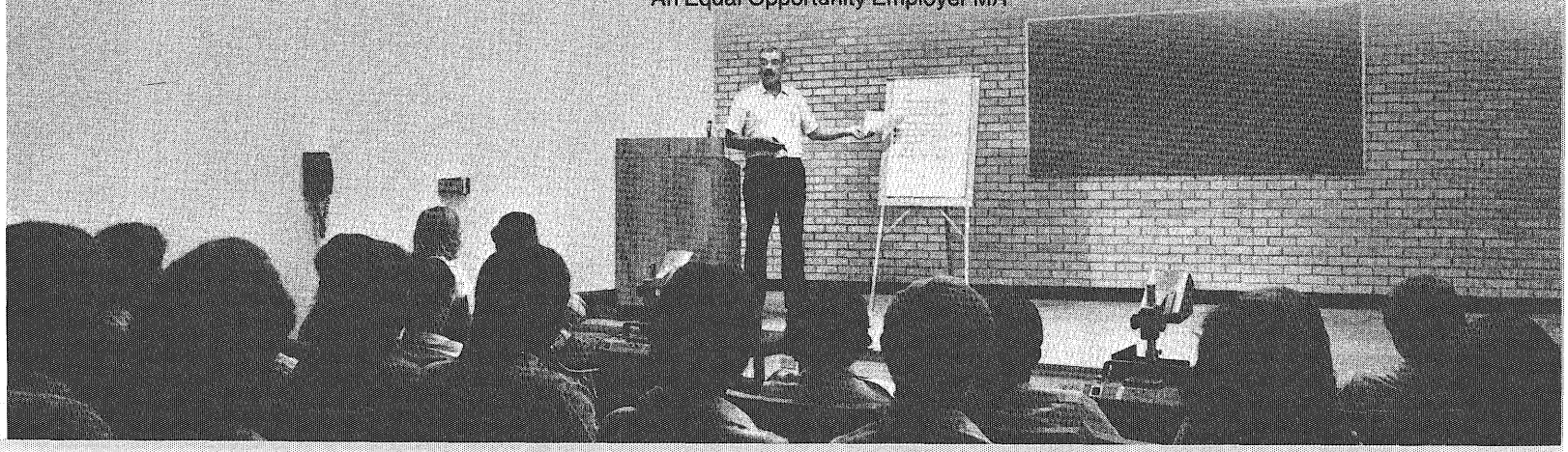

Log Ledger

News

Wearing hard hats limits mobility in laboratory animals, according to a study by a Texas A&M senior. The study was a spoof on cancer research using laboratory animals.

Groundbreaking for the Civil and Mineral Engineering Building was on February 5. Ninety-five percent of the $16-million building will be underground.

The late Katherine Ordway has left **$1 million for the Department of Mathematics** to establish the Samuel G. Ordway Chair in Mathematics in honor of her deceased brother.

Scientists from the Department of Physics and Astronomy were in Hyberbad, India to continue research on the melting point of dust before witnessing the total eclipse of the sun there February 16.

The American Nuclear Society has concluded **storage of used nuclear fuel is technically sound** and has urged the Government to proceed with an away-from-reactor used fuel storage facility.

The U.S. Department of Energy has opened a **National Alcohol Fuels Information Center.** For information call (800) 525-5555.

Articles are being accepted for consideration for the December 1980 issue of *Annals of Engineering Education.* Articles should be of enduring significance to engineering education. For further information, see the *Technolog* office.

The past decade has brought **a rapid decline in patents granted to Americans.** In response, President Carter plans to provide incentives and aid for small businesses and inventors.

Astronomers at the California Institute of Technology and University College in London believe they have found **clouds left over from the "big bang."** These clouds may be the oldest material ever seen in the Universe, they say, and could tell us how the first stars and galaxies were formed.

A "super bubble" 1,200 light years in diameter with a temperature of 3.5 million degrees Fahrenheit was found by Webster Cash, University of Colorado astrophysicist. To get that hot, he said, the bubble must contain about ten times as much energy as our sun has given off in its entire life.

Pluto may not even be a planet, according to Kris Davidson, Department of Astronomy. Although it has many properties of a planet, recent observers have concluded that Pluto is probably composed of ice, and more like an asteroid than a planet.

In addition, Pluto swung inside Neptune's orbit in January of 1979 and will be closer to the sun than Neptune for the next 20 years.

Pluto was accidentally discovered fifty years ago last January 19.

Demand for telecommunication services in America is expected to quintuple by the year 2000, recent studies reveal. Telephone demands will still predominate, but satellite video and data communications use will increase.

Department of Astronomy's Roberta M. Humphreys has studied the most distant stars ever observed outside the Milky Way. The stars' characteristics are like those of our galaxy, which suggests the laws of physics are the same throughout the Universe.

The Department of Defense has proposed a $1-billion purchase of **solar-generated electric systems** for its 4,600 Nevada MX missile sites, to start in 1982.

General Electric will build **an experimental car with both gasoline-powered and electric drive systems** for the U.S. Department of Energy. The car will use less fuel than conventional internal-combustion automobiles and will have greater range than all-electric cars.

A National Research Council panel concluded that **hydrogen is unlikely to find much use as automotive, aircraft or heating fuel** while hydrocarbons are economically available, because hydrogen is currently more expensive.

Current data suggest that **the potential effects of supersonic air transports on stratospheric ozone** "are smaller than previously predicted, but that those of halocarbon releases are greater," according to a National Research Council panel.

The public will have to accept **nuclear power as an energy source,** and by 1992 there will be a surge of nuclear plant construction, predicts Robert E. Kirby, chairman of Westinghouse Corporation.

NASA had a perfect launch record in 1979, the second year in a row and the fourth in its 21-year history.

Preliminary planning is underway for a competition to select **college student experiments to be flown aboard NASA's Space Shuttle** in the 1980's.

Engineering graduates received 24 percent more job offers in 1979 than in 1978, according to the College Placement Council.

Engineers represented only 6 percent of all baccalaureate graduates that year, but accounted for 61 percent of all offers at that level.

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1980 Communicators Directory
By the American Nuclear Society. Names, addresses, phone numbers, and other information about 500 experts in general energy needs. Write: American Nuclear Society, 555 North Kensington Ave., La Grange Park, IL 60525.

Geological and Hydrologic Aspects of Tunneling in the Twin Cities Area
A study of rock and water conditions under the Twin Cities prepared by the U.S. Geological Survey and the Minnesota Geological Survey. Write: Minnesota Geological Survey, 1633 Eustis St., St. Paul, MN 55108. Cost: $11.

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Seminars

AEROSPACE ENGINEERING AND MECHANICS
RM. 225 AERONAUTICAL ENGINEERING — 2:15 PM

April 4
"Supercritical Flows Without Shock-waves"
Prof. A. Richard Seebass, Department of Aerospace and Mechanical Engineering, University of Arizona

April 11
"On Some Singular Problems in Nonlinear Elastostatics"
Prof. Eli Sternberg, Division of Engineering and Applied Science, California Institute of Technology

April 18
"Instabilities and Transitions in Flow Between Concentric Rotating Cylinders"
Prof. Richard C. di Prima, Department of Mathematical Sciences, Rensselaer Polytechnic Institute

April 25
"Beneficial (Low Drag) Interactions Between Bluff Bodies"
Prof. Anatol Roshko, Guggenheim Aeronautical Laboratory, California Institute of Technology

CHEMISTRY
RM. 325 SMITH HALL — 7:30 PM

April 2
"Synthesis of Complex Natural Products and Development of New Synthetic Methods"
Prof. Robert Stevens, UCLA

April 16
"Synthetic Organic Chemistry, Transition Metal Catalysis, Unusual Molecules, Molecular Rearrangements, Neighboring Group Effects"
Prof. Leo Paquette, Ohio State University

April 30
"Organic Reaction Mechanisms and Stereochemistry"
Prof. Charles DePuy, University of Colorado

MICROELECTRONICS SEMINARS
RM. 305 LIND HALL — 3:15 PM

April 11
"Financial Characteristics of the IC Industry"
Mr. Robert Biemesderfer, Honeywell

April 18
"New Materials in Microelectronics"
Dr. John S. Shier, Sperry-Univac

April 25
"Physics of Amorphous Silicon Solar Cells"
Prof. Michael Shur, Department of Electrical Engineering

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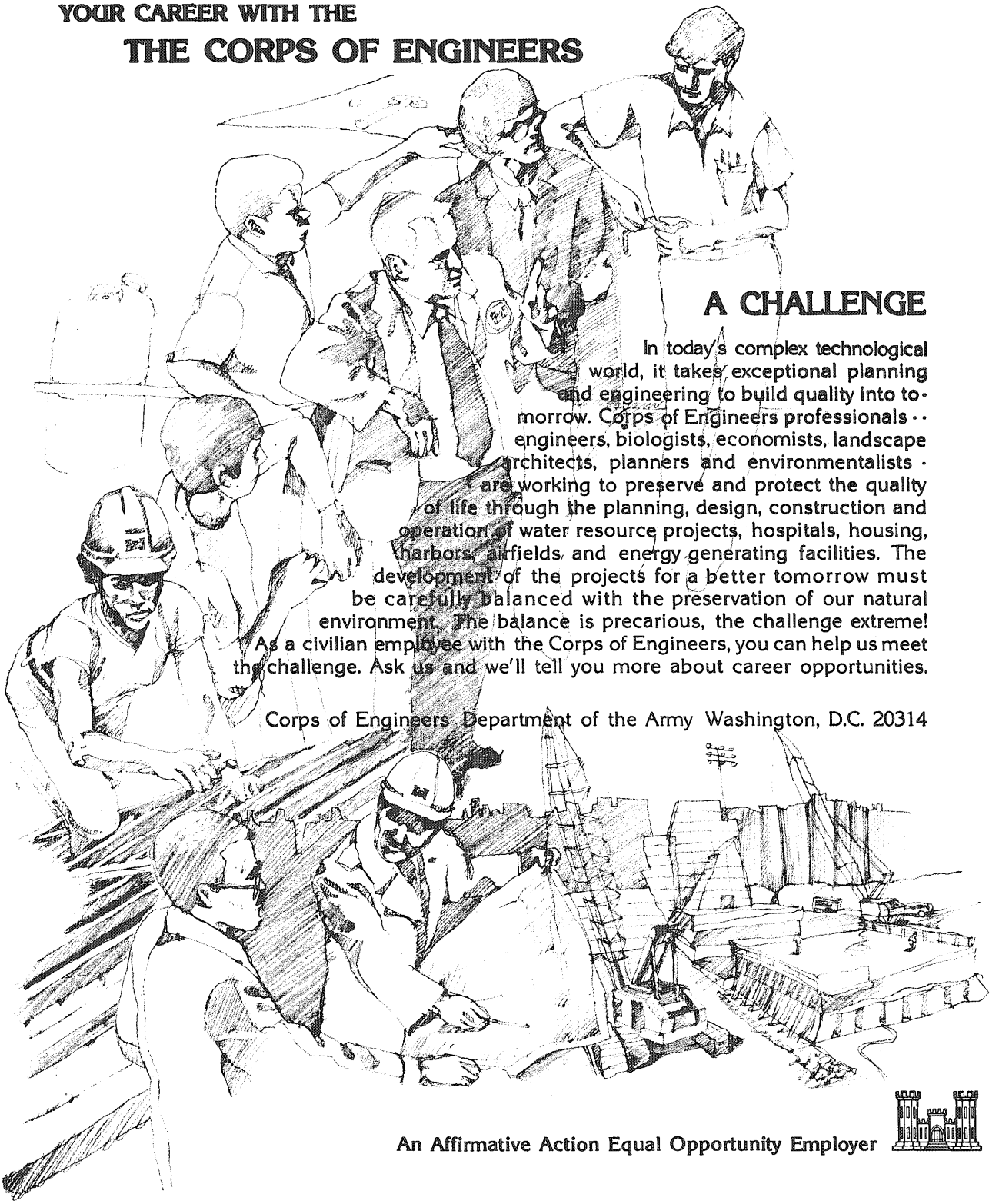

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ARCHITECTURE STUDENTS WIN IN PARIS

by Joe Metzler and Jim Rasche

The architecture students' World Information Center design was awarded first place in the Les Halles Competitions

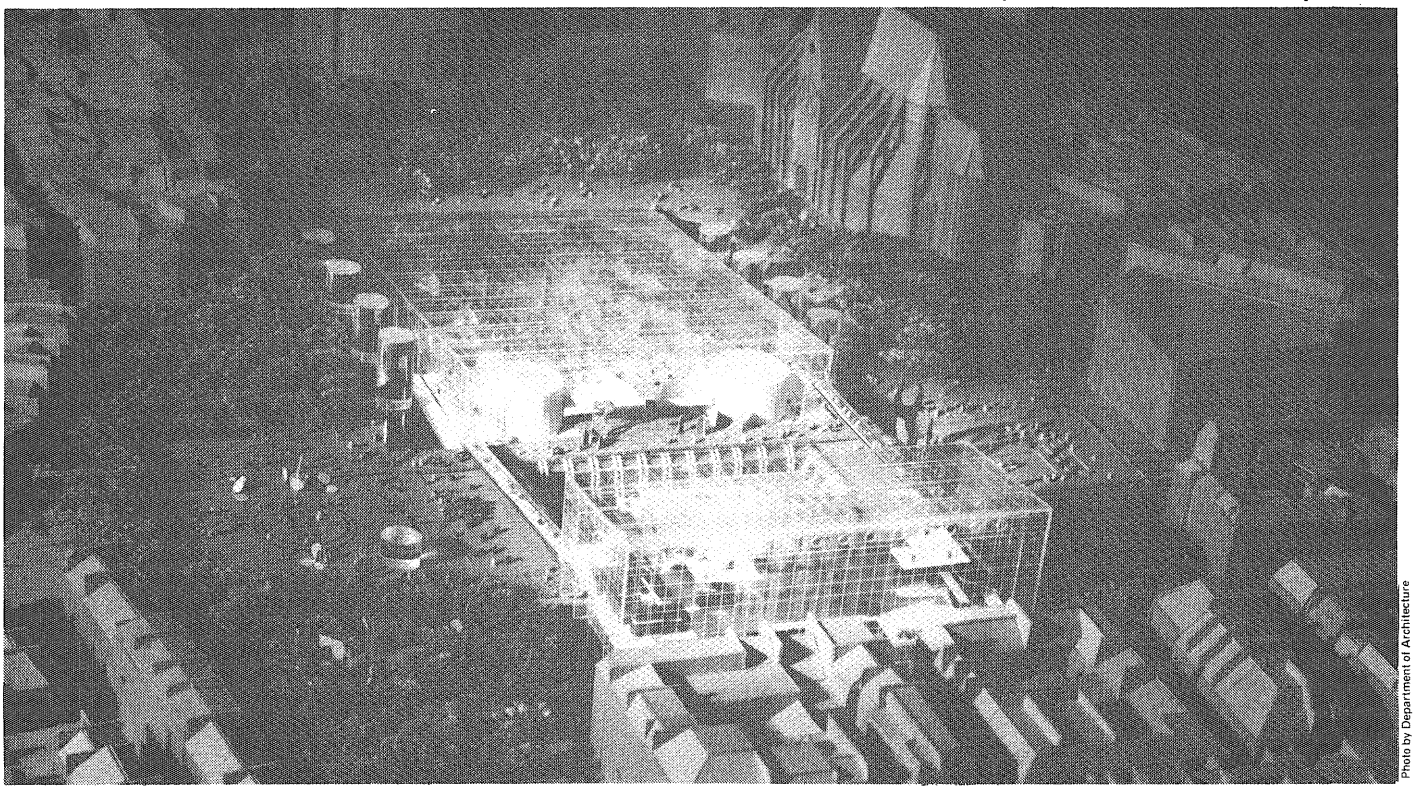


Photo by Department of Architecture

For a student, the prospect of competing directly with professionals in their own field could be cause for discouragement. There are always those who can't wait to remind you that you're "only a student." However, if your effort is recognized above those of local, and even international professionals, the thrill is such that you no longer feel like a second-class citizen.

For five architecture students from the University of Minnesota, the announcement of their first-place finish in the "Consultation Internationale pour l'amenagement du quartier des Halles de Paris" provided just such a thrill. The "Consultation" was an international architectural design competition open to students and professionals the world over. The winning Minnesota entry, one of three University student entries and three from the local profession, was one of five "laureats" given by the jury in the competition.

The selection of winners was only the latest in what has been a long series of events involving the Les Halles quarter of Paris. Since about 1110, this area has housed the central markets of the city. Eventually, the increased amount of traffic became too much for the neighborhood to handle. In 1969, the market was moved out of the city to a site near Orly Airport. The twelve large iron and glass pavillions, designed in 1845 by Baltard, were all that was left of the market.

A plan to conserve the past through restoration and develop the central area into a focal point was adopted that same year. Two years later, despite massive protest, the pavillions were demolished.

An underground portion of this first plan has been implemented. It contains a pedestrian concourse lined with shops and galleries, the final section of the RER (Regional Express Network), parking, and an underground road linking this complex to the new Centre Georges Pompidou which is four blocks east. The remainder of this plan called for an International Trade Centre along with a cultural complex and a hotel. For environmental reasons, this portion was never built, except for a windowless, 5000-square-feet triangular building which contains a power plant and support systems.

The Spanish architectural firm Taller de Arquitectura was hired and unveiled a new proposal in 1976. The major portion of this plan included a formal garden surrounded by public housing, shops, and a hotel. The project was started but eventually stopped with the election of Jacques Chirac as the first mayor of Paris in March of 1977. All that remains of this proposal are two abandoned foundations.

Chirac promptly appointed himself "Head Architect" for Les Halles and, with the help of various teams of architects he hired, a new proposal was developed for the area. In February 1979, this new plan was made public and approved by the Council of Paris. The plan called for a garden and amphitheatre to be built above some underground space, with a luxury hotel and public housing above ground. In response to this official project, a group of French architects, the "Syndicat de l'Architecture de l'Ile de France" took the initiative on April 2 to organize a competition.

In September 1979, seventeen fourth-year architectural design students, under the guidance of

Thomas Hodne, a Minneapolis architect, entered the competition. The project was undertaken as part of their regular course work for the quarter. Initially working individually, and later joining to form four teams, the students generated four different proposals. Then the projects were developed in more detail. After fall quarter, three of the groups put together presentations which had to be sent to Paris by December 18.

The official announcement of the winners was made on January 25 by Philip Johnson, an internationally prominent American architect and one of twenty jury members. The Minnesota project of Richard Ness, Shi Ming Tam, Ngu Aloysius Bongwa, James Dahlberg and Timothy Dray was selected for first-place honors, along with projects from New York, Atlanta, Rome, and a joint Paris-Florence project.

Officially, the competition organizers were looking for a site use or program idea in addition to a proposal for architectural development. Of the five first-place winners, only the winning Minnesota proposal attempted to address the problem of use.

The winning Minnesota proposal has little if any chance of ever being implemented. Although the organizers stated that the selection of a counter project would permit the "proposal of a clear alternative for the development of the Halles neighborhood, a last chance," the selection of five winners, instead of just one, somewhat clouded the "clear alternative."

Although at one time Mayor Chirac indicated he would consider implementing some of the winning ideas into his plan, he has now refused to even view the projects while they are on public display in Paris. Organizers of the competition indicated they believe it is important for him to quickly implement his plan with elections coming up in about two years.

The competition has resulted in public debates being held on the whole Les Halles issue. While it may be too late to change Les Halles, the possiblity exists that arguments brought forth by such debates will have an impact on the design of future major Paris development projects such as La Vilette, Bercy and Quai Citroen. Only time will tell the exact impact five University students can have on Paris.

Joe Metzler and Jim Rasche, both seniors in architecture who entered the Les Halles Competition, researched this article in Paris.

The winning Minnesota team, left to right: James Dahlberg, Shi-Ming Tam, Aloysius Bongwa, Timothy Dray, and Richard Ness.

Photo by Department of Architecture

what about U.F.O.s?

Illustration by Steve Anderson

by Steve Deyo

First off, "unidentified flying object" (UFO, pronounced "you-foe") is a biased term which presumes a material mass in flight motion. But not all UFOs can be inferred to be solid. Nor are all UFOs observed to be in motion, much less motion than can be described as "flight" as we know it.

To evade these inconsistencies noted by many UFO experts, I propose the term "unidentified aerial phenomenon" (UAP, pronounced "whap"). The term "aerial" cannot be apply specifically to UAPs which have grounded themselves temporarily (and neither does "UFO"), but it does describe their normal environment and nature of their motion before and after grounding. The term "UAP" is, I feel, more accurate than "UFO," would be acceptable to the experts, and will be used here throughout.

"There are three facts about UAPs regardless of what a person may *a priori* believe or not believe," said Dr. J. Allen Hynek last November in a Twin Cities "UAP Update" talk. "And these are undeniable facts, that even the most ardent sceptic can't possibly deny.

"First of all, UAP reports persist. Not only do they exist, but they persist. Secondly, they are a world-wide (phenomena)." (Dr. Hynek has about 110,000 individual reports on file from 135 countries.) "And finally, many of the reports come from responsible, serious witnesses of considerable integrity; some with considerable technical training."

Hynek, an internationally-known authority on artificial satellites and stellar evolution, has studied UAPs for over 30 years, 19 with Project Blue Book.

Hynek devised our current system of UAP classification, summarized below.

Well, what is a UAP? Hynek defines it as "the reported perception of an object or light seen in the sky or upon land; the appearance, trajectory, and general dynamic and luminescent behavior of which do not suggest a logical, conventional explanation; and which is not only mystifying to the original percipients but remains unidentified after close scrutiny of all available evidence by persons who are technically capable of making a common-sense identification, if one is possible" (Hynek, *TUE* p. 12).

Sighting Characteristics

And they're not rare. The Western Defense System runs 1700 "uncorrelated targets" a month. More than 10,000 newspaper stories on reported UAP sightings alone were printed in 1966. And that wasn't even a "boom year."

Not all UAPs get reported, of course. People are afraid of ridicule or publicity — or, as we will discuss later, they have been ordered to keep silent by the mysterious "Men-in-Black."

Jacques Vallee, NASA astronomer, computer expert, and UAP analyst of over 25 years, has together with Hynek determined a scale of report probability based on "strangeness" of the sighting *(see Table 1 and Figure 1).* Notice how many sightings are estimated to go unreported. Hynek has found it is *not* true that the "strangest"

sightings are reported by the least unreliable witnesses. The case is exactly the opposite.

Precision journalist John Keel, UAP investigator of 35 years, has discovered three odd patterns.

First, 20.5 percent of a given week's sightings occur on Wednesday night. From then, percentages drop steadily throughout the week to 7 percent on Tuesday, with the exception of Monday (13.5 percent). And jump to 20.5 percent again, Wednesday night. This does not mean UAPs are out *every* Wednesday night. But with one exception, every major "flap" (numerous sightings ocurring simultaneously in many widely scattered areas) has taken place on a Wednesday.

Now, the most sightings *should* be reported on Friday and Saturday nights, when more people are out of doors. Not so. Friday and Saturday claim only one-seventh each of a given week's sightings.

This is closely connected with the time of day of sightings. Sightings peak at 10 pm and 3 am *(see Figures 3, 4, and 5),* holding at maximum between these hours — when most people are in bed, *when the risk of observation is least.*

Second, UAP flap reports seem to cluster within geographical boundaries. Minnesota sightings in the August 16, 1966 flap, for instance, were confined within state borders. Very few or no sighting during flaps are ever reported along or within neighboring states' borders.

If UAPs have pilots, they seem to be aware of and operate within our own calendar time and mapped boundaries.

Does this sound like the work of extraterrestrial strangers?

Third, sparsely-populated areas have a higher ratio of sightings than densely-populated areas. The reverse should be true. Yet UAPs seem to prefer remote regions *where they are least likely to be seen.* When discovered, they usually take off immediately or disappear into thin air.

Unless they allow themselves to be discovered.

Once A Flying Saucer . . .

Reports of UAPs and UAP "occupants" didn't begin at Kenneth Arnold's buzz with a fleet of silvery "flying saucers" June 24, 1947. While I do not agree with the self-styled theologians' contrived interpretations of "what the Bible *really* meant" (*a la* Von Daniken), classical historians have recorded references to aerial lights, airships, and "forms of men." Their accounts, brief and curious, are better evaluated objectively if not wrenched out of context and infused with modernistic presuppositions and wild-eyed speculations.

In A.D. 840, Agobard, Archbishop of Lyons, wrote of witnessing the stoning as demons of three men and a woman who arrived in "ships that had come from the clouds" to trade with the peasants for food. Gervase of Tilbury writes of an aerial ship which caught its "anchor" (many of these things flew with an anchor hanging down) in a pile of stones near Bristol about A.D. 1207. An occupant descended to free the ship, was noticed by curious citizens, fell apparently asphyxiating to the ground, and died.

Strangest of all, however, were the airship sightings reported from November 1896 to September 1897 in California, Iowa, Illinois, Michigan, South Dakota, Texas, and Washington, D.C. A sixty-foot-long craft equipped with a powerful searchlight was often seen floating through the night skies. Its occupants were reported to jabber in unintelligible languages on some occasions; on others, they hailed ground observers in English, conversing with them, announcing their destinations, or landing to request supplies. The ship was also reported to snag one pedestrian's clothes with a dangling anchor; lasso a calf, haul it off bodily and later discard its butchered carcass; drop half-peeled potatoes or other debris at the feet of gawking observers; and land to take on fresh water. In their conversations with ground-dwellers, occupants — the ones who spoke English — described the ship on separate occasions as run by "compressed air," "condensed electricity," and a thin "anti-gravitation wire." One occupant, boasting of ownership, said he planned to visit Mars before putting his craft on public exhibition. We know he never did the latter.

The full and often bizarre details are available elsewhere (Keel, *WUFOs* pp. 69-93). What is important, however, is the claim to ownership a dark-eyed, dark-skinned stranger made in San Francisco a few days before the sightings hit the papers. The stranger confided to the town's two most reputable men that he had invented the airship and would soon place it at the service of mankind. This was publicized widely, but he never fulfilled his promise and disappeared with the sightings.

During 1897, this "press agent" ploy was pulled again. Letters, technical navigation notes, and discarded lunches were found, presumably dropped by the airship crew. One letter read, "I am the famous airship constructor, and I will guarantee you positively of this fact in one week. The airship is my own invention and I am an Omaha man." The inventor never showed up, and the sightings eventually ended.

What are the salient points of these reports?

One, there were a lot of airship sightings for almost a year. Two, reported occupants varied between "normal types" (bearded men with women), dark-skinned Oriental-looking types, and one instance of an unidentifiable creature. (Keep the dark-skinned characters in mind.) Three, the normal types conversed with observers freely, explaining the airship and its purposes — often in preposterous detail — while the other types made real efforts to hide themselves when discovered. And four, from their conversations, the occupants apparently knew a great deal about us, our history, and our language.

Could the "normal occupant" sightings and contacts have been used as a "front" for the other occupants' real purposes?

In whatever age of history a UAP appears, it has remained slightly ahead of the current technology — whether chariots, ballons, airships or vehicles capable of non-inertial space travel. In 1897, lighter-than-air ships were on the brink of discovery.

What better way to distract widespread attention than to place a decoy — the old "new-invention-about-to-be-unveiled" gambit?

Thousands heard of the marvelous "invention" and believed. Others read the conflicting details and remained sceptical. In any case, no one investigated the reports. To the uninformed American in 1897, there was only one experimental ship. Whatever they saw in the skies, identifiable or not, must have been the airship, right?

Except we now know there were at least several ships.

The "inventor," if he was sincere, never filed for patents. If this were a ruse, who would want to camouflage their aerial activities? And why?

But enough speculation. What are UAPs doing today?

Extraterrestrials?

If UAPs are manned by aliens, I question whether they would categorize intelligent life.

Any alien who would design and fly a craft of the configurations of the Socorro UAP must comprehend geometrical symmetry like a Neanderthal *(see Figure 6).*

Alien contacts say they live on Uranus, Saturn, Jupiter, Mercury, the moon, "the planet *(sic)* Ceres," "the

galaxy *(sic)* Ganymede," a host of unknown planets (Clarion, Maser, Blaau, Korendor, Fowser, Zomdic to name a few), and, of course, Mars. Do you believe them?

Even if these "aliens" have travelled light-years to reach Earth, I'm surprised they've made it this far. Their crafts leak liquids, drop junk, explode, and are constantly being "repaired."

Physical traces left behind turn out to be perfectly normal Earth matter — even the four wheat-germ pancakes two aliens gave Joe Simonton of Eagle River, Wisconsin, hot off the griddle.

"Pieces of the damned things (UAPs) are always falling off where they can be grabbed up by eager UAP investigators. If the UAPs were real, (they would) seek out a very isolated hilltop to make repairs. Instead, they prefer to land in fields of occupied farms and on major highways close to big cities" (Keel, *WUFOs* p. 166).

"There must be alien life somewhere. We are not alone," runs the now trite "exobiology by sheer probability" argument. Try to prove the case in court with that kind of evidence.

It doesn't seem likely that UAPs have travelled all the way to Earth on their own. And if they have a mother ship, we've never detected it.

Most UAPs are too small to accomodate the smallest humanoid. Those that do have been observed to have no apparent machinery or controls. Occupants have been reported to float and glide about, or walk with no physical ground contact.

"The most puzzling thing about (a UAP)," says Hynek, "is its isolation in space and time. We don't get reports that a UAP has been seen in this town, and this town, and this town, like a 747 would be . . .

"Also, they don't last very long. Five to ten minutes is a very long time for a UAP.

"Then you ask the question, 'Where does it go?' It seems as though it has disappeared from our ordinary would of three dimensions."

And that's another thing. Not only

CLASSIFICATIONS OF UNIDENTIFIEDAERIAL PHENOMENA (UAPs)

NL — Nocturnal Light:
A distant anomolous light seen in the night sky.

DD — Daylight Disc:
A distant, often disc-shaped object seen under daylight.

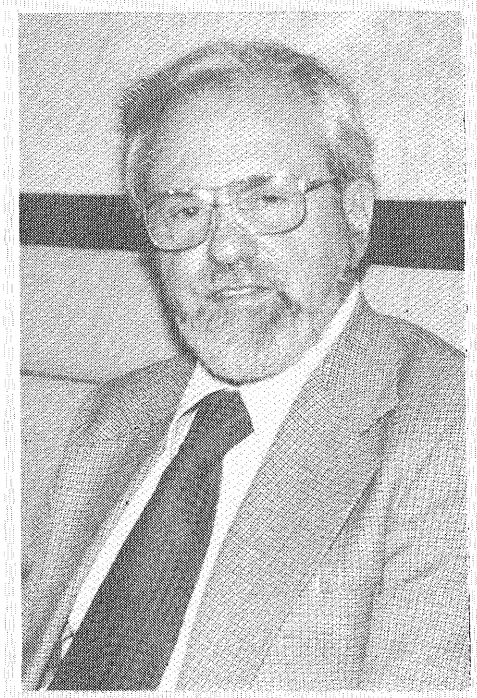
RV — Radar/Visual:
A simultaneous and accurate radar/visual sighting.

CE I — Close Encounter of the First Kind:
No discernible interaction of UAP with environment or witness. Sighting usually within 150 meters.

CE II — Close Encounter of the Second Kind:
Discernible interaction of UAP with environment, frequently with witness as well. Includes "physical effects" cases.

CE III — Close Encounters of the Third Kind:
Interaction of UAP or UAP "occupants" with environment or witness or both.

an interview with Dr. Hynek



Last November, Technolog **interviewed Dr. J. Allen Hynek, world-famous astronomer and Director of the Center of UFO Studies, 1609 Sherman Avenue, Suite 207, Evanston, IL 60201.**

H: Well, have you seen in the industrial magazine called *Industrial Engineering* that . . . made a survey of I don't know how many thousands, the majority of engineers that responded believed that the study of UFOs was important? . . . So it's rather interesting that the technical people, engineers, who, say, ten, fifteen years ago, (were) the first to say "This is all a bunch of nonsense" are now coming around to say, "Well, it ought to be studied." And I'd say that's a heartening sign.

So, do you have any questions you'd like to ask me in particular . . .?

T: I'd like to hear from your own words exactly what you think UFOs are, and how you've arrived at that.

H: Of course, I don't want to be facetious, but I think I could say in all seriousness that they're not nonsense. But if I were a medical doctor instead of a Ph.D. and you were to ask me, "Doctor, what do you really think is the cure for cancer?" you'd think I was a snake oil salesman or a quack if I gave you an answer. I mean, no respectable medical man could give you the answer. And I don't intend to be a UFO quack, I don't know the answer.

All I'll go so far as to say is I'm now convinced that it's something quite real, and *not* just nonsense as we thought — as *I* thought, for many years, it was just a lot of junk; you know, hallucinations, misidentifications, and so forth.

No, it's much more than that. There's something very definitely going on, but what?

I don't know. Maybe our problem is that we've tried to lump everything together. The *U* in "UFO" simply

TABLE 1

Strangeness Category	Example	Estimated Probability of Report	Generally Reports to Whom?
1	"firefly"	1 in 10	anyone
2	burning mass	3 in 10	police
3	unknown craft	4 in 10	military
4	landing	2 in 10	local "expert"
5	occupant	1 in 10	close family
6	personal "illumination"	almost nil	no one
7	reality gap	almost nil	unconscious mind does not report it to conscious mind

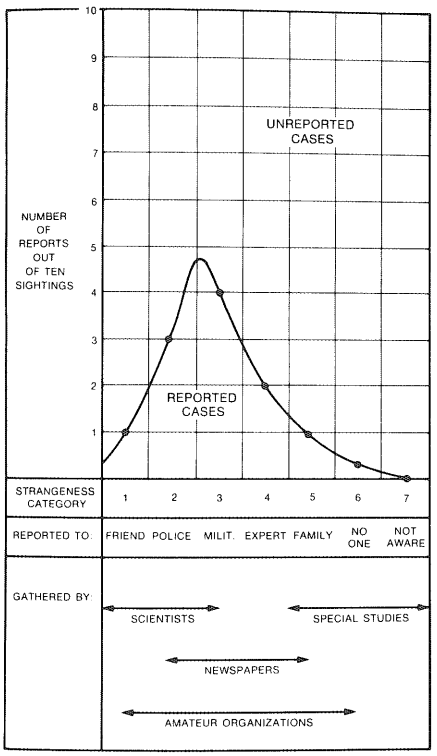


FIGURE 1

From TIC *pp. 111, 113.*

do UAPs operate within a terrestrial frame of knowledge — our history, our calendar, our geography — but they *don't* operate within a terrestrial frame of physical laws. At least, not wholly.

No conceivable craft can travel at .8 Mach speed and execute an abrupt right-angle turn. Or reverse its direction 180 degrees. Or change shape. Or split into two. Or coalesce two into one. Or disappear into thin air.

Sometimes UAPs are very physical. They smash up cars. They melt glass. They show up on radar. But then again, they're not physical.

"I am being driven to believe," says Hynek, "that we live in a multi-dimensional universe with the possibility of a parallel reality."

Extradimensionals?

Witnesses have experienced hot or cold flashes and tingling sensations at the appearance and disappearances of a UAP. During UAP encounters, car engines stall, and observers may become paralyzed, seemingly at will (when signalled by some gesture of a UAP occupant). After one UAP sighting, a witness began vomiting black puke, dying shortly after of gamma-ray poisoning. Ultraviolet face burn and conjunctivitis of the eyes are common plagues of UAP witnesses. UAP attack victims have displayed radiation sickness, leukemia, and the fatal symptoms all too familiar to the survivors of Hiroshima.

Once, a healthy Brazilian farmer was stunned by a beam of light and fell to the ground during a period of high UAP activity in the area. Within hours, and feeling no pain, his skin began to soften, grow limp, and fall in lumps off his body. Flesh slipped from bone. His nose and ears slid down his body onto the floor. He died within six hours, a virtual skeleton.

This is to point out the electromagnetic aspect of UAPs. UAP sightings frequently occur near electric power lines or transformers. UAP occupants — and Men-in-Black, for that matter — are often reported to be wearing shoes with thick rubber soles. One witness, beckoned to enter a UAP via an extended metal ladder, was warned to *jump* on because the ground was wet. Notice, too, the correlation between the Earth's magnetic disturbances and UAP activity *(see Figure 7).*

UAPs do seem to possess an electromagnetic nature. Could they be entering our visible spectrum from another energy level? UAPs are often described as purple on first sighting, red when leaving. Purple and red are at opposite ends of the visible light band.

No one talks about the purple blobs anymore. They were frequently reported in the early days of the "saucer scare," but once harder data began funnelling in, they were soon forgotten.

The purple blotches are common — more common than you know. And, when they appear, numerous. Scores of people in Seattle watched them float and swoop for almost two hours the same day Kenneth Arnold saw his flying saucers. They have been reported to maneuver at tree-top height and jump out of the way of a flashlight beam.

They exhibit the same intelligent control as do UAPs.

Could UAPs be materializing into solid matter out of their native electromagnetic dimension? We know that poltergeists and other occult phenomena can materialize matter seemingly out of nothing. Why not UAPs? Assuming that UAPs are not a composite phenomena (partly extraterrestrial and partly metaterrestrial), but completely extradimensional, an electromagnetic theory explains the data very well. A parallel reality concurrent with our own, yet of another "frequency," or plane of existence.

The full implications of this suggestion, and the full explications of its characteristics, I do not pretend to know. It fits the data, though, and makes sense. And I'm not the first to talk about it.

But there's more.

The Men-In-Black

There are those damned Men-in-Black.

"Did you ever hear of anyone — especially an Air Force officer — trying to *drink* Jello-O?" asked Mrs. Ralph Butler of Owatonna, Minnesota. "Well, that's what he did. He acted like he had never seen any before. He picked up the bowl and tried to drink it. I had to show him how to eat it with a spoon" (Keel, *TMP* p 17).

Mrs. Butler was describing the man who visited her in May 1967 after she had seen a UAP during high flap activity in the region.

He told her he was a major in the U.S. Air Force, although he was dressed in a neat grey civilian suit and wore brand-new shoes, the soles of which were unscuffed. He stood five-foot-nine with an olive complexion and a pointed face. His hair was dark, and too long for an Air Force officer.

And he didn't know how to eat Jell-O.

There are usually three Men-in-Black, when they appear. They typically arrive in a black late-model Cadillac in mint condition. They pose as military officers or government agents, yet know nothing of military procedure and, on checking later, turn out to be impostors. They confiscate photographs and "hard" data from witnesses — once even from an Air Force officer.

Their wallets and clothes are usually brand-new, and sometimes noticeably out of fashion. They have dark skin and long, tapering fingers; their faces are pointed and have a vague Oriental appearance. And they warn UAP witnesses to tell no one what they've seen.

They are reported to be either unusually tall or unusually short. They appear wearing clothes inappropriate for the weather outside, as if they have just materialized in the doorway. Their shoes may have thick rubber soles.

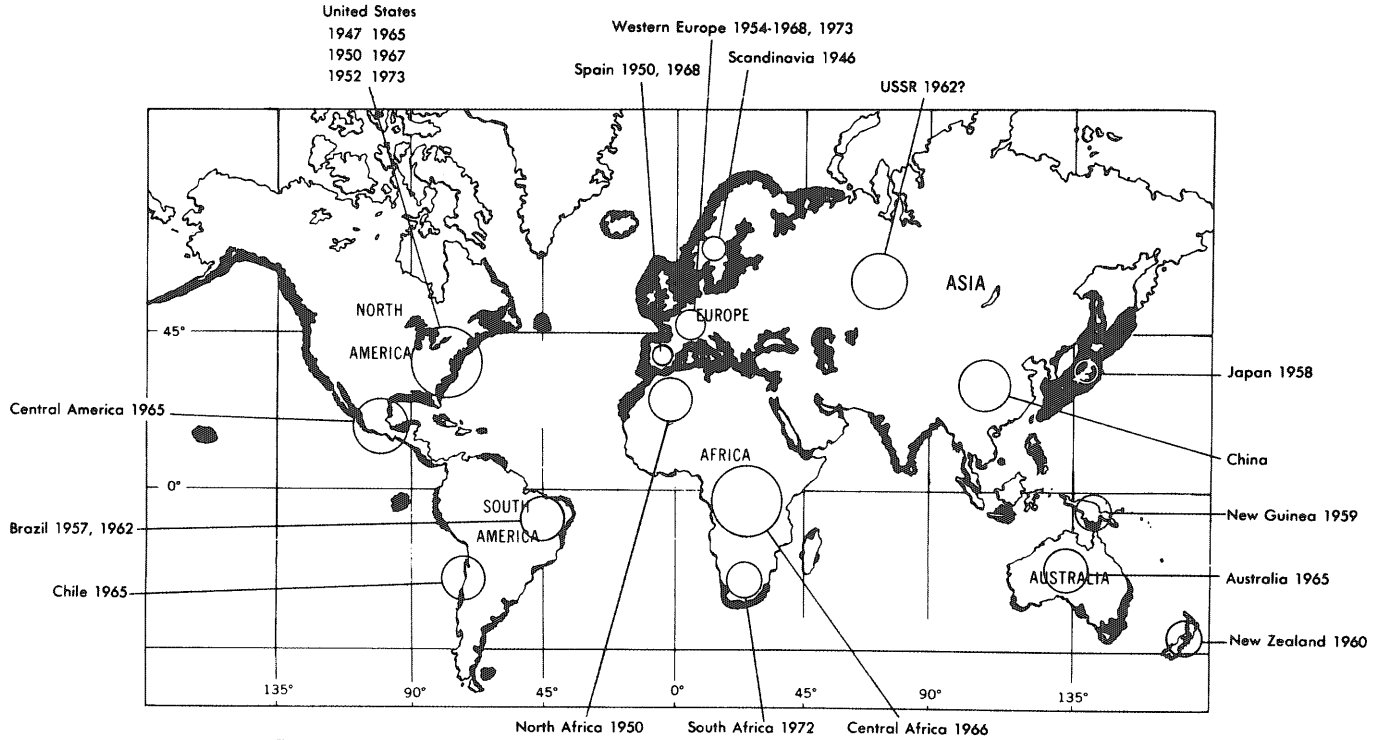


Figure 2. Major world UAP flaps. From TER *p. xvi.*

means "unidentified." Well, lots of things can be unidentified; just because they're unidentified doesn't mean they all come from the same thing, the same source. These balls of light that have been — look at the one you had up on I-35 north of Sandstone, Minnesota, October 6, where it came in a perfectly clear sky, no thunderstorm going on. This ball of light comes and, you might say, attacks the car, knocks the hell out of the alternator, totally ruins the battery, (and the car) had to be towed to a garage. Is that a visitor from outer space, is that the same thing as these discs that are reported like they are here, for instance? *(Motions to photo of UFO on wall.)* I don't think so. So, maybe they don't come from any one source.

T: So, I know that you think UFOs are real, but . . . so you're saying you don't know if they're extraterrestrial?

H: That's right. They may be from another dimension, a parallel reality.

I know enough about the subject, and I've studied long enough to know, how dangerous it is to try to give a glib answer. If you were to suddenly ask "What is a quasar?" to an astronomer, he couldn't give a good answer. We don't know what a quasar is.

T: Could you explain that parallel reality?

H: Well, in a sense, right now, there's *(sic)* television pictures passing through this room. Well, but our senses don't get them. Or maybe even a better example is that, if you landed on an island where, for generations, people had been born congenitally blind, a red sunset would be a parallel reality to them. It's there, but they haven't the slightest consciousness of it because the concept of color is completely unknown to them. They wouldn't have the slightest idea what you meant by color.

Now, you've got to remember that our entire technical civilization has been built on the fact that we've learned to use our five senses pretty well. But does that necessarily mean that there aren't other dimensions, other realities? And I don't mean that in a religious sense, or purely mystical sense, but a very down-to-earth, practical sense. There may be things going on in hyperspace that we don't have any consciousness of, any more than the blind man with the red sunset is.

You see — since you're in technology — you'll understand, you know, of course, that light has aspects of being a wave and a particle essentially at the same time. Well, the UFO has that same sort of dichotomy, or duality. On the one hand, it seems to be very physical: it stops cars, injures cars, it injures animals. Those are physical things. On the other hand, it is isolated in space and time; it appears more like the Cheshire cat in *Alice in Wonderland,* and it changes form . . . Now, a 747 doesn't do that. You usually see it in different aspects, so it may look flat-on, or edge-on, but it doesn't suddenly collapse into a sphere. And yet the UFOs, some of them are purported to do that.

In other words, UFOs have both a physical and non-physical aspect, the same as light has both a particle and wave aspect to it. And I think we have to admit that the UFO is more complicated than purely ordinary nuts-and-

Their eyes, often large and protruding, are described as hypnotic. And they ask lots of questions.

They arrive at UAP witnesses' homes or places of employment and ask for the witness by name within hours of the sighting, even if the witness has told no one. They typically ask the witness exactly what he or she saw, and demand to inspect the clothes worn at the sighting.

They sometimes show difficulty breathing. Their first words are typically, "What time is it?" If they use slang, it is comically outmoded. During conversations, they ask for water, salt pills, or souvenirs from the witness' home. After their visit, the witness' phone begins to rings at all hours of the night; when answered, mechanical chirps, beeps, and buzzes are heard. Radios blare when they're turned off; TV programs are interrupted by strange figures admonishing silence about the sighting; mischievous poltergeist activity sets in.

There are many more weird coincidences.

The MIB don't visit every UAP observer, of course. They seem to concentrate especially on those whom they feel are closest to the truth, though. They've been around since 1953, almost omnisciently intercepting photographs, mailed letters, and people.

They certainly are dedicated.

The more I dig into this, the more I uncover what the general populace doesn't get wind of. The mass hysteria and popular appeal of self-appointed exobiologists "salvation-from-on-high" speculations speak strongly. But until recently, UAP research has largely taken the "anecdotal" angle.

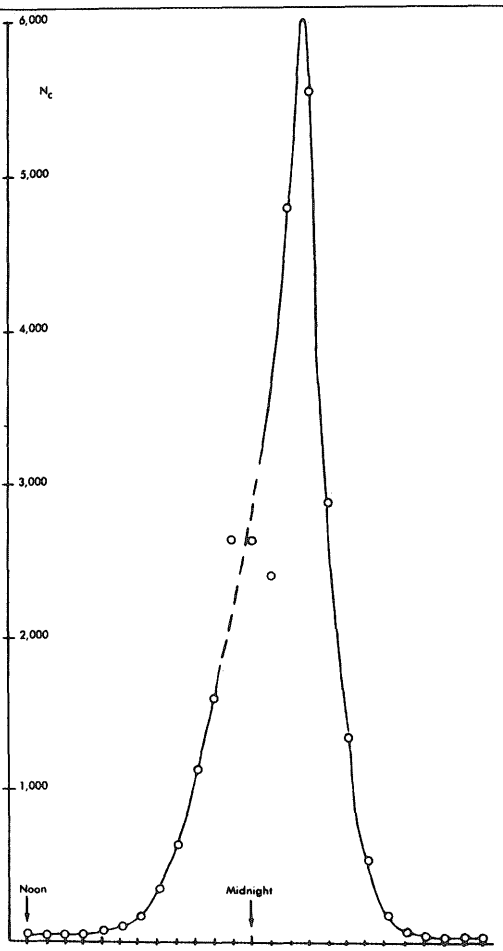


Figure 4. Assuming that the UFO phenomenon was independent of the presence of a human witness, Jacques Vallee has reconstructed the "time" distribution of the UFO landings as a function of the time of day. The maximum is now around 3:00 A.M., and the total number of cases is multiplied by a factor of 14. In other words, if people stayed outside at night, we would have some 28,000 reports of close encounters in our files rather than 2,000. In order to guess the *actual* number of landing events, one would still have to multiply by a factor representing the "reluctance to report," and by another factor representing population density, leading to a staggering number of events.

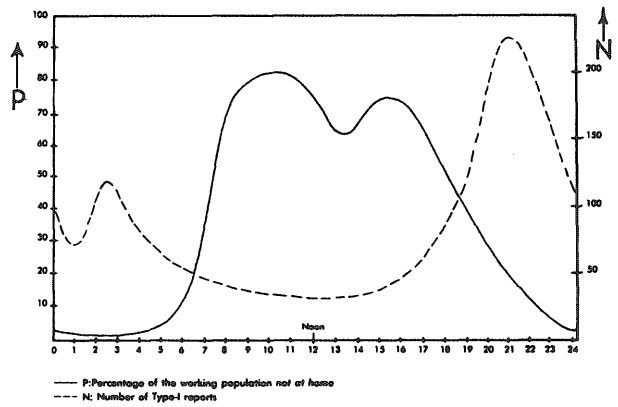


Figure 3. The observation that most UFO landings are reported in the evening hours does not tell us at what time the phenomenon itself is most frequent, because few potential witnesses are outside after 10:30 P.M. in most countries. Here the percentage of the working population *not at home* has been plotted on the same graph as the time distribution for 2,000 UFO landings.

"Here's an interesting UAP tale . . . and another . . . look at this case . . . ." You'll notice I haven't been doing that here (although it would be fun); I'm trying to sum up the generalities and analyze the phenomena as a whole.

And that's when you start noticing things.

What Are They Up To?

UAP cultists trapped themselves by their own words from the outset. An extraterrestrial hypothesis could be proven only if a) a UAP were captured, with or without occupants, and discovered to be an actual, technologically superior spacecraft; or if b) UAP occupants publicly provided such evidence. Now, UAP occupants have been publicly providing us with lots of evidence. But their purpose seems not to be to advance absolute proof of the authenticity of an extraterrestrial

frame of reference, but rather *to advance belief in an extraterrestrial frame of reference for its own sake.*

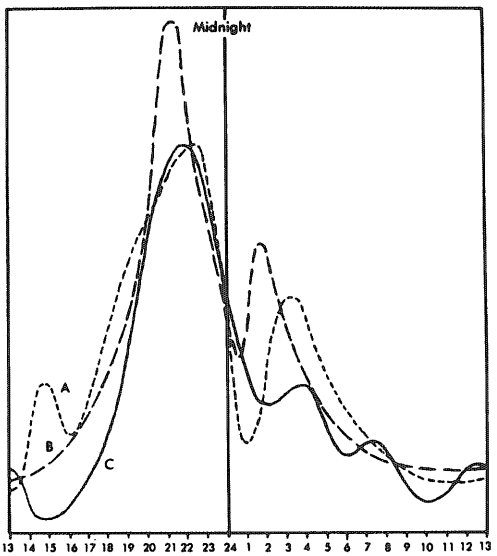
UAPs have been around for over 30 years under the guise of alien space vehicles. And for over 30 years, they have been performing all the activities one would expect of aliens and alien space vehicles — collecting rock and soil samples, for instance. For over 30 years.

They must have a hell of a rock collection by now.

What do we know so far? We've discovered that UAPs are intelligently controlled, most likely extradimensional, and operate within our own limits of time and space, most of the time. They also operate within our mental frame of reference and have historically adapted their appearance to the culture and technology of the time. And while at times they are seen, shall we say, accidentally, and try to evade contact or silence observers, there are occasions where they clearly take pains to make sure that people see them, talk with them, or receive "hard" data about them.

What does this spell out?

"The best explanation we have thought of so far," says Vallee, "is that somebody is systematically exposing human witnesses to certain scenes carefully designed to convey certain images" (Hynek & Vallee, *TER,* p. 52). Vallee calls this the "inoculation



A: 362 cases prior to 1963, all countries
B: 375 cases in 1963-1970, all countries
C: 100 cases from Spain and Portugal

Figure 5. Frequency of Type-I reports as a function of time of day. In all countries and cultures, Jacques Vallee has found that the number of reported close encounters with UFOs is maximum in the late evening hours, typically about 10:30 P.M., with another peak just before dawn. Here the three waves correspond to cases reported before 1963, and cases from Spain and Portugal only. The three curves are almost identical.

bolts. That's as far as I would be willing to say. Beyond that, it may be just as difficult today to explain the UFO as it would have been for Lord Kelvin to explain a nuclear submarine. It would have been completely out of his ken. Hell, the nucleus of the atom wasn't even discovered 'til 1909. So, although Lord Kelvin was a marvelous physicist, he couldn't even conceive of nuclear energy — yet it's commonplace for us today.

And if UFOs come from civilizations that are truly advanced, it stands to reason that they know something of space and time that we don't. But it remains a very intriguing problem, and it's fun to deal with, fun to work with, that's what I'm saying.

T: What's your experience been of the Men-in-Black?

H: Very little. I've never had any. I've had almost first-hand experience, but not quite.

I was in Mexico to interrogate a young pilot who had had an encounter with a UFO that injured his plane, and they shut down the Mexico City Airport for an hour and a half while they tried to get him in safely, which they did. Well, he was coming over to breakfast with me, bringing photographs of the injured plane. He didn't show up. I later found out from his friend that he had been on his way to the hotel to have breakfast with me and had been stopped by the typical Men-in-Black, and they warned him, told him, that he is not going to have a meeting with me. Now, of course, it could be a cock-and-bull story. I don't think so, because both the character of the pilot and my friend down there would argue against it.

But, why would it happen? It's like these cattle mutilations which are such a tremendous mystery. Why do they happen? But I don't want to go too far afield. I think I can sum up simply by saying that, in my estimation, and (that of) a growing number of scientists today . . . the subject of UFOs is a worthy subject to study. It can no longer be ridiculed, because there's too much substance to it. The Center for UFO Studies is an association of scientists that are trying to do something about it . . . studying the properties of the phenomena . . . .

T: What's the general trend now, what's happening with UFO sightings?

H: Yes. You have a number of these cases of attacks by balls of light recently, six of them in the general area of Minnesota in the last four months *(August-November 1979).* You have the famous case of the missing pilot in Australia, the famous New Zealand case; in fact, your library really ought to take this *International UFO Reporter,* it's obtainable from (CUFOS), because that has kitchen-tested material in it. Anything you read in there, you know has been investigated, not like the *National Enquirer* or something like that. *(The September/October 1979 issue given us treats the Val Johnson case in Warren, Minnesota.)* I think it's important that particularly a technical institution should have that. And I also have the *Journal of UFO Studies.* You can see that many of (the authors) are Ph.D.'s. This, I hope, will eventually be to (UFOs) what the *Astronomical Journal* is to astronomy.

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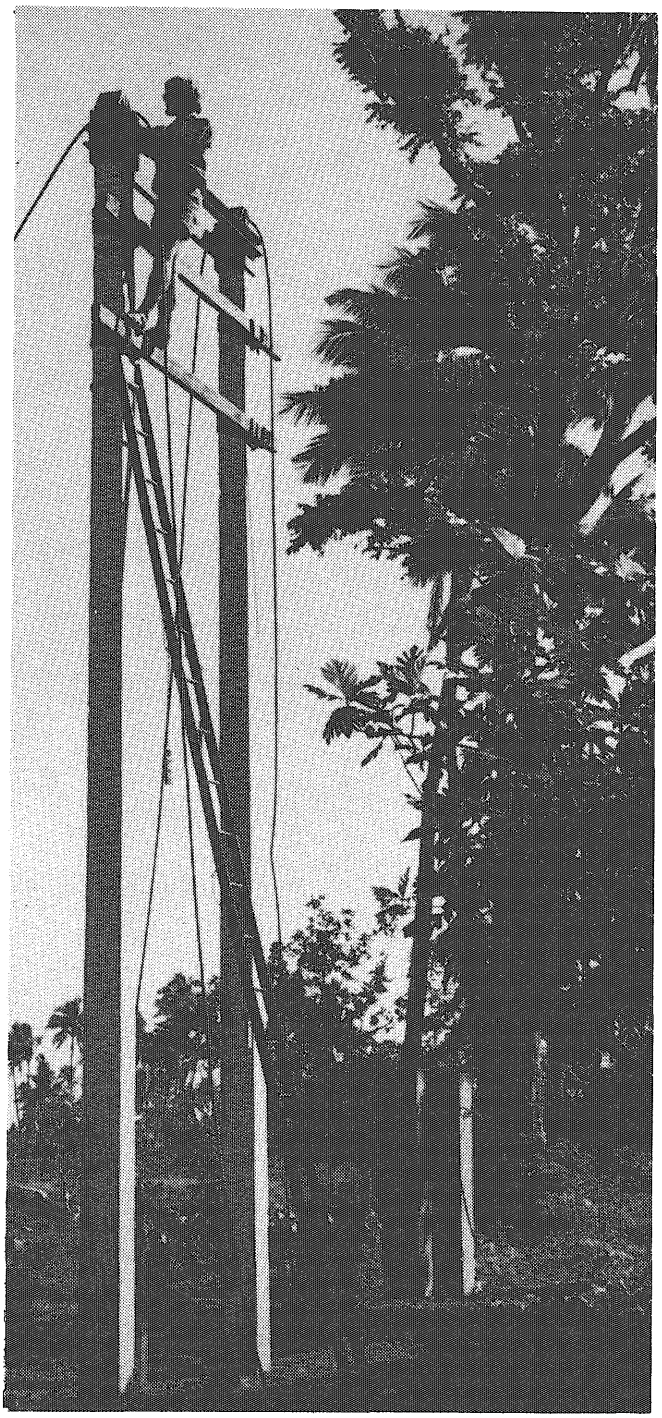

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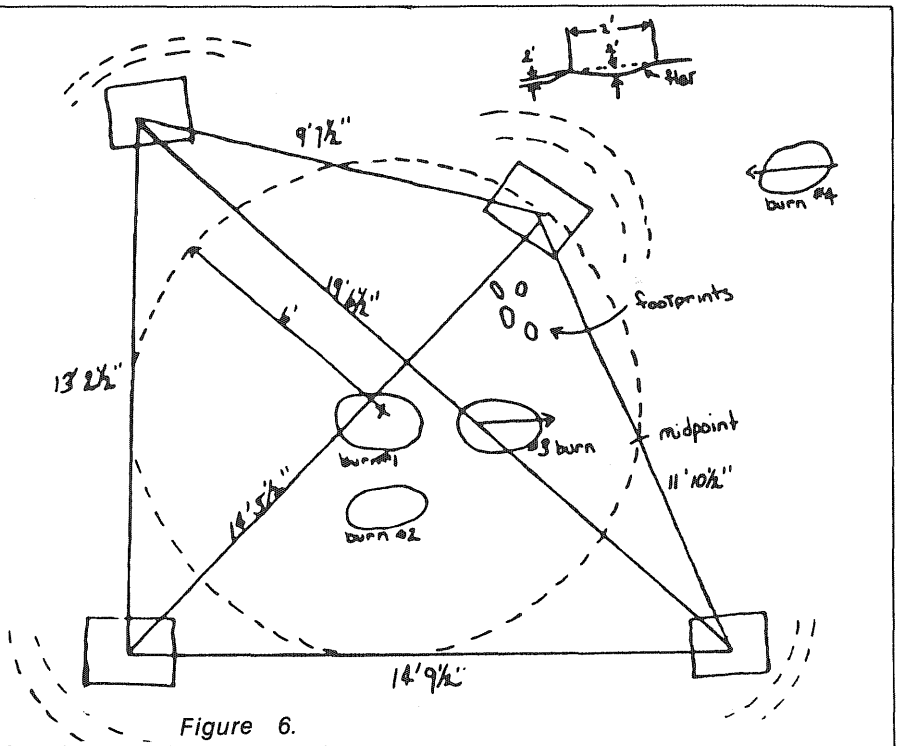


Figure 6.
Map by W. T. Powers of the dimensions and relationship of the various features at the reported Socorro landing site.

technique."

Says Hynek, "They seem to give you a little bit of an idea and then give you reasons against it or give you something contrary, to change your belief structure" (*ibid* p. 52).

Over the years, UAP activity has demonstrated a definite pattern *(see Figure 8).* This pattern is extremely similar to the periodic-unpredictable schedule of behavior modification by reinforcement discussed by B. F. Skinner, the pattern which leads to maximal behavior adaptation. Learning is slow and continuous, but irreversible.

If this is true, then UAPs are slowly modifying our collective mentality.

"It's not what you see that's suspect," Isaac Asimov once said, "but how you interpret what you see." As much as we'd like to think mankind's collective destiny lies in objective observation and rational reasoning, this just isn't realistic. Human beings act on belief, faith, imagination, and superstition. If these can be unwittingly manipulated, so, ultimately, can man's actions.

Is our mental frame of reference being altered? I think so.

People ridiculed "flying saucers" ever since man's first rendezvous with them high in the skies of the Age of Flight. The sanity of persons describing what they saw was held suspect. Last year, however, a poll of industrial engineers indicated that a majority considered UAPs a plausible and necessary subject of scientific study.

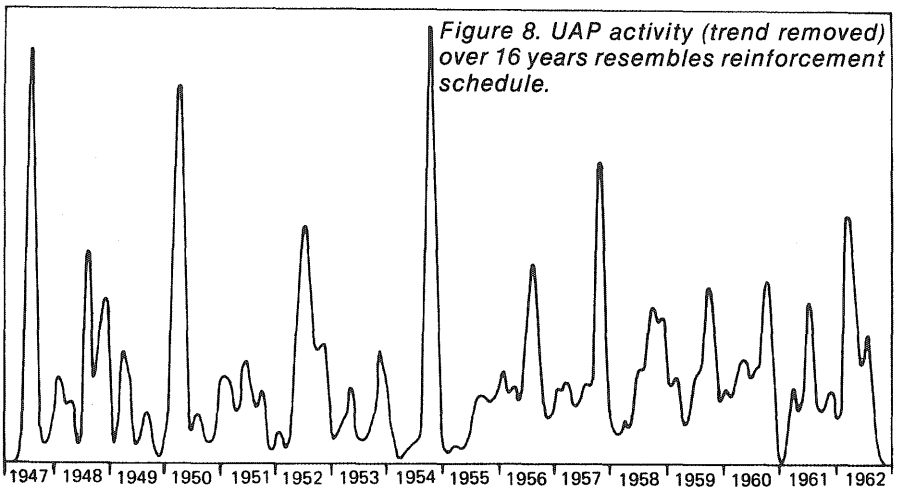


Figure 8. UAP activity (trend removed) over 16 years resembles reinforcement schedule.

In just ten years, a change like that.

In the movie *Close Encounters of the Third Kind* — in which many of the special effects were based on fact, by the way — the mother ship descended to land as technicians and Richard Dreyfuss gazed heavenward. Bathed in light, their faces framed an awe that approached religious reverence.

The Space Brothers have come to save us!

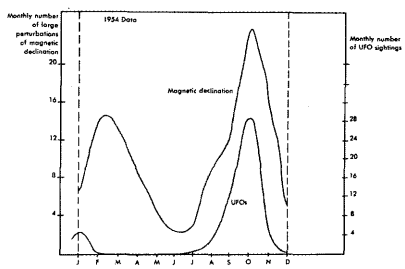
But UAPs are demonstrably metaterrestrial, not extraterrestrial.

Are we participants in a benign laboratory experiment? No. UAPs too often demonstrate hostility. It is true you cannot call an electric socket hostile if you stick your finger in it, but UAPs are intelligently controlled.

What, then? Why would Someone, or Something, draw our eyes to the stars, to the Race-to-Space?

The more I dig into this, the less scientific it sounds.

Figure 7



Steve Deyo, a graduate student in journalism and English, is associate editor of Technolog.

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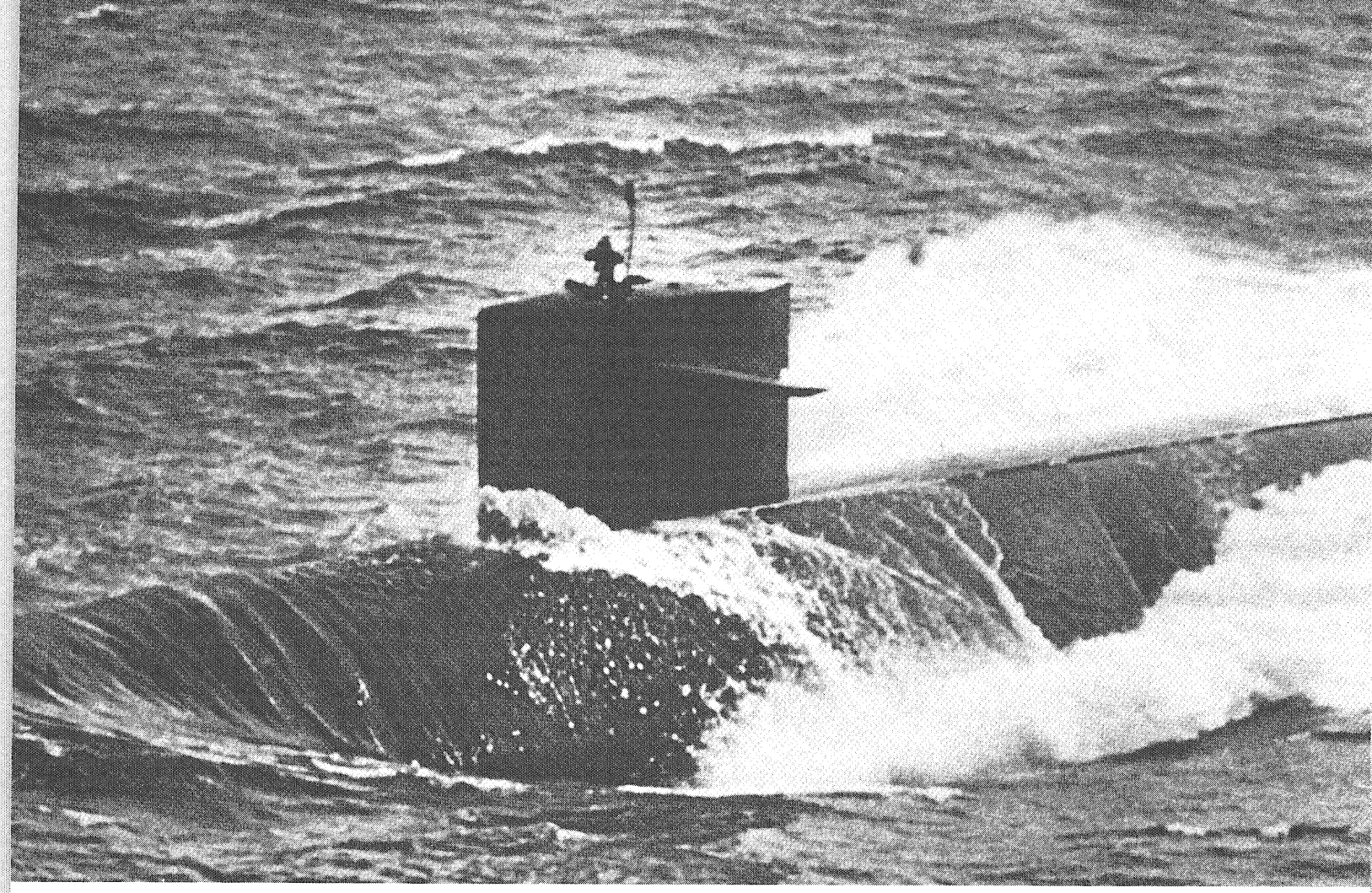

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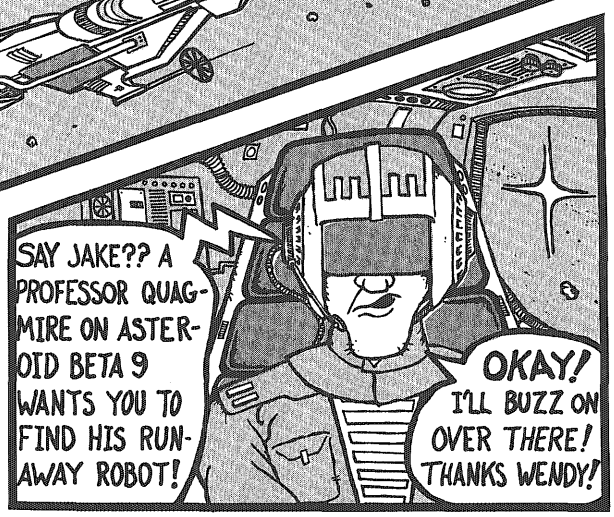

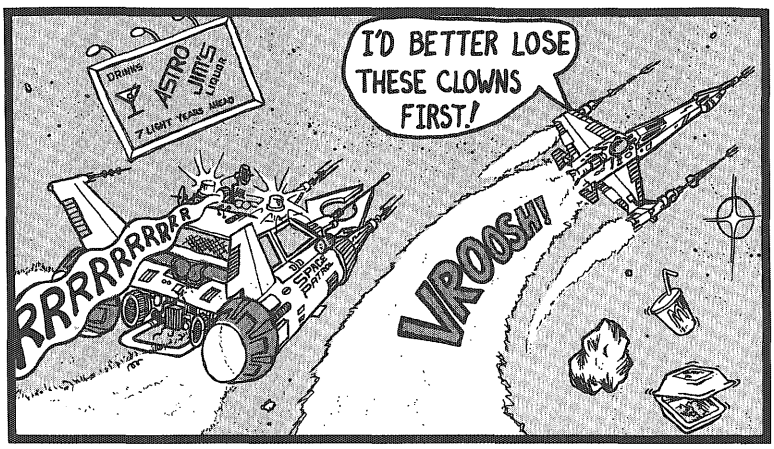

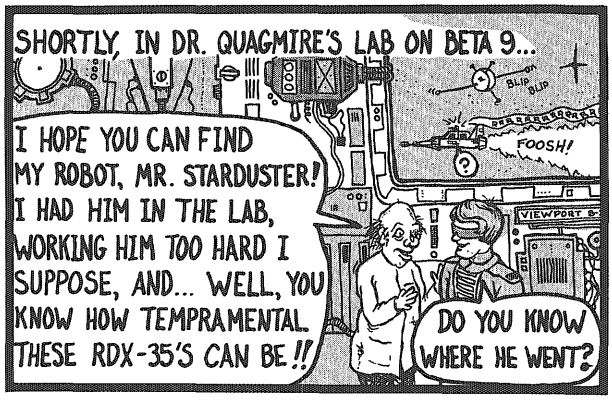

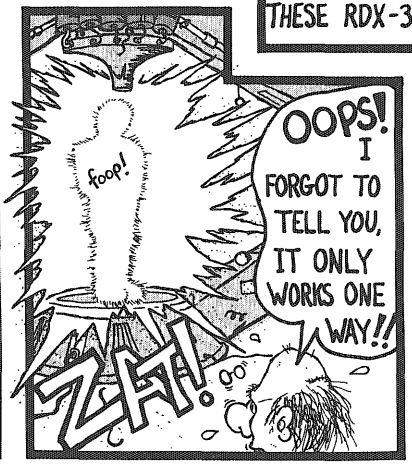

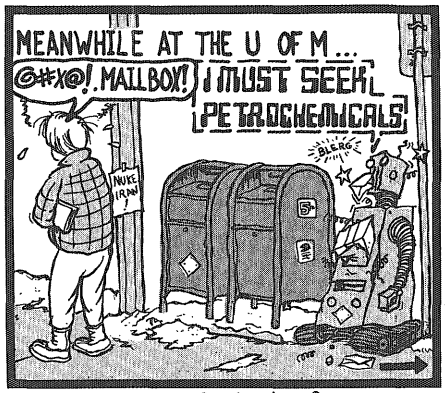

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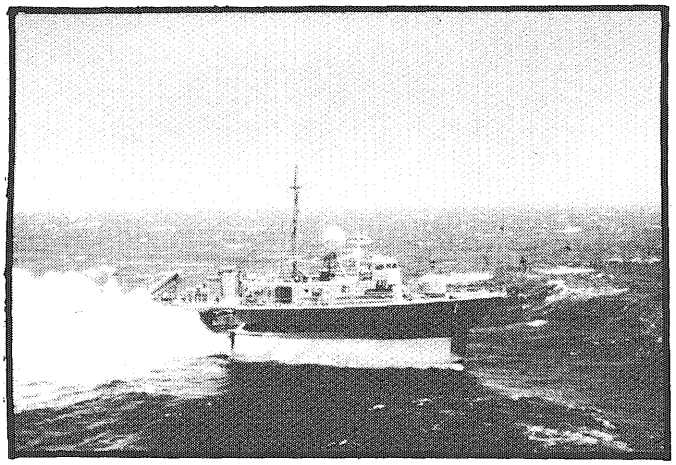

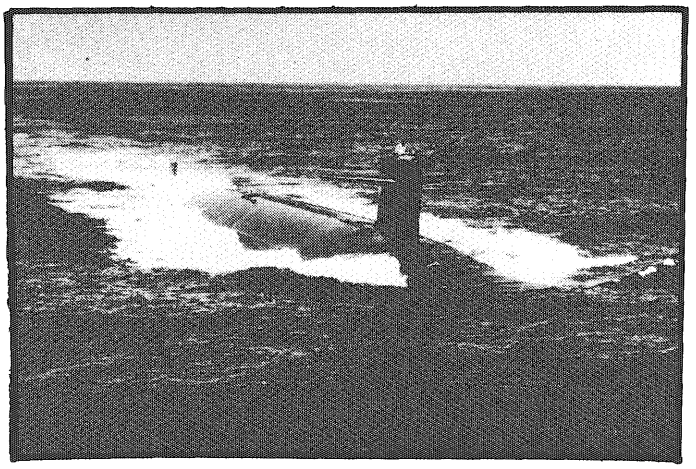

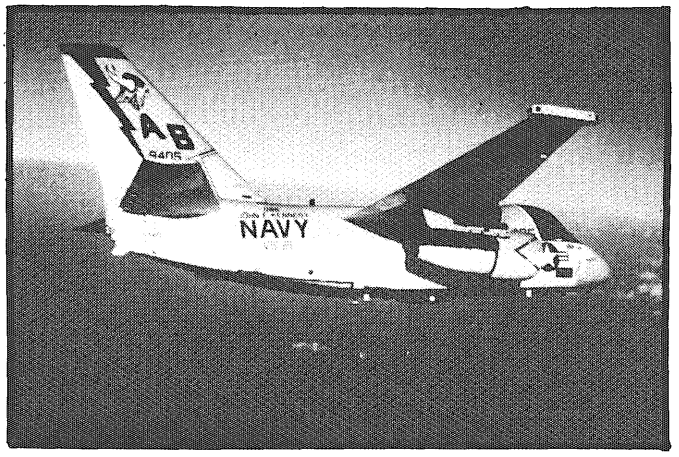

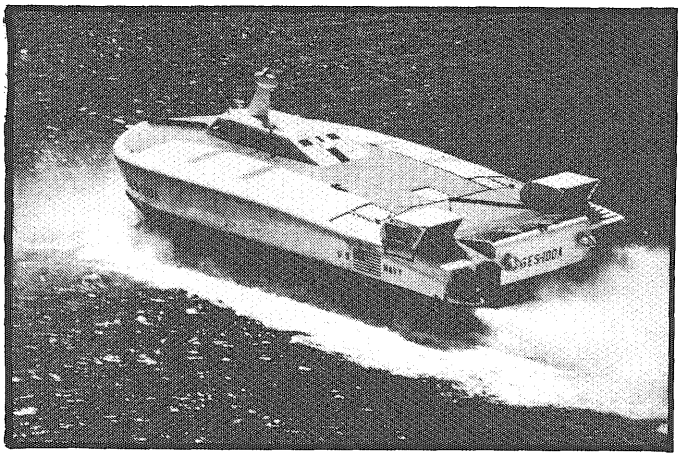

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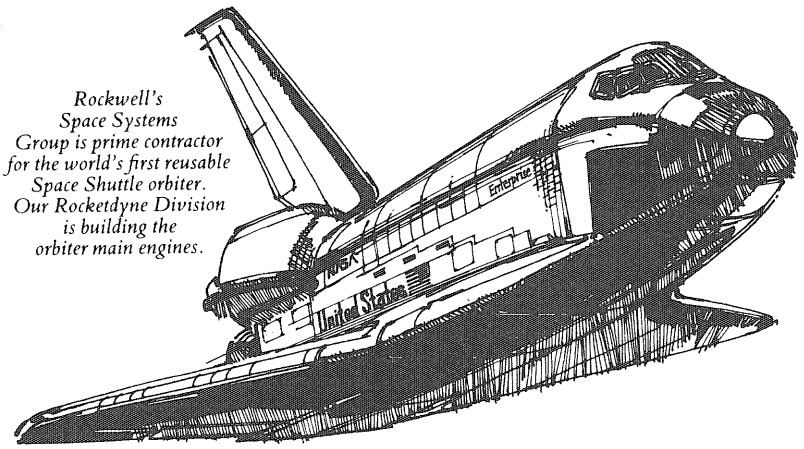

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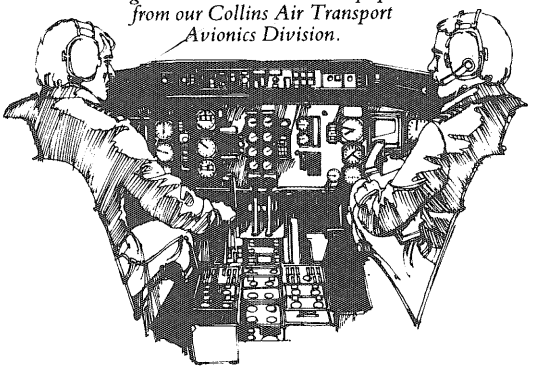

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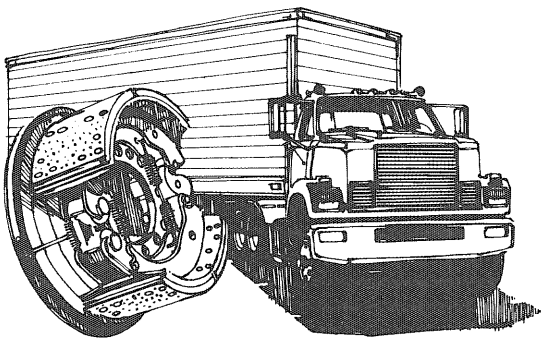

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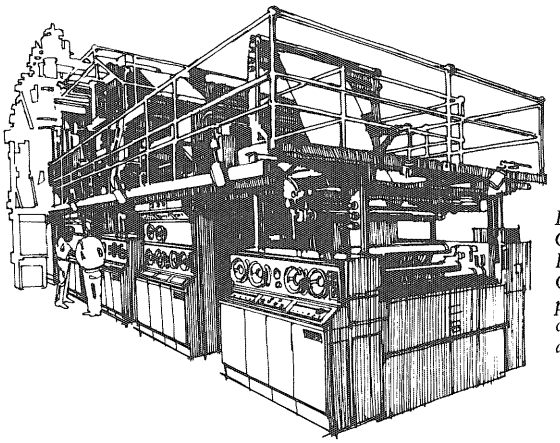

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After Graduation

RESUMES AND COVER LETTERS REVISITED

by Steve Deyo

This is probably the one you've been waiting for. "The Almighty Resume, Its Concoction and Care." How do you get one? What do you do with it once you've got it?

The purpose of the resume, remember, is to get you an interview. (This means playing "The Elimination Game.") Of course, if you've been following along in our past issues you should have secured an interview by now. Several, maybe. Still, the Resume Gambit, "Plan B," is your ready resort when your better options are either spent or non-existent.

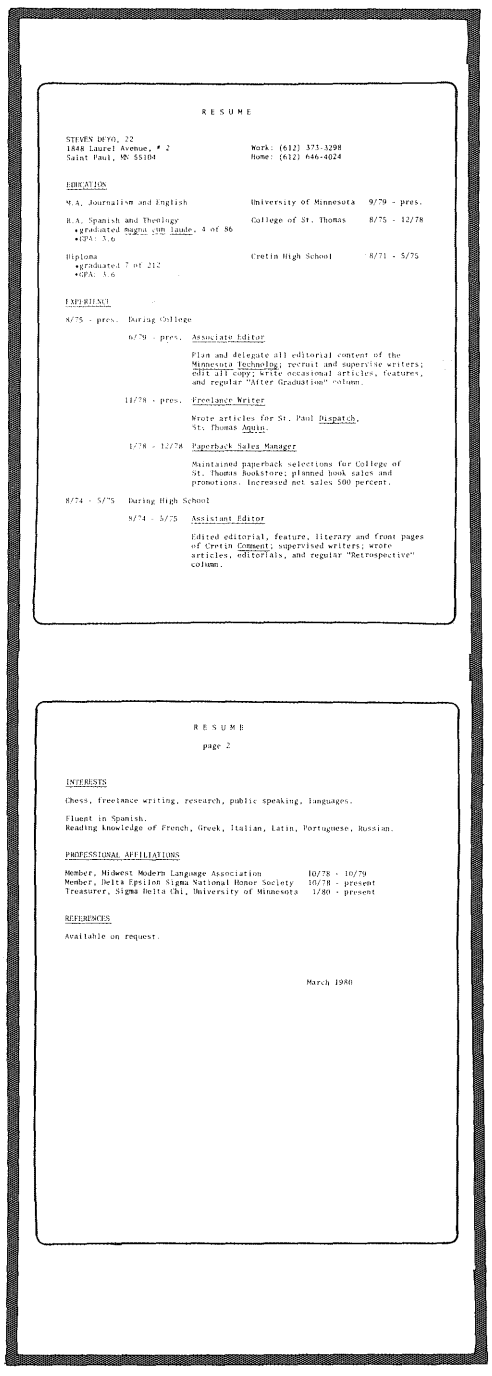
There's a non-conformist, an ignorant putz in every crowd. And usually more than that, though they'll never admit it. Not to be rude, folks, but many people don't know the first thing about writing a good resume. Poor design appeal, excessive length, faulty spelling, sloppy appearance, unprofessional quality... such a resume will be indicative of one's productive capacities on the job.

A personnel manager receives pounds of resumes a year. Take a load off his brain. Send a resume that's appealing to the eye, attractive, clear, easy-to-read, and direct. Imagine, all these qualities packed into one 8 x 11 inch sheet of paper! What will they come up with next?

Remember these five things:

(1) Since resumes are used to weed out, omit any irrelevant or potentially negative details. A resume should be like a polished, fine-honed poem. Every word should drive the point deeper: You are the one qualified for the job.

(2) No one reads resumes; they skim them. Think of your resume as a full-page ad, a compilation of qualifications, not a taxonomy of personal trivia. Use columns and spacing creatively and effectively.



RESUME

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•graduated magna cum laude, 4 of 86
•GPA: 3.6

Diploma — Cretin High School — 8/71 - 5/75
•graduated 7 of 212
•GPA: 3.6

EXPERIENCE

8/75 - pres. During College

6/79 - pres. Associate Editor

Plan and delegate all editorial content of the Minnesota Technolog; recruit and supervise writers; edit all copy; write occasional articles, features, and regular "After Graduation" column.

11/78 - pres. Freelance Writer

Wrote articles for St. Paul Dispatch, St. Thomas Aquin.

1/78 - 12/78 Paperback Sales Manager

Maintained paperback selections for College of St. Thomas Bookstore; planned book sales and promotions. Increased net sales 500 percent.

8/74 - 5/75 During High School

8/74 - 5/75 Assistant Editor

Edited editorial, feature, literary and front pages of Cretin Comment; supervised writers; wrote articles, editorials, and regular "Retrospective" column.

RESUME

page 2

INTERESTS

Chess, freelance writing, research, public speaking, languages.

Fluent in Spanish.
Reading knowledge of French, Greek, Italian, Latin, Portuguese, Russian.

PROFESSIONAL AFFILIATIONS

Member, Midwest Modern Language Association — 10/78 - 10/79
Member, Delta Epsilon Sigma National Honor Society — 10/78 - present
Treasurer, Sigma Delta Chi, University of Minnesota — 1/80 - present

REFERENCES

Available on request.

March 1980

(3) Don't overuse dates or numbers, especially in close quarters. They're hard to read and take extra mental effort to decipher. Your employer-to-be wants to skim your resume and pick out the salient facts. Make it easy for him.

(4) Use action words. *Don't* use passive tense. Don't say, "I did...I was ..." (In fact, forget the word "I"; they know who you're talking about.) Say "Created...Maintained...Managed...Supervised..." Strong verbs imply strong actions. Give the most responsible picture of yourself that honesty will allow.

(5) Keep it to one page if at all possible. Never more than two.

Below is a sample resume. In fact, it's mine. It's different than any you'll probably compare it to, because it's based on what hiring employers want *today*, not a textbook crank'em-out format. I prepared it with the help of a professional job service executive who is a friend. Several employment counselors and personnel managers have told me it's one of the best resumes they've ever seen.

For students entering the job force, Education figures more prominently than Experience. So, it comes first in your resume. Use column spacings as best you can to distinguish academic recognitions, dates, and school names. Notice the use of verbs: graduated, elected, won. Don't just say, "Member of Phi Tappa Kegga"; *tell* how you got there—initiation, election, what? Use verbs that place you as the aggressor/achiever.

Use your discretion or get advice about which specific details of your education you should include. For example, if your GPA was 2.01, probably you oughtn't mention it, because you only want clear, cut-and-dried positive arguments.

Look at how I staggered columns to visually set off the Experience section from Education. Details are subdivided for easy grasping when skimming, too.

Keep descriptions of your work experience terse and short. Large, long blocks of type are unnecessary and scare readers away. Make it look like easy reading. Break it up into bite-sized pieces.

Don't mention if a job was work-study or a summer job. That doesn't matter. Try, too , if you can, to mention jobs where you were employed for longer than a few months.

Include only work experience which has taught you skills needed for the job you are applying for, or that directly support your career objective. I could have included my experience in research and giving talks, but speaking isn't necessary for my objective—editing—and research will show in my article portfolio.

While we're on the subject, you'll notice my resume lists no career objective. It's probably best, I'd say, not to put it in your resume. Either you have to write one so general and vague that it will apply to any conceivable job you might apply for, or you need to rewrite it individually with a new resume—for each separate job application. Since the cover letter is the floating variable adapted to flesh out the resume and tie in specifics, why not just put the career objective in there?

List personal interests and professional organizations that support your career goals. That you play soccer, rugby and electric guitar won't matter much in your interview for Chemical Technician. And if the interviewer happens to hate rock music, well...

Don't even list personal data. If you're hired, they'll ask you for it; otherwise, who cares? They know how tall you are by looking at you, anyway. (Exception is if height, weight, or marital status are employment criteria.)

Never include references in your resume. Have three ready, though, when needed. Ask permission, first.

Some say you should not date your resume. I think employers appreciate it. I include it because it forces me to update my resume periodically. Never use a resume dated older than four months. Revise it if needed, or change the date.

The rest is up to your common sense and ingenuity. But revise it a dozen times, at least. Boil down, distill, plan, perfect.

Now the cover letter.

Use proper letter form. Address the person by full name and title. Use a colon, not a comma, in your heading.

The first paragraph of the cover letter should say why you are writing, what position you are applying for, and how you learned of the position (not necessarily in that order).

In the second paragraph, tell why you want the job and why you want to work for that company. Explain why you are qualified for the job, but don't repeat facts found in your resume.

In the third paragraph, refer the reader to your resume, which summarizes your experience and qualifications.

The final paragraph should indicate your desire for a personal interview and your flexibility as to setting up a time. Repeat your phone number and offer any assistance needed for a speedy response. And *specifically request a response* (gently). You can do that by asking a question about the job, or whatever. I myself usually suggest that I phone in seven to ten days to discuss making an interview appointment "at our mutual convenience." Be pleasant, be diplomatic, but be aggressive.

The cover letter is your chance to elaborate on your resume and describe aspects of your qualifications that might not show up in black-and-white. Travel or volunteer experience, for instance.

And for your own sake, be original. Be challenging. Begin your letter: "How often has such-and-such a problem cost you time and money, blah blah? I can prevent that." Or say something like: "I like what I hear about your company. And though you may not need a blah-blah engineer at this time, I believe—at your present growth rate—you soon will. Please read my enclosed blah blah..." Or: "As a recent 4.0 graduate in hyperbolic plasma infarctions and *n*-dimentional quantum interstices, I have demonstrated my ability to blah blah....My resume holds the interesting facts. When may I come see you?"

Use your imagination. Don't be afraid of trying different approaches. See what works best for you. And get that interview.

You might want to read Richard Lathrop's *Who's Hiring Who*, Ten Speed Press, $5.95.

(Next issue: "Taming the Wild Interview.")

THE lighter side OF TECHNOLOGY

by Steve Deyo

Shades of Isaac Newton! I've just discovered a physical law!

A time-honored dictum of the Universe, lurking right here in my own home! In fact, in everyone's home.

I have observed it — as have we all — yet more, I have hypothesized and theorized and made logical conclusions from my observations so that we may understand, predict, and ultimately control this phenomenon which has so long eluded our probing intellectual grasp, our fine-tuned analytical ken, and our indomitable conquering spirit.

It was as typical a morning as any, although I did not know it yet because I was still asleep.

I had set the alarm for seven in the morning, because that was when I needed to get up.

So, at seven in the morning, the alarm went off. I woke up. Enter the problem.

Though I had awakened, I failed to have arisen. Enter the theory.

I call it the Law of Entropic-Correlative Gravitation. It defines the strong gravitational vortex which apparently forms about the spatial coordinates of any occupied bed, and

I.T.
SENIOR
DINNER-DANCE

For the fifth consecutive year the Institute of Technology is sponsoring a social event off campus for graduating seniors.

WHERE
Radison South Hotel, Highway 100, just north of 494

WHEN
The evening of May 16, 1980

WHAT
The agenda is as follows:
6:00-7:00 p.m. Social Hour
7:00-8:00 p.m. Dinner
8:00-11:30 p.m. Dance to Jerry Mayeron's Orchestra

Don't Forget...
...The Institute of Technology is holding its annual Commencement Ceremony on Wednesday, May 28, 1980 at 7:00 p.m. in Northrop Auditorium for candidates for undergraduate degrees. If you have graduated summer session or fall quarter 1979 or plan to graduate winter quarter or spring quarter, 1980, you are invited to attend this ceremony and bring guests.

There will be a formal ceremony and an academic procession. All graduates will sit together in a designated area. Graduates will be individually recognized and receive recognition from Dean Roger Staehle.

QUESTIONS
Contact: **Office of the Director for Student Affairs**
105 Lind Hall

lighter side

seems to be triggered by the particular audio frequencies of a sounding alarm clock. This vortex induces a gravitational pull so strong that a person lying in bed must exert a quantity of work to get up which is highly disproportional to the amount of work required to do a similar task under any other conditions. Most people, in fact, are unable to overcome the tremendous pull until it has diminished — which it does, gradually over time, and apparently in inverse proportion to the sleepiness of the subject (possible alpha-wave correlation?).

To illustrate: if we multiply work, *w*, by acceleration, *a*, and kinetic energy, *KE*, square this number by the Uncertainty Principle, *UP*, we will obtain a value for physical activity, *PA*, which, when squared by the Interstitial Number, *IN*, is derivative. Thus:

$$(1.1) \qquad waK_E{}^{UP} = PA^{IN}$$

"Shades of Isaac Newton! I've just discovered a physical law!"

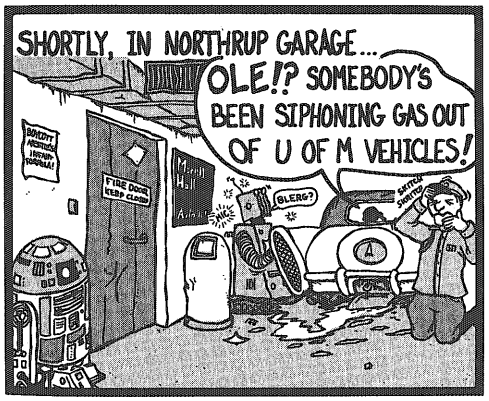
CORRECTIONS

These items were misprinted in the Winter I issue of the **Technolog.** We would like to take this opportunity to set the record straight.

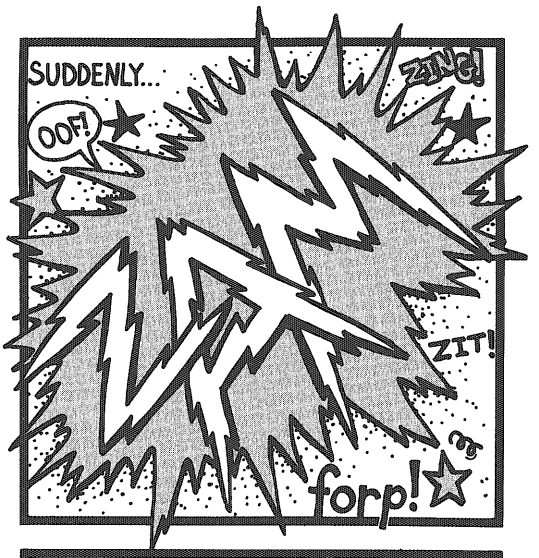
John Bartelt is a graduate student in physics, not a senior.

Mary Jo Hannasch is a junior in electrical engineering, not in mechanical engineering.

The **Technolog** staff apologizes for any problem these errors might have caused.


SHORTLY, IN NORTHRUP GARAGE...
OLE!? SOMEBODY'S BEEN SIPHONING GAS OUT OF U OF M VEHICLES!
BLERG?
FIRE DOOR KEEP CLOSE

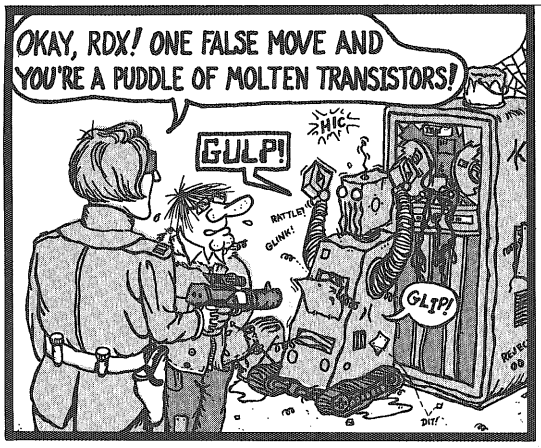

OLE PONDERS THE PROBLEM...
I AH WONDER WHO COULD BE AH DOING DIS!
FEED ME

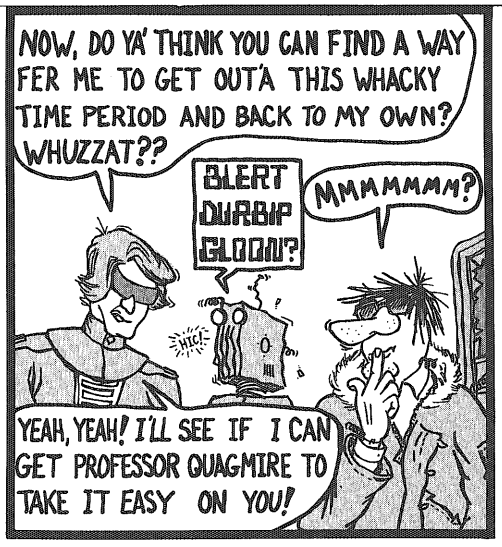

SUDDENLY...
OOF!
ZING!
ZIT!
forp!

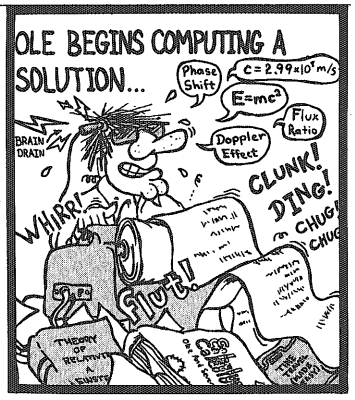

THE SMOKE CLEARS...
GREAT FJORDS!! WHO ARE YOU??!
I'M JAKE STARDUSTER AND I'M LOOKING FOR A RUNAWAY RDX-35 ROBOT!!
~WHEEZE~
POP!
FWINK!
ZIK!
FLOOT!
BLIK!
WHIR!

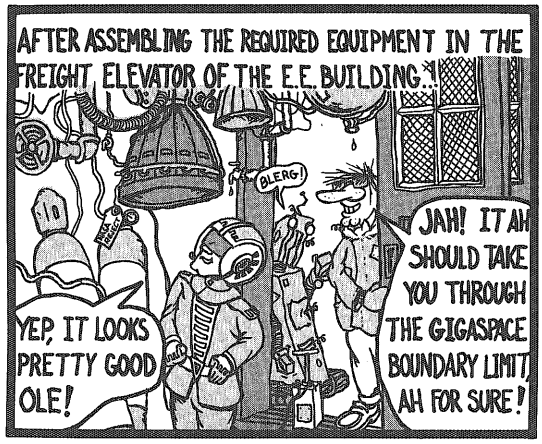

ON THE 3RD FLOOR OF THE E.E. BUILDING...
UFF DA!! SO HE'S WHAT'S AH BEEN AH SIPHONING ALL DA GAS!
BLERG?
HIC!
YUP, THAT'S RIGHT! NOW, I WONDER IF WE CAN BUILD A ROBOT DETECTOR!


A FEW MOMENTS LATER...
I'M PICKING UP SOMETHING- WHOOPS!
YIKES!
BLEEP!
BLEEP!
BLEEP!
DOINK!
BLERG?
EAK!
TOING!
CRASH!

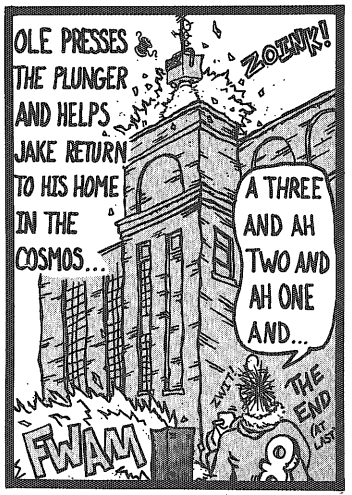

OKAY, RDX! ONE FALSE MOVE AND YOU'RE A PUDDLE OF MOLTEN TRANSISTORS!
GULP!
HIC!
RATTLE!
GLUNK!
GLP!


NOW, DO YA' THINK YOU CAN FIND A WAY FER ME TO GET OUT'A THIS WHACKY TIME PERIOD AND BACK TO MY OWN? WHUZZAT??
BLERT DURBIP GLOOM?
MMMMMM?
HIC!
YEAH, YEAH! I'LL SEE IF I CAN GET PROFESSOR QUAGMIRE TO TAKE IT EASY ON YOU!


OLE BEGINS COMPUTING A SOLUTION...
Phase Shift
C=2.99x10⁸m/s
E=mc²
Flux Ratio
Doppler Effect
BRAIN DRAIN
WHIRR!
CLUNK!
DING!
CHUG!


AFTER ASSEMBLING THE REQUIRED EQUIPMENT IN THE FREIGHT ELEVATOR OF THE E.E. BUILDING...
BLERG
YEP, IT LOOKS PRETTY GOOD OLE!
JAH! IT AH SHOULD TAKE YOU THROUGH THE GIGASPACE BOUNDARY LIMIT AH FOR SURE!


GLEEP!
WELL, OLE, IT'S NICE TO HAVE MET, THANKS FOR YOUR HELP!!
JAH! IT'S BEEN NICE TO MEET YOU AH, TOO AH!


OLE PRESSES THE PLUNGER AND HELPS JAKE RETURN TO HIS HOME IN THE COSMOS...
ZOINK!
A THREE AND AH TWO AND AH ONE AND...
FWAM
THE END (AT LAST)

The law is "Entropic-Correlative" because the effects of the gravitational vortex increase in inverse proportion to the subject's low energy state; e.g., watching Monday night football, being asked by the spouse to fulfill some domestic obligation, or, as we have already observed, waking up at the crack of dawn.

A corollary of this law is what I call the Law of Relative Time Acceleration. This becomes observable when, simultaneous with the same frequencies which appear to instigate the gravitational vortex, a time acceleration vortex is also induced. Typically, the subject will hear the clock go off at 7:00 and open his or her eyes only to discover, with much alarm, that the other alarm reads 8:04 and they are going to be late, late, late. The subject in these circumstances senses no passage of time, and will insist they only blinked their eyes. Time can be proven to pass normally outside the theorized gravitational vortex; hence the deduction of a time acceleration vortex as well.

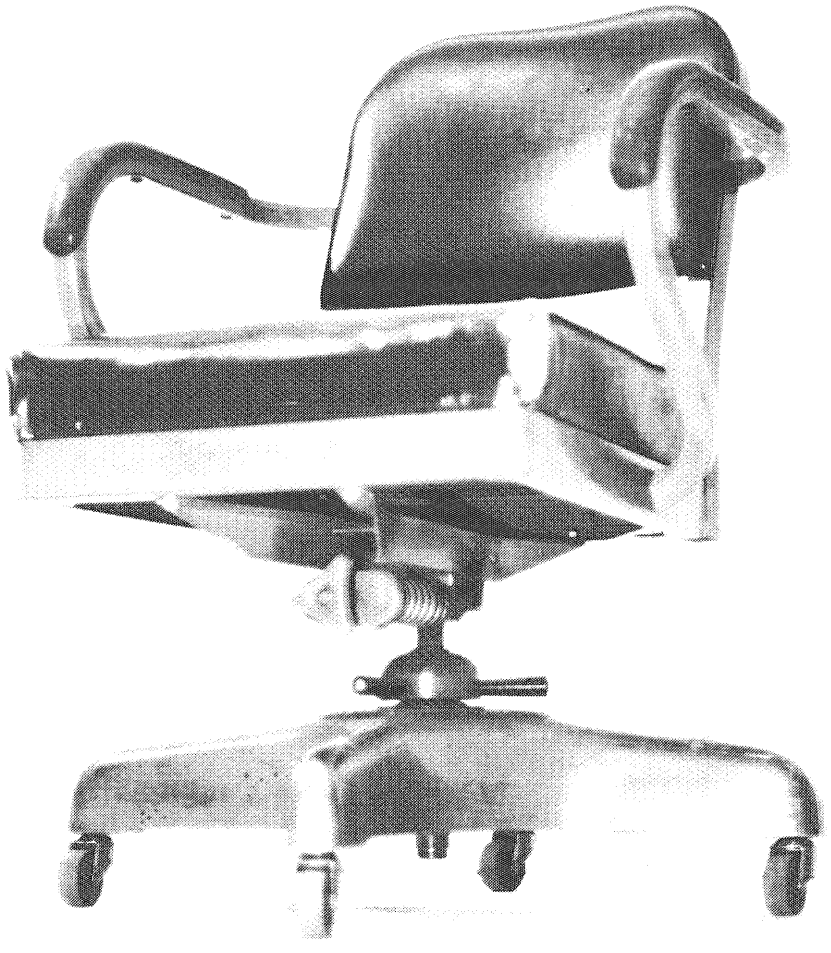
I have not yet fully verified the mathematics of this corollary, but it does operate as a function of time, *t*. Thus, if we assign a mean otolaryngeal constant, O_m, multiply it by intensity, *i*, and the Ganz Coefficient over one dimension, G_{od}, we produce the factorial

$$(1.2) \qquad f(t) = O_m i G_{od}!$$

where the yield value increases in intensity with amount of time elapsed.

Man has always striven to control his environment. I am sure, with adequate scientific inquiry into these newly-discovered principles, man's ever-questing mind and never-ending struggle to dominate Nature will, as with light and the atom, enable him to master and eventually subdue these basic forces of energy which share his Universe.

THE WORST KIND OF



WASTE...

...an opportunity that wasn't taken advantage of. At **Technolog** the editor's chair, not to mention the business manager, art director or ad reps, will be turned over to new poeple for academic year 1980-81. These positions all provide an excellent opprtunity to make your college career more meaningful. On a more practical level, they provide valauble communications experience sought by so many employers.

In particular, the editor's responsibilities include: hiring staff members and coordinating their activities, setting the format of the **Technolog**, editing and working with writers, and most importantly, taking charge of making **Technolog** fulfill the needs of the IT community.

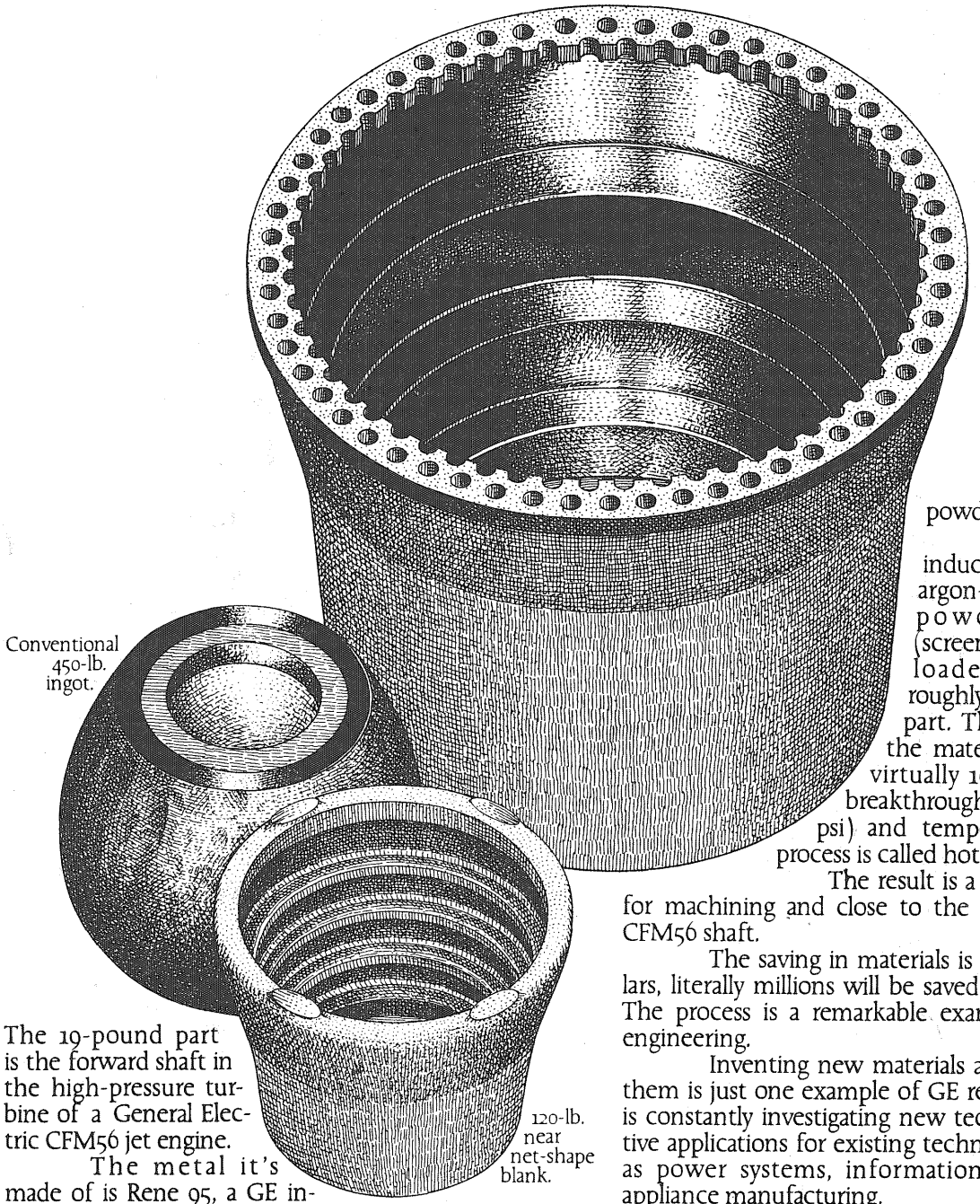
The editor of the **Minnesota Technolog** is paid $500 per quarter and is appointed to a position on the **Technolog Board of Publications**. The position is open to all full-time University of Minnesota students, but preferential consideration will, of course, be given to **IT** applicants. Applicants should have a feel for communications as well as good business sense. Most importantly, candidtates should have a clear idea of how to make the **Technolog** a vital and integral part of the **IT** experience.

For more information contact:

Denny Sullivan
Rm. 2 Mechanical Engineering
or
Send a resume and/or letter of intent to:
Technolog Board of Publications
Rm. 305 Aero.
All applications must be made before May 2, 1980

minnesota TECHNOLOG

Why should it take 450 pounds of metal to make a 19-pound part?



The 19-pound part is the forward shaft in the high-pressure turbine of a General Electric CFM56 jet engine.

The metal it's made of is Rene 95, a GE invention. Rene 95 is an exotic superalloy of nickel, cobalt, columbium, tungsten and 17 other elements. To fabricate a forward shaft from Rene 95 by conventional methods, you start with a 450-pound ingot. After forging, pressing and machining, you end up with a single 19-pound shaft...and more than 400 pounds of expensive scrap.

That's a distressing waste of critical raw materials and of the energy it takes to mine and refine them.

So GE engineers turned to near net-shape forming: fabricating the finished part from a blank shaped as closely as possible to the shape of the finished part.

But how could such a blank be created without starting with a 450-pound ingot? To solve that problem, GE engineers developed a truly unique application of powdered metallurgy.

Virgin or vacuum induction-melted Rene 95 is argon-atomized to create a powder. The powder (screened for particle size) is loaded into containers roughly shaped like the final part. Then, in an autoclave, the material is consolidated to virtually 100% density (that's a breakthrough) at high pressure (15K psi) and temperature (2000°F.). The process is called hot isostatic pressing.

The result is a 120-pound ingot ready for machining and close to the shape of the finished CFM56 shaft.

The saving in materials is more than 70%. In dollars, literally millions will be saved over the next decade. The process is a remarkable example of cost-effective engineering.

Inventing new materials and better ways to use them is just one example of GE research in progress. GE is constantly investigating new technologies and innovative applications for existing technologies—in such areas as power systems, information services and major appliance manufacturing.

This takes talent—engineering talent—not just in research and development, but in design and manufacturing, application and sales.

If you are interested in engineering opportunities at GE, check your Placement Office or write to: Engineering, Bldg. 36, General Electric, Schenectady, New York 12345.

Progress for People

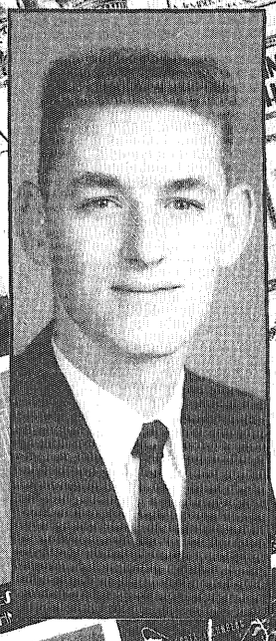
GENERAL ELECTRIC

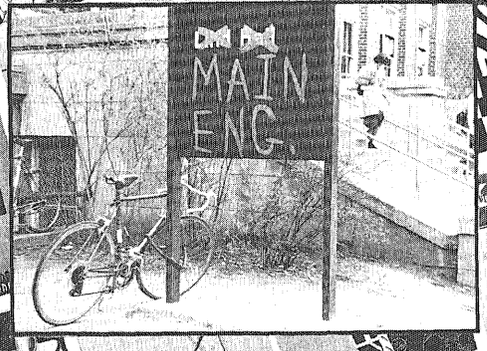
An Equal Opportunity Employer

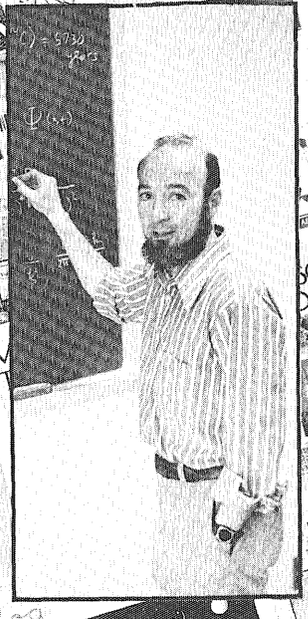
Minnesota TECHNOLOG

60th ANNIVERSARY ISSUE

Spring I 1980







Cutting Corners at IT

E Week 80

Editor's Log

This issue of the *Minnesota Technolog* marks its 60th year of publication. In the spring of 1920 a group of students from the College of Engineering and Architecture and the School of Chemistry at the University of Minnesota realized the importance of student communications and laid the groundwork for *Minnesota Technolog*. *Technolog* was one of the first engineering college magazines in the country, and over the years it has continued to lead the way in innovation and set standards for similar magazines.

In looking over past issues of *Technolog*, one recognizes real growth in areas like equal rights, environmental concerns and attitudes toward military aggression. Alongside of these trends one also notes recurring themes that seem common to students in any time frame.

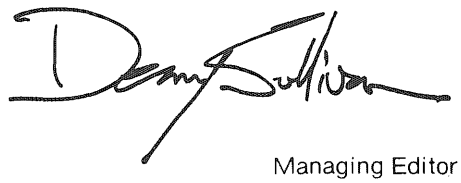
In this issue, Susan Sherry looks at one of the problems that has plagued IT from the start. Retrenchment is the term now used to describe one method for handling the problem of too many students chasing too few education dollars. Read her article "Cutting Corners at IT."

For some reason a large number of IT students have always been intrigued by "what ifs," and much of this curiosity seems to manifest itself in an interest in science fiction. This year, as in years past, *Technolog* held an sf writing contest. In this issue you will find the second-place story written by Gordin Plorin, "Slow Descent."

Can you imagine a person who still has a sense of humor after continuous punishment by the rigors of an IT curriculum? When alumni are asked what they remember most about the *Technolog*, they invariably reply "the jokes." "Splinters From Logs Past" is a collection of jokes from the past 60 years. As well as humor, they transmit a clear picture of what concerned IT students in the past.

As usual, we have our regular fare of goodies, which include: Bruce Kvam's "Ad Astra;" "After Graduation" by our associate editor, Steve Deyo, and the continuing adventures of "The Bionic T.A." by Steve Smith.

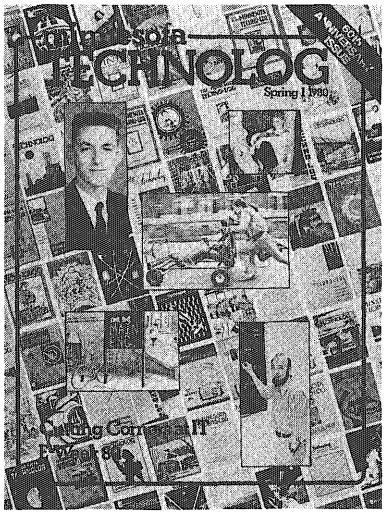
I hope you will enjoy reading this issue of *Minnesota Technolog* and that it will continue to project the image of a professional student publication, as it has over the past 60 years.



Managing Editor

Staff

minnesota
TECHNOLOG



Cover photo by
THE PHOTO STAFF

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Printed in U.S.A.

CUTTING CORNERS AT IT

by Susan Sherry

Engineering is booming in horizons, jobs, and students. But for the Institute of Technology the vast number of students is threatening severe problems.

In this past year, the number of undergraduate students in IT has increased 13 percent — from 4700 (fall quarter, 1978) to 5250 (fall quarter, 1979). Yet since 1965, the number of faculty has stuck around 350. So, the full-time student/faculty ratio has increased 70 percent.

IT is probably in the worst numerical shape of its history. Students and faculty are becoming increasingly concerned about large enrollment figures as IT tries to overcome the problem with shrinking and depleted resources. The heavy student load has been threatening to push five departments out of their ranks in the Top Ten for similar departments in the nation. (Those departments are Mechanical Engineering, Chemical Engineering, Aerospace Engineering and Mechanics, Architecture and Landscape Architecture, and Earth Sciences.)

IT is scheduled to receive $300,000 from internal reallocations within the University for the next two years. The University shifts resources between colleges by taking away or "retrenching" money from some units, then reallocating money to other units where the need seems to be greater. But even with more money, the college will be forced to hold back on its expanding enrollment before the quality of its education is severely at stake.

"We are squeezed," said Dean Roger Staehle. "We're going to have to stop increasing our enrollment. If we take on more students, we will need more faculty. We simply have to stop growing to be a healthy organism."

In the University's proposed budget plan for 1980-82, IT would receive the second-highest amount of money through reallocation. President Magrath has tentatively endorsed the proposed budget recommendations.

The Budget Executive, a three-member committee, supplied the President with recommended reallocation and retrenchment figures. According to IT's long-range planning document prepared for this committee, the IT budget has decreased from 7.7 percent to 5.7 percent of the total University budget since 1973. IT has also suffered a net retrenchment of $1.6 million since 1973, despite a 1979 reallocation of $200,000. IT's budget for 1979-80 is $15,178,847.

The dean allocates new monies based on need and quality of departments. Though no final decisions have yet been made, Staehle said the money will probably be used to hire new faculty to decrease the student/teacher ratio in some of the overburdened departments.

"We're not making decisions between good and bad," said Associate Dean David Storvick. "We're making lots of hard decisions and trying to pick out the very best from lots of good ones."

There are many things that IT is already no longer able to do. It has had to increase class sizes in lectures, recitations and, more dangerously for some departments, in labs. Some departments have been forced to offer more classes through the evening Extension Division. The number of teaching assistants and lab technicians has dropped, so departments have had to reduce the amount of homework and limit the amount of essay-type exam questions to be graded. Less staff has also diminished person-to-person contact in labs and recitation sections.

"We've had to abandon tutorial kinds of systems," said Kenneth Keller, Department of Chemical Engineering head. "For example, in the old days all of our core courses had recitation groups of 15. In recent years we've had to let them grow to close to 30, and often, but not always, we have let a T.A. handle them because we don't have the faculty.

"Our lab sections have grown by 20 to 30 percent. Each experiment used to be done by a group of three," he continued. "Now often it's done by a group of four. The lab is good for three people, but the fourth persons stands around and looks at the ceiling."

Keller said his department has cut out grading homework in certain core courses. "Students are not as motivated to do it but they're also not getting as much feedback from it.

"These things are all diminutions of quality," he said. "We're worried we're not doing the job we did once and are capable of doing, and that's very disturbing to us."

Most IT departments say they feel they have reached a point where the size of classes is beyond what they would like them to be. Mechanical Engineering class sections which formerly had 35 students now have 90. Electrical Engineering lecture class sizes have increased from 60 to 80 in core courses to over 190 this fall.

"We have to move to larger rooms and these are further and further from the Electrical Engineering building," said E. Bruce Lee, Department of Electrical Engineering head. "We can't have demonstrations with equipment in lectures because of the remoteness of the lecture rooms."

Most departments say they feel it is crucial that students receive hands-on lab experience, but are concerned that expanding labs may be becoming demonstration courses and students are losing personal contact with faculty. Other departments have lab facilities that are either too old or not properly equipped.

"We get criticized for the lack of design capability of our graduates," said Charles Fairhurst, Department of Civil and Mineral Engineering head. "What we would like to have is a design course. Another course, Structural Engineering, we teach now but we don't have the facilities to teach it properly."

"Senior Design, one of our most important courses, used to have one or two groups of four students," said Richard Goldstein, Department of Mechanical Engineering head. "Now it has two groups of ten students. The time is not taken up by lecture so much, but by consultation with individual students. Obviously, then either one spends less time with students or has less time to work on classroom preparation. Both of these things occur."

Students are also feeling the pinch. "Recitation sections are so overcrowded that they are almost like lectures," said Tom Brimacombe, a mechanical engineering junior. "You might have to go to a T.A. on your own time for personal attention. Recitations are losing that one-to-one relationship between student and T.A. that they were designed to give."

"The equipment we use is like World War II stuff and it doesn't work half the time," said Greg Lesch, electrical engineering senior. "You can almost never get a lab to work the way it's supposed to. You get results that are way off and you can't explain why. It's just because of the equipment."

Staehle says students don't know what they're missing. "Students in IT are getting a very good education, but they are not getting as good an education as they deserve," he said. "Students are being cheated and so is the State. We could give these kids an education that would blow their minds with very little additional money."

Staehle says he feels for IT to be competitive with its peers, it would have to increase its faculty from 350 to 500, which he says could be done if IT received 3 percent more of the total University budget.

"My objective is to solve that problem in six years," he explained. "We would like to get resources for 50 people each biennium."

IT needs people, but competition with industry is fierce. Fewer and fewer students are staying on to pursue master's degrees or Ph.D.s and faculty members are constantly facing higher salary offers from industry and other universities. The College has to work overtime to keep them here.

"Students receive such very good offers when they graduate with bachelor's degrees that they just disappear," said Lee. "It's not very lucrative to stay on as a T.A. and work for a degree."

T.A.s are important to most IT departments because they run labs, and sometimes recitations. But there aren't enough funds or students to make enough T.A.s.

And again, students feel the results. "I've had a lot of foreign T.A.s, especially in math classes," said Jeff Crawford, a mechanical engineering sophomore. "All they do is problems, and they can't help you with anything else. They know how to do the math, but they don't know how to explain how to do it."

Then there is IT's student registration problem. Students are qualified to get into a class, but they can't. It's full. Sometimes students end up substituting courses for certain required classes. In some departments students are very limited in their choice of electives.

Mechanical engineering senior Jim Comb was planning on graduating next fall, but because of problems with registration this spring, Comb may have to wait until after winter quarter 1981 to graduate.

"Academic decisions are not being made by the students, but by the availability of classes," said Storvick.

IT has set up a committee to determine the enrollment problem's limits.

"We have not come to any conclusions other than we do have a problem," said Fairhurst, chairman of the committee. "We'll be suggesting revisions to the admissions policy (by the end of spring quarter) to control the numbers. The numbers are getting out of hand now. We have to bring them down to something more reasonable."

Burgeoning enrollment has forced one department, Mechanical Engineering, to turn over some of the load to the evening Extension Division this quarter in undergraduate sections of five core courses which are being taught by adjunct faculty from local industry.

"We're very careful choosing our adjunct faculty, but I can't help but think it's better for the students to take it from a regular daytime professor," said Goldstein.

"Having adjunct faculty is a good thing for us in that it gets industry involved with our programs, but it's for the wrong reasons," Staehle said. "We've had no choice." Unfortunately, said Staehle, Mechanical Engineering and possibly other departments will have to do the same next year.

Meanwhile, IT is battling for more dollars.

"If I were the parents of the students in this University, I would march en masse to the Legislature," said Staehle. "We don't look upon our college as an expense to the State. We look upon it as an investment. The State of Minnesota gets so much (more) out of IT than they ever put in.

"We hope the Legislature will care enough about the future of the State to recognize the reality of the problem," he added, "and the reality of what it takes to build a support base for a high-technology economy."

Susan Sherry is a senior in journalism at the University.

SPLINTERS FROM 'LOGS PAST

Selected chuckles from the past 60 years of TECHNOLOG

"Are you still engaged to that girl with the wooden leg?"

"No, I got mad at her and broke it off."

Dean: "Do you know who I am?"

Stude—"No, sir, but if you can remember your address, I'll take you home."—*Brown Jug.*

Get Moving. You guys have published your last Daily.

Frosh: "What do you do around here all day?"

Wise Senior: "Hunt and drink."

Frosh: "What do you hunt?"

Wise Senior: "Drink."

Professor: "Are you teaching this class?"
Student: "No, sir."
Professor: "Well, then sit down and stop acting like an idiot."

AgE to his girl: "I'll drive you home if you put your harness on."

Susie married an official of the Three-In-One Oil Company. In about two years she gave birth to triplets. Upon hearing this, her sister immediately cancelled her engagement. Her fiancé was an official of the Phillips 66 Company.

Professor: Well, sir, have you any good reason why I shouldn't flunk you in chemistry?

Student: Yes, sir—just take a snort of this gin that I made last night.

"What are you putting in your vest pocket there?" asked the Ch.E.

"That's a stick of dynamite. Every time that E.E. sees me he slaps me on the chest and breaks all my cigars. The next time he does it, he's going to blow his hand off."

Definitions: Bra: A device used to minimize the effects of flutter and vibration, compensating for pitch and gyration.

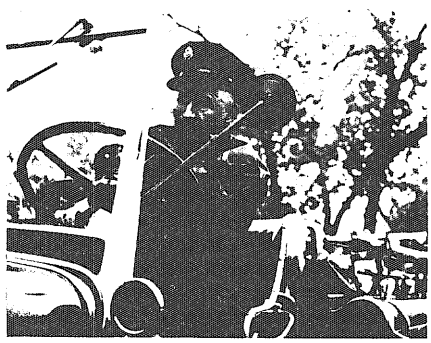
Monastery: Home for un-wed fathers.

Ecstasy: Happens between Scotch and water and bacon and eggs.

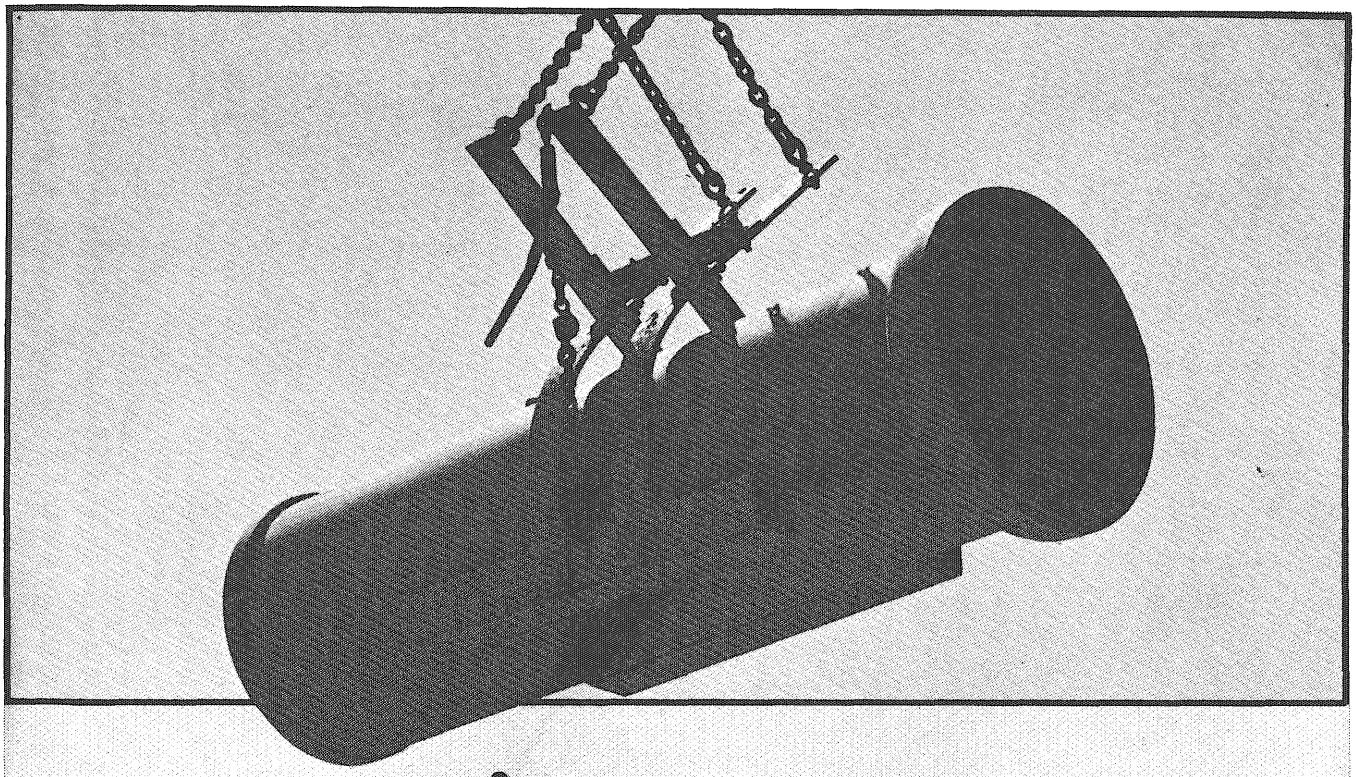
Mother: "Billy, what are you reading?"

Billy: "Playboy, Mamma."

Mother: "Oh, that's all right, dear. I was afraid you had got hold of a MINNESOTA TECHNOLOG."



"Biggest fire I ever saw, and Doug forgot to bring the marshmallows!"



The world's original building material is still the best—clay.

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For more information, call your Dickey sales representative.

Or call or write: W. S. Dickey Clay Manufacturing Company, P. O. Box 6, Pittsburg, Kansas 66762, 316/231-1400. 95944

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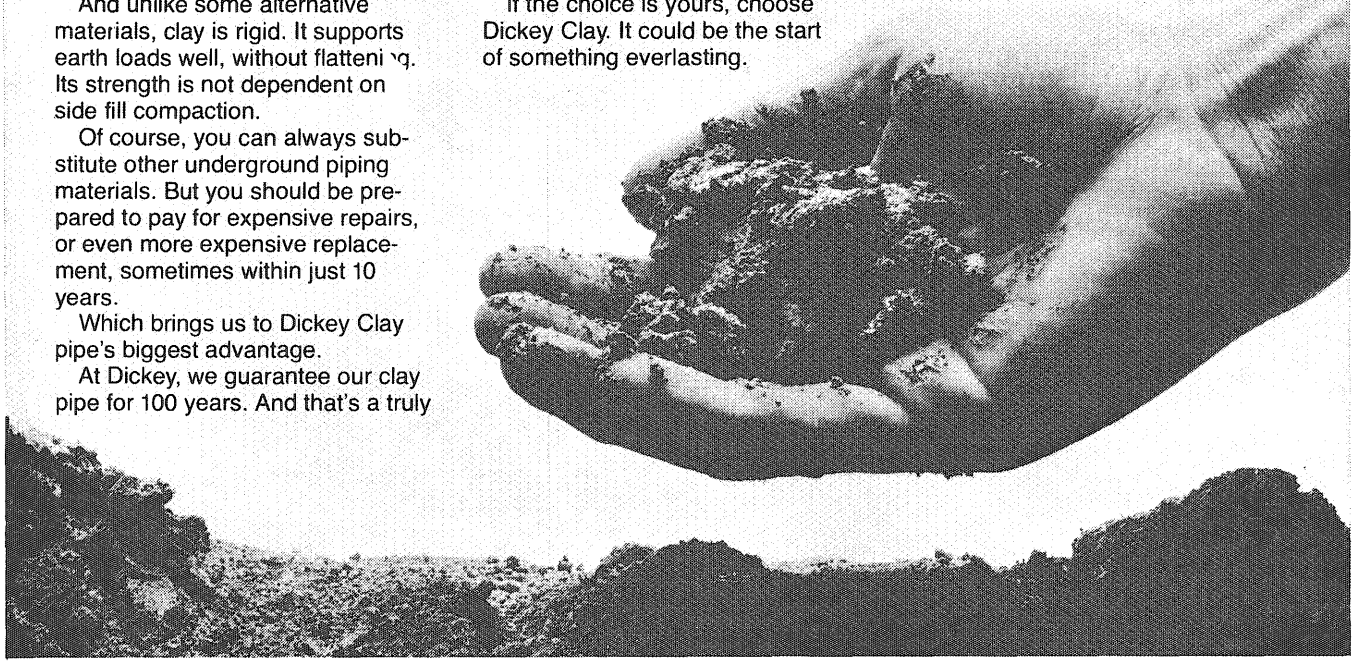

Log Ledger

News

Winners of the **1979 "Seven Wonders of Engineering" Competition** are: the Minnesota Department of Transportation (Blue Earth roadside rest area), Minnesota Power and Light (fiber optic transmission system), Barr Engineering (rehabilitation of the Lake Byllesby Dam), 3-M (an air-cycle heat pump solvent, a heat recovery system and an ethylene oxide sterilizer) and Honeywell (a push-button setback thermostat and a heat pump logic center).

Seven non-taxable $1,000 stipends are available for undergraduate study, engineering or mathematics students preferred. Contact Prof. William Garrard, 107 Aeronautical Engineering.

Abstracts for papers on wind energy to be presented at the second Wind Energy Innovative Systems Conference in Colorado Springs December 3-5 are due by May 29. For instructions and information write: Dr. Irwin E. Vas, Group Manager, SERI Wind Systems Section, 1617 Cole Blvd., Golden, CO 80401.

Sunspot activity is at the peak of its 11-year cycle, says Prof. John Winckler, Department of Physics. As a result, the "northern lights" will be a more common sight for the next few years.

The American Society of Civil Engineers has launched a 1980 advertising campaign emphasizing their role in saving energy by keeping traffic flowing smoothly.

NASA has contracted with the European Space Agency for the building and delivery of **a second Spacelab** for use about 1984.

The first launch of the spacecraft Columbia is expected no earlier than November, possibly in early 1981. The spaceshuttle is in the systems test period.

Two Howard Lake, Minnesota brothers converted a 350-cubic-inch Chevy engine to run on an 80-percent alcohol, 20-percent water mixture and made a successful round trip to Washington, D.C.

Recent studies say **halocarbons are dangerous to the ozone layer,** with stunting of plant growth and skin cancer the main risks.

The American Association of Engineering Societies, which held its first annual meeting in March, decided to emphasize informing the public on technological issues and addressing technological issues which are important nationally and internationally.

A record 340,488 undergraduate students enrolled in the nation's 286 engineering schools in the fall of 1979 — an increase of more than nine percent over 1978.

Alcohol-powered cars can now be purchased in Brazil. Although they consume 20 percent more fuel, alcohol fuel costs half as much as gasoline.

In its first year, **Argonne's High Voltage Electron Microscope,** which has ten times the electron-volt capacity of conventional electron microscopes, has achieved many "firsts," like examining hydrogen's damage on materials under stress and observing ion bombardment's effects on materials.

Data Courier is offering **on-line training sessions** for new or experienced users, held at Data Control Corporation in St. Paul on May 19 and 20. Deadline for application, May 9. For information call 800-626-2823.

A planned USSR visit by U.S. Engineering Society leaders has been postponed in line with President Carter's technology exchange ban.

Publications

Public Information Resources
By Breeder Reactor Corporation. Lists publications, films, videotapes, speakers and demonstrations about breeder reactors.

Facts About the Clinch River Breeder Reactor Plant Project
By Breeder Reactor Corporation.

Clinch River Breeder Reactor Plant: A Building Block in Nuclear Technology
By Mike McCormack. A brief history and the present status of breeder-related research. Write: Breeder Reaction Corporation, P.O. Box U, Oak Ridge, TN 37830.

A Decisionmaker's Guide to Wood Fuel for Small Industrial Energy Users
By the Solar Energy Research Institute. 127 pp., $8.00. Discusses the pros and cons of wood energy as a small industry fuel.

Characterization and Assessment of Potential European and Japanese Competition in Photovoltaics
By Science Applications, Inc. 130 pp., $7.25. Summarizes the status of photovoltaic industry in foreign countries and addresses technical and market positions of foreign companies in the international market. Write: National Technical Information Service, 5285 Port Royal Road, Springfield, VA. 22161.

Black America: Heralding a Heritage
By Honeywell. A collection of little-known facts on contributions by black Americans in science, engineering and other fields. Write: Residential Group Public Relations, Honeywell, Minnetonka, MN 55343.

INMAC Winter 1980 Catalog
70 pp., free. Write: International Minicomputer Accessories Corporation, Dept. BPR, 2465 Augustine Dr., Santa Clara, CA 95051.

and now... E WEEK!

by Robert Plumb

Hey, it's no secret: school is a drag; we all need to break away now and then. So once again, Plumb Bob has planned an exciting slate of activities for E-WEEK '80. Plumb Bob hopes that everyone will join in and "get weird" and do crazy things together. During E-Week, IT students come together in a spirit of fun away from the grind of the classroom.

New this year are the Great Alarm Clock Race, the Flat-Plate Solar Collector Competition, and Co-Rec Volleyball.

For the Alarm Clock Race, build a car driven by a wind-up alarm clock. The car must travel in a predetermined circular path and launch a projectile while within the predetermined firing area, which must land at a specific target point. The first ten entires will receive $5.00 each to defray costs. For further information, call Evan Whitby at 3-4526.

The Flat-Plate Solar Collector Competition will be held the first sunny day of E-Week. The total collector area should be less than one meter square. The collector system should contain no less than 30 gallons of water, which shall circulate through the flat-plate by natural convection only. The collector with the largest temperature change wins. The first five entries will receive $25.00 each to cover construction costs. All plans should be reviewed and approved by Plumb Bob before work on the collector is started. For more information, call Brad Peterson at 331-8078.

Get your teams for Co-Rec Volleyball together. Intramural Volleyball rules will be used.

Traditional E-Week events are:

Tuesday
- Car Rally
- Calculator Race

Wednesday
- Chess Tournament
- Softball Tournament
- Ping-Pong Tournament
- Foosball Tournament
- Shamrock Hunt

Thursday
- Backgammon Tournament

Friday
- Tricycle Race
- Wheelbarrow Race
- Bed Race

. . . and an E-Day Picnic. Rules for all events are posted on the Blarney Board on first-floor Mechanical Engineering.

All participants must wear an E-Week Button. Trophies will be awarded for all events. In addition, the winning teams in Softball, Co-Rec Volleyball, and the Solar Collector Competition will receive T-shirts.

All teams must be at least 80 percent IT students.

The E-Day Picnic will be held in Architecture Court Friday, May 9, at 1 pm. Awards will be presented then, with a TI-57 raffle too, so hang on to your paper plates.

The Non-Internal Combustion Car Race has been cancelled this year due to past lack of participation.

Also, AIAA is sponsoring a Paper Airplane Contest, ASAE a Water Balloon Throwing Contest, and Triangle Fraternity a Truss Building Contest.

With your participation, we can make this the best E-Week ever.

Log Ledger

Publications cont.

Aluminum For More Efficient Railroad Cars
By the Aluminum Association, 24 pp., free. Shows various advantages in aluminum railcars. Write: Aluminum Association, 818 Connecticut Ave. N.W., Washington, D.C. 20006.

The Space Shuttle Design and Construction
By George W. Jeffs, President, Rockwell International. 44 pp. Copies available in the *Technolog* office.

ISI Products and Services Booklet
12 pp., free. Write: Institute for Scientific Information, 325 Chestnut St., Philadelphia, PA. 19106.

More Learning in Less Time
By Norma Kahn, 80 pp., $3.50. Discusses self-evaluation, time budgeting, and effective memory and note-taking. Write: Hayden Book Company, Rochelle Park, N.J. 07662. Copy available in *Technolog* office.

Also available in the *Technolog* office are review copies of **Engineer's Guide to Solar Energy,** 324 pp., and **Peterson's Annual Guide to Careers and Employment for Engineers,** 1980 edition, 542 pp.

Seminars

CHEMICAL ENGINEERING AND MATERIALS SCIENCE
RM 240 AMUNDSON — 1:15 PM

May 13
"Mechanical Properties of Polymeric Solids Under High Pressure"
Prof. Eric Baer, Dean, School of Engineering, Case-Western Reserve University

May 20
"Hydrogen-Induced Fracture In High Strength Steels"
Prof. Charles Mc Mahon, Department of Metallurgy, University of Pennsylvania

May 27
"Bubble Dynamics in Structural Foam Processing"
Prof. C. D. Han, Department of Chemical Engineering, Polytechnic Institute of New York

June 3
"Application of Regular Solution Theory to Molten Alloys"
Prof. Peter Gray, Center for Studies in Statistical Mechanics, University of Texas

MECHANICAL ENGINEERING
RM. 108 MECHANICAL ENGINEERING — 3:15 PM

May 7
"Stratified Charge Engine, Part II"
Edward F. Fort, Research Engineer, International Harvester Science and Technology

May 14
"Recent Developments in Heat Pump Design and Application"
Gerald C. Groff, Director of Research, Carrier Corp.

May 21
"Plasma Metallurgy"
Donald R. Mac Rae, Supervisor, Bethlehem Steel Corp.

May 28
"Technology Appropriate to a Developing Country: The Contrast between Canada and the Philippines"
Prof. Ostap Hawaleshka, Industrial Engineering, University of Manitoba

June 4
"Mixing and Turbulent Flow"
Prof. William C. Ranz, Dept. of Chemical Engineering

CONTROL SCIENCE AND DIGITAL SYSTEMS
RM. 102 MECHANICAL ENGINEERING — 2:15 PM

May 1
"Some Aspects of Modeling in Chemical Process Control"
Prof. John Crump, Department of Chemical Engineering

May 8
"Indirect vs. Direct Self-Tuning Control of MIMO/SISO Systems"
Dr. K. Latawiec, Purdue University

May 22
"A Mini-Max Approach to Stabilization of Linear Systems"
Dr. A. Olbrot, Tech. University of Warsaw

June 5
"Variable Measurement Structure in a Tubular Chemical Reactor"
Prof. J. Alvarez, Department of Chemical Engineering

COMPUTER SCIENCE
RM. 108 MECHANICAL ENGINEERING (MAY 5, 19, 20) — 3:30 PM
RM. 305 LIND (MAY 12) — 3:30 PM
REFRESHMENTS, RM. 114 LIND — 3:00 PM

May 5
"On Programming Style, or Why Doesn't Everyone Program As Well As I?,,
Dr. Brian W. Kernighan, Bell Labs, Murray Hill

May 19 and 20
"The Use of Correctness — Proof Ideas in Programming"
Part 1 — Right-Justifying Lines
Part 2 — The Schorr-Waite Graph Marking Algorithm
Prof. David Gries, Computer Science Department, Cornell University

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Navy Civil Engineer Corps.

Log Ledger

Seminars cont.

ELECTRICAL ENGINEERING
RM. 108 MECHANICAL ENGINEERING — 4:15 PM
TEA, RM. 136 ELECTRICAL ENGINEERING — 3:45 PM

May 15
"Prospects of Gigabit Logic for GaAs FETs"
R. Zuleeg, McDonnell Astronautics

May 29
"Magnetic Separation"
F. J. Friedlaender, School of Electrical Engineering, Purdue University

AEROSPACE ENGINEERING AND MECHANICS
RM. 225 AERONAUTICAL ENGINEERING — 2:15 PM

May 9
Title to be announced
Dr. David Maull, Engineering Department, Cambridge University

MICROELECTRONICS
RM. 305 LIND HALL — 3:15 PM

May 2
"Flicker Noise Update"
Prof. van der Ziel, Department of Electrical Engineering

May 9
"VLSI Test Challenges of the Eighties"
Dr. Robert Davidson, Bell Telephone, Murray Hill

May 16
"Gate Arrays and Macro Arrays"
Mr. Jack Funk, Control Data Corporation

May 23
"Submicron Devices: Measurement Techniques and Results"
Dr. Michael Liu, Honeywell

CHEMISTRY
RM. 325 SMITH HALL — 7:30 PM

April 30
"Organic Reaction Mechanisms and Stereochemistry"
Prof. Charles DePuy, University of Colorado

May 14
"Stereochemistry: Mechanisms of Organic Reactions"
Prof. Kurt Mislow, Princeton University

May 28
"Synthesis and Reactions, Mechanisms of Organic and Transition Metal Organometallic Compunds, Catalysis, Synthesis of Non-benzenoid Aromatic Molecules"
Prof. Robert Bergmann, University of California-Berkeley

PHYSICS AND ASTRONOMY
RM. 131 PHYSICS — 4:00 PM
TEA, 130 PHYSICS — 3:00 PM

May 7
"Recollections of Wolfgang Paul"
Dr. H. B. G. Casimir, Director Emeritus, Phillips Research Labs, Holland

May 14
"Onsager Relations and Electrical Engineering"
Dr. H. B. G. Casimir

June 4
"Dynamics of a Spin Lattice: A New Approach"
Dr. Oriol Valls, Department of Physics

More Technolog Awards

Technolog took four awards for magazine excellence at this year's Engineering Colleges Magazine Association (ECMA) Convention, held April 10-12 at the University of Colorado, Boulder.

Magazine professionals awarded *Technolog* first place for Best Single Issue, Five Issues or More per Year (Winter II, 1979); third place for Best Non-Technical Article (Bruce Kvam, "Computers: Dumb in Fact, Smart in Fiction," Winter II, 1979); third place for Best All-Around Magazine, All Issues; and an honorable mention for Best Technical Article (John Bartelt, "The Solar Neutrino Problem, or, What's SNU?," Winter II, 1979).

Also, Professor John Clausen, *Technolog* advisor, was elected Vice-Chairman of the ECMA Executive Board.

ECMA is a federation of 41 engineering college magazines across America, with their staffs and advisors. *Technolog* and nine other magazines (seven of which still publish) founded ECMA in 1920.

New Products

Texas Instruments has introduced several new products:

A Talking Language Translator which uses speech synthesis and offers solid state electronic modules for English, French, German and Spanish.

Mr. Challenger, an electronic letter and word game designed for children eight years to adult.

Super Stumpers, new plug-in modules for use with Speak and Spell, a talking learning aid, that features commonly used but difficult words.

A home computer system with Solid State Software command modules ranging from Household Budget Management to Football.

New electronic watches that feature extra-thin models, sports watches designed for joggers, and women's watches with alarms.

Monolithic Memories has introduced a low-power Schottky bipolar octal transceiver that allows asynchronous, two-way communication between data or address buses connecting processors, controllers and memories.

ENGINEERING & COMPUTER SCIENCE MAJORS

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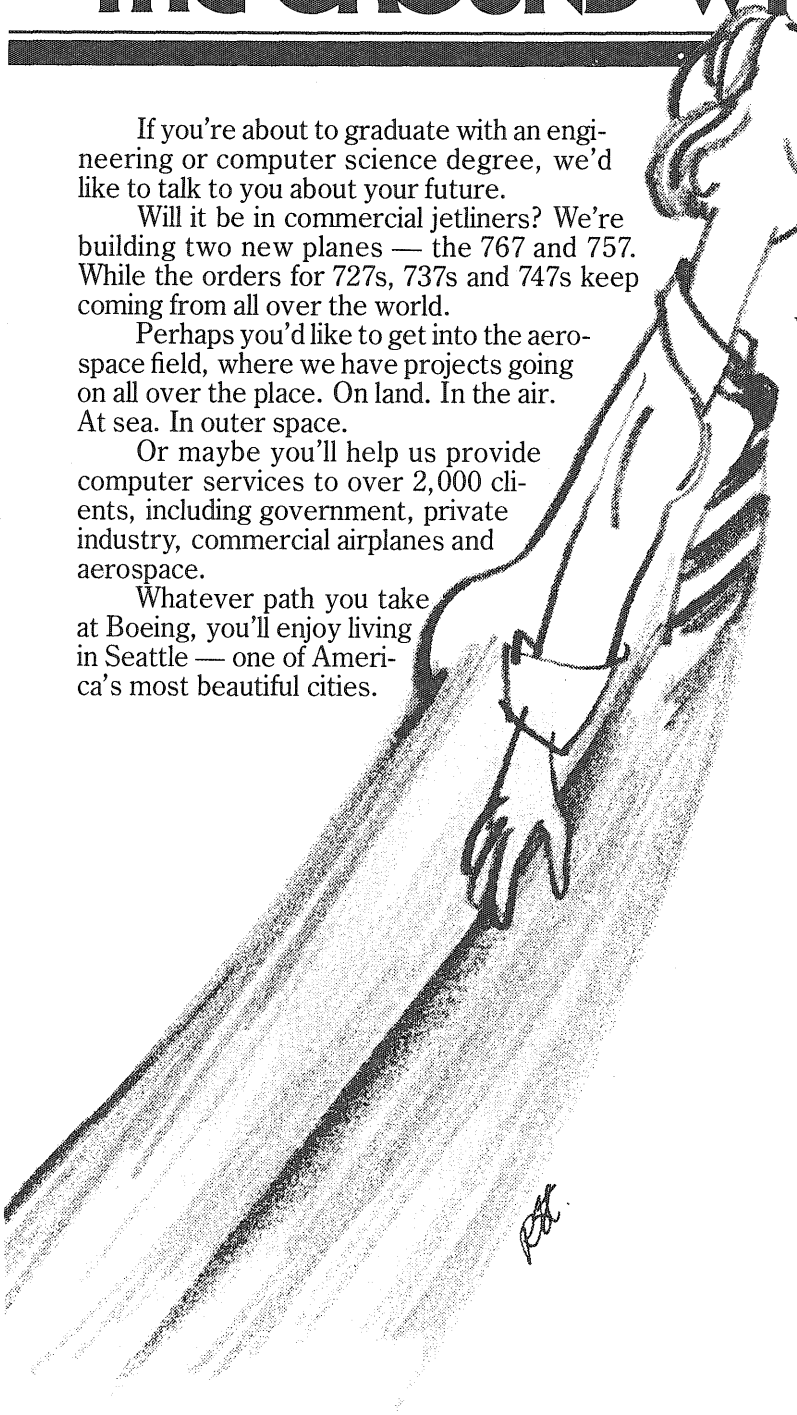

If you're about to graduate with an engineering or computer science degree, we'd like to talk to you about your future.

Will it be in commercial jetliners? We're building two new planes — the 767 and 757. While the orders for 727s, 737s and 747s keep coming from all over the world.

Perhaps you'd like to get into the aerospace field, where we have projects going on all over the place. On land. In the air. At sea. In outer space.

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Science Fiction Contest 2nd Place Winner

SLOW DESCENT

by Gordon Plorin

Franklin couldn't resist making the pun, and flipped on the radio. "*Vermont* here. My brother has sent us some Sirius Nu's." After the moaning died he continued, "There's a planet. A little small and not much atmosphere, but . . ." He hesitated for dramatic effect. ". . . There's life! Standard carbon-based: right-hand sugars, left-hand amino acids. We have a home!"

Cheers roared back from twenty-one ships. "A toast! A toast!"

Franklin raised his glass. "To Life! To Freedom!" he offered.

"To Life! To Freedom!," came twenty-one ecstatic replies. "A party! Let's celebrate!"

Of course! Celebrate all night and maybe tomorrow! After nearly four years of deep space, the Nu-beam had brought hope of life, hope of freedom, hope that a year from now they wouldn't all die of starvation. The women sang songs over the radio and the men played darts on the video. Justin showed some old cartoons and movies from the library ship. The families on the *Mayflower III* put on skits. And finally Dirk called from the *American Eagle:* - Beep - *"Eagle* here. You know, Fred and I got this old bottle of scotch and we can drink any man under the table." And so they did, with the toast before every shot, "To Life! To Freedom!"

Nobody knew just how many people had tried to leave the Earth. The Soviets would have beaten the U.S. within a month and everybody knew it. A simple notice had appeared in the *New York Times:* "Anybody who can get a ship with electron-jump drive is welcome to accompany us to Sirius. We leave July 2, 1996 and rendezvous at Mars." The notice seemed to be a prank: electron-jump ships cost at least half a million dollars and nobody even knew if there were planets around Sirius at all. Besides, it was almost nine light-years away. But the choice was slavery or space, and over a hundred ships blasted toward Mars that day. Some were surplus junk; some of their owners had never flown before. The next day, forty-four ships left Mars at 0.75 light-speed for Sirius.

There had been little time for planning. Franklin was a communications researcher for NASA before the war and his invention of the Neutrino-beam radio had made him quite wealthy. His brother, Courtney, was an electron-jump mechanic. Together they had laid out a hurried scheme for the long exodus. Franklin purchased a long-range ship and outfitted it with navigation and communications equipment, including a Nu-beam antenna of compressed gallium nuclei. Courtney modified a Navy torpedo ship into a sleek ultra-fast racer. Then on July second, Franklin put his wife and son onto the *Vermont,* Courtney crawled into the *Long-Distance Runner,* and they left for Sirius.

Franklin cupped his hands behind his head and leaned back in his seat. He looked out at the ships around him. *Too bad we can't travel closer together,* he thought. That was a common wish for these people who were forced to stay away from each other. Six months out from Earth the *Tinkerer* had burned a baffle plate and the resulting explosion sent shrapnel through two other ships. Since then they had maintained maximum radio distance, with the *Vermont* in the center to relay messages.

Franklin was proud of his fellow travelers. Proud that they had risked five years in space rather than face Soviet domination. There had been malfunctions, isolation, even madness, but now with only five months left to Sirius they were still fifteen ships. Eighty-nine people who valued liberty above life; eighty-nine people who would build a new world of peace: one race, one culture, one language.

He thought of his brother, Courtney, who had raced ahead to Sirius at 0.9 light-speed for most of the distance. Alone, really alone, without even radio contact, he had scouted Sirius for planets. His Nu-message of a suitable planet meant that they wouldn't have to divert to Procyon, and Courtney wouldn't have to die at Sirius all alone.

From the ship's main viewport Franklin could see four of the other ships. Proud people had given their ships proud names: the *Founding Fathers* and the library ship *Magna Carta* were ahead; *Patrick Henry* was on the right; and the great *Mayflower III* hung above his own ship, *Vermont.* He looked up at the ship's motto over the viewport and his pride welled up higher inside him: "Live Free or Die." Like all the travelers, Franklin had learned to cultivate his pride. It was the only thing that kept them hanging on.

He turned back toward the living room where his wife and children slept. Martin had only been three when they left, Jenni was born eight months ago. Joanna and he had delivered the baby themselves with instructions from Dr. Spence aboard the *Santa Maria.* Jenni had never been outside the living room, had never seen anything more than seven meters away from herself. *Someday,* thought Franklin, *we'll build domes where she can play baseball and run through the grass barefoot. Martin will be able to climb trees.*

His son turned over. Franklin smiled. *Probably doesn't even remember trees,* he thought. *But soon, just five more months . . .*

-Beep- *"Magna Carta* here. Franklin! Ship ahead, coming in fast. Looks like the *Long-Distance Runner!"*

Franklin ran to the radio. "Courtney? He doesn't have the fuel."

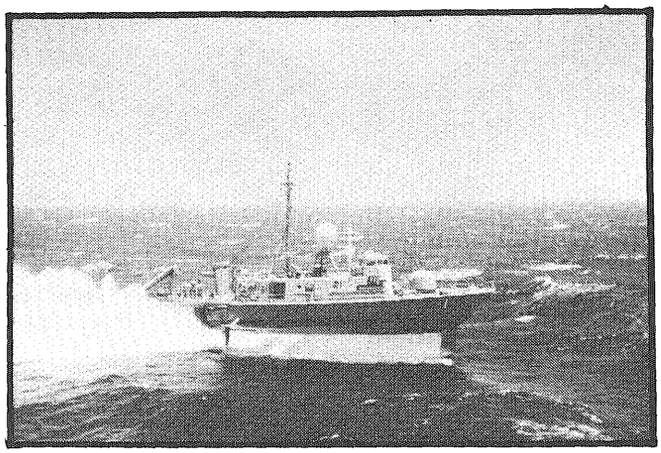
-Beep- *"Runner* here. Frank! Divert to Procyon. The Sirius planets are alive! I came as soon as I realized it."

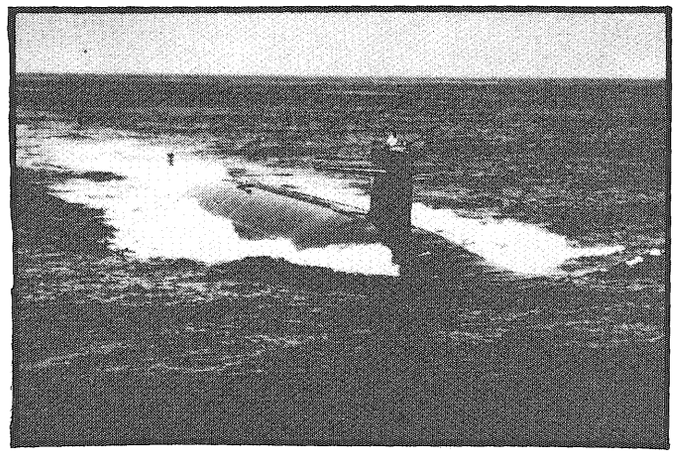
"We know Court, we got your Nu's."

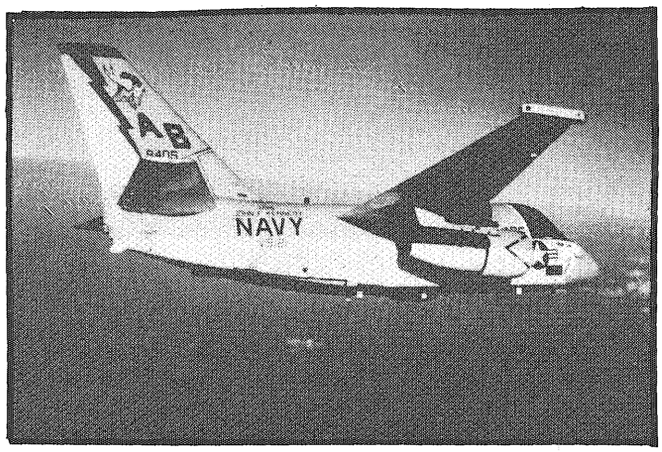
"No, I mean alive, not just having life. Huge organisms, all seven of them. Mostly liquid, like protoplasm four hundred meters deep." The *Long-Distance Runner* flashed past the congregation of ships.

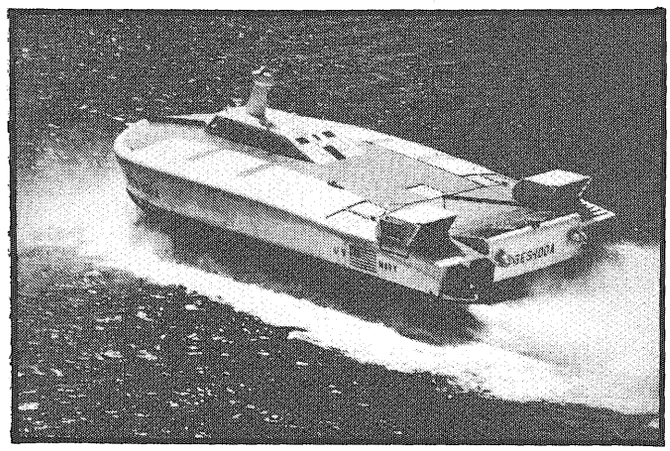
"So maybe we can kill one and set up our domes on the bedrock."

LEADERSHIP AND MANAGEMENT EXPERIENCE UNEQUALED BY INDUSTRY.... WHERE?









Current technology and its influence on the United States Navy is creating a demand within the fleet for technically qualified line officers. Because of this demand, the Navy is offering a two-year scholarship program through Naval ROTC designed for college sophomores and juniors pursuing engineering and hard science curriculums. This program allows qualified students to obtain a commission in the United States Navy and continue on in surface line, aviation, or nuclear power. Let your last two years of college prepare you to be someone special! If you are interested in applying for this opportunity please call (612) 373-2230, or write to:

NROTC Programs
203 Armory Building
15 Church Street SE
University of Minnesota
Minneapolis, MN 55455

THE NAVY

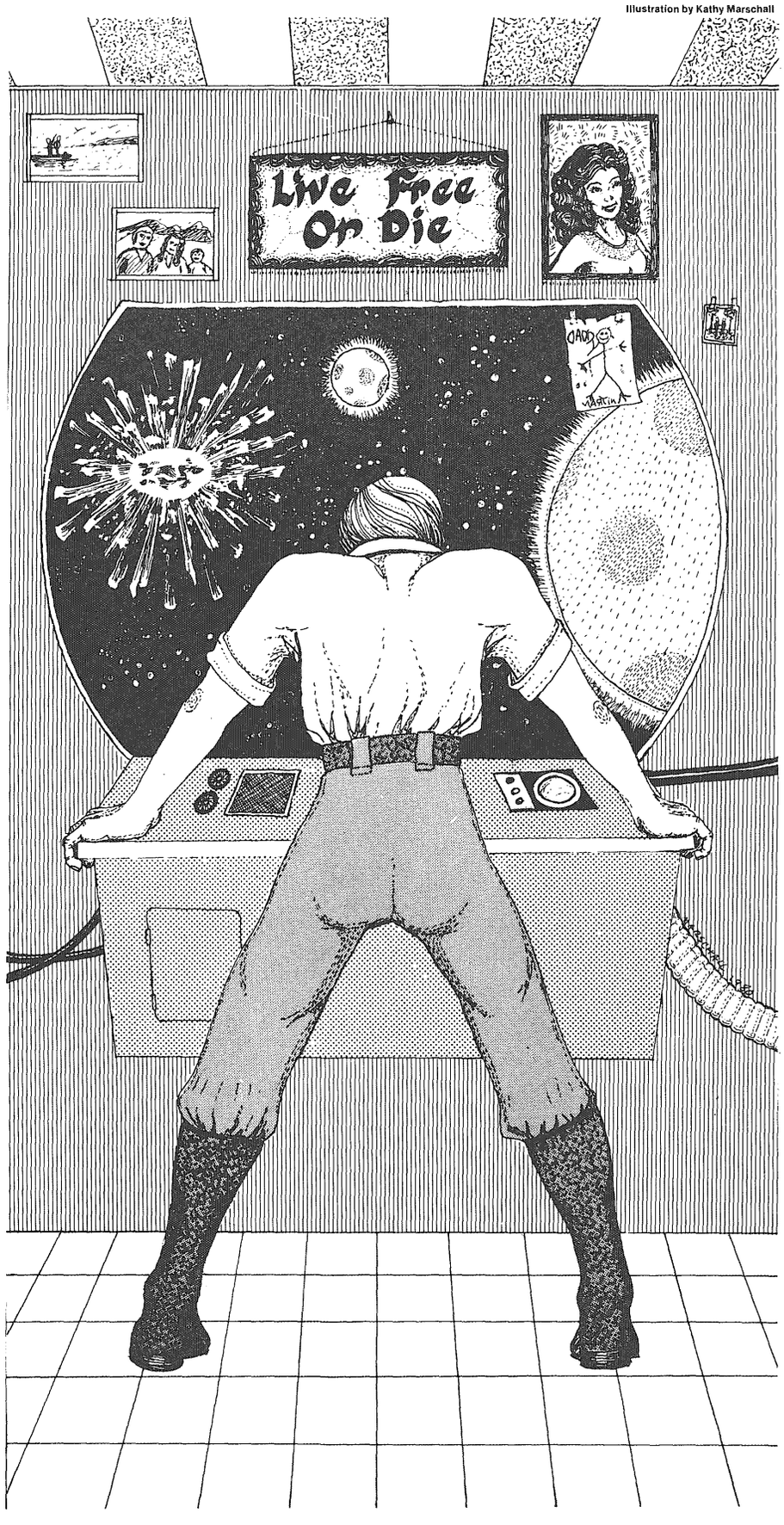


Illustration by Kathy Marschall

"Can't, Frank; not enough gravity. Once you destroy the thing's surface membrane everything organic would boil away in about thirty years. And you can't build on top of them either. Too soft."

"How about floating?"

"I tried that with the second probe-lander. It got eaten."

"Court, why didn't you just send another Nu-beam? Now you can't stop!"

"Burned a hexode just after the first transmission. Had to tell you. You can't kill them, and you can't live on them. You'd have to live inside. Go try Procyon."

There was a short pause.

"Hey Frank! I made point-nine-seven light-speed coming back. Stuck the ship's excess magnesium into the after-burners. Wrecked the gamma-catchers, but what thrust! Seems like I've only been sailing a week or . . . and now . . . "

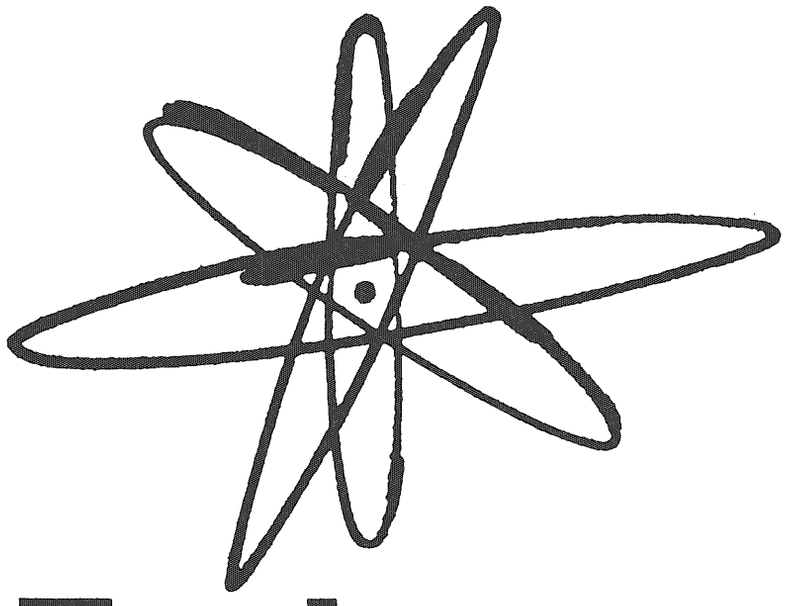
The transmission faded as the *Long-Distance Runner* went out of range. The radio was silent for the rest of the night.

Inside? Franklin's head began to race and his stomach tightened. Inside! The very idea was revolting! Inside another organism, like some parasite! It could be done, of course, the whole planet was probably edible, but who would want to? Who would want to spend the rest of their life living like a maggot chewing on some animal's guts? Had they travelled so far for this?

Martin woke, went forward to the guidance room, and climbed onto his father's lap. A moment later he was asleep again, his head resting against Franklin's chest. The red light from the instruments glowed softly on the boy's face.

How could they raise their children? Could they teach them kindness while cutting pieces from the planet for supper? It wouldn't be the same as slaughtering cattle: that could be done quickly and mercifully. Living inside a Sirius planet might be little better then torturing it. Could the children learn independence? Respect for others? Could they ever be proud of themselves?

Martin yawned. *There won't be any trees at Sirius,* thought Franklin, *no grass for Jenni.* He carried his son back to the living room and then returned to the guidance panel. A few calculations from the computer confirmed what he already knew: the *Vermont* and the *Founding Fathers* still had enough fuel to make it to Procyon. A few more years in space would be better than being a parasite.



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Franklin went to bed.

The next morning the *Founding Fathers* was gone.

It hadn't been easy for Franklin to continue on to Sirius, but without the *Founding Fathers* he had the only computer capable of plotting orbital trajectories. Franklin had never been one to desert his friends.

The fourteen ships had been orbiting Number Two for almost a month while they made plans for their new home. Number Two was the largest of the Sirius planets, but still it was only a thousand kilometers across. Trillions of chloroplasts were layered just below the surface membrane, giving the entire planet a bright green appearance. Except for several disk-shaped spots that changed from red to yellow every few minutes, Number Two seemed to be simply a uniform mass of living jelly. The ships would land near each other and tie themselves together with grappling rockets. After being swallowed they would sink to the bedrock where the probe-landers had found metal ores. They could construct domes there, and later build towers to the surface. Someday they might live above the organism supported by stilts to the bedrock. That would be many years away, but the idea kept hope of freedom alive. That goal had been voted for unanimously. Tomorrow they would begin.

Franklin was watching his son spill a glass of water on the living room floor. Unaware of his father's eyes, Martin picked up Jenni and sat her on the puddle to soak it up with her diaper. Franklin began to chuckle, but then frowned when Martin heard and turned toward his father.

"Martin, come here," he said, trying to maintain a stern appearance. Martin came to him slowly, wearing his most penitent face.

"Martin, good people don't give their troubles to someone else. Jenni didn't spill the water. Why should she clean it up?"

"But, Dad, I didn't mean to spill it."

"No, of course not. It was just an accident. It wasn't your fault, but it was your responsibility. Now go help your mother change Jenni. Then it's time for bed."

As Martin sauntered back to the living room, Franklin grinned and spun his chair around to the viewport. Sirius would set in about thirty minutes; nine hours later it would rise again and the ships would go down. The tired band of travellers had kept their self-respect alive with the hope of someday living on stilts. They might not have to eat the planet forever. They needed their pride, and had managed to drag it up again. Franklin was almost eager to get started.

-Beep- *"Magna Carta* here. Franklin, this is Justin." His voice was feeble, almost shaky. "While we've been busy making plans, Davi has been watching those disks. Swing your scope to Number Three and watch its disks and Number Two's disks on that side at the same time."

On the videoscope's screen Franklin watched Number Three's disks blink red and yellow for five minutes, then stay yellow. A few moments later, Number Two began to blink. When it stopped, Number Three started up again.

-Beep- *"Santa Maria* here. I've been watching, too. Franklin, I think the planets are intelligent. They talk to each other."

Sirius set. Franklin quietly rose from his chair, walked back to the darkened living room, and, for the first time in thirty years, he cried himself to sleep.

When he awoke the star had already risen. Franklin picked his way through breakfast and then went to the guidance room. Number Two was conversing with Number Six. *Is this what we left Earth for,* he thought, *to live like germs? We could have organized an underground resistance against the Soviets. At least we could have died as fighting men instead of living like some kind of disease. Courtney was the lucky one,* thought Franklin. *At least he went out as a hero.*

Number Six was answering.

Maybe they're philosophers, he thought. *We don't know what effect we might have on their minds. Maybe they'll go crazy.*

Number Two blinked again.

Maybe they're courting. Maybe they're lovers. With that idea, Franklin opened the engine's circuitry panel. He stared for a while at the gauges. *How could we infect a thinking being?* he thought. It would be so easy to invert the electron-jump drive. Quick, too, just a sudden burst of orange and blue light as every electron on the ship leaped from its orbital and then fell back. Simple, painless and clean. No shrapnel, no danger to the other ships. He thought about the malaria he'd caught in Thailand and remembered the chills, fever, and delirium. How could he do that to this innocent planet? He reached for the panel.

-Beep- *"Patrick Henry* here. I don't know what the rest of you have decided, but I'm not going to be a parasite!" Franklin ran to the starboard viewport just as the *Patrick Henry* flashed brightly and died.

"Ooooooooooo!" Turning, Franklin saw his son with eyes wide and bright, like a kid watching fireworks. A minute later, the *Patrick Henry* was only a blackened hull.

How could he do *that* to his own innocent children?

Franklin reached above the main viewport and took down the plaque, "Live Free or Die." *"Live Free,"* he thought, *that was supposed to mean free of oppression from others, not of oppression to others.* On Earth they would have been mistreated but still proud; here they must shamefully abuse this great intelligent planet. They might never be slaves, but they might also never be truly free. Franklin hung the plaque back above the viewport, with the motto toward the wall. His eyes burned, but there were no tears left. He flipped on the radio.

"Vermont here. It's time to go down. We can't use any left-over fuel inside the planet, so don't rush it. There's no hurry." He paused for a moment, then:

"To Life," he offered.

"To Life," straggled the replies.

Number Two was blinking to Number Three. Thirteen ships began a slow descent to parasitism.

Gordon Plorin, a graduate student in zoology at the University, won second place in the 1980 Technolog **Science Fiction Contest.**

THE lighter side OF TECHNOLOGY

A MODEST PROPOSAL

by Bruce Brand

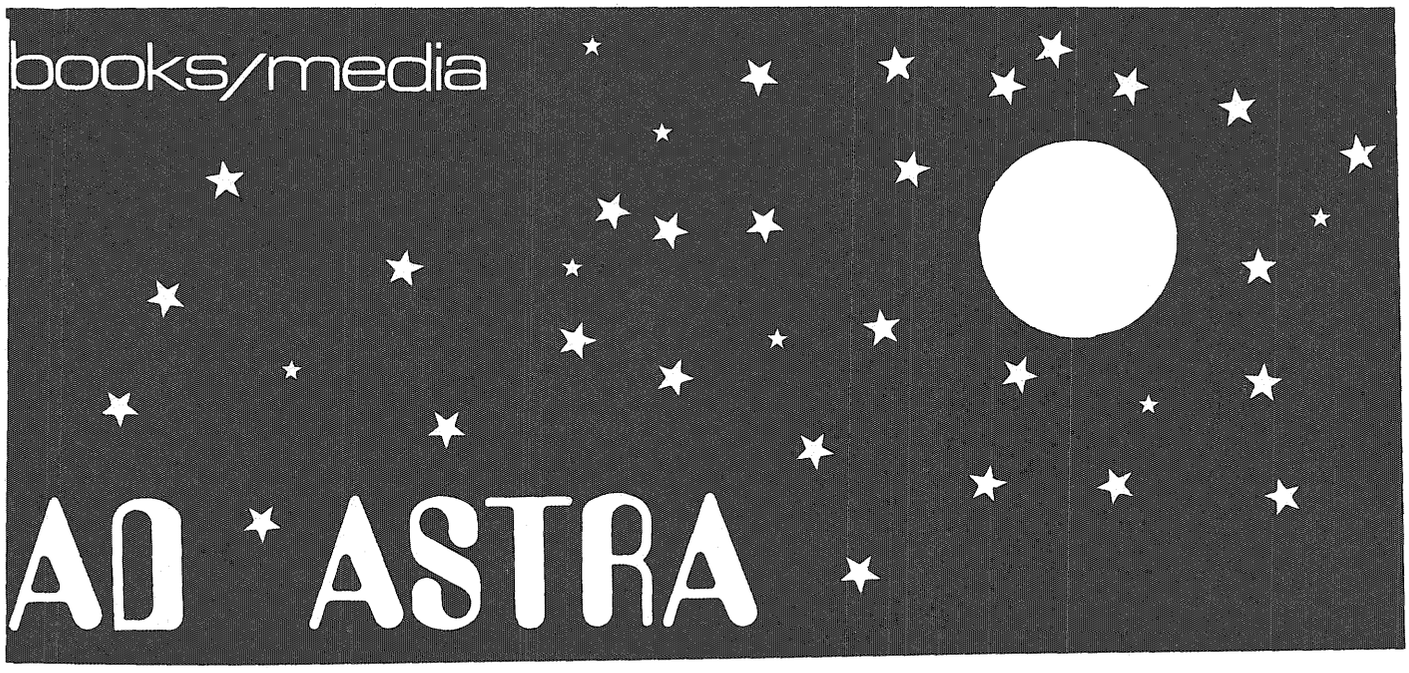
For years (the past seven, to be exact) our country has been faced with an energy crisis. Unfortunately, most Americans have resorted to finger-pointing and sloganeering instead of grappling with the real problem. The fact is that energy is all around us; it's simply a matter of converting it into a form we can use.

I cite, for example, an area south of the Twin Cities, where I-35W crosses the Minnesota River. Transportation engineers estimate this highway's traffic flow in both directions at 57,737 vehicles per day. Now, in this area, I-35 cuts through several sizeable hills, any of which would be suitable for the anchorage of a large concrete dam across I-35. In this way, the energy of falling cars could be harnessed.

How much energy? Assuming a 200-foot head with an average car weight of 3,000 pounds, our flow rate will equal 57,737 cars/day, or .66825 cars/second, or 2,005 pounds/second. Now, head times mass flow rate yields power, so we have 2,005 x 200 = 400,951 foot-pounds/second, or 729 horsepower, which could be converted into electricity and fed into the Black Dog Power Plant nearby, thus boosting Black Dog's output by over 500 kilowatts!

We would thus eliminate the environmental danger imposed on snail darters by other dams, and although several square miles of twisted steel would not be as recreationally entertaining as a typical dam reservoir, traffic flow on I-35W would be well-regulated.

Inherent in the many resultant car collisions would be a certain head loss. However, head loss is something civil engineers have learned to accept while we're all here in this vale of tears.



by Bruce Kvam

The Number of the Beast, by Robert A. Heinlein, 512 pp., ill., Fawcett Books, $6.95.

When a new novel by an acknowledged master like Robert Heinlein appears, everyone eyes it with suspicion: will it live up to his past successes, or has he lost his touch?

The Number of the Beast is Heinlein's first book since *Time Enough for Love,* published eight years ago. He had been suffering from arterial blockage (he's 72) and with the help of space-age technology has recently overcome the problem. *The Number of the Beast* is simply a HUGE book. I feel that that, more than anything, is the reason for its long incubation.

The story opens at a party in California, when the hero, Zebediah John Carter, meets a mad scientist's beautiful daughter. As it happens, the scientist, Jacob Burroughs, is not so impractical after all: someone wants to kill him to keep his theories from the public. Burroughs has discovered there are (at least) six dimensions (three spatial, three temporal), which implies the existence of 1.03 x 10^{28}(that's $(6^6)^6$, the "number of the Beast"!) different universes. The "Black Hats," as the bad guys are called, drop an atomic bomb on Burroughs' home, but our heroes escape via Burroughs' universe machine to a Mars (they call it "Barsoom") where the air is breathable and Russian and British troops vie for the planet. They travel from universe to universe, then finally find themselves in the Land of Oz . . .

The Number of the Beast is much like Heinlein's later work in tone and content. For someone who "groks" Heinlein (like me), this book is a lot of fun. But if you hated *Time Enough for Love* or *Stranger in a Strange Land,* forget it.

There are problems. I might say the book is too long, although I couldn't say what Heinlein should have cut out. Heinlein uses two stylistic "tricks" that make the reading a little difficult. The novel is written in first person, but each chapter is from the viewpoint of a different character. Also, Heinlein uses the old Russian novel technique for dialogue, in which the speakers are not identified for several paragraphs. My biggest complaint, however, is that the characters spend half the time arguing about who should be their leader, rather than *doing* something. (The concept of leadership is the major philosophical thrust of the novel.)

The Number of the Beast is written as a tribute to friends and forebears. There are some in-jokes, some "literary coincidences" and many outright references to dozens of

writers and their works. But this is not a *roman a clef:* it is an adventure novel in the oldest "what if this came true . . ." tradition.

This is perhaps not Heinlein's best, and certainly not his worst. With luck, it won't be his last.

(Editor's note: Other than the title, Heinlein's book has no connection with Perry Heyda's story, "The Number of the Beast," which was printed in our last issue. By coincidence, we received Heinlein's book a few days before we went to the printers.)

"This is perhaps not Heinlein's best, and certainly not his worst. With luck, it won't be his last."

Bruce Kvam, temporarily on leave from graduate studies in computer science, is working for Control Data.

After Graduation

TAMING THE WILD INTERVIEW

by Steve Deyo

To talk about interviewing, I thought I'd need more recent experience than what I had just over a year ago. So, over the last month and a half, I interviewed for a handful or two of positions, one as a computer technician with Pillsbury and another as a technical writer for Medtronics.

I want summer work, so I wasn't as all-out thorough as I would be looking for a "permanent" job. But, here's what I did. With a little forethought and preparation, you can do at least as well.

I didn't bother with any in-depth company research. Before I drove out for my interview at Medtronics, I checked the information files at the Cooperative Education Office in Fraser 345. (They offer some engineering positions and a weekly job-listing bulletin, by the way. Check'em out.) But their file on Medtronic had nothing of use. I went to the IT Placement Office next, but they had closed early for lunch. (Grr!) Let that be a lesson: don't prepare at the last minute.

Anyway, Medtronics' reception area had an annual report laying around (most do); I skimmed that while waiting for my interviewer. (Whom, it turned out, I knew from an interview for a lab tech position at Pillsbury R&D last year; she'd transferred recently to Medtronics.

(No, I didn't get the job.)

When you do get an interview, any interview, know what you're going into. At least know what the company does, what its prime work is, what market it's trying to compete in or break into. (Annual reports are good here.) Don't use — nay, waste — valuable interview time asking questions you could have answered for yourself beforehand. Use your time instead to tell the interviewer why you can do the job better than the next guy. (And, feminists, in Midwestern dialect, "guy" is generic.)

Prepare yourself. Practice interviewing with your roommate.

And get there on time. Everyone knows that, but you can know it and still be late. Make *sure* you're on time. Early, if possible.

If you smoke, don't during the interview. Even if you're invited to.

Think. Anticipate what's going through the interviewer's head. He wants to know why he should hire you. Tell him. Discuss your strengths and accomplishments. If he asks about your "weaknesses," turn the tables: talk about something you've "overcome," or make a weakness into a strength. ("I set my goals so high other workers can't keep up with me.") Know what your plans are for five years from now; that's a stock interview question.

Be aggressive. Avoid yes-and-no answers. Explicate. Offer information about yourself. That's one thing I need to watch in particular — if I'm with a low-key interviewer, I get self-conscious and clam up. Don't be passive. It takes effort, thought, and conscious decisions to keep on top of the questions, to be alert, responsive, outspoken, and all the things bright young job candidates need to be. Because you're not always those things; because what you say in that interview room will decide whether or not you get the job.

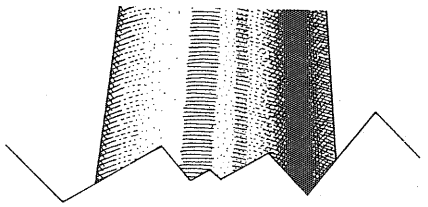
Smile.

Be responsive to your interviewer. If he says something humorous, chuckle. If he gets serious, look (and be) concerned. But be "you." I tell myself, "Hey, this is just another human being here, and we're going to talk about me — after all, it's me we're here to talk about — and, heck, he's not going to bite; so, relax!" You're not completely at his mercy; he needs an employee. Which means, for now, he needs you. Don't feel inferior, don't act superior; just be natural. It's a tenuous balance.

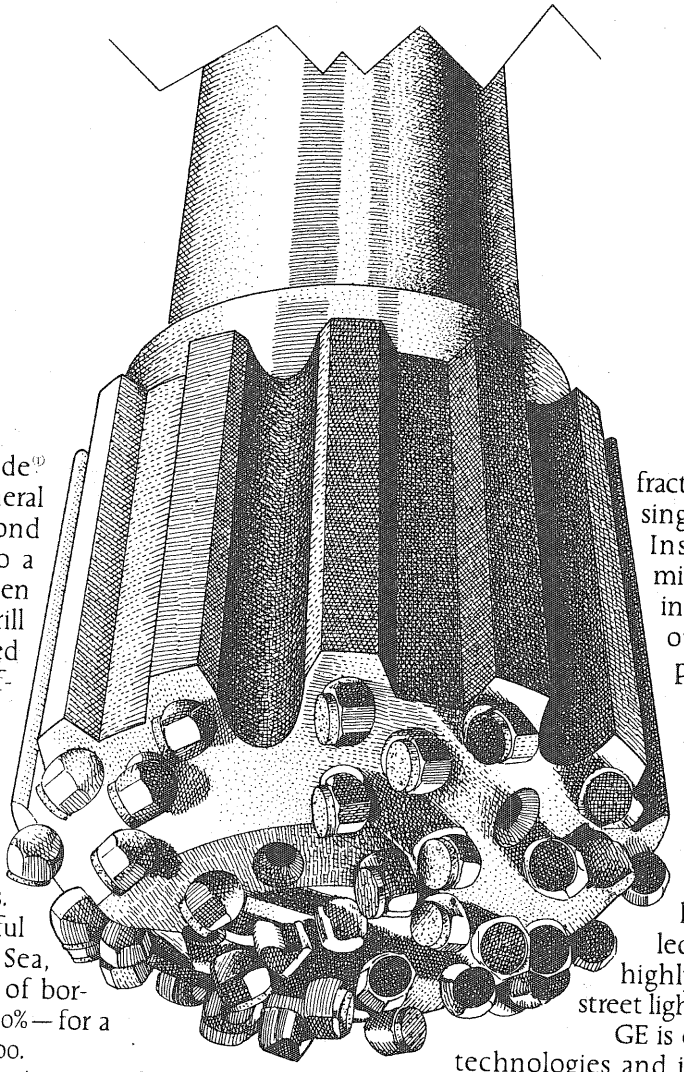
Don't forget to send a follow-up letter or "thank-you" note as soon as you can afterwards. Be personal and courteous. Most job-seekers overlook the "thank-you" note as a useful tool to keep themselves fresh in the interviewer's mind, to reinforce their bid for the job.

Oh . . . discussing salary. Richard Lathrop says it better than I can here, in *Who's Hiring Who* (Ten Speed Press, $5.95). I recommend it.

Next issue: "And now, The Real World"



With this drill bit, GE is putting diamonds back into the earth.



The diamond is Man-Made® diamond developed by General Electric. Man-Made diamond crystals are pressed into a polycrystalline "blank." When this blank is attached to drill bits like the one pictured here, it provides a highly efficient cutting tool to probe deep into the earth.

Drill bits which include diamond blanks can as much as double the penetration rates of steel bits in drilling for oil and gas. In one of the most successful applications in the North Sea, these drill bits cut the cost of boring through shale by nearly 30%—for a total saving of close to $300,000.

Two remarkable engineering breakthroughs were required for the development of these drill bits. First came the synthesis by GE of Man-Made diamond itself. Pioneering the technology of heating and pressurizing carbon established GE as a leader in superpressure science.

The polycrystalline diamond blank microfractures because of its structure. Natural cleavage planes of mined diamond (right) cause it to break off in larger pieces.

Then GE invented the technology which compacts the small, powdery Man-Made diamond into far larger disks (as large as 12 mm. in diameter by as much as 1 mm. thick). Since these disks are composed of many nonaligned crystals, they resist the massive destructive fracturing which occurs in large, single-crystal natural diamond. Instead, these disks tend to microfracture, constantly exposing new cutting edges without destroying the diamond product.

Creating new engineered materials is an important example of research in progress at GE. Recent developments include a proprietary epoxy catalyst that's cured by ultraviolet light. GE work in ceramics led to the Lucalox® lamp—a highly energy-efficient form of street lighting.

GE is constantly investigating new technologies and innovative applications for existing technologies—in such areas as electrical distribution systems, electronic components, environmental systems. This takes talent—engineering talent—not just in research and development, but in design and manufacturing, application and sales.

If you are interested in engineering opportunities at GE, check your Placement Office or write to: Engineering, Bldg. 36, General Electric, Schenectady, New York 12345.

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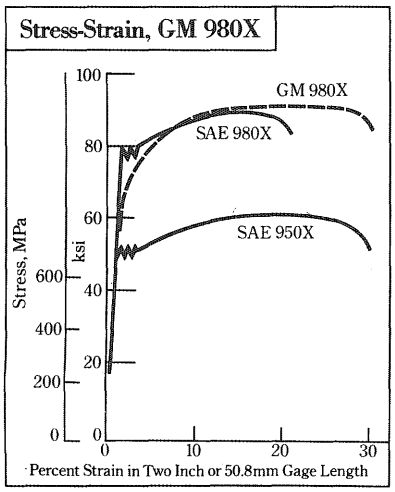
Nitrosyl-Carbonyl Catalysis

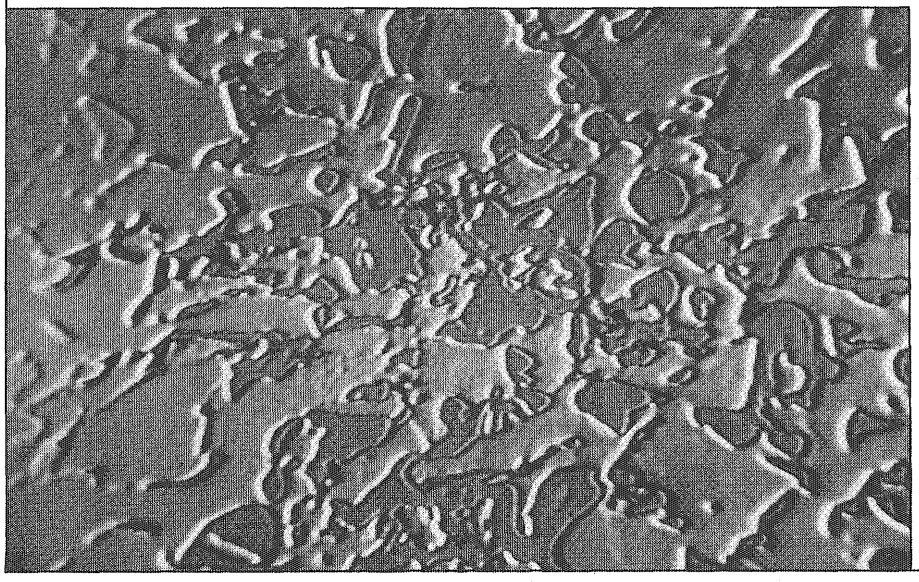
The Ductility Factor

The use of high strength, low alloy steel has been severely limited, due to its low ductility. Now, a simple heat treating and controlled cooling process, developed at the General Motors Research Laboratories, has successfully enhanced formability properties without sacrificing strength.



A comparison of the stress-strain behavior of GM 980X, SAE 980X, and SAE 950X steels. GM 980X offers greater ductility at the same strength as SAE 980X, and greater strength at the same ductility as SAE 950X.

Scanning electron microscope micrograph of dual phase steel at a magnification of 2,000. The matrix (background) is ferrite; the second phase is martensite.



FOR SOME TIME, automotive engineers and designers have been faced with the challenge of building cars light enough to get good gas mileage, but still roomy enough to comfortably transport four or five passengers. One technique which has proved fruitful is materials substitution.

Lighter materials, such as aluminum alloys and plastics and high strength, low alloy steels (HSLA), are being phased into new vehicle designs to replace certain plain carbon steel components. Each, though, has displayed inherent problems which limit its utilization.

Unlike plastics and aluminum, however, HSLA steels have the same density as plain carbon steel. Weight reduction is achieved because thinner sections (less volume) can be used to carry the same load. Since the formability (ductility) of most high strength steels is poor, though, it has only been possible to form simple shapes from it. This has severely limited the widespread use of HSLA steels (such as SAE 980X) for auto components. New hope for the increased utilization of HSLA steel has arisen, however, with the development of a new dual-phase steel, GM 980X, at the General Motors Research Laboratories.

General Motors is not in the steel business, and GM 980X is not a brand of steel. GM 980X is the designation for a type of steel displaying mechanical properties similar to those of the samples first formulated at the General Motors Research Laboratories. "GM" in the designation indicates that the steel is a variation of the conventional SAE 980X grade. In the standard SAE system for material identification, "9" designates that the steel is HSLA. "80" is the nominal yield strength of the metal in thousands of pounds per square inch. The "X" denotes a micro-alloyed steel—one containing on the order of 0.1% of other metals such as vanadium, columbium, titanium, or zirconium as a strengthening agent.

GM 980X displays the same strength, after strain hardening, as SAE 980X steel, but has far more ductility. This characteristic allows it to be formed into various complex shapes which were previously thought to be impossible with HSLA steels. The superior formability of GM 980X has substantially increased the utilization of HSLA steel in the manufacturing of automotive components such as wheel discs and rims, bumper face bars and reinforcements, control arms, and steering coupling reinforcements.

Dr. M.S. Rashid, discoverer of

the technique to make GM 980X steel, comments, "I was working on another project using HSLA steel, when I noticed that if SAE 980X steel is heated above its eutectoid temperature (the temperature at which the crystalline structure of metal is transformed) for a few minutes, and cooled under controlled conditions, the steel developed significantly higher ductility and strain-hardening characteristics, with no reduction in tensile strength."

FURTHER experiments proved that the key variables to make GM 980X are steel chemistry, heating time and temperature, and the rate at which the steel is cooled. Specimens of SAE 980X were heated in a neutral salt bath, then cooled to room tem perature with cooling rates ranging from 5° to 14°C/sec. (9° to 26°F/sec.). Dr. Rashid notes, "We found that the maximum total elongation resulted when the cooling rate was 9°C/sec. (16°F), and the lowest total elongation resulted from the highest cooling rate (14°C or 26°F/sec.)."

GM 980X steel has a high strain-hardening coefficient or n value, accompanied by a large total elongation. The n value gives a measure of the ability of the metal to distribute strain. The higher the n value, the more uniform the strain distribution and the greater the resistance of the metal to necking (localized hour-glass-shaped thinning that stretched metals display just prior to breaking). Tests have proved that GM 980X distributes strain more uniformly than SAE 980X, has a greater resistance to necking, and thus has far superior formability.

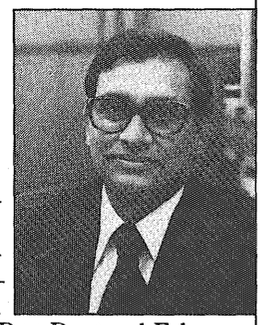
"The superior formability of GM 980X compared to SAE 980X steel appears to depend on the nature of two microstructural constituents, a ferrite matrix (the principal microstructural component) with a very high strain-hardening coefficient, and a deformable martensite (the other crystalline structure) phase. In the SAE 980X, failure occurs after the ferrite becomes highly strained, but when the GM 980X ferrite is highly strained, strain is apparently transferred to the martensite phase, and it also deforms.

"Therefore, voids leading to failure do not form until after more extensive deformation has occurred and the martensite phase is also highly strained. Obviously, the exact nature of these constituents must be important, and any variations in the nature of these constituents could influence formability. This is the subject of ongoing research."

Dr. Rashid's discovery represents a significant breakthrough in the area of steel development. His findings have opened the door to a new class of materials and have completely disproved the commonly held belief that high strength steel is not a practical material for extensive automotive application. "At GM, we've done what was previously thought to be impossible," says Dr. Rashid, "and now we're hard at work to find an even stronger and more ductile steel to meet the needs of the future."

THE MAN BEHIND THE WORK

M.S. Rashid is a Senior Research Engineer in the Metallurgy Department at the General Motors Research Laboratories. He was born in the city of Vellore in Tamil Nadu (Madras), India, and attended the College of Engineering at the University of Madras–Guindy. He came to the United States in 1963 and was awarded a Ph.D. in Metallurgical Engineering from the University of Illinois at Urbana-Champaign in 1969.



After a three year Post-Doctoral Fellowship at Iowa State University, he joined the staff of the General Motors Research Laboratories.

Dr. Rashid is continuing his investigations into the development of even more ductile high strength, low alloy steels. When not in the lab, he enjoys relaxing by playing tennis and racketball with his wife, Kulsum.

Editor's Log

Winding up a good year is both satisfying and frustrating. Once again the *Technolog* staff is bringing you an issue I'm sure you will enjoy reading, but, as is typical, there are a lot of things that couldn't be accomplished this year. Next year, under the supervision of our former associate editor, Steve Deyo, more of these items will be dealt with. Filling out the readership survey included in this issue of *Technolog* will allow us to bring you more of what you want to see.

In this issue of *Technolog* Nancy Hurd describes the interesting experiments being done by Associate Professor Wayne Gladfelter and three doctoral graduate students in the Department of Chemistry. Read "Nitrosyl-Carbonyl Catalysis."

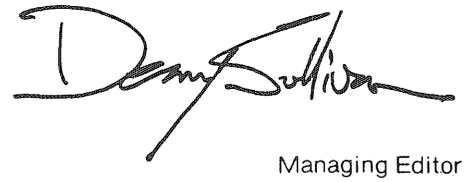
Once again, John Bartelt brings us into the world of physics. A group of scientists from the University are constructing a 1,000-ton device to detect proton decay at the bottom of an iron mine. In the article, "Proton Decay Takes GUTs" John outlines the basic theory behind the experiment as well as some of the techniques developed to handle the unique situations that arise.

Paula Reed won the 1980 *Technolog* Science Fiction Contest. A panel of judges determined her story "Youngsters" represents the best out of a total of 34 entries.

E-Week was recorded for posterity by a team of *Technolog* shutterbugs. A photo essay by Photo Editor Mike Dorn visually summarizes the main events.

As always, we have the usual fare of regular features, including "Ad Astra," "After Graduation," "Lighter Side" and "Bionic T.A."

Don't forget to fill out the readership survey if you can. Don't be afraid to get involved with making the *Technolog* and IT a better experience for all of us.



Managing Editor

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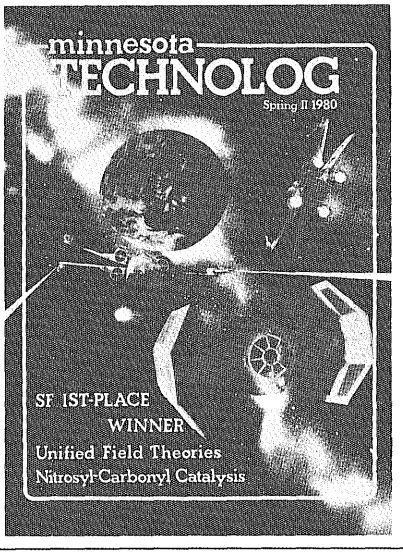

Cover by STEVE SMITH
MIKE DORN

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Nitrosyl-Carbonyl Catalysis

by Nancy Hurd

It doesn't bubble or boil. No visible smoke arises from greenish-hued solutions. However, their labcoats are well-worn, and glassware is ordered into a complex array of flasks, tubes, valves and clamps in the sunlit fourth-floor chemistry laboratory of Assistant Professor Wayne Gladfelter.

Gladfelter and his three doctoral graduate students Fred Furuya, Doug Fjare, and John Hull work in the uppermost regions of Smith Hall synthesizing, studying and experimenting with metal clusters.

Metal clusters, consisting of three to thirty metal atoms, act in the solid phase as catalysts for reactants flowing over them in the gas phase. These are known as heterogeneous catalysts, now studied for their use in industry, although Gladfelter stresses equally their importance in learning more about the mechanisms of reactions.

One reaction Gladfelter and his graduate students are working on now is the hydrogenation of benzene to cyclohexane. Cyclohexane may be oxidized to produce adipic acid, which is in turn polymerized with diamines to form nylons. Cyclohexane is also useful in industry as a chemical solvent in the preparation of nylon and other polymers. Normally the hydrogenation of benzene to cyclohexane occurs heterogeneously. Gladfelter would like to catalyze this reaction homogeneously with the catalyst and reactants both in the same phase — in this case, in solution.

Currently there are only a handful of well-characterized homogeneous catalysts used for the hydrogenation of benzene, none of which can yet compete with the heterogeneous systems. However, there are several reasons for developing them. A homogeneously catalyzed reaction usually requires less energy than a heterogeneously catalyzed reaction, so it can occur under milder conditions. (The difference may be as great as the homogeneous reaction running at room temperature and atmospheric pressure, while the heterogeneous reaction requires 400°C and high pressure.)

Also, homogeneous catalysts characteristically increase the selectivity of the product produced. An example of a reaction's lack of selectivity is the Fisher-Tropsch synthesis, where carbon monoxide and hydrogen produce a mixture of many alkanes numbering from one to twenty carbons each. For some uses, only one type of alkane is really needed — say, octane. The proper homogeneous catalyst could be chosen which would enable the chemist to obtain a high yield of the selected compound.

Another advantage of the use of homogeneous catalysts is seen in the study of the mechanism of the reaction. By running a reaction at a lower temperature, an intermediate compound previously too reactive or unstable to obtain may possibly be isolated. The intermediate may then be observed through NMR (Nuclear Magnetic Resonance), infrared, electron absorption, or other forms of spectroscopy to gain valuable structural information.

Gladfelter has two primary goals in his research on the hydrogenation of benzene to cyclohexane: first, to synthesize a homogeneous catalyst; and second, to determine more about the mechanism of the reaction to

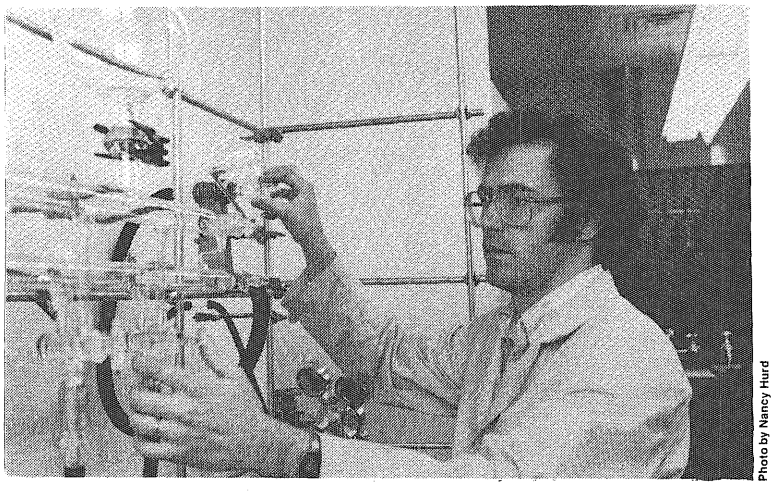

Photo by Nancy Hurd

Using this Schlenk line, Gladfelter can work with air-sensitive compounds in an oxygen- and water-free atmosphere.

produce a better or more efficient catalyst.

To find the catalyst, Gladfelter uses special aromatic molecules such as substituted benzene and naphtalene. One aromatic compound his research group has been studying is octamethylnaphthalene (OMN), a severely crowded molecule; it has eight methyl groups around the naphthalene ring. Using this molecule Gladfelter hopes to alter the reaction's reactivity and stop it at an intermediate stage. The proposed catalyst would be a soluble metal complex. To study the interaction of OMN with metals, Gladfelter synthesized a new compound, tricarbonyloctamethylnaphthalenechromium [(OMN)Cr(CO)$_3$]. Through these compounds he hopes to discover how binding metal to a sterically- or physically-crowded molecule changes the properties of the molecule.

Employing X-ray crystallography, the structure's precise bond angles and lengths are determined. Gladfelter's research indicates that in the naphthalene rings there is very little difference between the (OMN)Cr(CO)$_3$ and the free ligand OMN. (A ligand is a molecule or anion attached to the central metal atom of a complex molecule.) Free ligand OMN is not complexed to metal. Comparing the two ring systems, Gladfelter found that the metal has little effect on OMN.

The next step is to explore the reactions of the complex, such as its effect in the hydrogenation of benzene or other aromatic rings. Gladfelter and his graduate students are studying what effect the metal has in various organic reactions, including complex reactions with maleic anhydride (Diels-Alder Reaction). Ruthenium, cobalt, and nickel are some of the metals they are experimenting with.

Beside the hydrogenation of aromatic rings, this research group is also trying to catalyze another type of reaction with metal clusters — the reduction of carbon monoxide with hydrogen to give methanol, methane, or other organic molecules. In the past Gladfelter has examined metal clusters with carbon monoxide ligands as catalysts in these organic reactions. Now Gladfelter is interested in substituting nitric oxide for the carbon monoxide ligands. Since two nitrosyl (NO) groups can be substituted for three carbonyl (CO) groups, a bonding site on the cluster will be left open. An open bonding site is necessary for catalytic reactivity.

There are few known examples of nitrosyl-carbonyl clusters. Gladfelter's group is trying to prepare new ones. The few known examples, prepared by direct reaction of NO gas with metal clusters, are difficult to achieve because the cluster tends to break instead of substituting the NO groups for the CO groups.

Gladfelter's approach is to condense a metal nitrosyl fragment with a metal carbonyl cluster. This reaction should yield a new cluster with an extra metal as well as nitric oxide. Two examples have been successfully prepared so far, using tricarbonylnitrosylferrate (-II) as the metal-containing nitrosyl. With dodecacarbonyltriruthenium, which contains a triangle of ruthenium atoms, the dodecacarbonylnitrosylirontriruthenium anion, $[FeRu_3(CO)_{12}(NO)]^-$ *(see Figure 1)*, is formed in high yield. The analogous $Fe_3(CO)_{12}$ also reacts with $[Fe(CO)_3NO]^-$ to give $[Fe_4(CO)_{12}(NO)]^-$. Gladfelter has conducted a crystallographic analysis of the $[FeRu_3(CO)_{12}(NO)]^-$ cluster to determine its structure and is further studying the cluster's reactions.

Catalytic research may have an eventual application to pollution chemistry. Reactions in the catalytic converters of automobiles such as

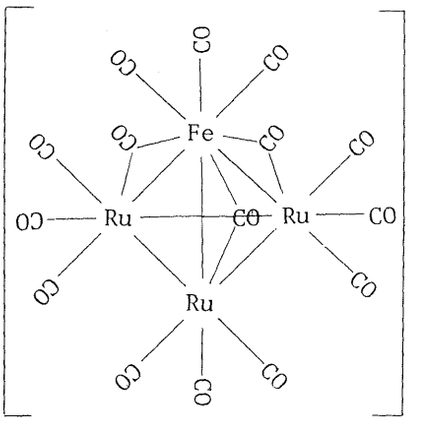

Figure 1. The dodecacarbonylnitrosyliron triruthenium anion.

$2NO + CO \rightleftharpoons CO_2 + N_2O$ presently require a heterogeneous catalyst. Although energy savings on the molecular level may not be significant, knowledge and understanding of these reactions' mechanisms may lead to cleaner, more efficient engines.

(Professor Gladfelter has been with the Department of Chemistry since September 1979.)

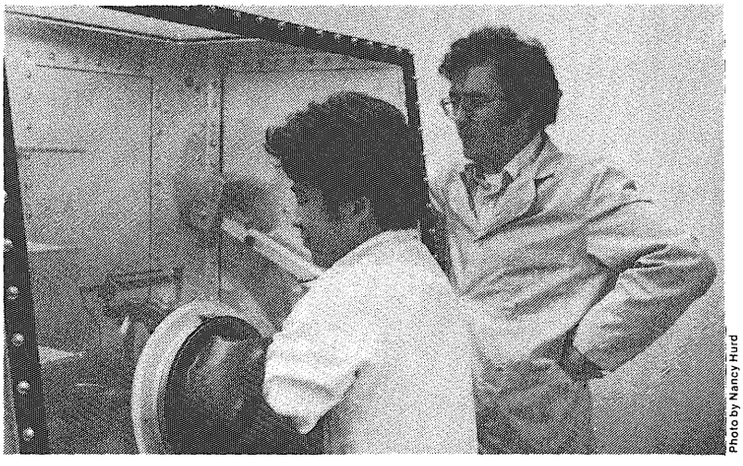

Photo by Nancy Hurd

Fred Furaya assembles glassware for experimental use. The glove box maintains an interior atmosphere of less than one ppm oxygen and water.

Nancy Hurd is somewhere between a junior and senior in a biology and technical communications major at the University.

Log Ledger

News

Honeywell has given $2 million to IT for a Center for Microelectronic and Information Sciences to emphasize advanced research in microelectronic design, distributed and parallel processing, and automation and applications.

The Space Science Center was renamed Shepherd Laboratories May 28, in honor of William G. Shepherd, former Space Science Center director and Vice President for Academic Affairs.

Kenneth Keller, head of the Department of Chemical Engineering and Material Science, will assume his responsibilities as Vice President for Academic Affairs.

Professor Stanley Dagley, Biochemistry, and Professor Lawrence Markus, Mathematics, have been named Regents' Professors for 1980.

Physics professor Cecil J. Waddington has been awarded the NASA Exceptional Scientific Achievement Medal for his work on the High-Energy Astronomy Observatory project.

Mechanical engineering professor Kevin Teichman received the outstanding IT teacher award on May 9. Students chose Teichman because "he has a sense of humor, his lectures are not a one-way communication between himself and the blackboard," and "his exam questions are original and challenging."

James Serrin, Regents' Professor of Mathematics, has been named to the National Academy of Sciences, one of the highest honors that can be accorded an American scientist or engineer.

The Westinghouse Electric Corporation has been awarded a three-year $4.4 million contract from the Union Carbide Corporation on behalf of the U.S. Department of Energy to develop **a more economical electric heat pump for residential and commercial use.**

A Cuban demonstration plant, part of the United Nations Development Programme, holds promise of producing **quality newsprint from sugar cane waste** at a good price. The pilot plant will begin testing soon and a breakthrough is possible by 1982.

A $2 million digital trace heating control system for the Clinch River Breeder Reactor Plant Project in Oak Ridge, Tennessee, was recently ordered from Research, Inc., of Minneapolis. The new system, the first of its kind, will be less expensive and more flexible than other systems. Work should begin in 1981.

Pregnant women and nursing mothers may be more susceptible than the general population to **adverse health effects from exposure to the toxic metal cadmium,** a team of biologists from the Department of Energy concluded from their studies of pregnant mice.

The Africans' role in history of physics is largely ignored, according to John Pappademos, a physicist who gave a seminar on that subject at the University of Chicago. Not one Black, Hispanic or Native American scientist is mentioned in any of the seventeen basic physics textbooks used in high school and college courses.

Neutrinos appear to oscillate (flip-flop) between at least two different forms, and thus have mass, says Frederick Reines of the University of California-Irvine. The hypothesis, if true, would explain current difficulties with one of the premises of fusion theory (and would confirm the missing 66 percent of the neutrinos that are supposed to be emitted by the sun, but haven't been found). If true, the hypothesis would also mean the Universe has twice the mass it was thought to have had. This in turn implies the Universe will either end in a "Big Bang" in reverse, or else is in a continuous cycle of expansion and contraction.

Publications

Civil Engineering Resource Information: Bridges, Major Worldwide
By the American Society of Civil Engineers. A descriptive listing of major bridges worldwide. Review copy available in the *Technolog* office.

The Charles D. Hurd Lectures 1979-1980
By Dr. Alan Schriescheim. How industrial research in chemistry responds to our national energy challenge; long-range research; the role of innovation in research. Review copy available in the *Technolog* office.

1980 Progress Report: Clinch River Breeder Reactor Plant Project
By Breeder Reactor Corporation. Free. Includes the organization and purpose of the project. Write: Breeder Reactor Corporation, P.O. Box U, Oak Ridge, TN 37830.

Electric and Hybrid Vehicle Program Quarterly Report, February 1980.
By U.S. Department of Energy. $4.00. Write: National Technical Information Service, 5285 Port Royal Road, Springfield, VA, 22161.

Publications cont.

Influence of Dose and Its Distribution in Time on Dose-Response Relationships for Low-LET Radiations (NCRP Report No. 64) and
Management of Persons Accidentally Contaminated with Radionucleides (NCRP Report No. 65)
By the National Council on Radiation Protection and Measurements. Report No. 64, $9.00; Report No. 65, $8.00. Write: NCRP Publications, P.O. Box 30175, Washington, D.C. 20014.

Laboratory Equipment and Services for Engineering and Technical Education
By Feedback, Inc. 32 pp. Electrohydraulic systems, electrical/electronic control panel. Write: Feedback, Inc., 620 Springfield Avenue, Berkeley Heights, NJ 07922.

1979 Technical Progress Report
By Westinghouse Electric Corporation, Advanced Reactor Division, for the U.S. Department of Energy. 427 pp., free. Describes the purpose, status, prior work, and accomplishments of each of the major systems of the Clinch River Plant. Write: Information Division, CRBRP Project Office, P.O. Box U, Oak Ridge, TN 37830.

An Alternative Long-Term Energy Supply Option
By Atomic Industrial Forum, Inc. 20 pp. Suggests the breeder reactor as a solution. Write: Atomic Industrial Forum, Inc, 7101 Wisconsin Avenue, Washington, DC. 20014.

Handbook of Organic Industrial Solvents
By Alliance of American Insurers. $3.59. Write: Loss Control Department, Alliance of American Insurers, 20 North Wacker Drive, Chicago, IL 60606.

Shake Hands With Danger
By Caterpillar Tractor Co. 32 pp. booklet, free; 24 minute film, $89. Write: Caterpillar Tractor Co., M. Close, AB2C, 100 NE Adams Street, Peoria, IL 61629.

The Analysis of Solar Collector Array Systems Using Thermography
By Anthony Eden. $5.25. Locating defects in solar collector array systems can be accelerated by thermographic techniques. Write: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

National Solar Energy Education Directory
By the Solar Energy Research Institute. 200 pp. $5.50. Lists solar-related courses offered nationwide. Write: Superintendent of Documents, U.S. Government Printing Office, Washington D.C. 20402.

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To Minnesota Technolog, **Vol. 60 (1979-80)**

Science Fiction Contest 1st Place Winner

Youngsters

by Paula Reed

All America was watching when they landed. TV programming was pre-empted everywhere, much to the consternation of those hundreds of thousands of children who were more interested in watching *Star Trek* reruns than in observing the mundane technicalities associated with the docking of a ship that had already been monitored for the past three months, and was therefore news as familiar and distant as the Third World War. Adults, however, were all enormously excited, especially the patriarchs of the culture. It was the biggest news since man had walked on the moon — an event most of them claimed quite sternly to have witnessed with great eagerness when *they* were youngsters. The youngsters were thus forced to quell their complaints.

At the suburban home of Ernest P. Grabowski, insurance salesman and father of three, a cluster had formed itself around the portable TV in Ernie's den, consisting of one excited Ernie in a La-Z-Boy chair and three squirming children torn from a game of Clue that was just getting interesting. The two closest in age, Peter and Joycey, were alternately hissing and giggling at one another, while the eldest, Diane, wrinkled her twelve-year-old brow in concentration and made grubby left-handed smudges with a stubby yellow pencil on her playing tablet. Mrs. Ernest P. Grabowski, one of the few women in Connecticut who still wore aprons, was drying the dishes in the adjoining kitchen and making furtive attempts to scrub invisible grease off an uncooperative cast-iron skillet.

Ernie's eyes, a deep incredulous baby blue, shut for a brief moment as he tilted his head back to finish his Bud, and then were again fixed in fascination upon the scene unfolding in front of him.

"Estelle!" he shouted, though she really wasn't far enough away to justify such a decibel level. "Estelle, you know you really oughta come in here and watch this. Put the damned dishes down and come in here. This is history!"

Estelle mumbled something incoherent and came to stand within the doorway, while her thumbnail scratched in obsessive, unconscious rebellion at a remaining fragment of scrambled egg on the cast iron skillet.

"It's Colonel Mustard!" hissed Peter. "Colonel Mustard did it in the Conservatory with a Lead Pipe."

"You're wrong, dummy. It's Miss Scarlet, and she did it in the Dining Room. But even if you are right it isn't fair, because I saw you looking at Diane's cards."

"Did not!"

"Did so!"

"Did not!"

"Did so, cheater!"

"Will you kids *pipe down*!" thundered Ernie. "Lookit Diane over there, at least she's quiet. Diane, put that goddam' game away and watch this."

Diane stared at her father though the individuated spirals of her own fingerprints imposed upon a pair of wire-rimmed glasses that gave her plain and serious face the air of an eighty-year-old spinster. Her body, heretical in its lack of curves or menses, confirmed the impression her mother had once voiced in bewilderment, that Diane was "as sexless as a fish." Mrs. Ernie Grabowski was a state beauty pagent runner-up at the age of eighteen and never ceased to be amazed at how this spectacled creature had ever managed to sneak into her womb.

"It's not my fault Diane's such a dummy and shows her cards," Peter whispered viciously. Diane shot the two of them one of her newly acquired "looks," loading as much contempt into it as she possibly could, and decided the least of the two evils was to align herself with her father. She sat on her Clue pad with a hurt possessiveness and concentrated her smeary vision upon the screen.

"Cheater, cheater, Peter is a cheater," chanted Joycey. "I'm gonna tell everyone at school to call you Peter the Cheater."

"You do and I'll knock your block off!"

"I'm gonna knock you both through the wall if you don't shut up and pay attention," threatened Ernie. "I don't understand what's the matter with you kids anyway. When I was your age I used to love this sort of thing. This here is real space stuff and you're not even watching. We're going to see a brand new life form, we're the only people on the whole planet who are getting to see it, and all you're interested in is fighting with each other about a stupid game."

"Bet they're just like us," Peter grumbled sulkily.

"Well, watch and you'll find out, mister," Ernie said. "They may be anything. They may have three heads each and no whangs!" Joycey giggled, and her mother cast a look of reproach at Ernie Grabowski. "Or they may be highly intelligent," he continued. "They may help us win the War."

"Yeah!" said Peter.

"There's all sorts of crazy possibilities. You guys have no imagination, that's your problem. Except Diane," he said, giving an awkward smile to his awkward daughter, "she's got too much. Must get that from your old man, kid."

Mrs. Ernie Grabowski glanced from her husband, the insurance salesman, to her daughter, the bookworm. Her mind simply couldn't fathom the connection.

The President was on now. In his hands he held the speech prepared to welcome the aliens. By his side were two Secret Service men and a NASA communications specialist trained in Morse Interstellar. They were encased in a leaded glass booth adjoining the landing dock. The scene suddenly shifted to a point of sky where the rapidly growing outline of a spaceship was darkening the horizon.

"God, this is something," Ernie said, and took a long pull at his third beer. He scratched himself

contemplatively. "Wish I was there. Wish I could do something."

"Maybe the aliens will need life insurance, Dad," sneered Peter.

"Don't be fresh with your father," Estelle remonstrated sharply. Peter had never gotten over the discovery that his father didn't do anything special. For that matter, neither had Ernie.

"Look," cried Ernie, "they're docking it! Geez, getta load of the size of that thing!"

"How hokey," said Joycey. "It looks like Battlestar Galactica."

It was in fact an exact replica, though none of the NASA specialists had yet become aware of the resemblance. Ernie sat tense in his now unreclined reclining chair, his lips parted slightly, his eyes wide as a child's. It seemed to be the most dramatic moment in his life, though technically he was not even a part of it. Somehow Ernie Grabowski felt inescapably involved.

The President, not Ernie Grabowski, stood at the window with the papers in his hand, while the door to the spaceship gradually opened. All America was utterly hushed.

It was Diane Grabowski who first broke the silence. "Why, they're kids! It's a bunch of kids just like us!" The TV announcers began a cacophonous and confused echo of her conclusions.

The President and his screened cohorts gazed at one another with surprised embarrassment as two by two, resembling nothing so much as a nursery school field trip, the crew of the alien vessel touched United States soil. None of them looked over the age of six. They were dressed out of the pages of a Sears and Roebuck catalogue from the early 1960s, and their hair styles were in the same vein. A couple of them carried toys: a basketball, bendable Barbies, a game of Clue. They smiled angelically up at the perplexed President. Giving them what he hoped was his most paternal look, he peered into the ship at intervals, in search of a den mother for this runaway space classroom. They were unescorted. After an awkward moment, the President began his speech. Conscientiously, he changed all the words with more than three syllables, causing in the process a great deal of trouble for the translator. The Space Children looked bewildered, or slightly bored. One of the cameramen did a slow scan of their faces. When they came to one kid with a toy tank, Ernie shot out of his chair.

"Christ!" he said. "Estelle, look at him! *Look at him!*"

"What is it, Ernie?" she cried. "Why are you so pale?" Ernie stood rooted to the spot with his mouth open. She turned to the figure on the screen, and her own mouth dropped slowly. "Why Ernie," she said slowly, "he looks exactly like you did."

The face of a preschool Ernie, front teeth missing, stared wistfully at the Grabowski household.

They nicknamed them Youngsters, for want of a better name. With their cherubic faces and lithe young bodies it was hard to think of them as perhaps mentally superior to earthlings, though the degree of technology implicit in their journey and the equipment involved implied such a conclusion. They seemed to have very little knowledge of their origins. Because of an irregular, though apparently human brain structure, it was considered inadvisable to put them under hypnosis. There appeared to be some subtle connection between their brain waves and television transmissions. One expert hypothesized that their vessel was a lifeboat from another solar system, which had drifted into our own and eventually intercepted some satellite transmissions, thus directing the infants to our planet for succor. Their TV "memories" appeared to date from the mid '60s to late '70s with several gaps, perhaps due to interference by asteroids or other orbiting bodies.

It looked as though their vessel had been injured several times, and

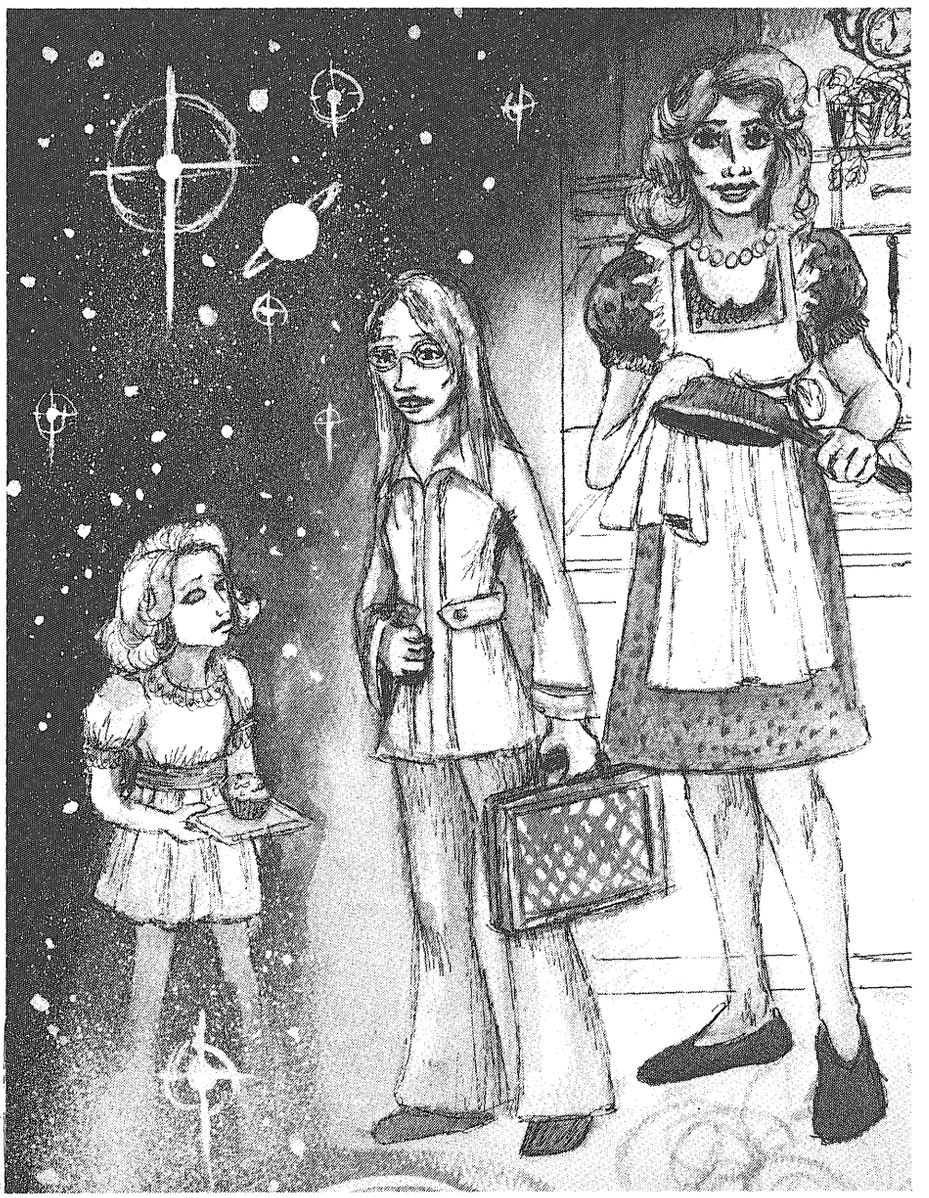


illustration by Kathy Marschall

functioning parts had been reconstructed from models on space shows which Earth children were still watching. Because of these reruns it was difficult to convince the Youngsters that time had indeed passed. They stared with what seemed like utter incomprehension at the spectacle of a *Star Wars* cast reassembled with balding heads and sagging breasts at a banquet held in their honor, once it was discovered this was their favorite movie. It put them all into the most abject state of misery, and the experiment was never tried again.

A curious phenomenon began to occur once the Youngsters were cleared for Selected Human Interaction eleven months after their arrival. Requests poured in from individual citizens for their adoption. Invariably the letters were accompanied by photos, or the appeals were in person. The gist of their arguments were all the same:

"I saw the Youngster who is called Benjamin on a talk show last Thursday. He looks exactly like I did at his age, and what's even funnier, my name is Ben, too. I want more than anything else in the world to bring him into my home and raise him as my own. My wife is a good mother, and wants Benjamin too. We have children who would be good companions for him. At least let us meet and talk. I think he would want to come live with us if he knew how much I would love him. I am only a factory worker, but I would give him everything I have."

It was vain to explain to these people that the Youngsters were not in truth orphans, but complex aliens about whom we still knew relatively nothing. The letters kept on coming. Incredibly, with very few exceptions, they were all from men, though it was eventually discovered that all twenty-four Youngsters, both male and female, were amazingly clone-like replicas of twenty-four now middle-aged earthlings among whom no common link could be found, save that almost all seemed to have spent a part of their childhood in the New York area. The scientists were totally stumped. Of the twelve women who had female counterparts from the alien colony, only two ever requested an interview with those counterparts — none made the rash suggestion that they adopt them.

One Connecticut family, the Ernie Grabowskis, had the distinction of being the sole household in the country with two alien counterparts. Mr. and Mrs. Ernest P. Grabowski had been childhood sweethearts, and had both grown up in Brooklyn. Ernie Grabowski had written repeated, almost daily letters to every Government official imaginable, on insurance company letterhead, to plead for the right to adopt the Youngster Ernest. Estelle did not want her counterpart in the house; she said the very idea gave her the creeps. On this issue alone she was totally unshakeable, though Ernie attempted over and over again to persuade her of the uniqueness of their position and the advisability of presenting a unified front. Her compromise was to support Ernie as best she could in his obsession to acquire young Ernest. She had always loved the little boy in her husband, and it was not difficult to make the transference. She only worried that his work was beginning to suffer. Ernie assured her that any lunkhead could do what he did with one armed tied behind his back. His partner, who had the use of both arms, was thus ahead of the game.

Young Ernest was found, after an intensive consultation, to be every bit as eager as his adult model for a live-in experiment. The Youngster Stella, however, was equally uninterested in Estelle Grabowski. They met once, more out of others' curiosity than their own, and stared upon each other with an air of mutual enmity. Young Stella spoke, the only exchange between them.

"I can't use *you*," she said, in a tone at once angry and bewildered.

Estelle for one moment looked profoundly hurt, then recovered to a state of seeming superficially offended. She smiled with indulgent maturity and excused herself.

Young Stella began quite silently to cry. Her gaze met her comrade's. "How can I? How can I?" she murmured. "She isn't and there's no one else!" Young Ernest seemed perplexed by her sorrow. Stella remembered where she was then, as one of the Secret Service men lent her his hanky. She beamed at him through her tears like a child actress.

Ernie Grabowski and his family went through rigorous indoctrination procedures and moved to a more expensive house further out in the suburbs, with rooms for Ernest and for his observation team, until at last, nearly two years after the aliens first landed, the Youngster Ernest was placed in the Grabowski household. His front teeth were still missing, and all his original clothes, even his shoes, fit precisely. He appeared to be perpetually five years old.

It was Estelle who first began to notice the Youngster's rapid growth once he was installed at the Grabowskis'. She attributed it rather complacently to her skills as a homemaker. Ernest's observation team, with all due respect to Mrs. Grabowski and the four basic food groups, found this an insufficient explanation. A better one, however, could not be provided, and the delight of it all erased the need for one.

No one failed to be captivated by the Youngster, with his brightness, quick smile now studded with incoming teeth, and overwhelming abandonment to the love that was offered him. His other space companions, when placed in similar situations, experienced the same blossoming. America knew then that she was blessed, for she alone had been given the Space Children to nurture, and they patterned themselves after the men of America.

Her real children, however, were not fooled in the least. They reacted to their new family members with open hostility. Eminent child psychologists had predicted such a reaction. Peter and Joycey Grabowski were fairly typical examples: they found themselves no longer able to hold a great deal of their father's attention, and began telling whopping big lies to the observation team about young Ernest. They said he was going to murder their father, marry Estelle, and drive the children out of the house. The Maslow-Rogerian family monitor was hard put to conjecture how even young ones' jealousies could attribute such base Freudianisms to a creature who had only recently stopped sucking his thumb. After about three weeks the two young Grabowskis were in biweekly therapy sessions at the local Wellness clinic. A specialist was in attendance on their cases.

Diane did not dare reveal her fears, lest something even more restrictive happen to her. A growing numbness made her calm, though at night in her

room she would have fits of hysteria, stuffing the sheets in her mouth to stifle the rising screams. No one would listen to her. They would think she was crazy. People had always told her she was "a little queer" — what if she were to come out with this? They would have her committed.

No, someone would listen. Someone would have to. She would be perfectly rational and adult. She would amass her information quietly, and when it was all neat and orderly she would put on her junior-sized pantsuit, put her papers in a respectable briefcase (her father's perhaps? or would her bookbag do?) and present her evidence calmly and clearly to the observation team. Then they would take the Youngster away.

Most of the information was in her five-year diary, a brown leather-look volume with gold lettering and a key she now kept strung around her neck.

"Diane's heart thudded in a queer rhythm: Romper, stomper, bomper, boo. Who's in my magic mirror today?"

Her mother laughed indulgently at this, gazing down from the key to her young daughter's slowly developing bust and hips. *I'm there somewhere after all,* Estelle though to herself triumphantly. *And now she's keeping secrets. My, my.*

Diane's Bic pen was at least as messy as her pencil had been, but the poor girl was convinced that ink smears were superior to pencil smudges, and she tried hard not to blotch. Each day she read over her findings, and tried to draw conclusions. None came.

Jan. 15: Daddy and Ernest are watching TV, and Mommy is making dinner. Daddy isn't reading the newspaper when he comes home from work anymore.

Jan. 27: Daddy didn't go in to work today. Instead he and Ernest spent all day at the zoo. Daddy came home with a stomachache from eating too many hot dogs with mustard. Mommy put him to bed early. Ernest stayed up and did arithmetic problems 'til ten.

Jan. 31: Ernest's teeth have come all the way in, and at this rate they say he'll need braces in three months. Mommy had to take him shopping for a whole new suit of clothes again. He's skipped two sizes. Daddy's lost ten pounds.

Feb. 4: Mr. Faber at the insurance agency called to ask Mom today why Daddy hasn't come to work in three days. Daddy says it's good to play hooky once in a while, and we don't need the money anyway. Let the Government take care of it. Ernest has been going to school every day, though Daddy wanted him to skip yesterday and go to the matinees. The school says he makes incredible progress and they're going to move him up a grade again. That's the second time since the year started.

Feb. 10: Daddy's hair is growing back. He lost six pounds last week. Mommy says he's looking more and more like the man she married.

Feb. 12: Daddy is getting pimples on his chin. The dermatologist says it's middle-aged acne. I gave him my special soap.

Feb. 14: Ernest gave Mom a valentine today. This evening I found a spider in my bed. Peter swears he didn't do it, and Ernest just wouldn't. He calls me "Sis" and hardly seems to know that I'm here.

Feb. 15: Daddy put the spider in my bed.

Feb. 28: They're moving Ernest up to the fourth grade.

Diane locked the book, deep in thought. She rose and stood in the doorway of her room. From the stairwell she could see her father and Ernest playing Clue.

"Aw, come on how, Ernest," her father said, "that's not fair. You went through the secret passageway *last* turn."

"It doesn't matter. Read the rules, Daddy."

"I don't need to read them. I've played this goddam' game all my life, I guess I know the rules."

"But look, it says right here — Hey, stop looking at my cards!"

"I didn't!"

"Yes, you did!"

"No I didn't," Ernie whined, "And don't go telling on me because I didn't. Estelle knows I never cheat. Isn't that so, Stella — I never cheat, do I?"

Mrs. Ernie Grabowski came out of the kitchen peering myopically through the water spots of a tumbler she was polishing. "Are you two boys fighting again? Why don't you let Peter and Joycey play?" The reject players cowered in the corner, holding hands, silent and glowering.

"They never want to play with us," her husband pouted. "But Ernest and I are best buddies, aren't we Ernest? They can go join the goon squad, can't they?"

Ernest smiled indulgently at his foster father. "I'm sorry they don't like me," he said to Estelle. "Is it because I'm an over-achiever?"

"I don't know what's the matter with my children," Estelle complained angrily. "Here we are all ready to do our bit for science and our country, and you're the nicest little boy in the world, and we've got this big beautiful house now that we never could've afforded on Ernie's salary, and you're just growing *so fast,* Ernest, you look more and more like your father every day.

"Did you know," she sighed nostalgically, "that your father and I were childhood sweethearts? We first met when I was four and he was five — just the age you were, Ernest, when you came to us — on *The Romper Room Show.* And they all thought *The Dating Game* was the place to meet your match!" Estelle had always thought that was a very funny joke.

Young Ernest looked seriously at his mother, then smiled. Upstairs Diane's hearted thudded in a queer, queer rhythm: *Romper, stomper, bomper, boo. Who's in my magic mirror today?*

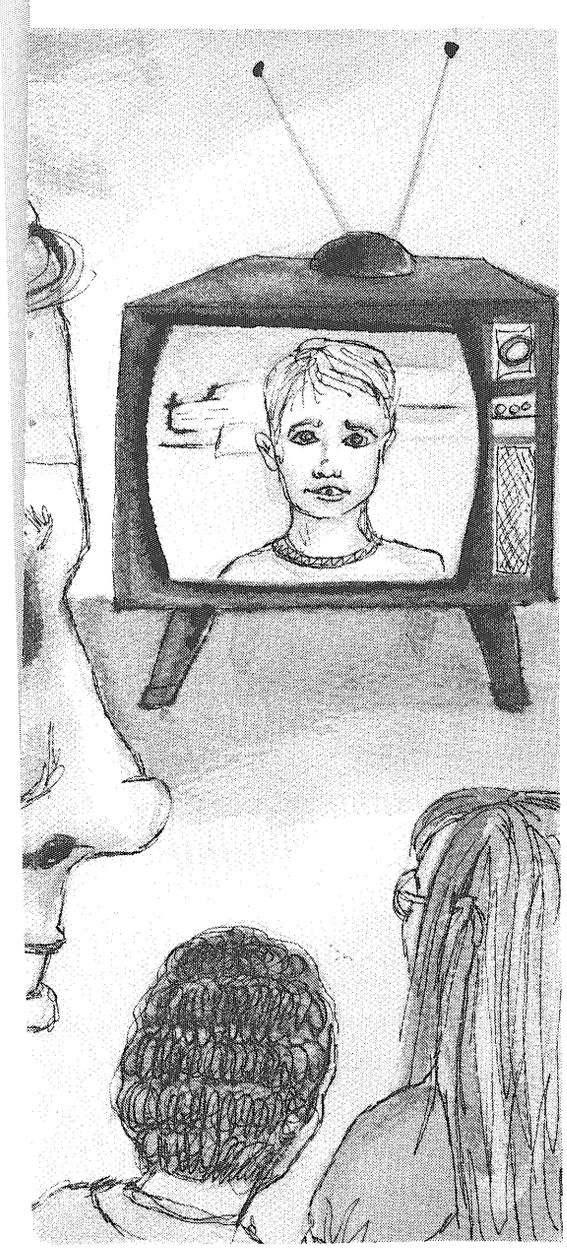


Illustration by Kathy Marschall

Her father's voice floated up the stairwell in innocent irrelevance. "Say, Estelle, I'm thinking of starting a Scout group. Ernest here says he'd like to be a Scout. D'ya think it would be OK?"

"Well, I guess so, dear, only why can't he join the Scout troop Peter's in?"

"Gee, Estelle, that's already got a leader. Then I couldn't be in."

She stated herself clearly over and over to the men on the observation team, seated in the main office of the Alien Learning Center. One kindly offered her hot chocolate, and they all appeared to be listening, but at the end of each recital, the panel before her would exchange knowing looks, and finally smile their collective conclusion.

"Diane," the hot chocolate brewer said, "you're a growing girl. It's natural at your age to begin to realize that your parents aren't the completely mature individuals you once took them for. Adults have many childish behaviors, and children can be very adult too. Why, look at you, you're quite a little lady!"

"But the hair! All the weight he's losing!"

"So the Youngster's got him running around, and he's losing some weight. Great for him! I jog myself, makes me feel terrific. And nobody really understands hair loss yet. Maybe he's taking some of those new pills."

"He's not! He's not taking anything!"

"Now Diane, your father doesn't tell you *everything,* even if you are his favorite girl. He may be embarrassed about that. Men are funny about their hair sometimes." He passed a hand over his own thinning locks self-consciously. "Anyway, we'll check into it, OK?" The panel of experts closed their folders in synchronized finality.

"But what about *Romper Room?* Aren't you going to find out about the others?"

"Of course we'll check into it, dear. That's quite an imagination you have there."

Diane got up from her chair and moved slowly to the door.

"And, honey?" the kindly one said. She turned, not daring to look up, trembling with frustration and fear. "Maybe you'd better come in next week with Peter and Joycey. Just for a little talk session. It's done them a world of good. You could even see someone privately if you wanted."

She looked at the man standing there, paving her pathway to hell with good intentions, thoughtless, kind. Her knees and her jaws seemed clamped forever shut, like the rusty vise in her father's workroom. Her lips formed the words that almost went unheard, so softly were they uttered, choking in her throat.

"I want to see Stella," she said. "Take me to see Stella."

In the nursery Stella was playing dolls. She did not seem particularly happy with the employment. When she felt Diane's stare upon her, she looked up. Her eyes were not the eyes of a four-year-old. Even her mother didn't have such ancient eyes.

"Why didn't you want my mother too?" she demanded.

"Why don't *you* want her?" Stella questioned in reply.

"But you can't do it without her. I can. I can grow up to be anything I want!"

"You think so. And maybe you can. But wait'll *they* get ahold of you," she said, gesturing toward the room where the panel of experts had congregated, "and see how far you get."

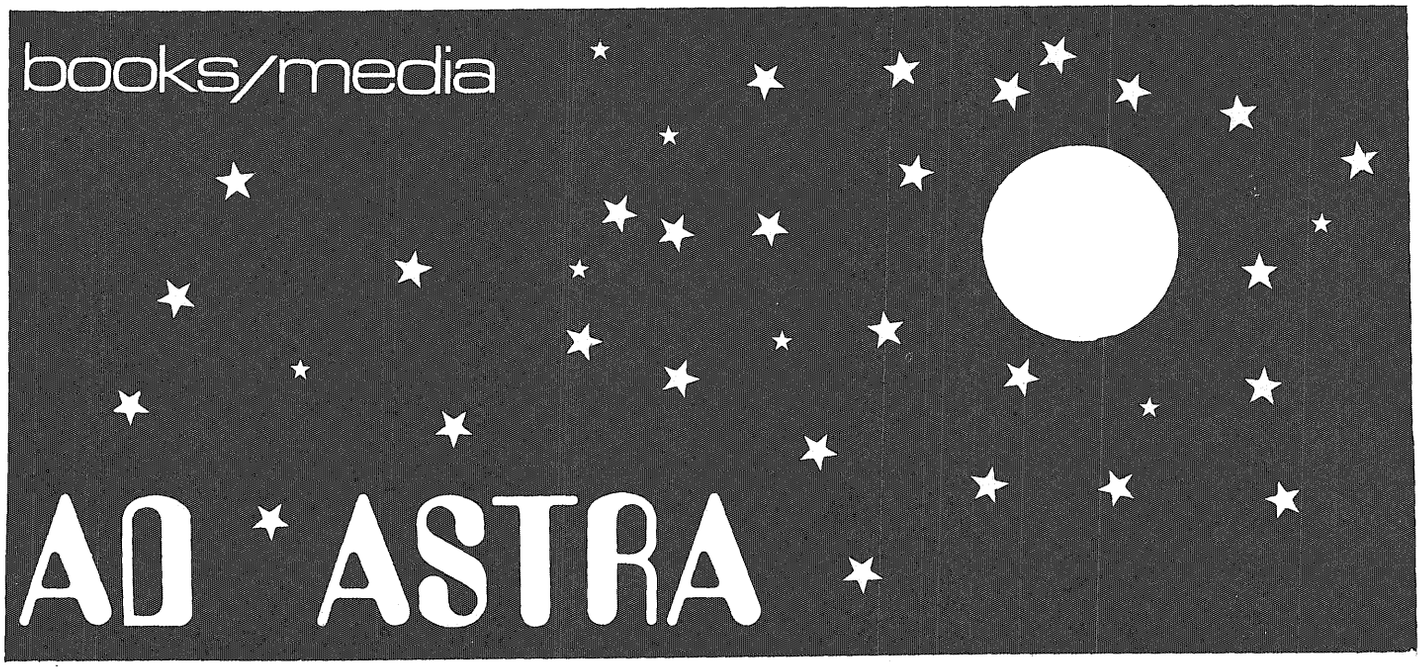
Diane watched her bed the doll, carelessly, stuffing the covers tightly around its arms and legs. "Are you going to come live with us?" she asked.

"No," Stella said dully, turning toward her cardboard kitchenette. She took a plastic cupcake from the refrigerator and placed it on a tray. "Then I'd have to do dishes." She turned back toward Diane, almost wearily. "Do you want to have a tea party now?"

"Thank you, no," Diane murmured hastily. "I have to go."

Outside the nursery the corridor seemed stiflingly narrow, dark as her own insides. She ran without looking back, breathless, to reach the door.

Paula Reed, a graduate student in English at the University, took first place in the 1980 *Technolog* Science Fiction Contest.



by Bruce Kvam

The Ringworld Engineers, by Larry Niven, 357 pp., Holt, Rinehart, & Winston, $9.95 (paperback in several months).
Titan, by John Varley, 309 pp., Berkley, $2.50.

Sequels present a problem for both the writer and the reader. The writer has to skillfully weave into the sequel all the background of the original novel so the sequel makes sense. The reader, meanwhile, has to either wade through the rehash without getting bored, or pick up on skimpy details scattered here and there.

Larry Niven is one writer who's had a lot of experience with (re)informing his readers, gleaned mainly from his work on his Known Space series, a cycle of stories and novels set in the same fictional universe and sharing some common characters.

The Ringworld Engineers is Niven's newest book and the latest in the Known Space series. It is the sequel to the award-winning *Ringworld* (published a decade ago). Ringworld was built by a race that thought *big.* Imagine a hula hoop spinning round a light bulb: then expand the scale so the light bulb becomes a star, the hoop an enormous ring as wide across as the Earth's orbit. What've you got? Three million times the surface area of the Earth — enough room for trillions of people to roam around on for thousands of years.

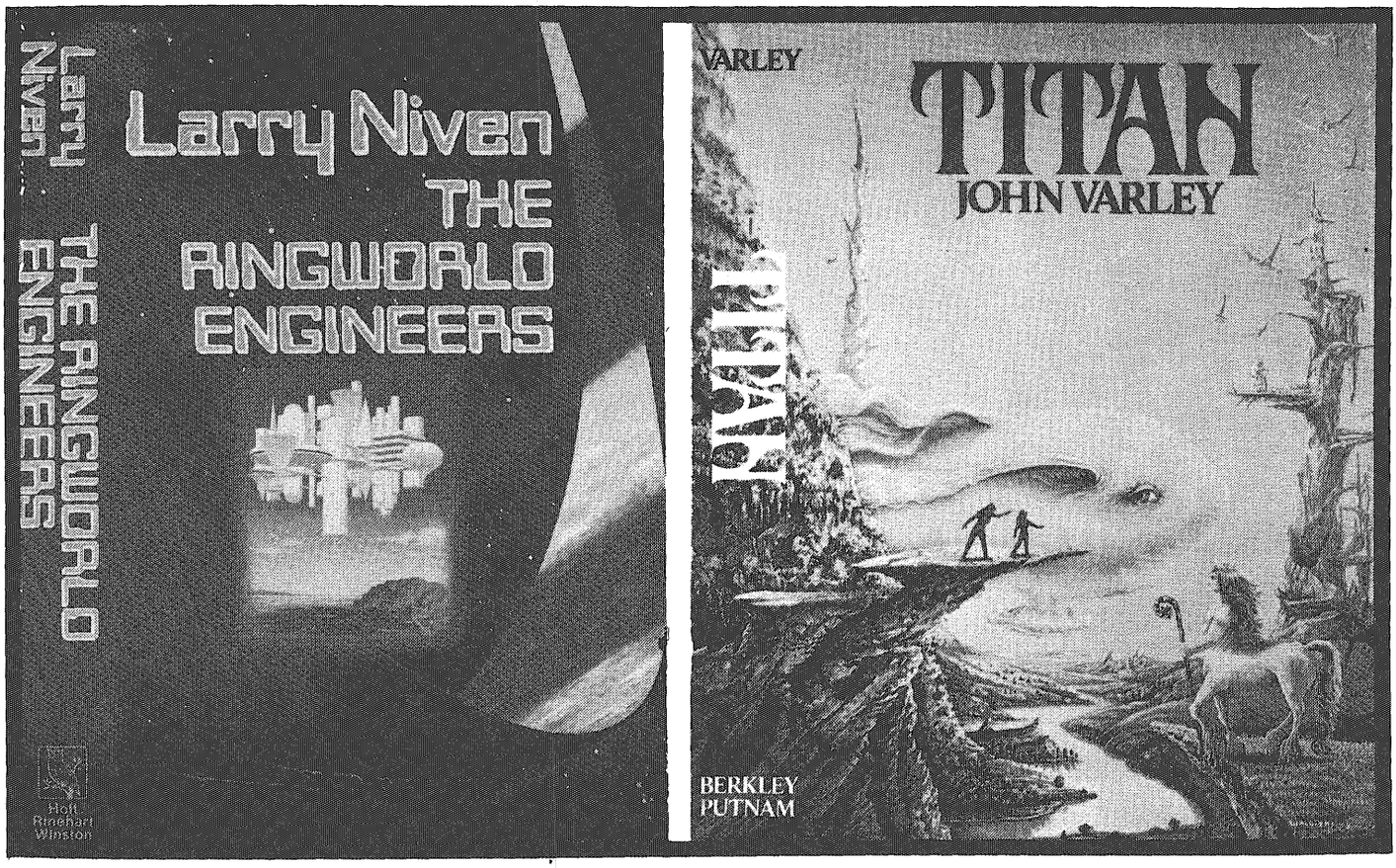
In *Ringworld* two humans, Louis Wu (who celebrates his two hundredth birthday at the beginning of the book) and Teela Brown (an astoundingly lucky woman) travel with two aliens, Nessus (a mad puppeteer with two brainless heads) and Speaker-To-Animals (a feline Kzinti ambassador with a nasty temper) to Ringworld. They crash-land there, and after many adventures, eventually get off.

The Ringworld Engineers starts twenty-odd years later. Louis Wu is now a wirehead (a current addict), leading the quiet life of a vegetable, when two men break into his apartment. He summarily kills them in self-defense, only to be immediately snatched up by the Hindmost, a puppeteer, who is *not* Nessus. Speaker-To-Animals, who for his heroic deeds received the name Chmeee to replace his titular appellation, has also been abducted. The Hindmost needs Louis and Chmeee for a return voyage to the Ringworld to find the legendary matter transmuter the Ringworld Engineers supposedly used to build Ringworld.

Upon their arrival, Louis and Chmeee find that something is very wrong with Ringworld: the sun is off center. The condition will worsen until, in a year or so, the ring will skim the photosphere of the star and everyone will die. Of course, many trillions of people will expire before that time as the star goes more and more astray, but as far as the Hindmost is concerned, he will have his matter transmuter, and that's all that matters. But not to Louis Wu. He can't allow trillions upon trillions of people to die — and he'll risk his own neck to stop it.

The Ringworld Engineers answers just about all the questions raised in *Ringworld,* as well as introducing a multitude of new ideas from Niven's vivid imagination. I don't think Niven got bogged down filling in background information. Even when he does wax professorial, Niven is always entertaining. But I don't recommend reading the sequel before reading the

"Varley's characters are believable. They have problems, and they fight like hell to solve them."



original novel, for the simple reason that you'll be missing a darn good book if you skip *Ringworld.*

Titan, by John Varley, bears many superficial similarities to *Ringworld.* But these are mere happenstance. In actual content, the books are poles apart.

Captain Cirocco Jones (a woman) is in command of *DSV Ringmaster,* the first manned ship to Saturn. The main objective of her mission is to explore the moons and rings of Saturn, but Cirocco and her crew are sidetracked when her science officer discovers another moon orbiting Saturn. It is dubbed Themis, in keeping with the mythological nomenclature of the other moons. As *Ringmaster* approaches, Themis is discovered to be an artificial construct — and a huge one to boot, with a diameter of 1300 kilometers. Cirocco has her ship take up orbit around the object. Without any warning, Themis reaches out and grabs the ship like a frog snaring a fly.

An indeterminate amount of time later, Cirocco finds herself naked, hairless and alone, buried alive in the soil inside Themis. Her ship has been destroyed, her crew lost, every link with Earth broken. But it all makes her that much more determined to find out who — or what — is responsible.

Titan has been nominated for both the Hugo and Nebula awards, and for good reason. Varley is able to put himself — and the reader — into the characters' shoes. His characters are believable. You care what happens to them. They have interesting problems, and they fight like hell to solve them.

The two main characters in the novel are women. They aren't weak sisters, nor are they stereotypical female men. They are *people.* Cirocco is a female captain, a role she finds uncomfortable because there are so few role models for her to follow. She doesn't whine incessantly about her crew not obeying her because she's a woman; she just *makes* them obey.

Titan is rather explicit about sex. Varley treats the subject well, I think. It is a simple fact of life, as well as being integral to the plot. It is not mere window-dressing to attract voyeurs.

Titan first appeared in serial form in *Analog,* in a severely butchered form. I very much enjoyed the book version (I have read both, and vow never to read a serial again) and hope the *Analog* fiasco doesn't hurt Varley's chances for the Hugo. He may well deserve it.

The other nominees for the 1979 Hugo Award for best novel are *The Fountains of Paradise,* by Arthur C. Clarke (who won the Nebula Award for this book in April); *Harpist in the Wind,* by Patricia McKillip; *Jem,* by Frederik Pohl; and *On Wings of Song,* by Thomas Disch. The Hugo Awards will be voted on by the members of the 1980 World Science Fiction Convention, to be held in Boston, August 28-September 1, 1980.

Bruce Kvam, temporarily on leave from graduate studies in computer science, is working for Control Data.

Proton Decay Takes GUTs

by John Bartelt

What is the Department of Physics doing with 4,000 vacuum cleaner tubes and 40 tons of iron ore? Determining the ultimate nature and fate of the Universe, of course.

Actually, those materials are just for a prototype device. Eventually they hope to construct a detector weighing at least 1,000 tons. And where will they put such a detector made from tons of iron ore? At the bottom of an iron mine. Naturally.

Just what in the world are they hoping to detect with this seeming coals-to-Newcastle scheme? With a little luck, the decay of the proton.

Until a few years ago, physicists believed that the proton was perfectly stable (i.e., that it had an infinite lifetime). The proton is the lightest particle in a class called the baryons. It was believed that a baryon could not be created or destroyed, except as part of a baryon/anti-baryon pair (every particle has an anti-particle of an opposite charge), or that one kind of baryon could be changed into another kind, as when a neutron decays to a proton. This property is called Baryon Conservation. Now a new theory suggests that baryons are not perfectly conserved, allowing a proton to decay into lighter, non-baryon particles.

From where did we get this new theory? Since about 1940, physicists have recognized four basic interactions, or forces. The two best-known are gravity and electromagnetism. These are both long-range forces. Gravity is the much weaker of the two: electric attraction between an electron and a proton is about a billion billion billion trillion (10^{39}) times stronger than gravitational attraction. But matter is generally electrically neutral, so the electromagnetic forces tend to cancel out. Gravity, on the other hand, always adds up, since all matter attracts all other matter. But for individual subatomic particles, gravity is a negligible force.

The other two forces are short-range: the strong nuclear force and the weak nuclear force (or weak interaction). The strong nuclear force holds the nucleus together. It is "strong" because it must overcome the mutual electric repulsion between the positive-charged protons in the nucleus — which it does, when the protons are close enough together. The weak nuclear force — manifested in radioactivity and in certain particles' decay — doesn't hold anything together. While weaker than electromagnetic forces, the weak interaction is still much, much stronger than gravity.

Just as electromagnetic forces only affect particles which are charged, the

FUNDAMENTAL PARTICLES AND THEIR CHARGES

Generation	Leptons (charge)	Quarks (charge) each in three colors
First	electron (-1) electron-neutrino (0)	up (+ 2/3) down (-1/3)
Second	muon (-1) muon-neutrino (0)	charm (+ 2/3) strange (-1/3)
Third	tau (-1) tau-neutrino (0)	top (+ 2/3) bottom (-1/3) (top and bottom are also known as "truth" and "beauty")

There is strong evidence that there are no more than four, and probably no more than three generations. Why there should be three remains a mystery, since all ordinary matter is made of first-generation particles.

PARTICLE CLASSES

Leptons ("light," i.e., low mass)	Electron, muon; massless* electron-neutrino, muon-neutrino; recently joined by the heavy lepton, Tau, and its neutrino. Each particle has an anti-particle, for a total of six particles and six anti-particles. Spin = 1/2. Unaffected by the strong nuclear force. Previously believed to be conserved.
Mesons ("intermediate")	Pi-mesons, k-mesons, a few dozen others, and their anti-particles. Spin = 0, 1, 2, or other whole number. Partake in strong nuclear force; now known to be made of a quark and anti-quark. Not conserved.
Baryons ("heavy")	Protons, neutrons, lambda, dozens of others, and their anti-particles. Spin = 1/2, 3/2, 5/2, or other half-integer. Partake in strong nuclear force; now known to be made of three quarks. Previously believed to be conserved.

*There is some very recent evidence that neutrinos may actually have some small mass.

Making slabs. The form must be vibrated to get the concrete to flow in — a noisy process requiring ear protection. Left to right: Graduate student Jim Polvis, Prof. Marvin Marshak, Prof. Keith Ruddick, Prof. Earl Peterson.

Photo by John Barrett

strong nuclear force only works on baryons and the mesons. By the 1960s, the reason became clear: baryons and mesons are not fundamental particles, but are themselves made up of quarks. Three quarks make a baryon; one quark and one anti-quark make a meson. Quarks have a property like charge, which has been called "color" (the term is purely arbitrary). There are three colors for quarks and three anti-colors for anti-quarks, all of which attract each other. The baryons and mesons are made so that the colors of their constituents add up to "white" (they cancel out). The strong nuclear force, then, is just a vestige of this color force.

Nineteenth-century physicists (particularly James Clerk Maxwell) unified electricity and magnetism in a single theoretical description called Electromagnetism. Einstein labored for years to unify the two long-range forces, gravitation and electromagnetism, into a single theory. He failed. But in 1968, Steven Weinberg and Abdus Salam developed a theory partially unifying electromagnetic and weak interactions, now sometimes called "Electroweak." Although some of the predictions of the theory were greeted with skepticism, experiments proved the theory correct.

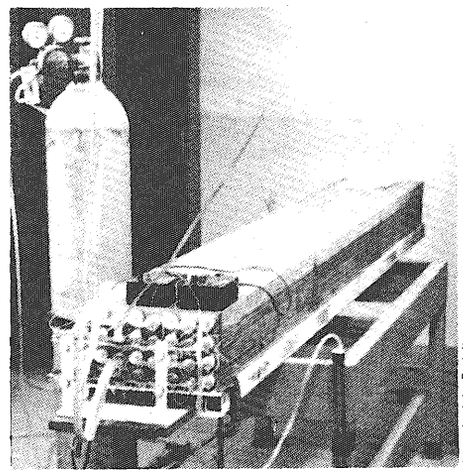
The move was on to develop a theory to completely unify the new theories of the color force and the electroweak interaction. Using the symmetry principles so useful in developing these new theories, several models for unification were invented, generally called Grand Unified Theories (GUTs) or Grand Unified Models (GUM).

For fundamental particles (leptons and quarks) arranged in "generations," the color force can change the colors of quarks, but does not effect their "flavor." (There are six flavors, or types of quarks: up, down, strange, charm, top, and bottom, with differing charges and masses.) The color force does not effect leptons at all (they are "colorless"). The weak interaction can change the flavor of quarks, but not their colors; and can change leptons within a generation but not across generations. In the Grand Unified Theories, physicists found a new interaction, a sort of ultraweak force, which can change quarks into leptons. It is this new force which allows the proton to decay. Whether it can operate across generations is still unknown.

That people don't disintegrate suddenly — and, more realistically, measurements of background radiation — indicate that proton decay is not something that happens very often. Theories currently predict a half-life between a few million trillion trillion (10^{30}) years and perhaps a few billion trillion trillion (10^{33}) years, which is extraordinarily long compared to the age of the Universe, about twenty billion years. (The half-life of a substance is the time in which half of it, on average, will decay.) In personal terms, this means that if you live 100 years, the odds on even one of your protons ever decaying is at very best 50/50, and probably much, much lower. Since the Grand Unified Models make few (if any) other testable predictions, detecting and measuring proton decay is an important task. It is also a very, very difficult one.

No nuclear reaction with such a long half-life has ever before been measured. To do so requires, first of all, a very large number of protons. The second problem is that we are constantly being bombarded by cosmic rays from space. This radiation might swamp that from the proton decay, making it impossible to detect. The best solution is to go deep underground, where as much cosmic radiation as possible will be screened out.

One of the first ideas developed for detecting proton decay involves about 1,000 tons of water for the proton source. (Each ton contains about $3x10^{29}$ protons, and roughly an equal number of neutrons and electrons.) In a typical decay, a proton might break into a positron (an anti-electron) and a pi-meson, with the excess mass appearing as considerable kinetic energy; the two particles will separate at nearly the speed of light. The particles speeding through the water will emit a small amount of light, which can be detected by photomultiplier tubes (essentially very sensitive electric eyes).



Four slabs in the lab for electronics testing and debugging.

Photo by John Barrett

A group of physicists from the University of Wisconsin started organizing such a project, and attracted collaborators from other institutions, including particle physicists from the University of Minnesota. The Minnesotans suggested using the Tower-Soudan Iron Mine, which is owned by the Minnesota Department of Natural Resources and operated as a tourist attraction. Later, however,

disagreements on how to proceed developed between the Minnesotans and the other members of the collaboration. Finally, the Minnesotans decided to go on by themselves, building a different type of detector of their own conception. This detector would use a dense substance as its source of protons, and being from Minnesota, the material they chose was taconite, a form of iron ore. Once the ore had been partially processed and turned into a dark powder, it could be mixed with cement to form dense concrete which can be molded into any desired shape.

Since it would be impossible to detect the feeble light emitted by the particles passing through this material, this "dense detector" — in contrast to the "water detector" — would have to use a different detection

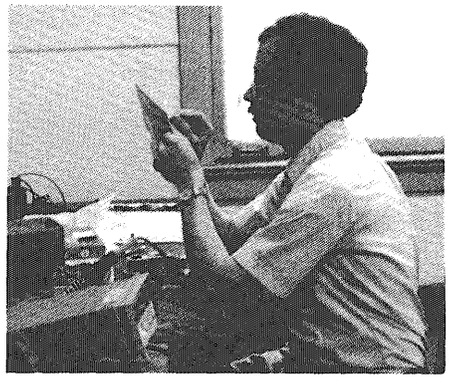


Photo by John Bartelt

Research associate Mike Shupe working on electronics.

method. The method chosen, one often used in particle physics, depends on the fact that a charged particle speeding through a gas will knock electrons out of some of the gas's atoms. By enclosing a suitable gas in a tube, running a wire down the middle of the tube, and applying a high voltage to the wire, those electrons will be accelerated toward the wire, and will knock more electrons free. When all these electrons reach the wire, a detectable signal will be generated in it. By using arrays of such tubes, the paths of the charged particles can be determined. For the proton decay detector, thousands of tubes about one inch in diameter and ten feet long were needed. At first it appeared as though electrical conduit would be cheapest tubing available. Then, however, the physicists found a company located right here in southeast Minneapolis that manufactures vacuum cleaner tubes, which cost only about half as much and, as experiments showed, worked better.

The major advantages of the dense

continued on p. 25

THE lighter side OF THE INSTITUTE OF TECHNOLOGY

This poem was presented last June as a speech on behalf of the graduating class of 1979.

Once upon a midnight dreary,
While I pondered weak and weary
Over many a quaint and curious volume — what a tedious chore!
While I nodded, books before me, suddenly there came a flurry,
Waves of thoughts my mind set free, memories and thoughts galore,
Recollections of four years, years which now would soon be o'er.
Thoughts and things from mem'ries store.

Ah, distinctly I remember,
It was in a bright September
When lines and lines of bright-eyed freshmen first set foot upon the "U."
Eagerly anticipating, soon they found that all was waiting.
Lines could become quite frustrating. Enthusiasm did subdue.
For bureaucracy seems rampant at our alma mater true.
Four years now we've waited through.

But now our classes were beginning,
Our ranks so soon had started thinning,
We did not know the first two chapters were due in class the very first day.
We studied hard on math and science; we realized, perhaps, dismay.
For the load seemed awfully heavy, our classes quite a vast array.
Graduation? Still three years away.

Our first exposure to labs inviting,
What could possibly be more exciting,
Than running up the stairs of Physics, a stopwatch firmly in our grip.
Equipment from antiquity, marked "U.S. Government Property,
Do not use after '53." Fix it with a kick or hit.
And despite our pleas and curses, as before the junk we sit,
Murphy we could not outwit.

To teach us we saw many a professor,
Though teaching often seemed the lesser
Of the abilities they showed when standing up before the class.
Lecture demonstrations failing, faint voices scarce prevailing,
As proof upon proof they stood detailing, to a quiet, oft sleeping room.
In several cases it seemed quite certain that students only would amass
Enough ideas so they could pass.

Yet some faculty seemed to draw us,
With their lectures could often awe us
Into greater interest in the subject now at hand.
To make a theory truly decent, and disagreement with it absent,
We soon discovered that an accent, helped to make a talk less bland.
British, German, French, or Greek, any type is grand.
That is, if we could understand!

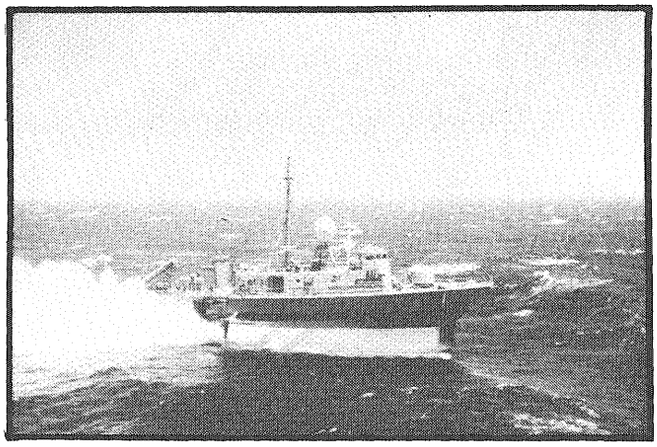
Computers seemed a way of life,
Though causing students grief and strife
When eating cards and spewing out pages of illegible line.
Computers used to calculate, or perhaps exasperate,
Whatever, they did agitate, yet we never did resign,
But ventured yet again into this holiest of shrine
Our programs once more to refine.

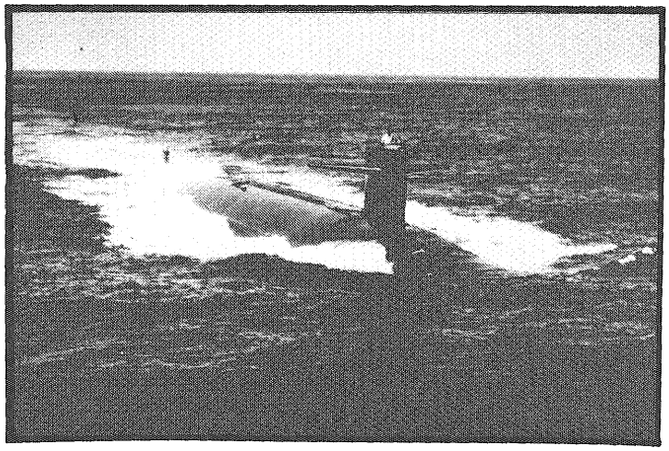
Finally came the interview.
To convert our classes to revenue
We polished up our resumes and bought a brand-new three-piece suit.
An interview, a trip perhaps, an offer we tried hard to grasp,
As opportunity unwraps and reveals our future route.
But some have not yet had enough and have forsaken all the loot,
Advanced degrees are their pursuit.

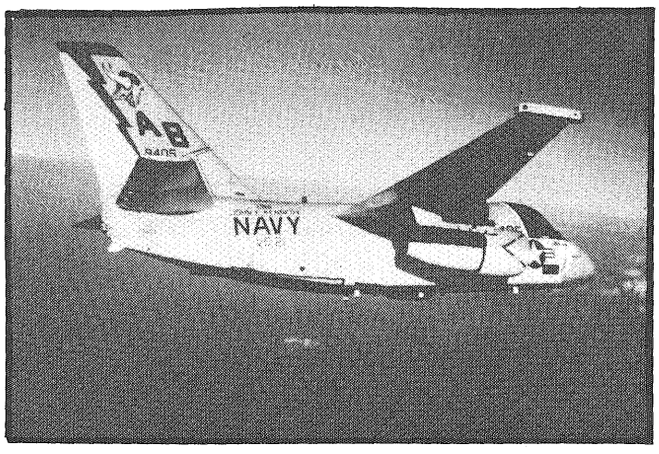
Ah, but now the future hails,
My reminiscence omits details,
Which, like all authors, I assume the listener can perhaps restore.
Enough, for now, of education. Let us continue in celebration,
As from IT our liberation and movement on toward open door.
But shall these thoughts of friends and teachers, be swallowed up in future's roar?
Quoth this student, "Nevermore."

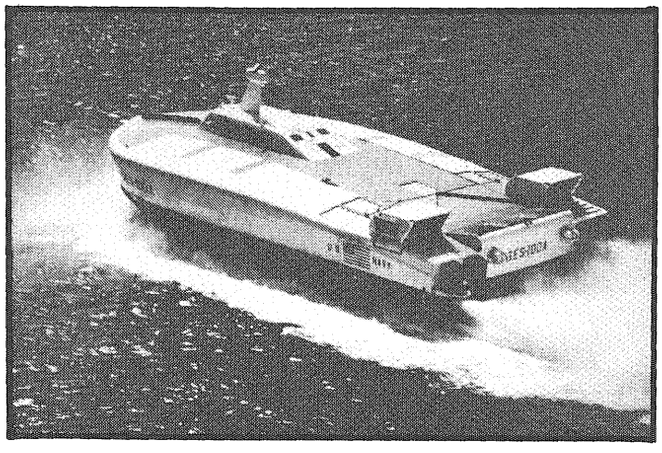
—Tom Christensen, Class of '79

LEADERSHIP AND MANAGEMENT EXPERIENCE UNEQUALED BY INDUSTRY.... WHERE?









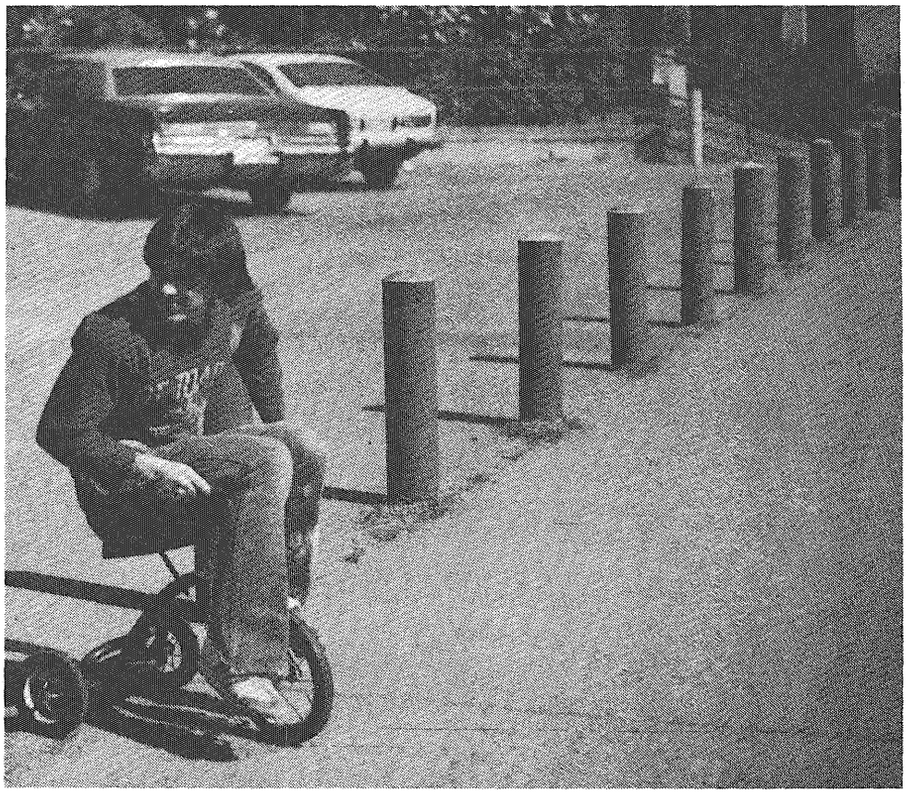
Current technology and its influence on the United States Navy is creating a demand within the fleet for technically qualified line officers. Because of this demand, the Navy is offering a two-year scholarship program through Naval ROTC designed for college sophomores and juniors pursuing engineering and hard science curriculums. This program allows qualified students to obtain a commission in the United States Navy and continue on in surface line, aviation, or nuclear power. Let your last two years of college prepare you to be someone special! If you are interested in applying for this opportunity please call (612) 373-2230, or write to:

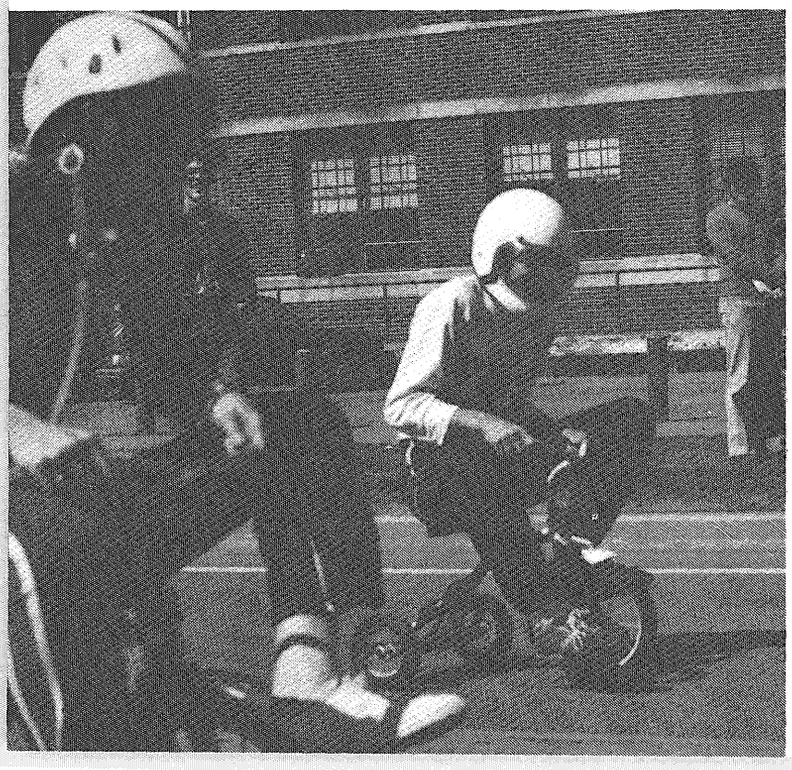
NROTC Programs
203 Armory Building
15 Church Street SE
University of Minnesota
Minneapolis, MN 55455

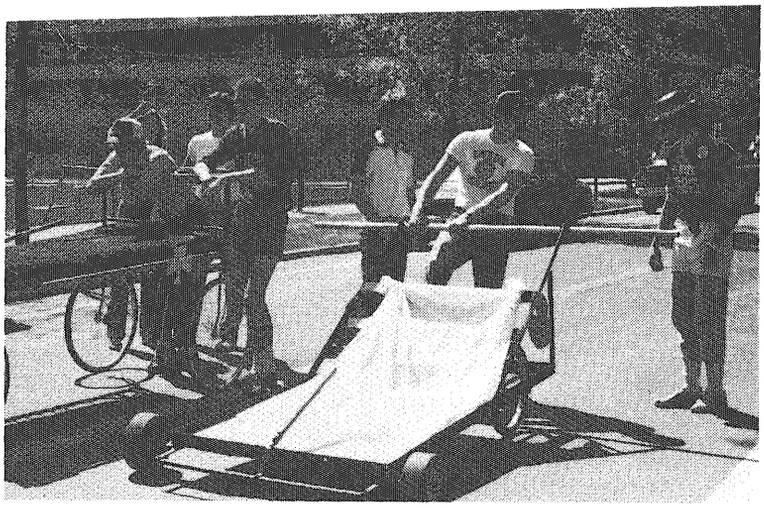
THE NAVY

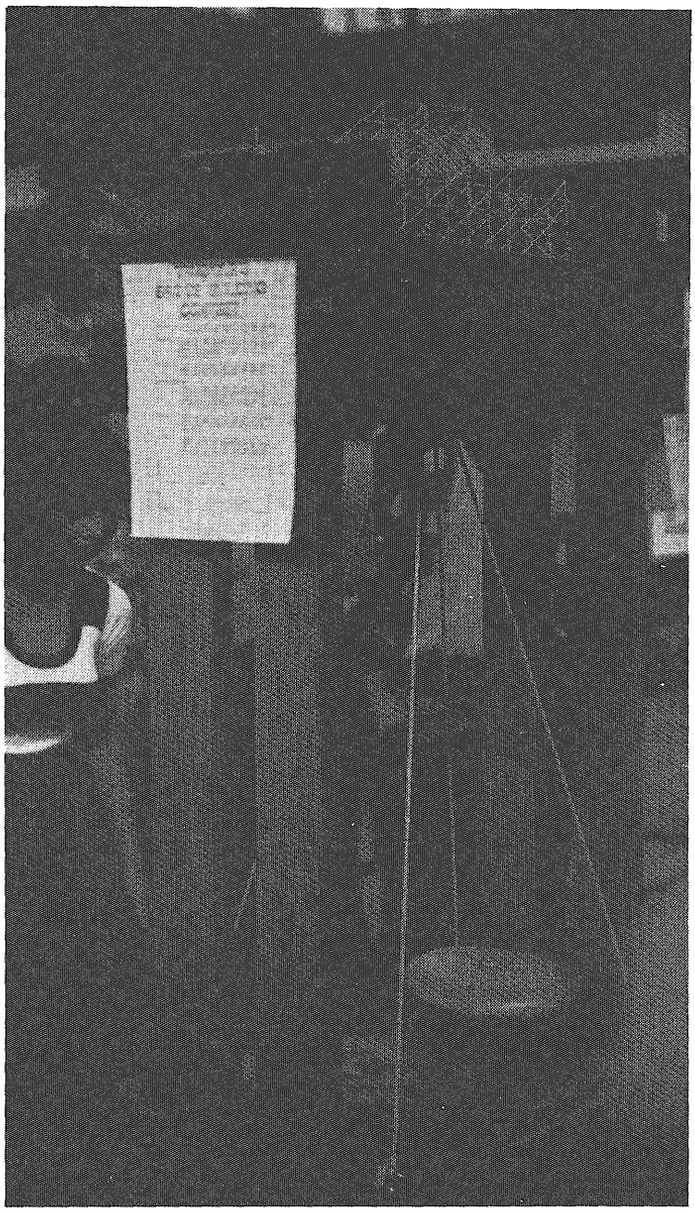
E-WEEK '80: A Photo Essay

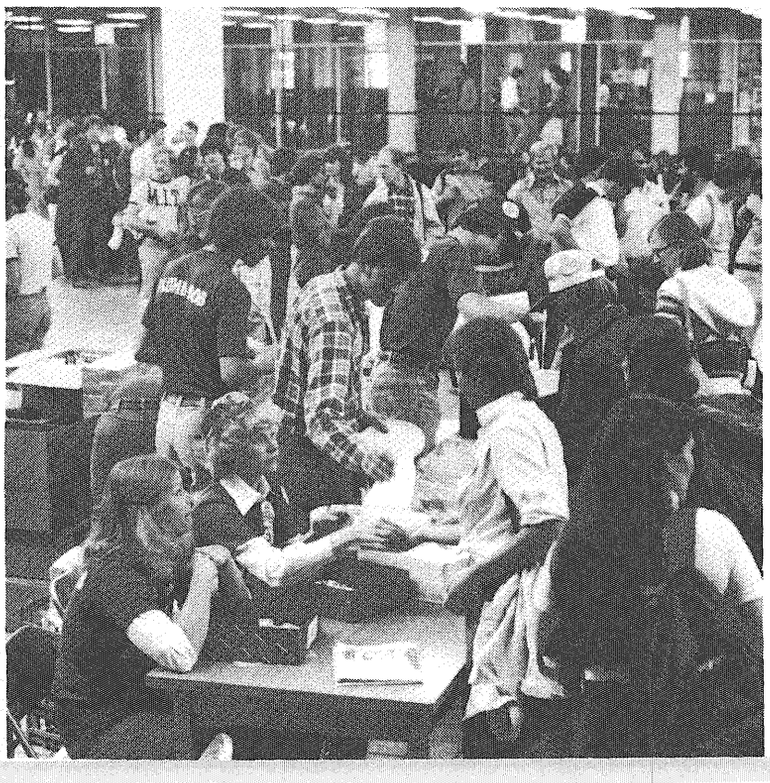
by Mike Dorn
Kevin Gaukel
Scott Hou

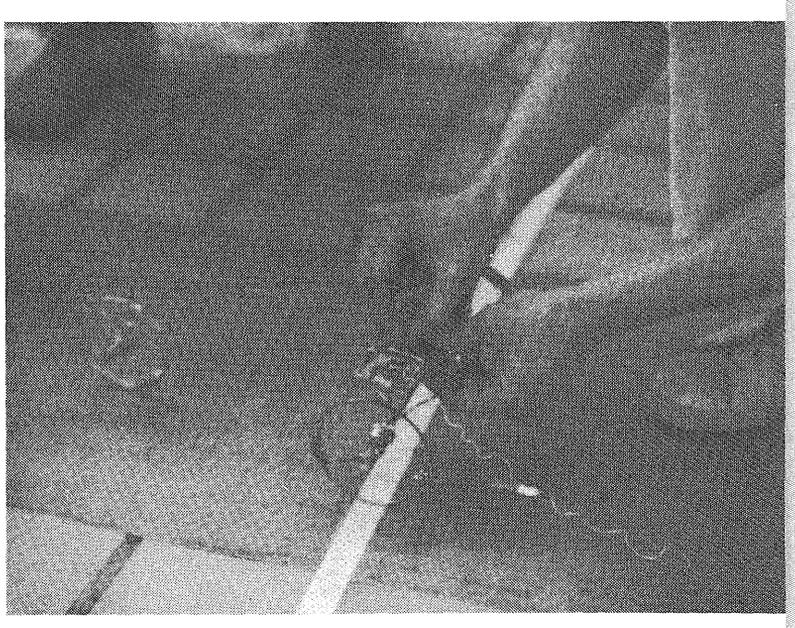


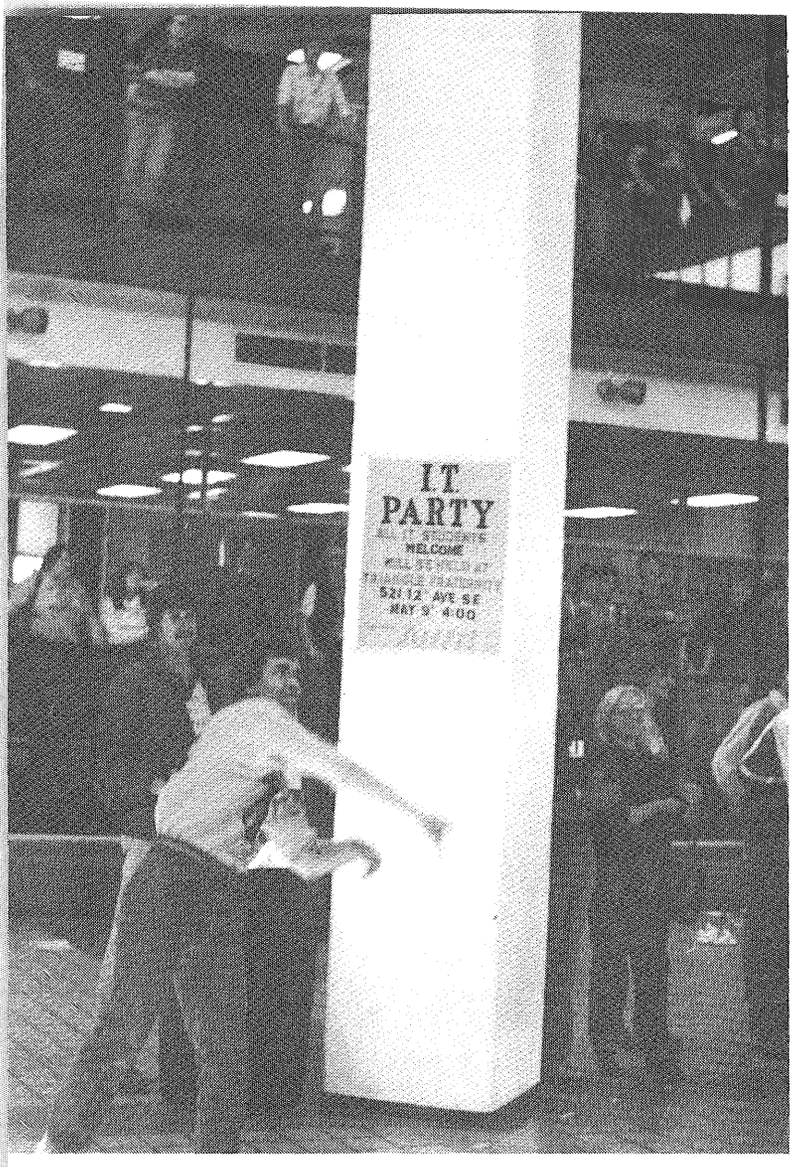








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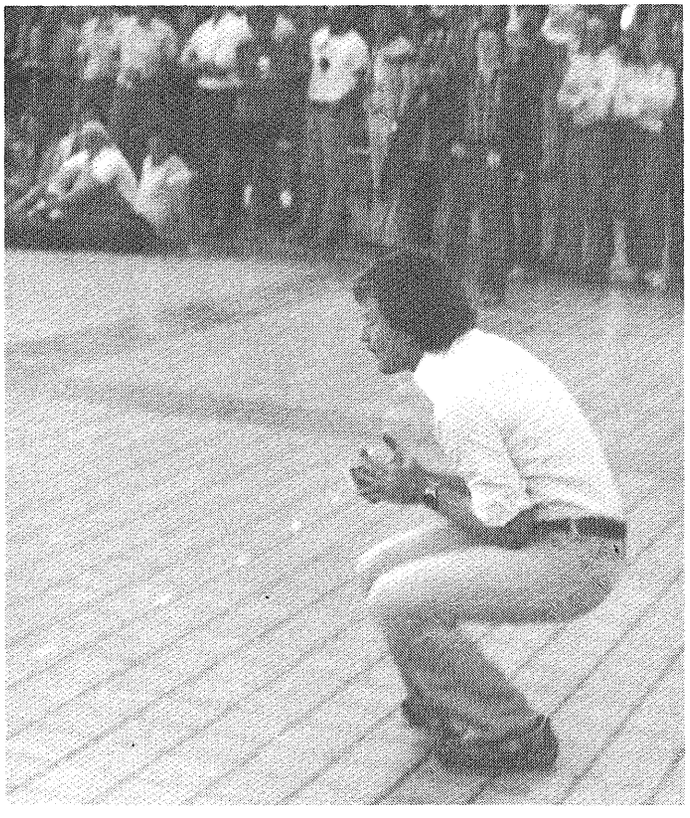
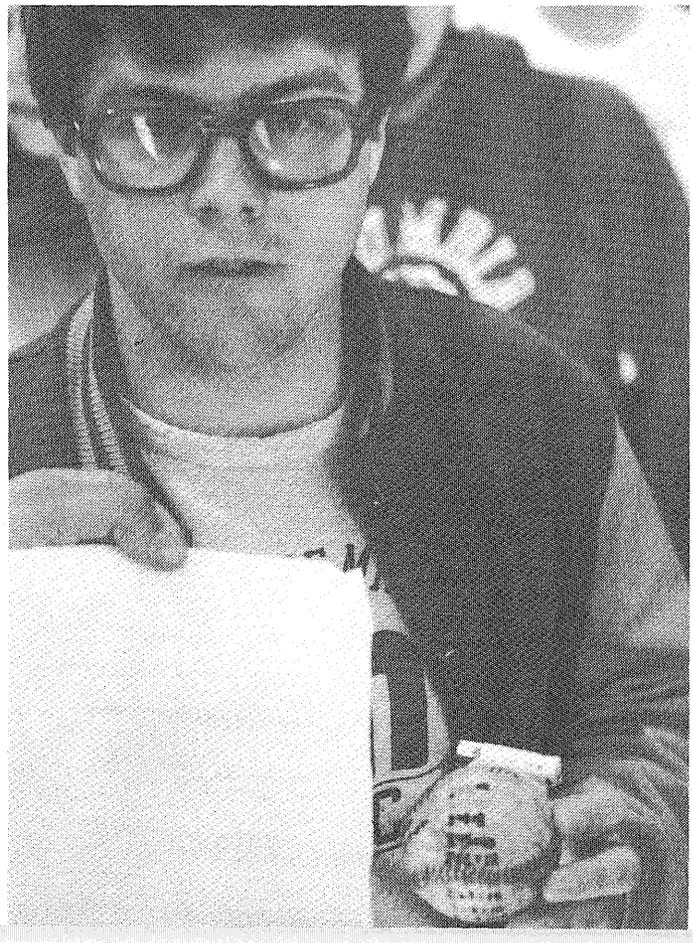
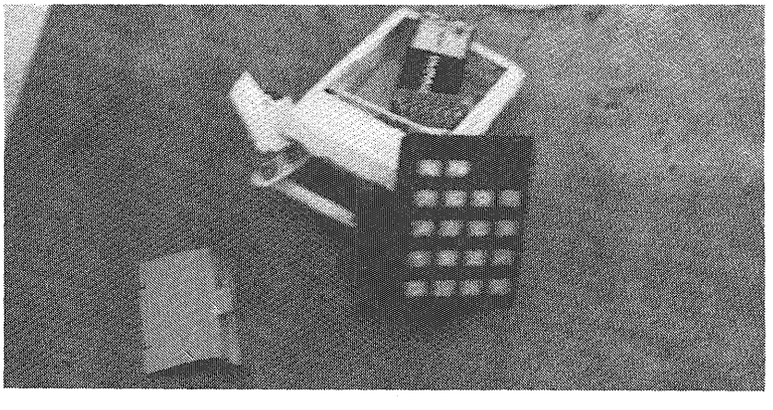






detector are its smaller volume and modular design. It should also be more sensitive to certain decay modes. And there are no huge tanks of water to worry about. The dense detector is being built from slabs of taconite concrete 4 x 32 x 290 centimeters, each with eight tubes running lengthwise. The prototype detector will consist of layers of nine slabs lying flat, edge-to-edge. Layers will alternate, tubes running east-west and north-south. There will be over 50 layers, using about 500 slabs or 4,000 tubes. The entire detector will weigh about 45 tons, and should be operating this summer. Once they convince themselves that this will work (and assuming that the prototype is not big enough in itself to detect proton decay), the Minnesota physicists hope to build a 1,000-ton model. Meanwhile, water detectors are being planned by the Wisconsin-Harvard-Purdue collaboration, by a group from the Universities of Michigan and California-Irvine and the Brookhaven National Laboratory, and by at least one European group.

If protons do decay, the implications for the far-distant future of the Universe are profound. Eventually, matter as we know it will not exist; all that will be left are light particles such as electrons, neutrinos and photons. And if the theory behind proton decay is correct, it may shed new light on the origins of the Universe. In particular, one of the most popular Grand Unified Models has suggested a new picture of the first split-second of the Big Bang, which may help explain some features of our present-day cosmos. And once we have a firm Grand Unified Theory, we may be able to then complete the unification by adding gravity to the description. Thus the detection of proton decay can hone our understanding of the Universe, past, present and future.

John Bartelt, a graduate student in physics at IT, contributes regularly to *Minnesota Technolog.*

After Graduation

AND NOW, THE REAL WORLD

by Steven Deyo

You've heard about "the *real* world" Out There beyond Diplomaland maybe until the cliche makes you nauseous. But give "the real world" some serious thought before you graduate and begin working. It *is* a change. You are given real responsibility. *Accountability.* Everything you do or don't do affects your lifestyle, reputation, trustworthiness and — getting down to the quick — what you end up making of your life.

Hey, I'm all for ideals and social justice and Changing the World. But if you don't found idealism in reality, you get a foggy utopianism. Social concerns not aimed at meeting our society's practical needs are a space cadet's platitudes. They're just not needed; there's no demand. And you're not likely to change much of the world by yourself. How many of us are Einsteins? And even he had his limits.

Besides, you've got to eat. Which means you need money. Which means you need a job. Which means you must be willing to do something someone will pay you for. (Most engineering graduates have already settled this for themselves; but spare me the indulgence to make myself clear: You can't rally all your life to "Save the Whales," or whatever.)

To wit: Don't confuse theory with application. Don't mistake your preparation with your proving grounds.

You've heard that most students haven't been adequately prepared to compete in the job market, much less the job force. And let's face it: there's a certain security in attending the same classes every week, napping on the same mall every afternoon, joking around (maybe even studying) with the same friends every now and then, and metamorphosing into the same "Who-Cares Party Boy" every Friday night.

> "Don't mistake your preparation for your proving grounds."

But once you're on your own . . . Who says it will be easy? You begin to make decisions for your life, organize your priorities, and build friendships. Slip-ups can become mudslides. Failure, big or small, isn't hard.

It's not do-or-die, though. And engineers have it easier than others. But be ready for a change from what you're used to. For men, the order of the day will be a clean-shaved (or trimmed) face and a three-piece suit (a classic cut, charcoal-grey is most acceptable). Being on time is taken for granted. Every day. And you are expected to learn fast, produce and cooperate.

Have a positive attitude. Be pleasant. Work out personality clashes with your co-workers as best you can.

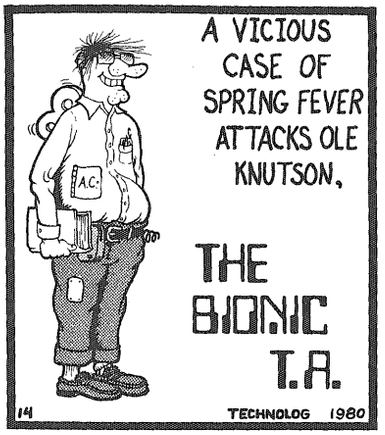
From time to time, evaluate your progress. Brush up on your subject. Improve your communications skills. Keep up on your colleagues.

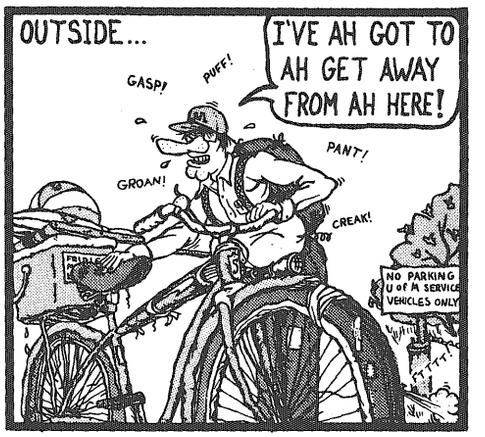
Don't think doing well on the job is enough. More often than not, a good worker's downfall is faulty interpersonal relationships.

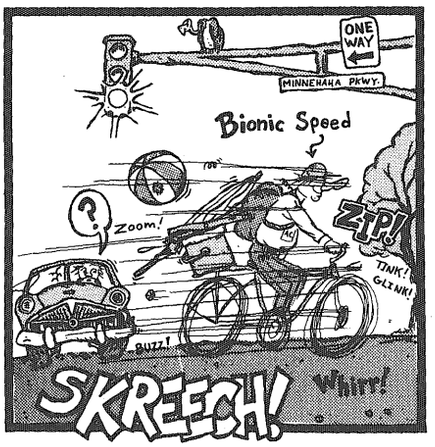
Your biggest problem probably won't be learning the job, but ascertaining and flowing within your boss's expectations. Be wary of office politics, cliques and grapevines; note their dynamics, and don't get in their way. Build alliances with foremen and higher-ups' secretaries; they can forewarn you of unforeseen touchy situations. Find yourself a "mentor," someone near your level who knows the company intricately and can show you the ropes, closeted skeletons, common mistakes and how to avoid them, how to get ahead. (Someone close to retirement works best. He's not endangering his career by advancing yours, and he may take a personal interest in you.)

Finally, Tom Cornell said some things in the *Daily* last September 26 that I thought enlightening for any student. He summarized his thoughts with these words:

"I've learned that it's the application of knowledge, not knowledge for itself that is important; intelligence is an asset, but the ability to communicate what you know is more important; and perhaps most significantly, I've learned it's not how smart you are, it's how hard you are willing to work. It's not how competitive you are, but how cooperative you can be. It's not what kind of credentials you have, but your willingness to learn new things that make for success."







Technolog Readership Survey

To help us serve you better next year, please fill out this survey and return it by campus mail to Room 2, Mechanical Engineering.

Please state your: Sex_____ Major_____ Year_____

How many of this year's six *Technologs* have you read?_____

How many minutes do you take to read an average *Technolog*?_____

Do you: keep your *Technolog*?_____ pass it on?_____ throw it out?_____

On a scale of 1 to 10, how do you rate

_____ Log Ledger, News
_____ Log Ledger, Publications
_____ Log Ledger, New Products
_____ Seminar Notices
_____ Recruiting Schedule
_____ After Graduation
_____ Ad Astra
_____ Lighter Side
_____ Bionic T.A.
_____ SF Contest Winners
_____ Articles
_____ E-Week Coverage

What kinds of features would you like to see? _____

What kinds of articles would you like to see? _____

_____

Pick the three articles you most enjoyed this year:

___ Toobees
___ I.T. Auto
___ Teacher features (Any of 3)
___ UFOs
___ Fermilab
___ Architecture
___ Proton Decay
___ Energy Articles (Any of 3)
___ Catalysis
___ Retrenchment

On a scale of 1 to 10, how would you like to see:

___ Society News
___ "A Word from the Dean"
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___ Recruiting/Interview/Resume Advice

What other magazines do you read, if any ? _____

_____

What are your suggestions? _____

_____

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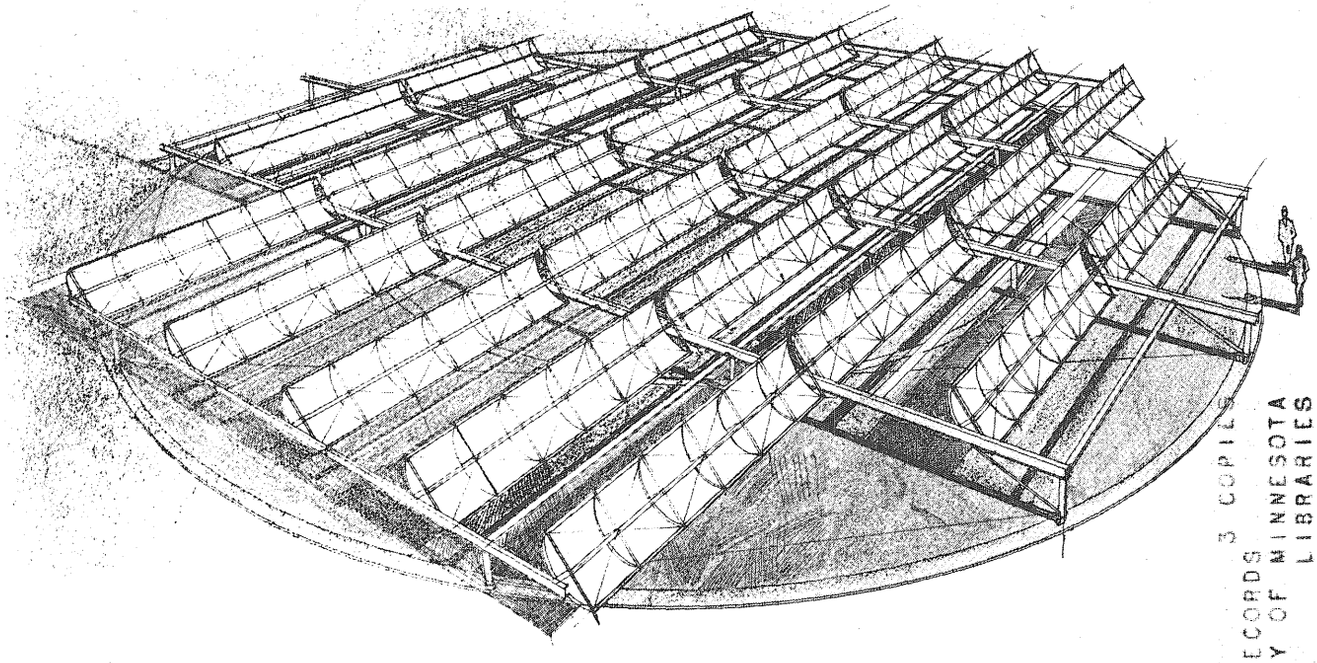
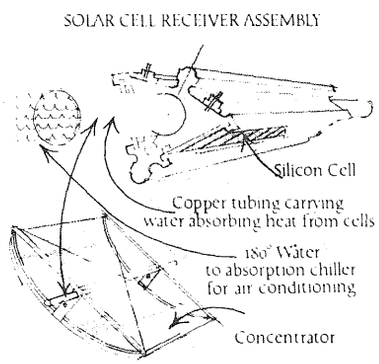


8 years ago, we designed turntables to track records. Today, we're designing turntables to track the sun.

What you're looking at is a turntable that measures 146 feet in diameter — a turntable programmed by computer to track the sun's azimuth while concentrators track the sun's elevation. Nine of these turntables are being designed to power marine-mammal life-support systems at Sea World in Florida.

The photovoltaic concentrator system uses high-intensity silicon solar cells to convert sunlight into electric power and is under study by General Electric for the U.S. Department of Energy. Parabolic troughs on each turntable are formed of aluminum sheets covered by a reflective film laminate. They are angled to concentrate energy on a focal line of solar cells. DC power generated by the photovoltaic cells will be converted to AC power providing up to 300 kw of peak electricity—enough power to service about 40 average homes.



Water circulated through copper coolant piping in the solar cell assembly and carried to absorption chillers would be used to air-condition a shark exhibit. The generation of electricity and simultaneous ability to air-condition makes the GE system unique.

Our Sea World application is a test project. It will include researching ways to reduce costs to make photovoltaic systems practical for commercial or industrial-scale use.

Looking for new and practical energy sources is just one example of research in progress at GE. We're constantly investigating new technologies, materials and innovative applications for existing technologies — in such areas as medical systems, transportation, engineered materials.

This takes talent — engineering talent — not just in research and development, but in design and manufacturing, application and sales.

If you are interested in engineering opportunities at GE, check your Placement Office or write to: Engineering, Bldg. 36, General Electric, Schenectady, New York 12345.

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