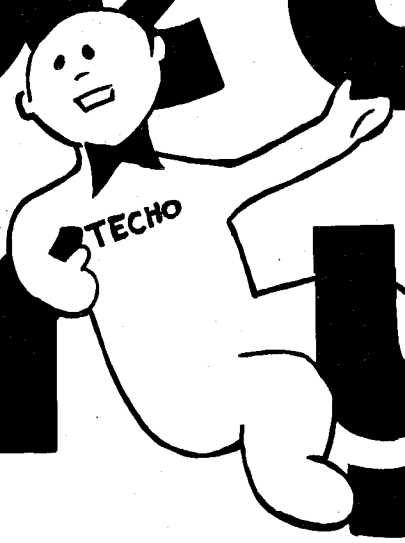
Minnesota
TECHNOLOG
Welcome, September 1978

We do it for you!



Seven issues. This special, new welcome back/summer wrapup issue plus six more to come. They'll have all the news and information that's important to you. Informative features, humor pieces and some good tips on how to make the most of your career in I.T. and at Minnesota. This year we'll cover research and development in I.T. and a look at what the professional scientific world is up to. We'll keep you informed about policy changes in I.T. which could otherwise mess up your next registration. Throughout the year, enjoy Bruce Kvam's insightful science book reviews; watch for the annual science fiction writing contest. Watch for new columns like "After Graduation" with special job hunting information and a look at the I.T. Alumni Association. We'll let you know the good national personalities speaking on campus, what the fraternities and other I.T. organizations are doing—everything you'd expect from your own I.T. magazine.

And don't forget the **Technolog** Open House. It's Thursday of the first week of classes, September 28, from 12-4 p.m. in the **Technolog** office. We're in Room 2 Mechanical Engineering Building. Here's a chance to meet the staff, voice your concerns about scientific issues or just enjoy some of the free refreshments we'll have.

Technolog still needs creative, ambitious staff members to produce the kind of quality you'd expect from a national award-winning magazine. To find out more about working on **Technolog** stop by the Open House or call 373-3298 afternoons. We're still interviewing for writers, photographers, artists, office help and ad salespeople.

Minnesota **Technolog.** We do it for you.

minnesota
TECHNOLOG

Editor's Log

Whenever you combine the energies of a group of diverse individuals, exciting things begin to happen in rapid succession. Change occurs almost inevitably, usually for the better. And the end results often boggle the imagination.
Here at **Technolog** this summer, a similar kind of change movement began, the first results indicating a healthy, exciting future for your I.T. magazine.

The metamorphosis began early, just after Spring Quarter ended. Favorable response from a readership survey included in the Spring II issue pointed out some strengths and weaknesses in previous issues. We're grateful for your response. That, coupled with strong staff interest in redesigning **Technolog** graphically, sparked a kind of revolution and brought change—we hope it's for the better.

For instance, the "Log" you're holding in your hands is an all new, extra issue, a welcome back edition designed to aquaint both new and old readers with basic services and opportunities available to students in I.T. If you're a brand new reader this fall, don't forget Mary Haywood's list of facilities and services. It may help untangle some first-day knots.

If you're graduating soon, don't forget to take advantage of the I.T. Placement Service. Inside you'll find the Fall Quarter Recruiting Schedule printed out along with some important pre-interviewing information.

And if last year's stint in the dormitory wasn't quite up to your likes, maybe a professional fraternity is the answer this year. Scott Ferguson, a new staff member, visited all the I.T. fraternities recently. His report with a cost breakdown begins on page 17.

Thumbing through this issue, it won't take long to notice that **Technolog** got a facelift over the summer. **Technolog**'s new art director, Mary Gress, designed the bolder, more streamlined format and title. We think it will allow greater flexibility in the way we present stories and information to you throughout the year.

A fresh face, bright new staff members, a productive summer. We're all set for a great year ahead. Watch for the **Technolog** the fifth and ninth weeks of each quarter. We'll let you know in advance when each issue is coming and what to look forward to—an appetizer before each juicy edition.

Last, here's a formal invitation to the **Technolog** Open House. We're opening our office door to you Thursday, September 28 of the first week of classes so we can get aquainted with as many new and old students as possible. If you can't make it then, stop by anytime during the year; we'd like to get to know you and what concerns you as an' I.T. student.

The year ahead outlines one overall goal for the publishing year ahead: to zero in on the meat of activity in I.T. wherever we find it and inform you in an interesting manner what you couldn't possibly learn or accumulate on your own. We'll step beyond the confines of the Institute often, too. The basis of your magazine stems from home, however. That's I.T. We hope you agree.

Jon Kavanaugh
Editor

minnesota
TECHNOLOG

Welcome
Volume 59, No. 1
September, 1978

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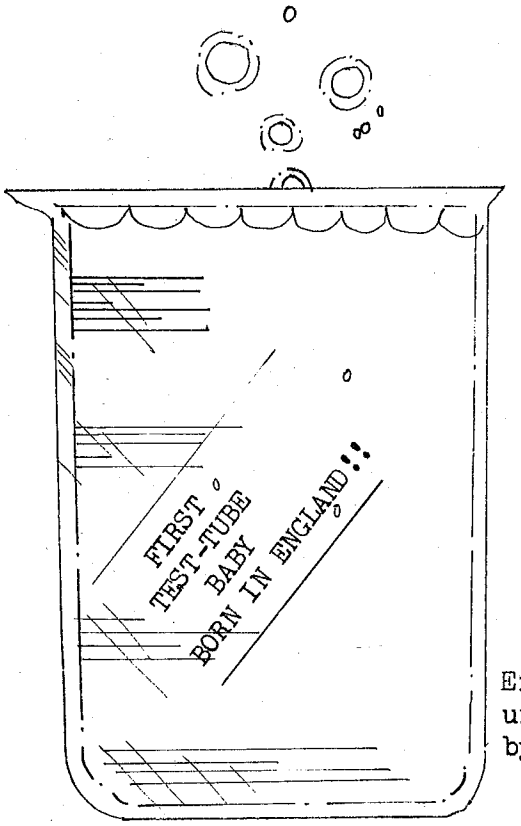
Wrapping up Summer

For a publication like TECHNOLOG that is used to appearing only during the school year, the numerous events of the summer often get overlooked; a gap occurrs. The volume of mail, news releases and "walk-in" stories into Room 2 Mechanical Engineering over the summer contained hundreds of items of interest. A sampling to wrap up summer and kick off fall follows:



Dear Editor:

SCORE, a national competition for designing energy-efficient autos is accepting designs through August 1979. About 30 students from Mech. Eng. are already involved in research for the competition.

For details, see Dr. Erdman in 307 Mechanical Engineering.

The University of Minnesota Chemistry and Chemic Engineering Depts. were named among 25 colleges and universities to receive research grants totalling $24 by Eastman Kodak Co. of Rochester, N.Y.

The awards are given annually to selected graduat departments to assist and encourage education at the master's or doctoral level i fields related to the compa own research and development

Kodak also sponsors se other grant and fellowship programs throughout the yea

Kodak Grants

The main I.T. office announces a new service. A display rack, containing pamphlets on career planning, I.T. bulletins and current I.T. policy information, will soon be available in 105 Lind Hall. Career pamphlets include good job descriptions and general information about various engineering fields. Most materials may be taken from the rack. The rack will appear sometime during Fall Quarter.

Board Candidates Reinstated

Two candidates for ~~positio~~ ions on the Technolog of Publications were ed to assume their ions, following dis- l of complaints filed st them in the spring ampus elections. Karl Jorgenson, running the name Sun Party, tan Brooks, a Board r last year, both filed aints against each other, ing violations of Elections ssion campaign rules. Jorgenson complained of anner Brooks had displayed ign posters; Brooks ed Jorgenson with unethical ign practices, stemming posted literature nson distributed to aid s election. Both candidates were ed by popular vote in ll-campus ballotting. Jorgenson and Brooks not allowed to partici- officially in the last meeting spring quarter, ting traditionally ned to exchange old for embers. Later, in an mal meeting, however, the ere acquitted by the ions Commission who the complaints prior to nformal board meeting nnounced they would the complaints and any ties. Both Jorgenson rooks will begin the 79 publishing year in standing with the , with full voting leges.

Wrapping up Summer
Continued

AWARDS***AWARDS***AWARDS***AWARDS&MORE AWARDS

Dr. Gordon Beavers, Associate Head of Aerospace and Mechanics, was named to receive the I.T. Teacing Award. Also in that department, Dr. Philip Hodge Jr., was elected honorary member of the National Academy of Engineering over the summer.

Richard B. Diver (graduate student, Mechanical Engineering)
--Received Natural Gas Council Award, July 17. Given for Diver's research in energy-related projects in the Mechanical Engineering Dept.

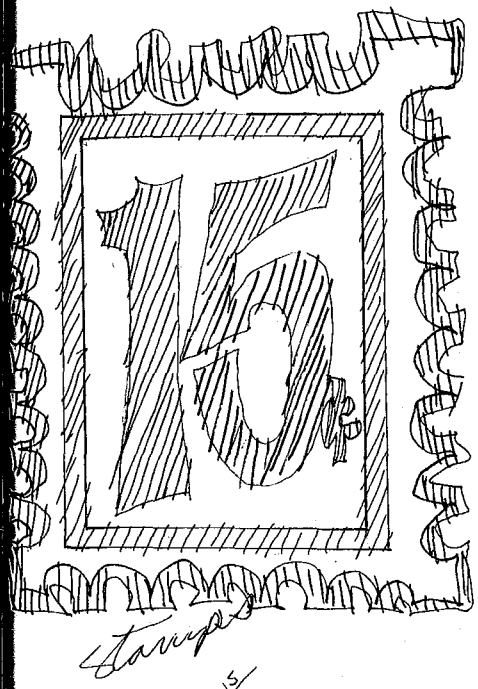
Kevin B. Dunshee (undergrad in Mechanical Engineering)
--Received Rosemount Engineering Co. Instrumentation Award. Given to the Mechanical Engineering student each year judged to have the greatest potential for design and development of industrial, aircraft and/or space instrumentation. Established March, 1967.

"Guidelines to Professional Employment for Engineers and Scientists" was updated over the summer. It replaces the January, 1973 edition. Contains a summary of mutually satisfying relationships between employers and employees. Deals with recruitment, employment, professional development, and termination and transfer. Available from Dept. GL Engineers Joint Council, 345 East 47th St., New York, N.Y. 10017.

Magrath Appoints New Dean

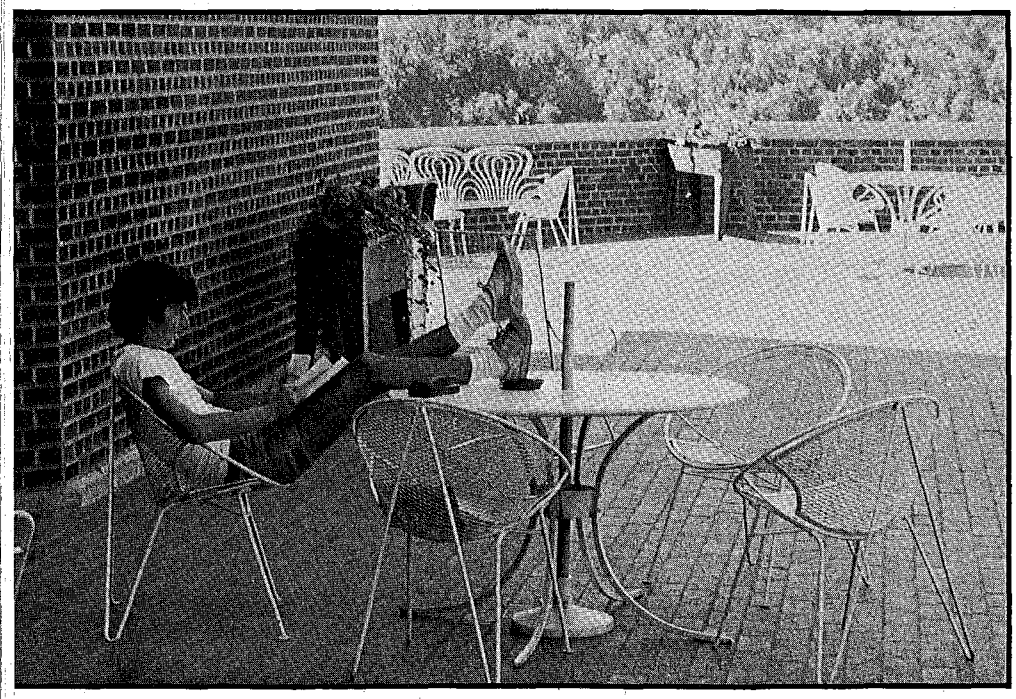
I.T. has a new dean. Roger Staehle, a professor of metallurgical engineering at Ohio Satte University was appointed by President C. Peter Magrath and approved by the Board of Regents of the University recently. Staehle, 44, will join the University in February. He replaces Richard Swalin who left the post to become vice president for technology at Eltra Crop. in New York. Acting Dean Johnson will return to teaching in the physics department.

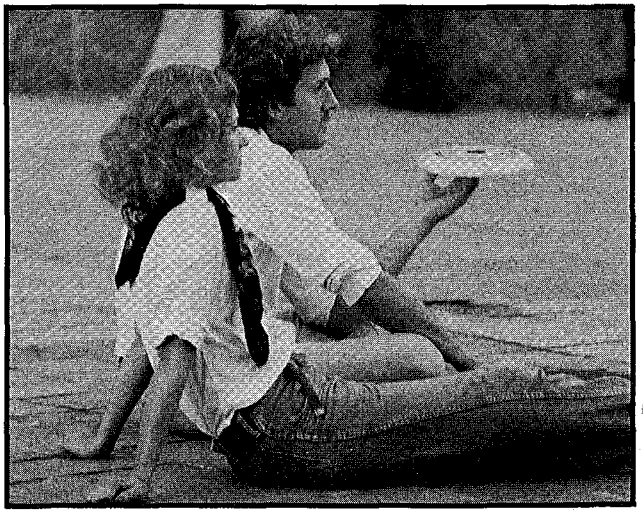
August's Popular Science Magazine reports that to date 4,500 man-made objects are circling the Earth as tracked by North American Air Defense Command headquarters in Colorado. While about one of the objects falls through the atmosphere a day, most burn up on reentry. Scientists are concerned, however, because the objects don't always burn up as evidenced by the Cosmos 954 from the Soviet Union that fell to earth in Canada last spring. The concern is with Sky Lab, the unmanned space station, which is expected to fall through the earth's atmosphere a year from this fall--destination unkown. NASA hopes, according to the report, to send up a booster rocket with the first space shuttle which could dock with Sky Lab and redirect it toward a better orbit.

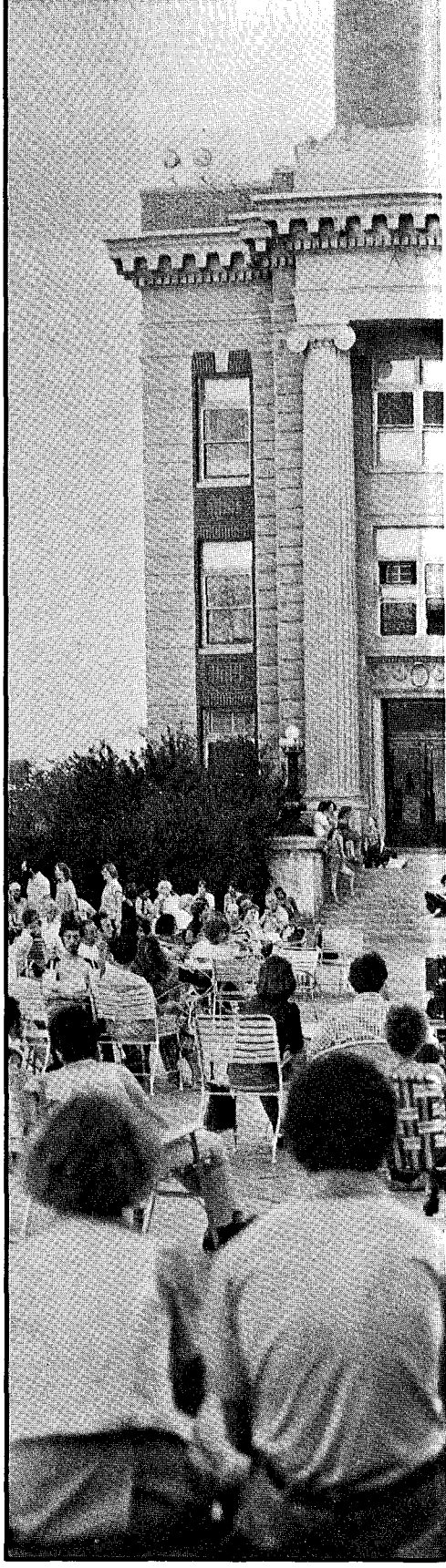


The Viking missions to Mars were commemorated by the issuance of a special postage stamp July 20, the second anniversary of the Viking I landing on Mars.

The Science Museum of Minnesota's space-age Omnitheater opens in St. Paul. The ultimate in advanced sound and projection techniques employed, the theater provides entertainment in a planetarium with the most sophisticated computer-driven equipment in use for such presentations.

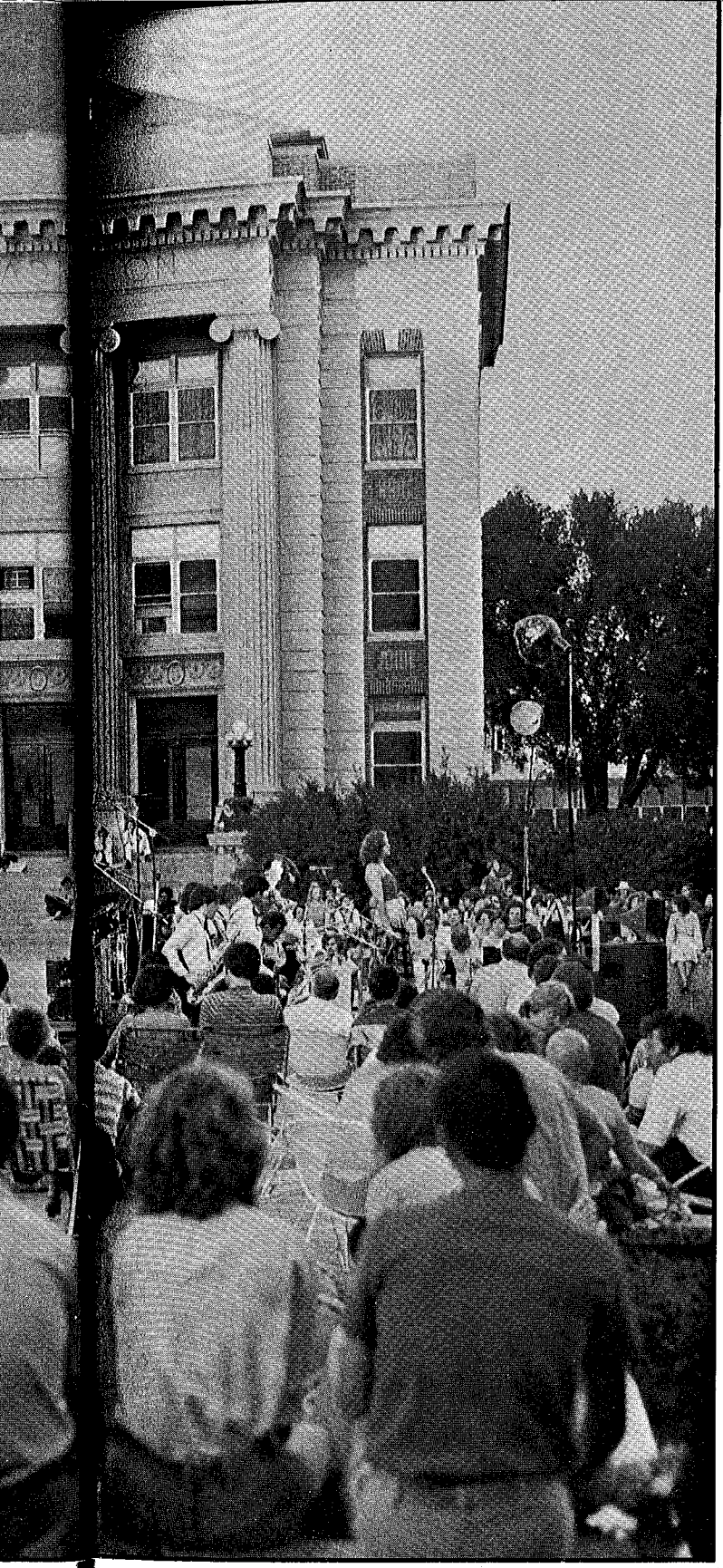






Wrapping up Summer

The atmosphere around I.T. and the Unive
during the summer is not unlike the eerie calm bef
monstrous Midwestern thunderstorm. This sum
save for the interrupting noise of street crews and
hammers along Church St., there was visible calm
relaxation. Restful concerts on Northrup Mall, time
from frisbee-tossing, a leisurely stroll with the Mi



Univer
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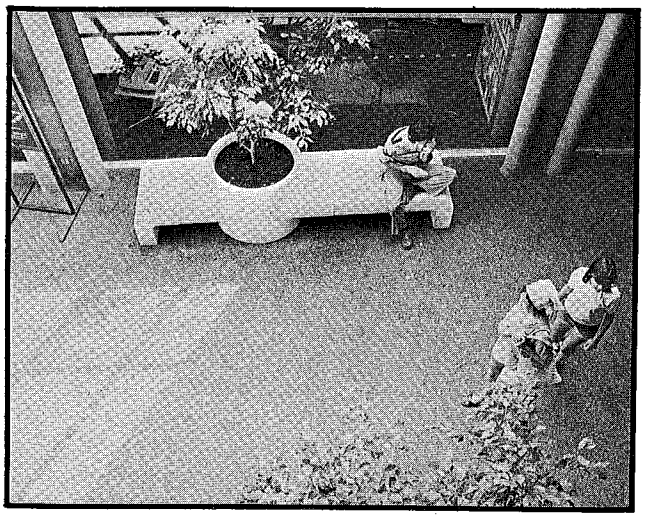
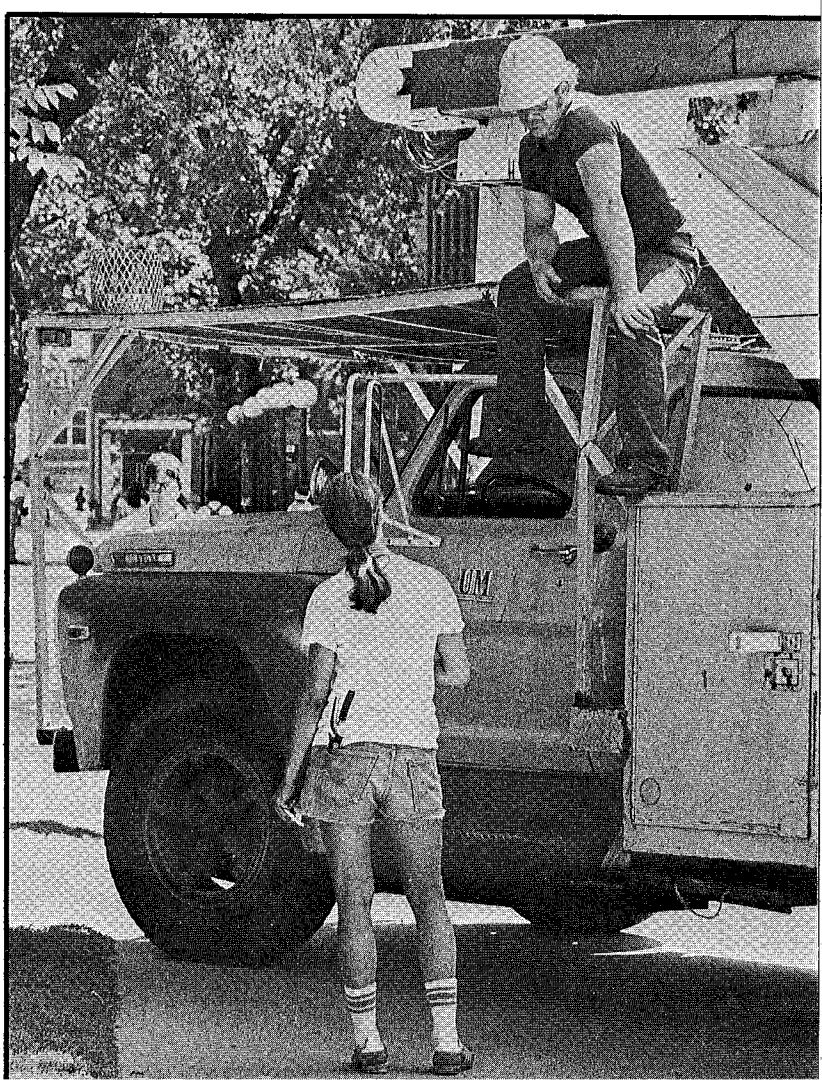
nd studying outdoors—a little slower pace
radual increase of activity that means regis-
es and the stormy-like chaos of Welcome
e opening day of classes.

Photos by
Mike Dorn and Terry Ruane





After Graduation

By Jon Kavanaugh

It may seem premature to include a column entitled "After Graduation..." at the beginning of the school year. Early Fall Quarter, however, means it's prime time for new and soon-to-graduate I.T. students to begin seriously looking over career choices. And the best way to begin is to take advantage of the I.T. Placement Service.

A small but productive office managed by Director Lee Ponto, the Placement Office operates several services, including the all-important campus interviews where students and industry representatives have their first encounter, a selling experience. Students sell their personalities, talent, objectives and GPA's; company representatives sell their benefit package, growth opportunities and salaries.

Registration. All I.T. students who wish to use the Placement Service must register with the office located in Room 15, Experimental Engineering. Do this simply by filing a resume, including the most up-to-date scholastic and work-related information available. These resumes will later be compiled into a handbook and sent to companies. They, in turn, select and encourage certain students to interview with their representatives during the campus visit.

Placement Meetings. Students graduating Fall, 1978; Winter, 1979, Spring, 1979 and either Summer Session, 1979, are required to attend at least one placement meeting in September. These meetings are designed to acquaint students with the interviewing procedure, how to improve resumes and presentation, how to sell yourself to a prospective employer and more. Special information about these meetings and the interviewing is available now at the Placement Service. Meetings will be held as follows:

Wed., Sept. 27, 1978 3:15 p.m.
Thurs., Sept. 28, 1978 3:15 p.m.
Both will be held in 150 physics.

The meetings will not be repeated during the year.

Literature Library. A well-equipped literature file/library is also available at the Placement Service for registered students to use in preparing for career selection and interviewing.

The library holds 250-300 files containing annual reports, financial statements, job descriptions, product lines and personnel structures for a wide variety of companies in diverse industries.

Like all of the other services at the Placement Office, use of the literature library is free.

Interviewing. This is the most important service offered in I.T. Placement as it is the key to formal job application and eventual hiring by a company for most I.T. students.

First, choose which companies you wish to interview with and examine their facilities in the literature library. Next, check the schedule at right or at the Placement Office and signup for interviews as directed at the Service. Signups occur every Friday for interviews approximately one week later. First signup day is Friday, September 29. Interviewing begins Monday, October 9.

For personal counseling about interviewing or other job-related concerns, contact the Placement Office at 373-2922.

"After Graduation" will appear as a regular feature in future issues of Minnesota Technolog.

Fall Quarter Recruiting Schedule

The following companies have announced that they will be interviewing at the I.T. Placement Office during Fall Quarter on the dates listed below. This schedule includes interview dates through November 14, 1978. Subsequent issues of **Technolog** will contain the remaining Fall Quarter interview dates. Contact the Placement Office for weekly revisions of this schedule. Numbers in parenthesis indicate more than one interview date for a particular company.

Monday, October 9
American Cast Iron Pipe Co.
Central Intelligence Agency
Champion International
Johns Hopkins University—Applied Physics Laboratory
Eastman Kodak Co.
Texaco, Inc.
Warner Electric Brake & Clutch Co.

Tuesday, October 10
Archer Daniels Midland Co.
Atlantic Richfield Co.
Central Intelligence Agency (2)
Colgate-Palmolive Co.
Employers Insurance of Wausau
FMC Corp./Packaging Machinery Div.
B.F. Goodrich Co.
Johns Hopkins University—Applied Physics Laboratory (2)
Eastman Kodak Co. (2)
Monsanto Co.

Wednesday, October 11
Control Data Corp.
General Electric Co.
International Paper Co.
Marathon Electric Mfg. Corp.
Monsanto Co. (2)
Stimulation Technology, Inc.
United States Air Force
Westinghouse Electric Corp.

Thursday, October 12
Bucyrus-Erie Co.
Chrysler Corp.
Cutler Hammer, Inc.
Monsanto Co. (3)
St. Regis Paper Co.
Rexnord, Inc.
Schlumberger Well Services
Texas Instruments, Inc.

Friday, October 13
Allen-Bradley Co.
American Can Co.
Gould, Inc.
Hercules, Inc.
Storage Technology Corp.
Texas Instruments, Inc. (2)
Union Oil Co. of California
Wisconsin Public Service Corp.

Monday, October 16
Honeywell, Inc.
Kohler Co.
McDonnell Douglas Corp.
Minnesota Mining & Manufacturing Co.
Mostek Corp.

Tuesday, October 17
Exxon Corp. & U.S.A. Affiliates
Honeywell, Inc. (2)
Johnson Controls, Inc.
McDonnell Douglas Corp. (2)
Minnesota Mining & Manufacturing Co. (2)
Trane Co.
U.S. Patent and Trademark Office

Wednesday, October 18
Celanese Corp.
Exxon Corp. & U.S.A. Affiliates (2)
Interstate Power Co.
Merck & Co., Inc.
Minnesota Mining & Manufacturing Co. (3)
Trane Co. (2)
UOP Process Div.

Thursday, October 19
Celanese Corp. (2)
Exxon Corp. & U.S.A. Affiliates (3)
Intel Corp.
Minnesota Mining & Manufacturing Co. (4)
National Semiconductor Corp.
NOAA Corps.
Trane Co. (3)

Friday, October 20
Bemis Co., Inc.
Exxon Corp. & U.S.A. Affiliates (if needed)
Indiana Steel Co.
Intel Corp. (2)
Minnesota Mining & Manufacturing Co. (5)
Minnesota Power & Light Co.
Trane Co. (4)
Westvaco Corp.

Monday, October 23
Boeing Co. (Seattle, Wash.)
Boeing Co. (Wichita, Kan.)
Chicago & Northwestern Trans. Co.
Conwed Corp.
Deere & Co.
Dow Chemical U.S.A.
FMC Corp./Northern Ordinance Div.
Geo. A. Hormel & Co.
Rexnord, Inc.

Tuesday, October 24
Boeing Co. (Seattle, Wash.) (2)
Boeing Co. (Wichita, Kan. (2)
Conwed Corp. (2)
Deere & Co. (2)
Dow Chemical U.S.A. (2)
Nalco Chemical Co.
Olin Corp.
Phillips Petroleum Co.
Rexnord, Inc. (2)
United States Steel Corp.

Wednesday, October 25
Allis-Chalmers Corp.
Detroit Edison
Dow Chemical U.S.A. (3)
FMC Corp./Research
Eastman Kodak Co.
National Steel Corp.
Phillips Petroleum Co. (2)
Pullman Kellogg, Inc.
Sperry Univac Defense Systems

Thursday, October 26
Allis-Chalmers Corp. (2)
Factory Mutual Engineering
Hewlett-Packard Co.
Procter & Gamble Co.
Pullman Kellogg, Inc. (2)
Outboard Marine Corp.
Sperry Univac Defense Systems (2)

Friday, October 27
Babcock & Wilcox Co.
IBM Corp.
Procter & Gamble Co. (2)
Sperry Univac Defense Systems

Monday, October 30
American Cyanamid Co.
Federal Highway Administration
Pratt & Whitney Aircraft Group
Shell Co's.
Shell Development Co.
Stanley Consultants, Inc.
United States Air Force (2)

Tuesday, October 31
American Cyanamid Co. (2)
Consolidation Coal Co.
Continental Oil Co.
Hughes Aircraft Co.
Modine Manufacturing Co.
Shell Co's. (2)
United States Air Force (2)
Wisconsin Natural Gas Co.

Wednesday, November 1
Aluminum Co. of America
Caterpillar Tractor Co.
Oscar Mayer & Co.
Occidental Research Corp.
Rosemount, Inc.
Shell Cos.
Standard Oil Co. (Indiana)

Thursday, November 2
Chevron Cos.
General Dynamics Corp.
Granite Construction Co.
Sandia Laboratories
Shell Cos. (4)
Standard Oil Co. (Indiana) (2)

Friday, November 3
Argonne National Laboratory
Cargill, Inc.
Chevron Co. (2)
Corning Glass Works
Granite Construction Co. (2)
National Security Agency
Sandia Laboratories (2)
Wisconsin Power & Light Co.

Monday, November 6
Air Products and Chemicals, Inc.
Burlington Northern, Inc.
Graco, Inc.
Hutchinson Industrial Corp.
Minnesota Valley Engineering
Northern States Power Co. (Wisconsin)
Osmonics
Union Carbide Corp.

Tuesday, November 7
American Medical Systems, Inc.
General Foods Corp.
Gulf Oil Corp.
Motorola, Inc.
Natural Gas Pipeline Co. of America
Raychem Corp.
A.O. Smith Corp.
Union Carbide Corp. (2)

Wednesday, November 8
Ball Electronic Display Div.
Comten, Inc.
Eaton Corp.
Gulf Oil Corp. (2)
North American Engineering & Manufacturing
Rockwell International
Square D Co.
Standard Oil Co. (Ohio)

Thursday, November 9
Burroughs Corp.
Duval Corp.
Fruin-Colnon Corp.
Procter & Gamble Paper Products Co.
Rockwell International (2)
Square D Co. (2)
Standard Oil Co. (Ohio) (2)

Friday, November 10
Donaldson Co., Inc.
Dow Corning Corp.
Fruin-Colnon Corp. (2)
Al Johnson Construction Co.
Northern States Power Co. (Minnesota)
Peace Corps/Vista
Procter & Gamble Paper Products Co. (2)
TASC (The Analytic Sciences Corp.)

Monday, November 13
Amoco Production Research
Bendix Corp. (FRAM)
Dow Corning Corp. (2)
Fisher Controls Co.
Gould, Inc./Automotive Battery Div.
Micro Control Co.
Onan Corp.

Tuesday, November 14
Burroughs Corp. (a.m. only)
Fisher Controls Co. (2)
Michelin Tire Corp./Mfg. Div.
Moorhead Machinery & Boiler Co.
NASA/Lewis Research Center
Northern Indiana Public Service Co.
Polaroid Corp.
Whirlpool Corp.
Wisconsin Electric Power Co.

Photo by Glenn Flekke

I.T., University Student Services: an answer to every need

Compiled by Mary Haywood

It is possible to amass hundreds of pounds of information, produced by countless organizations, departments, services, etc.—all within the University community. With a phenomenal memory, the latest computer search and storage techniques and a lot of luck and ingenuity, all of the information might be digested into one centrally-located, easy-to-use index. Because that hasn't happened yet, however, here is yet another list, an attempt to supply information especially useful to I.T. students about the broad range of academic and social services available at Minnesota.

Libraries

There are seven I.T. libraries. All have access to the Minnesota Interlibrary Telecommunications Exchange. (MINITEX), a network funded through the state legislature which attempts to share all library resources at the Universities of Wisconsin, North Dakota and South Dakota. Access to this service is available at library reference desks. In addition, librarians at all campus libraries are willing to do extensive manual and computer searches, if necessary, to provide requested information. All libraries have photocopying machines available.

For a list of hours for each library, call the campus telephone number listed by each facility. Generally all I.T. libraries are also open from 7 p.m.-9 p.m. Wednesdays and from 12 p.m.-4 p.m. on Saturdays.

A list of the libraries, including specialized holdings and extra hours, follows:

Architecture Library
160 Architecture 373-2203
•Energy conservation file, including solar energy and underground systems.

Chemistry Library
4 Walter library 373-2375
•Chemical abstracts available.

Engineering Library
128 Lind Hall 373-2957
•Extra hours: 6 p.m.-10 p.m. Sundays
•Four calculators, for in-library use, on tables in the basement.
•Five calculators, available for limited check-out, at the reserve desk.
•Physics exam file, indexed by course number and by professor for use in library only, no photocopying allowed.

•Change machine available.
•Videocassettes of Electrical Engineering and Chemistry lectures plus playback machines.
•Wilson card catalog on microfilm through 1969 plus supplements.

•The Renewable Energy in the Environment Collection (TREE), featuring information on solar, geothermal and wind energy, etc.
•Three-hole punch, stapler and paper cutter at front desk.

Geology Library
204 Pillsbury Hall 373-4052
•Hydrology, petrology, oceanography collections, among others.
•Depository for all United States Geological Survey documents.

Mathematics Library
310 Vincent Hall 376-7207
•Emphasis on pure mathematics and theoretical statistics.

Mines, Metallurgy and Chemical Engineering Library
132 Chemical Engineering 373-2313
•Reserve collection on control of pollution and solid wastes, which can be taken out for one-week periods.
•Information on every nuclear power plant in the U.S.A., available through Prof. Isbin's microfiche collection. Source: U.S. Nuclear Regulatory Commission.

Physics Library
260 Tate Laboratory of Physics 373-336
•Materials in astronomy.
•History of physics collection.

Wilson Library
•Government Publications Division 373-7813. Many scientific and technical publications available.

•Rare Books Division. 373-2897. Astronomy collection with early mathematical tables; ballooning collection most items of which were printed before 1800 AD, others.

St. Paul Campus
373-0902, 373-0903
•Agricultural Engineering collection, main body of Biology materials.

Computer Services

There are two systems available to students: Minnesota Educational Regional Interactive Time-Sharing Systems (MERITSS), Michael Skov, Associate Director, 373-7745; and the Time-sharing Service on the CDC Cyber 74, Peter Patton, Director, 373-4361. Both are coordinated from 227 Experimental Engineering.

Computer Laboratories—
East Bank

Site	Equipment	Phone
Centennial Hall	TTY (1)	373-2289
Elliot Hall	TTY(6), CRT(5)	373-5456
Frontier Hall	TTY(1)	373-2740
Experimental Engineering 140	CRT(3)	373-4599
Health Sciences Unit A 1-752	TTY(6), CRT(2)	373-0331
Lind Hall 136A	CRT(6), Decwriter(2), Printer(1)	373-7582
Mechanical Engineering 308	TTY(10, CRT(2)	373-2977
Territorial Hall	TTY(1)	373-3567
Vincent Hall 4	TTY(1,1), CRT(2)	376-7529
West Bank		
Middlebrook Hall	TTY(1)	373-9818
Social Science 167	TTY(8), CRT(4), Decriter(1)	373-3608
Social Science 1009	TTY(3), CRT(2)	373-3608

The University Computer Center offers non-credit **short course on programming** languages and systems. Call 376-1637 for more information.

Videotapes aid in learning to use computers are available at Learning Resource Centers in Walter Library, Diehl Hall, Lind Hall and at Temporary South of Coffey Hall in St. Paul.

Help Line: For assistance with breakdowns, programs, etc., 376-5592

Tutorial Services

Offered in Mathematics, Physics, Chemistry and other I.T. courses during Fall, Winter and Spring quarters both on and off campus and in study halls and through departmental offices.

Tutor Locations:

•Lind Hall 3. Both a.m. and p.m. Monday through Friday.

•Comstock, Frontier and Territorial Halls: 7-10 p.m. Sunday through Thursday. Live-in tutor begins first week of classes; itinerant tutor begins second week.

•Sanford Hall. 8-9:30 p.m. Monday-Thursday. Begins second week of classes.

•Middlebrook Hall. 8-9:30 p.m., Monday through Thursday. Begins second week of classes.

•Bailey Hall (St. Paul). 8-10 p.m., Monday through Thursday, begins 2nd week of classes.

Tutors in High Schools:

All of the following meet on Tuesdays and Wednesdays, 7-9 p.m., beginning the second week of classes of each quarter.

•Edina Southview Junior High School, 4725 South View Lane, Edina, Rm. 112.

•Johnson High School, Arcade and Clear Sts., St. Paul, Rm. 109.

•Moundsview High School, 1900 West County Road F, St. Paul, Rm. 254.

•Robbinsdale Junior High School, 4139 Regent Ave. No., Robbinsdale, Rm. 121.

•Sibley High School, 1897 Delaware Ave., at Hwy. 110, West St. Paul, Rm. E 108.

•Washburn High School, Wentworth Ave. and 49th Sts., Minneapolis, Rm. 016.

•Call departmental offices for locations of individual subject tutorial services.

•Other questions about tutorial services should be referred to Prof. John Clausen, director of lower division programs, 104 Lind Hall.

104, 105 Lind Hall:

•Location of the central advising office for I.T. students. Information available on job opportunities, advising needs, counseling needs, questions answered about tutorial services, university policies and much more.

Ask about:

•Comprehensive exams—testing for credit, free first quarter in residence, in several subject areas.

•Psychological Counseling. For reading and study problems, anxieties, relationship concerns, personal problems, etc. For appointment call 373-9753.

•Math quiz review materials for 1211/21/31, normally distributed in recitation sections of your classes, but may be obtained in 105 Lind Hall. Especially helpful if you become "out-of-sequence" by missing class or losing time from a previous quarter.

•Old Chemistry 1014 exams.

Student Services

Student Information Center. Eddy Hall. 373-1234. A starting place for any kind of information or question.

Reading and Study Skills Center. 104 Eddy Hall—help in improving study habits.

Student Ombudsman Service (SOS). 102 Johnston Hall. 373-9788. Free coffee, campus and local free phone available, help in solving problems of all types "without the usual run-around."

Minnesota Women's Center. 306 Walter Library. 373-3850. Provides information about academic resources and support services available to women on campus, helps with discrimination problems, etc.

Student Activities Center (SAC). 350 Coffman Union. 373-3955. Information about every student organization and how to join them or how to start your own.

Miscellaneous Services

Telephones:
- Main Engineering Library—Campus phone.
- Morrill Hall—Campus phone, ground floor.
- Student Ombudsman Service. 102 Johnston Hall—Campus line and free local calls.

Notary Service:
- Perine's Bookstore, Dinkytown. Free, between 10 a.m. and 2 p.m. weekdays, ask for Bill Walden.
- Marquette National Bank, Stadium Village, fee for service.
- Riverside Community State Bank, no charge to customers, 50¢ for others.

Calculators:
- Main Engineering Library—for both in-library and two-hour reserve.

Residence Halls—ask at dormitory desk (HP 21's and 35's available).

Photocopying machines.
- Available in most libraries.

Check Cashing. Bursar's offices, at Williamson and Blegan Halls. Open until 3:30 p.m. weekdays, will cash personal checks up to $25 with ID and current fee statement. The information desk and the MSA bookstore, both at Coffman, will cash up to $5 with fee statement and ID.

Lost & Found. Located in basement, Coffman Union, or try departmental offices.

Referral Numbers. For help with drug and alcohol problems, pregnancy testing and counseling, etc.
- YES 339-7033, 339-0895. Referral service, phone counseling.
- Pharm House 870-7028. Drug abuse, crisis intervention.

Recreational Sports Office. 373-4200. Provides access to a huge variety of sports activites and clubs.

Sports facilities. Pools, saunas, weight training facilities, indoor track, outdoor track, racquetball courts, tennis courts, etc. The main sports buildings are: Norris Gym, Cooke Hall and Bierman Field Athletic Building. Check at these locations for facilities or call the Rec Sports office, 373-4200.

> **"With a phenomenal memory, the latest computer search and storage techniques and a lot of luck and ingenuity, all of the information might be digested into one centrally-located, easy-to-use index... that hasn't happened yet."**

Special Opportunities

I.T. Student Board. Needs several representatives for campus councils, assemblies, etc., as well as departmental representatives on the board and two freshman class representatives. Pick up applications in 105 Lind Hall; call Tom Christensen, 633-5667, for more information.

Technolog Board. Needs a freshman board member. See Jon Kavanaugh, Rm. 2 Mech. Eng., stop by 305 Aero call 373-3298.

Technolog magazine. Accepts contrib tions of writing, photography, illust tions for two issues each quarter pl Welcome Back issue in Septemb Many staff positions for a variety of jo available. Call Jon Kavanaugh, 373-32 Monday-Friday, 2:30-5:30 p.m. or st by the **Technolog** office, Rm. 2, Mec Eng. Come to the **Technolog** open hou Thursday, September 28, of the fi week of classes. Meet the staff, discu your ideas for **Technolog**, free ea

College Level Examination Progra (CLEP) Eddy Hall. 373-4193. Exa which measure "achievement in fo basic areas of the liberal arts" and passed successfully may provide up 32 credits and save you from repeati work you've already had. Cost: $20 per exam.

Office for Special Learning Opportu ties (OSLO). 201A Westbrook Ha 373-7550. Provides information abo how to set up an independent stu project and obtain a faculty advisor it; internships, field experience, or pra ticums; credit for study abroad, as w as many other types of alternati methods of education.

X and Y Registration. X registration volves arranging for one to three ex credits in a course or subject whi interests you. Y registration makes possible for a student to take a cou without attending class. Both types quire special arrangements with instru tors. Ask at 105 Lind Hall for more inf mation.

Coffman Union Program Council (CUP A student volunteer organization cov ing a wide variety of social, cultural a educational events. Volunteers gain broad range of experience in sever areas while picking up valuable skil Call 373-7600 for specific information.

Coffman Memorial Union. Contai restaurants, meeting rooms, new stands, barber/beauty shops, WMM Radio, Music Listening Center, bowli and other games facilities, sewing ma ines, photography facilities, woodwo ing facilities and much, much mo Check with the Information Center, 1 Coffman or call 373-2403 for speci information.

Professional Fraternities: A Living Education Outside the Classroom

By Scott Ferguson

Quick. What is the first thing you think of when you hear the word "fraternity?" Beer? Strange and embarassing initiation rites? A big broken down brick house with Greek letters on the front door? Softball? Sorority women? Vast sums of money?

If you are a serious student in a difficult curriculum, you may wonder if belonging to a fraternity is really worth it. Social fraternities can range in price from dirt cheap to brutally expensive.

The lifestyle of the members of each frat is different. One frat might put primary emphasis on "brotherhood," another on academic excellence, yet another on getting drunk and never really know what to expect until you visit the fraternity.

There are, however, five professionally-oriented residential fraternities available to I.T. students. Their positive features make them attractive alternatives to dorm and apartment living.

•They limit membership to people studying in a specific field. Because of this, members are taking or have taken the same courses that you will. It's easy to get help on tough course work.

•People who study the same things tend to have similar interests. If you're just starting at this big, cold university, fraternity membership can help you get to know people in your school and adjust to university life.

•Professional fraternities tend to put learning as their first priority. Of course, this doesn't rule out socializing or sports, or any other activities outside the classroom.

•They have programs and facilities keyed to your curriculum, such as test files, dinners and seminars with professionals in your field. For example, Kappa Eta Kappa, the Electrical Engineering fraternity, has a well-equipped lab facility for doing lab assignments at home.

•Generally, the professional fraternities are cheaper to live in than the social fraternities. They're much cheaper than dorms or apartments. And the bigger houses offer quite comfortable living arrangements.

•Fraternity alumni work for many different companies and industries. They are excellent contacts for part-time and full-time work relating to your field. After you finish school and enter the job market, fraternity membership might give you an important job placement edge.

To become a fraternity member, you have to go through a period of "pledgeship" in which you "check out" fraternity life first-hand. Fraternity members use this time to check **you** out, too, to see if they want you in their organization.

If you like them and they like you, then you must endure an initiation process. This consists of anything from a mildly unpleasant hazing to a series of surprise activities. In either case, you'll survive.

The best way to pick a fraternity is to call them up or knock on their door and ask a lot of questions. Take the time to visit the house, look around and talk to the people living there.

Here are the five residential professional fraternities organized around I.T. fields:

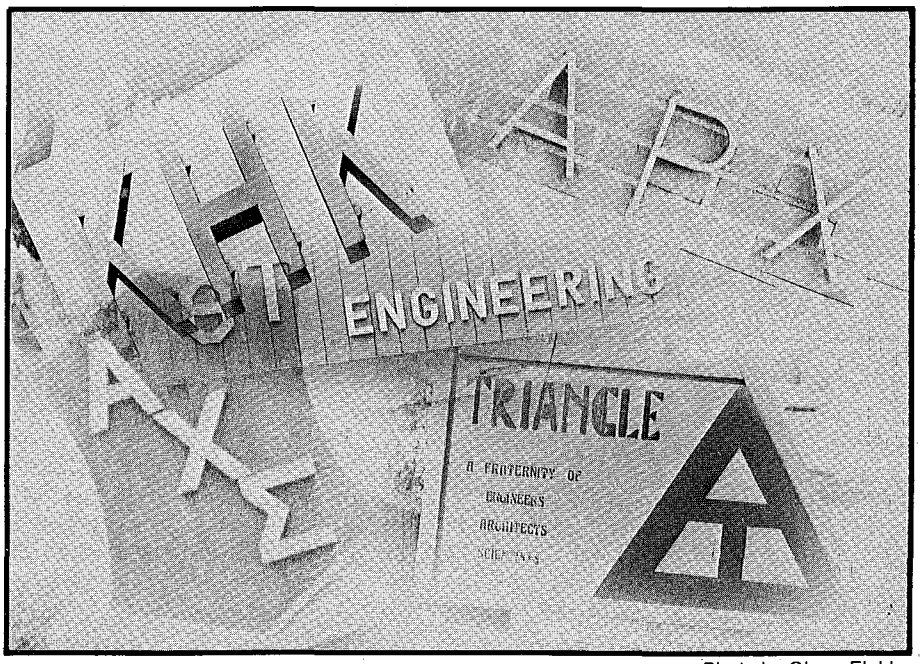


Photo by Glenn Flekke

Alpha Chi Sigma
613 Oak St. SE
331-5951

Members' studies must be chemistry-related. Members must maintain a 3.0 average.

COSTS:
$10 pledge fee
$15 initiation fee

$36 one-time national dues
$60 double/$75 single room rent per month

"It has traditionally been a small fraternity," said Alpha Chi Sigma president, Fred Weber. "Since I've been here, it has been around 10 or 12 (members). How, it's down to four."

Alpha Rho Chi
605 Ontario St. SE
331-7961
Membership open to students in Architecture, Landscape Architecture and certain other related fields.
COSTS:
$30 one-time initiation fee
Variable monthly dues
$100 rent per month

Buckminster Fuller used to hang out at this fraternity when he was teaching at the University in the 1950s. The concrete slab for one of his plywood geodesic domes is still in the fraternity yard—an informal monument to the man.

The fraternity has an active guest speaker program. "We've had interior design people come in, landscape people—a cross section to introduce people to other things that aren't covered in the school, but are covered in the field," said Jon Papke, professional chairman. "We use this as a tool to tie in school with the professional world. We have fun with it, too."

Kappa Eta Kappa
330 11th Ave. SE
331-2133

Members are Electrical Engineering majors.
COSTS:
$25 One-time initiation fee
$25 membership per month during the school year
$65 per month for members ($90 for nonmembers)

KHK has a big house a few blocks from Dinkytown. The roof has many antennas sprouting out of it. Several members are ham radio operators. "We take a lot of pride in our house. We keep it really clean," said John Perlick, a member.

Besides the E.E. lab, there's a darkroom and a well-organized test file. "There is a file on any E.E. class that's offered," Perlick said. "We go through them every year to throw out the old stuff."

Theta Tau
515 10th Ave. SE
331-7932

Members are enrolled in I.T.
COSTS:
$20 pledge fee
$40 one-time national initiation fee
$150 one-time building fund fee
$500 room and board per quarter ($60 per quarter for nonresident membership)

"Our founders were all mining engineers," said Mike Eul, fraternity president. "It has changed. We tend toward Civil, and we have some Mechanical and E.E. people. We're open to all types of engineering.

"We have a balance of professional leadership and development activities—speakers and other programs that enhance your degree in some way other than school—and the social thing. We go both sides."

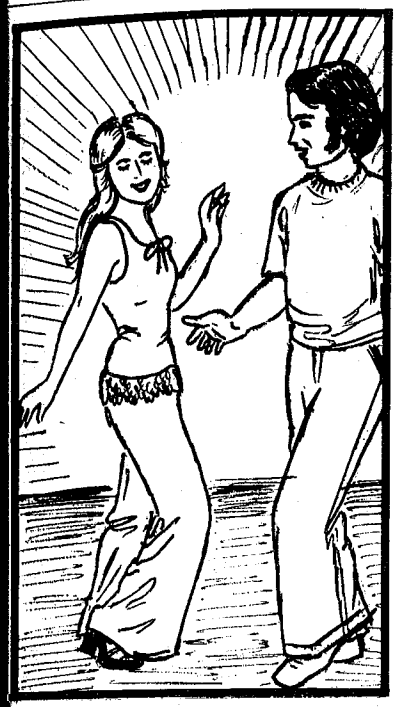
Triangle Fraternity
521 12th Ave. SE
331-7969

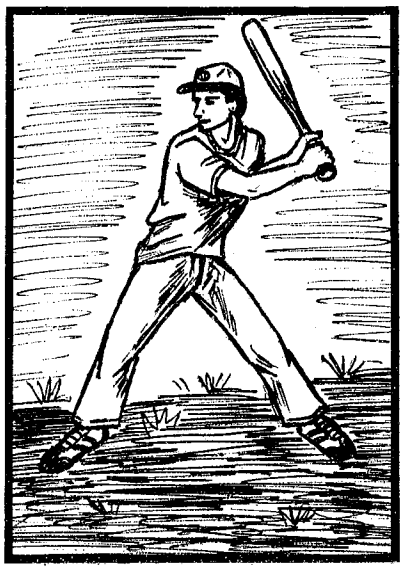
Membership open to men in I.T. who maintain a 2.0 Grade Point Average.
COSTS: (Approximate. Expected revision for fall quarter.
$62 initiation fee
$6 chapter dues per month.
$180-190 per month room and board

Of the fraternities listed here Triangle is the only one that will not consider women for membership. Jim Bailey, fraternity president, explains that "our national organization's constitution won't allow it. There's not much that we can do about it right now."

"I feel that Triangle has a lot to offer people. But at the same time, a lot of people don't realize that they have a lot to offer Triangle and the other fraternities as well. We need people with fresh ideas. People coming into I.T. really fulfill that need. I don't know if they realize that. I like more people to stop over and have a look."

There are also many non-resident professional organizations open to various majors in I.T. Your adviser can help pinpoint which one suits your particular field of interest. To reach a representative of these organizations contact the Student Activities Center at 373-3955.





Your college years are what you make of them, educationally, socially and professionally.

We offer: Economical on-campus housing, parking, social and sports programs, electronics lab, ham station, computer (to U of M), excellent rapport with EE faculty, job connections, and academic assistance.

KHK

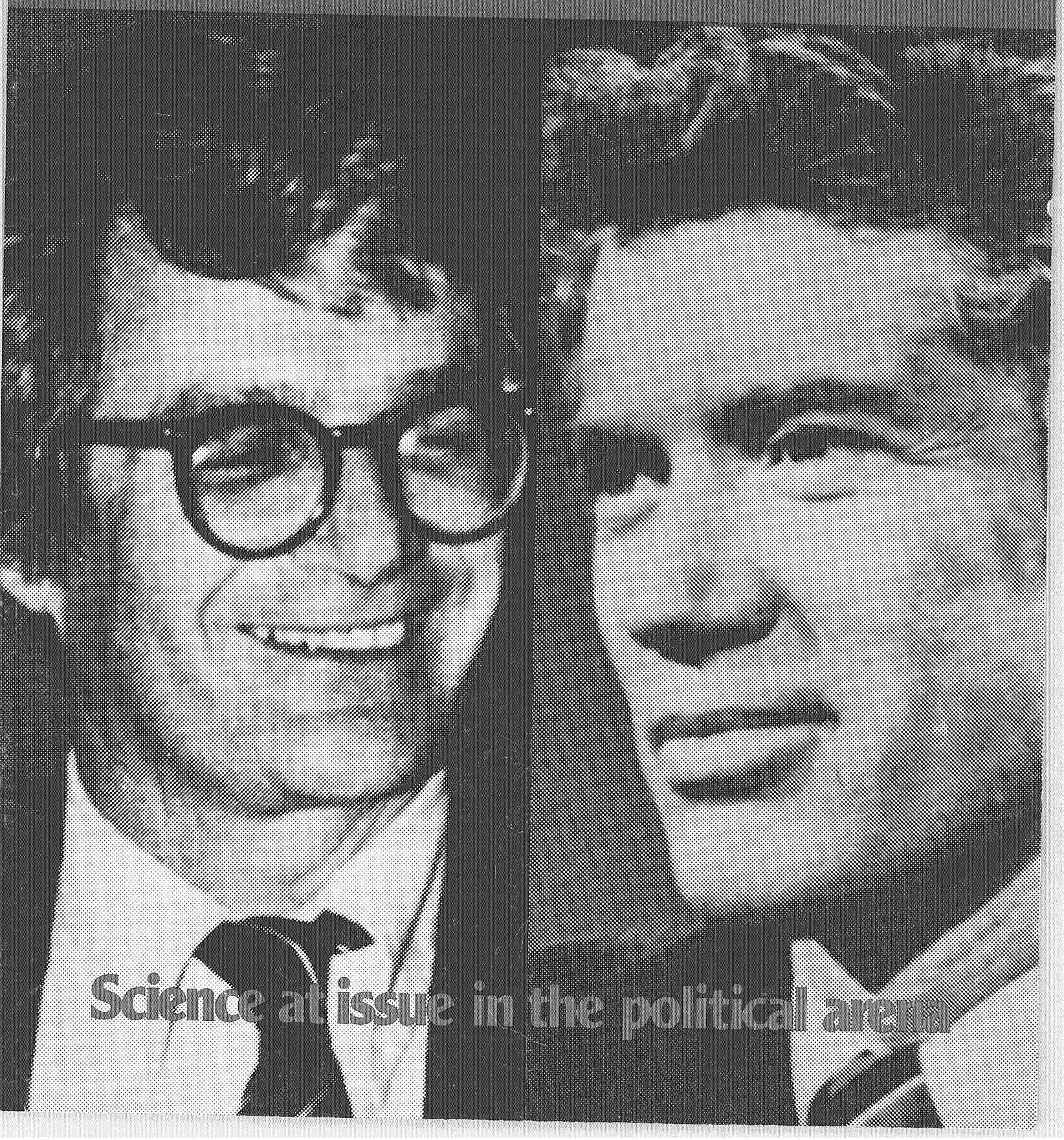
The Professional Electrical Engineering Fraternity

330 Eleventh Ave. SE 331-2133

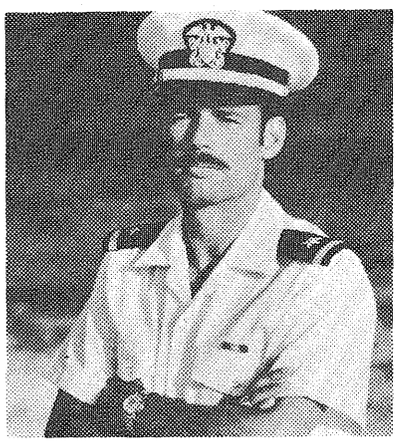
minnesota

TECHNOLOG

Fall 1, 1978



Science at issue in the political arena



The Navy's Nuclear Power Program.

Not everybody can get into it.

This year, we will choose a select number of top college graduates for our Nuclear Power Program. And naturally, we want to give every qualified man a fair chance of being considered. So, we urge you to act quickly.

The first thing you should know about the Navy's Nuclear Power Program is that it is probably the most comprehensive training available in the nuclear field.

It is also the most rigorous.

It's got to be. The majority of our country's nuclear reactors are operated by Navymen. And since we expect you to begin work as quickly as possible, it is an accelerated program.

The hours are long. The course difficult.

What's more, in order to qualify, you must have a solid background in engineering, math or physics. And have what it takes to be an officer in the U.S. Navy.

You must also be a man with a unique sense of dedication. For, once you have completed our program, you could be in charge of the supervision, operation and maintenance of a division of the reactor plant on one of our nuclear-powered ships or submarines.

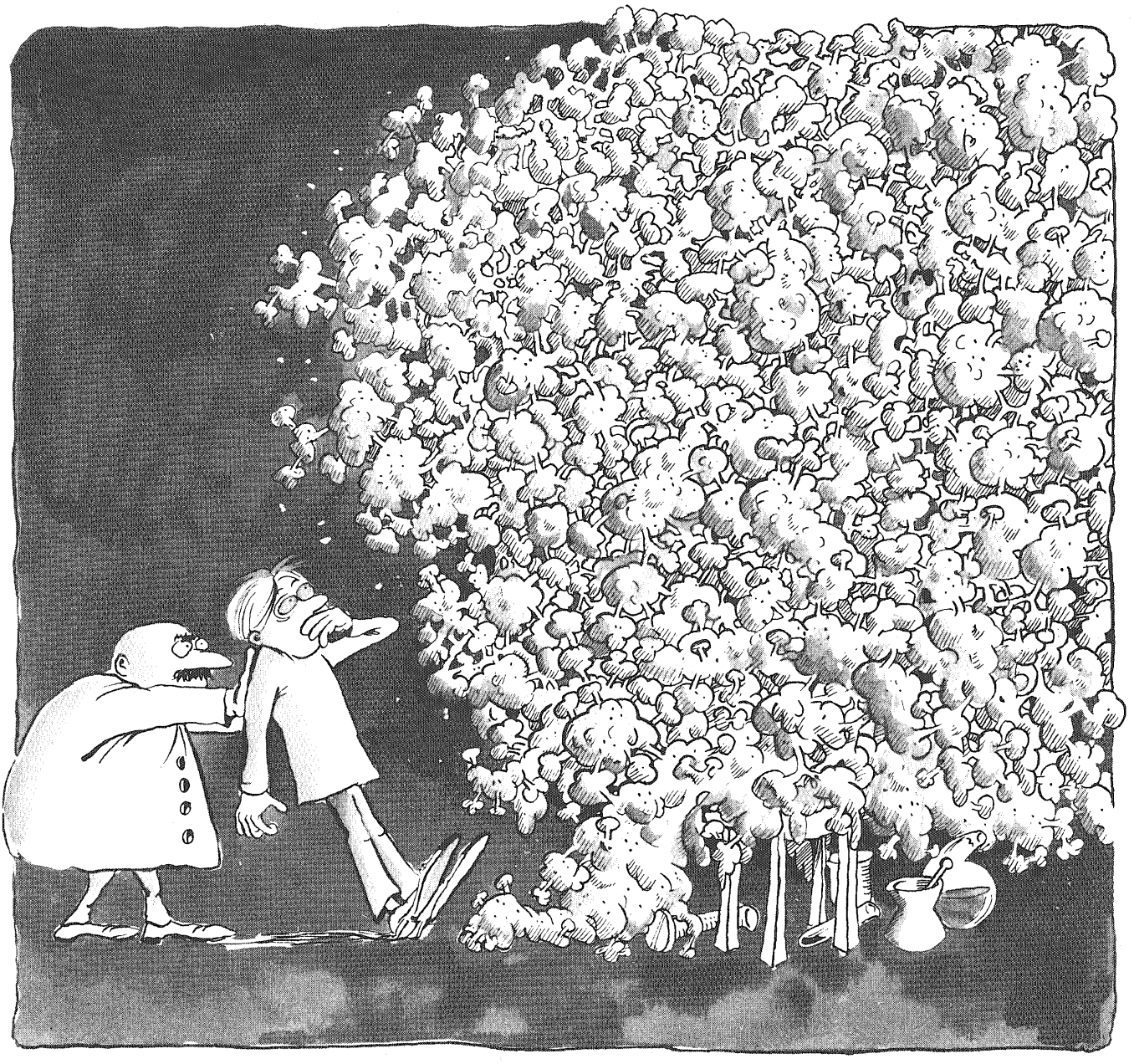
You've studied and you've worked. Now make it all mean something. Find out more about the Navy's Nuclear Power Program from our Officer Programs Officer when he visits your campus.

This year the U.S. Navy has already accepted five U of MN I.T. seniors, outside of NROTC, into the Nuclear Power program alone (currently there are an additional five applications pending and nine earlier applicants were not selected).

Why would such a large number of engineering and science majors with above a 2.8 grade point average be willing to commit themselves to four years active duty with the Navy when the job market for these students is at its peak? The reasons that these engineers felt that "industry was an alternative" to the **adventure** and **opportunity** of Navy span an entire spectrum of thinking and are exactly what the Navy would like to discuss with qualified juniors and seniors at the University.

For more information call 373-2230 and leave your name and number. Dave Storer will recontact you in person.

The Nuclear Navy.



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When you come to work at Celanese, you'll be assigned to a project right away. You can put your creativity and decision-making skills to good use. We won't waste your time in lengthy training programs – we won't waste your mind by forcing you to fit into a corporate mold. You'll have the freedom and the opportunity for rapid growth and advancement at Celanese.

We're looking for people who are still growing, and want to be part of an expanding industry. You just might fit in – your way – at Celanese.

If you have a degree in engineering or chemistry, ask your placement officer to set up an interview with us, or write Tom Clark, Celanese Building, 1211 Avenue of the Americas, New York, N.Y. 10036.

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Editor's Log

Star Wars and **Close Encounters of the Third Kind** have long since disappeared from local movie screens but a flood of science fiction magazines, books and a new television drama have entered the now lucrative media blitz on SF. For an update check out Bruce Kvam's Ad Astra column which returns this issue. Kvam recently returned from the annual Worldcon Science Fiction Convention in Phoenix, Ariz. He has a full report plus a rundown of the professional science fiction winners, some new books and three new magazines to hit the newsstand: **Omni**, **Isaac Asimov's Science fiction Magazine** and **Galileo**.

One he doesn't mention, the existing **Penthouse**, is also worth checking out. The October, 1978 issue is a special issue devoted to future science, space and technology. All sexism-of-the-month aside, the issue contains provoking features and fiction. Page 11.

Jesse Hamilton Gorn, longtime student political observer, has dubbed the current races for two U.S. Senate seats and the Minnesota governor's office, appropriately, "wild and crazy." As Campaign '78 nears an end, the six major candidates took the time to answer questions prepared by **Technolog** on important science and technology issues. With the help of Gorn and Rick Kravik and the campaign staffs, our cover story this issue includes the political stances of the candidates on issues not frequently covered in the professional press. Fellow I.T. students had a chance to comment on the candidates and issues as well. It all begins in Science at Issue in the Political Arena, page 19.

Also in this issue, take a look at the I.T. Alumni Society (ITAS), providing learning and career guidance for engineers, scientists and architects After Graduation. Page 25.

For the growing number of disabled students enrolling at Minnesota, the University and I.T. offer an increasing awareness and compliance with new regulations regarding the treatment of the handicapped in public institutions. Although progressive with programs and facilities, some attitudinal adjustments still require attention as we head Toward a Better I.T. for the Disabled. Page 26.

Last, just when you thought it was safe to go back into the I.T. Library, the mad demons of Krybulon had returned to carbonize the Xerox machines and destroy all of the reserved reading for Fluid Mechanics 9011. Well, a late report indicates all is calm in the library but mad demons beware...the All New Adventures of the Bionic T.A. returns this issue, compliments of Steve Smith. Page 30.

Jon Kavanaugh
Editor

Letters

The Minnesota **Technolog** welcomes letters for publication. They should be typed, if possible. **Technolog** reserves the right to edit letters for length and clarity. Send to: Editor, Minnesota **Technolog**, Rm. 2 Mech. Eng. Bldg., University of Minnesota, Minneapolis, MN 55455.

Received the Sept. '78 (Welcome Back) **Technolog** and found it interesting to read, without being an I.T. student.

I would like to clarify a reference to us in Mary Haywood's article (University Student Services: An Answer to Every Need) on services under Check Cashing. Both of our stores, MSA Too and MSA Student Store cash checks. The article implies that we require I.D. and a fee statement. Untrue. As a student-owned corporation we pride ourselves on reducing hassle and providing friendly service, therefore all we request is a current address and phone number. This is a real boon to those hapless souls, among others, who mail their fee statement into the Bursur for fee payment and never to see it a) again b) for two weeks c) before their bus comes and they need bus fare home.

As a last point, you refer to Mary Gress' design of the bolder, more streamlined format and title, and yet the style of Wrapping Up Summer obfuscates this intent... Having lambasted what I fear is the editor's own idea I would nonetheless like to thank you for the mention in the services article.

Jo Ann Johnson
Manager, MSA Student Store

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TECHNOLOG

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Fall 1, 1978

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Cover photo of
candidate Rudy Boschwitz
by **Mike Dorn**

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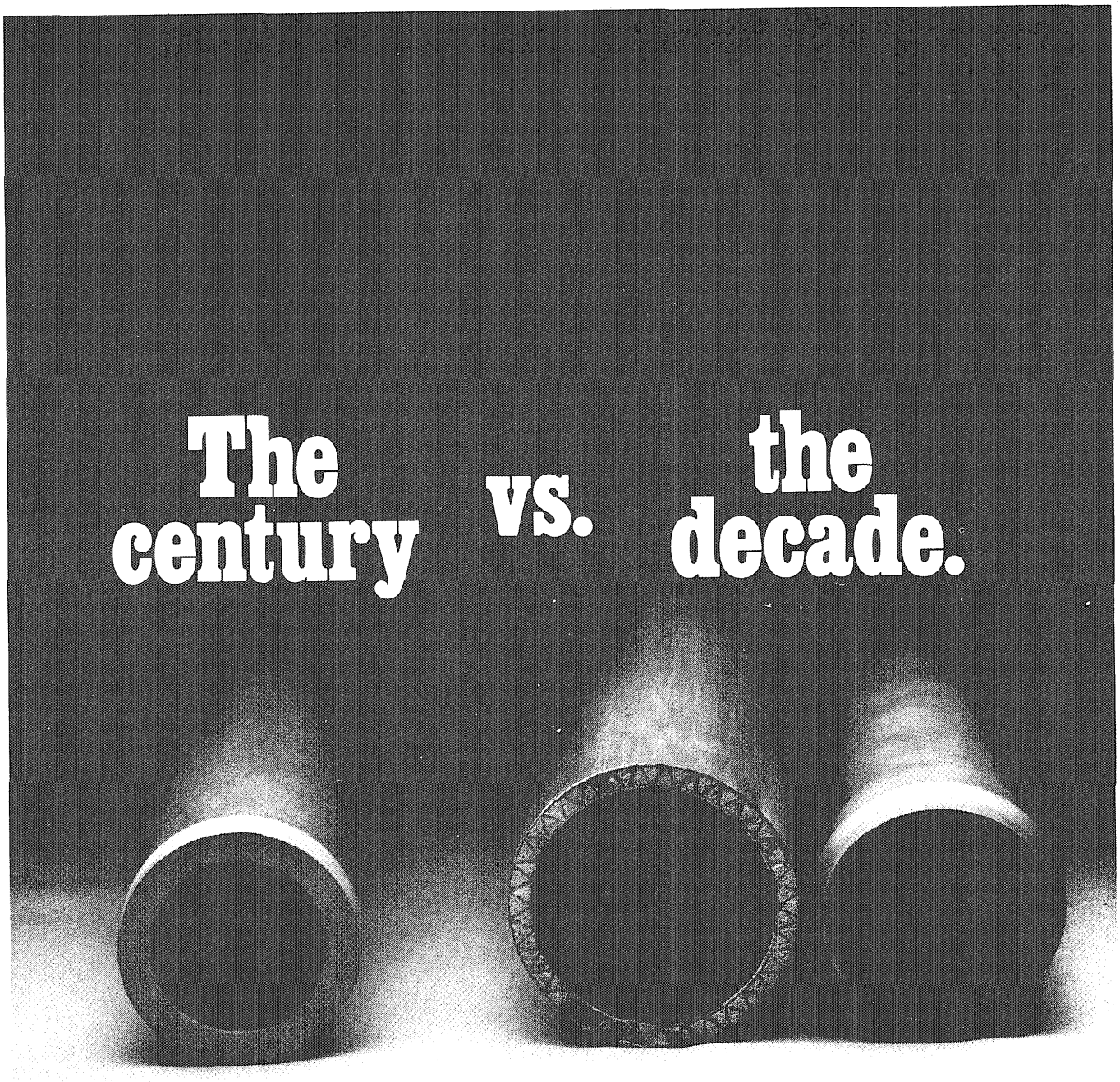

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Or call or write for more information to W. S. Dickey Clay Manufacturing Company, Post Office Box 6, Pittsburg, Kansas 66762, 316/231-1400. 7801

Dickey Clay.

Log Ledger

Honors

•I.T. senior Linda Sue Dreschsel was awarded a $200 scholarship by the American Institute of Industrial Engineers recently. Drechsel is an Industrial Engineering major.

•The American Society of Mechanical Engineers, student section, has recognized three Minnesota students.

John Dieseth was given a Certificate of Award from ASME national headquarters. Dieseth, Kris Ewen and Paul Svenkeson were presented awards by the local chapter of ASME.

•Prof. Emil Pfender, of the Dept. of Mechanical Engineerng, has been recognized by the Federal Republic of Germany with the Senior U.S. Scientist Award (Humboldt Award) for his past accomplishments in research and teaching. Pfender is conducting research in the areas of plasma and high temperature physics and heat transfer.

•The Society of Automotive Engineers has awarded Dr. David B. Kittelson with the Arch T. Colwell Merit Award for his paper "Sampling and Physical Characterization of Diesel Exhaust Aerosols," written with John Verrant. Kittelson is on the faculty of the Dept. of Mechanical Engineering.

•Dr. Ephraim M. Sparrow received the American Society of Electrical Engineers Ralph Coats Roe Award at the ASEE Annual Meeting recently. Sparrow, who is on the faculty of the Heat Transfer and Thermodynamics Divison of the Dept. of Mechanical Engineering, was recognized for excellence in the instruction of engineering students.

Technolog welcomes items for publication concerning outstanding achievement of students and professors in I.T. as well as notices of seminars, exhibits, guest speakers, special learning opportunities and other extra-curricular activities. Send typewritten material to Minnesota **Technolog**, Rm. 2 Mech. Eng. Bldg., University of Minnesota, Minneapolis, MN 55455 or call 373-3298.

I.T. enrollment, class sizes continue upward trend

Again this year, I.T. enrollment has increased significantly and the number of faculty and budgeted T.A.'s has declined. As a result, some departments have experienced overcrowded classes.

Figures for this fall have not been completely tabulated, but a preliminary class card count indicates an enrollment of 4,780, up 5.5 percent from last year's fall enrollment of 4,531 and only 20 head short of I.T. Assistant Dean Paul Cartwright's projected 4,800. Carwright said, recently, he has not seen enrollment this high since the post-World War II years when returning G.I.'s flooded I.T. on the G.I. Bill.

Overall teaching load has not increased quite so dramatically. This figure is expressed in terms of Full Year Equivalent (FYE) students, a number derived by dividing the total number of credits taught over the academic year by 45. The number of FYE students is estimated to be 7,002 for the 1978-79 school year. This is an increase of approximately 1.1 percent over last year's figure of 6,925 FYE students.

The combination of a 5.5 percent overall increase and only a 1.1 percent FYE student increase indicates a tendency for I.T. students to take fewer credits per quarter then they did previously.

Faculty and teaching assistant numbers are expressed in terms of Full Time Equivalents (FTE). They reflect the varying time commitments of individual faculty members and T.A.'s. The number of FTE faculty members has decreased from 342.67 in 1977 to 341.42 this year. Budgeted FTE T.A.'s have decreased in number from 140.85 to 137.30 in the same period.

The modest increase in overall teaching load and only a slight decrease in teaching staff masks the effects of enrollment increases in I.T. Even if I.T. students are taking fewer credits, the increase in enrollment automatically increases the administrative load. Also, enrollment shifts from department to department. The biggest increases have occurred primarily in Electrical, Mechanical and Chemical Engineering departments. Other departments have had smaller increases or have leveled off.

Acting I.T. Dean Walter Johnson said, in an interview, that overcrowding adversely affects the way classes work. Discussions become unwieldly and the amount of feedback in the form of graded assignments and quizzes must diminish as the ratio of students to T.A.'s increases.

To cope with enrollment increases I.T. has been forced to hire more T.A.'s than originally budgeted for. Twenty T.A.'s alone for chemistry courses have been hired. I.T. does not have the funds to continue paying for these extra T.A.'s through Spring Quarter. The money may come from University administration. $300,000 was socked away last year to provide a buffer fund for enrollment problems.

While enrollment limitations have been discussed, administrators are reluctant to apply what is essentially a long term solution to what has, in the past, turned out to be a relatively short term problem. Limitations would take the form of tougher admissions standards and/or quotas. There is no chance of enrollment limitation for 1979.

But another increase in enrollment is predicted for next year, and, as Dean Cartwright said, "There's no fat left in the system at all."

—**Don Leeper**

Log Ledger

U.S. DOE energy technology grant program

The U.S. Department of Energy (DOE), through its Chicago Operations Office, is offering a regional appropriate technology program for the Midwest. For students in Minnesota this means grants averaging $12,000 are available for award to those submitting proposals for energy-related projects which would utilize local materials, labor and ingenuity toward the development and use of energy-related appropriate technology. For applications and information contact: Appropriate Energy Technology, Chicago Operations Office, U.S. Department of Energy, 175 W. Jackson, Room A1136, Chicago, IL 60604.

Air Force team to hold informational dinner, interviews

An Engineer Search Team, sponsored by the local office of the U.S. Air Force, will hold an informational dinner presentation and interviews Nov. 16 and 17. The team, comprised of working engineers from Air Force Systems Command and Air Force Personnel Manpower Center plus a representative from Air Force Recruiting Service headquarters, will present a film and answer questions about Air Force lifestyles, benefits and career opportunities at a dinner Nov. 16. The dinner will be held at Mancini's Char House, 531 W. 7th St., St. Paul at 7 p.m. Attendance is limited to 30 students and graduates. Cost is free.

On Nov. 17, the team and others will available for interviews at the Placement Office; students in Electrical, Mechanical, Metallurgical and Civil Engineering, especially, are encouraged to attend. Offers of location and position may be made to a few qualified Mechanical, Electrical and Metallurgical Engineering students at that time.

For more information call Tom Crandall, regional coordinator, Officer Programs, U.S. Air Force at 331-1880.

Dept. of Mechanical Engineering Seminars, Fall Quarter

The following seminars are carried live interactive on UNITE Channel A. Anyone may attend. For information, contact David Kittelson, 373-3009. All seminars are held in Rm. 108 Mech. Eng. Bldg. Overflow in Rm. 202 Mech. Eng. Bldg., Wednesdays at 3:15 p.m.

October 25
Modular Integrated Utility Concept
M.H. Nimmo, U.S. Bureau of Standards, Washington, D.C.

November 1
Solar Heating: The Essence of a New Industry
Prof. John Duffie, Dept. of Chemical Engineering, University of Wisconsin, Madison

November 8
To be announced

November 15
Design and Operation of the John Hancock Tower Building Stabilization System
Mr. Neil R. Petersen, MTS Systems Corp., Minneapolis, Minn.

November 22
Solar Energy Development at Honeywell
Mr. Roger Schmidt, Honeywell, Inc., Minneapolis, Minn.

November 29
Energy Conservation Via Heat Transfer Enhancement
Prof. A. Bergles, Dept. of Mechanical Engineering, Iowa State University, Ames, Iowa

Dept. of Computer Science Colloquium Speakers, Fall Quarter

All colloquiums are held in Rm. 305 Lind Hall at 3:30 p.m.

October 2
Scheduling Independent Tasks
Yookun Cho, University of Minnesota

October 16
A Hierarchial Computer Network
Dr. J.R. Greenwood, Lawrence Livermore Laboratory

October 30
Protocols for Fandom Access Channel Computer Communication
Mr. Imrich Chlamtac, University of Minnesota

November 6
Title to be announced
Dr. Larry Flon, University of Southern California

November 20
Data Base Processors: Requirements and Design
Dr. Harvey Freeman, UNIVAC

November 27
To be announced

Control Science Seminars, Fall Quarter

Seminars held in Rm. 102 Mech. Eng. Bldg., Thursdays, 2:15 p.m. For information contact Prof. Bailey at 373-4527 or Prof. K.S.P. Kumar at 373-5228. Note: Students may register for EE 8290 for one credit.

November 2
Hierarichal Optimizing of Stationary Steady-State Systems (con't.) and Introduction to Nonstationary Steady-State Systems
Prof. M. Brady's

November 9
Hierarchical Optimizing Control of Nonstationary Steady-State Systems Using Price Coordination Mechanisms
M. Brady's

November 16
Hierarchical Optimizing Control of Dynamic Systems
Prof. K. Malinowski

November 30
Informational Problems in Decentralized and Hierarchical Control
Prof. F.N. Bailey

Fall Quarter Recruiting Schedule

Representatives from the following companies will be on campus for interviews on the dates specified. For a list of other Fall Quarter interview dates consult the Welcome Back issue of **Technolog** or contact the Placement Office, 373-3298.

Wednesday, November 15
BASF Wyandotte Corp.
Cities Service Co.
Ford Motor Co.
G.T.E. Automatic Electric Corp.
Owens-Corning Fiberglas Corp.
RTE Corp.
Union Carbide Corp.

Thursday, November 16
American Hospital Supply Co.
Pickands Mather & Co.
Sperry Univac (Roseville)
Union Carbide Corp. (2)
Western Gear Corp.
Whirlpool Corp.

Friday, November 17
American Hospital Supply Co. (2)
Menasha Corp.
Western Gear Corp. (2)

Monday, November 20
U.S. Army Materiel Development and Readiness Command
Electronic Data Systems Corp.
Corps of Engineering, St. Paul District

Tuesday, November 21
Electronic Data Systems Corp. (2)
Economics Laboratory

Monday, November 27
Northern States Power Co. (Minnesota) (2)
Boise-Cascade Corp.

Tuesday, November 28
E.I. du Pont
MIT Lincoln Laboratory
Texas Instruments, Inc.

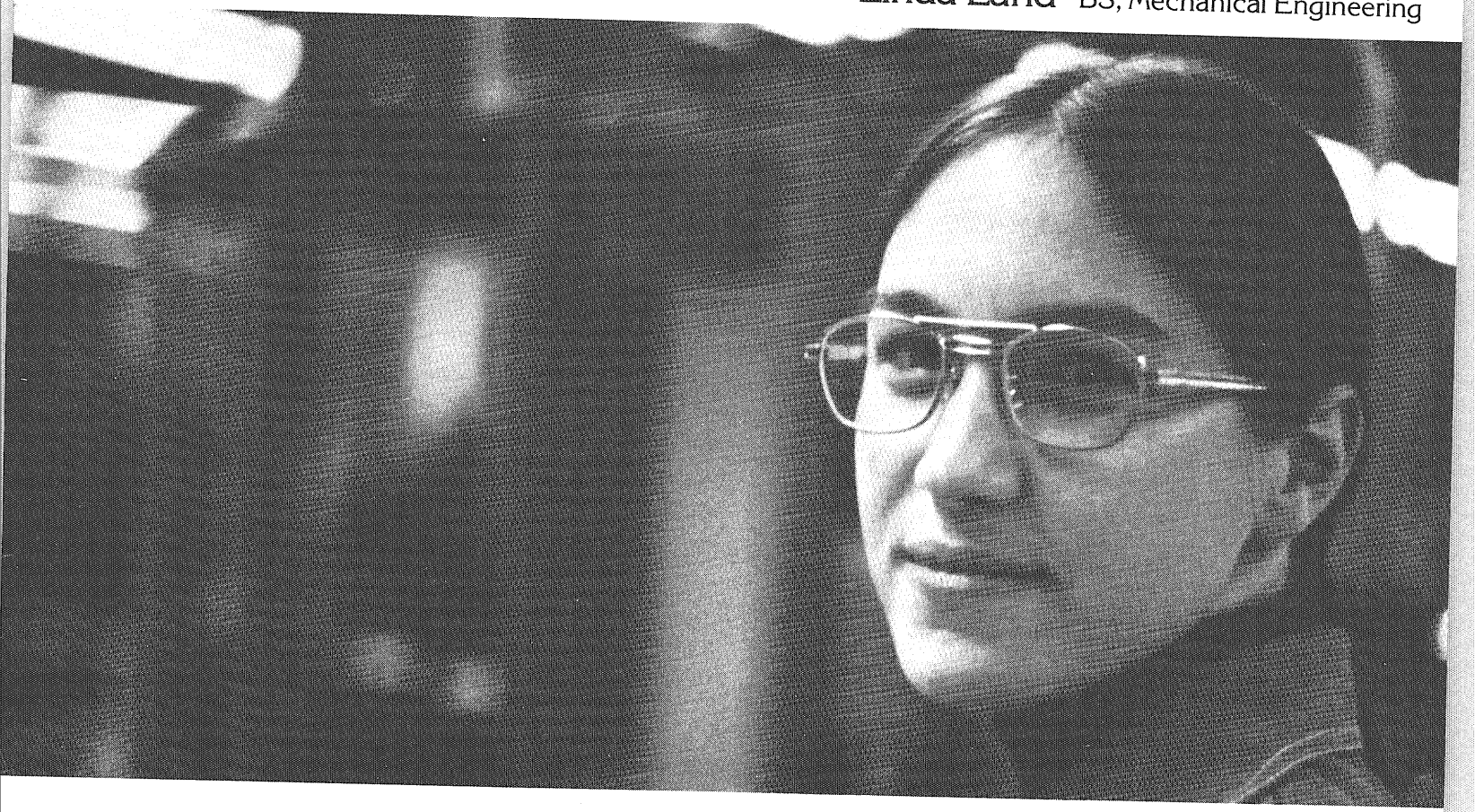
Wednesday, November 29
E.I. du Pont (2)
Firestone Tire & Rubber Co.
Texas Instruments, Inc. (2)
Rohr Marine

Thursday, November 30
E.I. du Pont (3)
Armour Dial Co.

Friday, December 1
Armour Dial Co. (2)

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

—Linda Land BS, Mechanical Engineering



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

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Books/Media

AD ASTRA!

By Bruce Kvam

The 1978 World Science Fiction Convention was born amidst confusion and remained in that state until its last gasp. Which is not to say that the convention, dubbed "Iguanacon" and held in Phoenix, Ariz. last Labor Day weekend, was bad: it was a thoroughly enjoyable event, if a little disorganized.

The center around which most of the confusion revolved was the political stance of Iguanacon's Guest of Honor, science fiction writer Harlan Ellison. When Ellison agreed to be Guest of Honor (one morning at two a.m. over the telephone when he was half asleep) he did not realize that Arizona had not ratified the Equal Rights Amendment. Ellison is a very vocal supporter of women's rights and adheres to the National Organization of Women (NOW) boycott of states that have not yet ratified. At first he was going to resign the position but allowed himself to be convinced to stay and use the Guest of Honorship to further the cause of the ERA.

A wave of horror swept across science fiction fandom. Ellison received hate letters, angry editorials, irate phone calls, heaps of slander and even a death threat or two. *Politicize* the Worldcon? Sacrilege! Treason!

Well, Ellison came, and everyone else came, and all three or four thousand of us had a good time.

There were parties held every night during the convention by various fan groups that were bidding for future Worldcons. There were author panels, discussion groups and lecturers, ranging from building planets to writing fiction to the role of technology in women's liberation to space colonization. There were movies and more movies: the world premiere of **Watership Down** was at Iguanacon. There was a huckster room where you could buy anything even faintly connected with science fiction. And through it all, the oppressive heat of Arizona (over 100 every day, with lows of

85 at night) kept us running from air-conditioned building to air-conditioned building.

On Sunday night, of the the five-day Worldcon, the Hugo Awards for best work in science fiction were presented. The best novel of 1977, as determined by the members of Iguanacon, was **Gateway,** by Frederik Pohl. Pohl also won the 1977 Nebula Award for **Gateway** earlier this year.

Despite the chilly forecasts of doom, Iguanacon left most of its members satisfied. The fans found out what Ellison's position *really* was and Ellison found out that it was impossible to politicize science fiction fans in the first place.

There was one upset at Iguanacon and one very interesting development, both in the area of new magazines.

For five years running Ben Bova had won the Hugo Award for Best Editor for his work on **Analog Science Fiction/ Science Fact.** This year, George Scithers of **Isaac Asimov's Science Fiction Magazine (IA'sfm)** snatched the award from Bova's hands. **IA'sfm** had been around for only a year and had already surpassed **Analog** in per-issue circulation.

Also at Iguanacon a brand new magazine made its first public appearance: **Omni.** It's a big, slick magazine costing two bucks a throw, published by Penthouse. **Omni** is chock full of advertising and color photos and paintings, with content that seems to be a mixture of **Psychology Today, Scientific American** and **Analog.** At Iguanacon **Omni** representatives gave away 10,000 T-shirts (they forced three on me before I could escape) as a promotional gimmick. Bova, who has quit **Analog** and is now fiction editor for **Omni,** told us at a Q&A session that the magazine had a press run of one million copies. **Omni** has also been running TV ads like crazy.

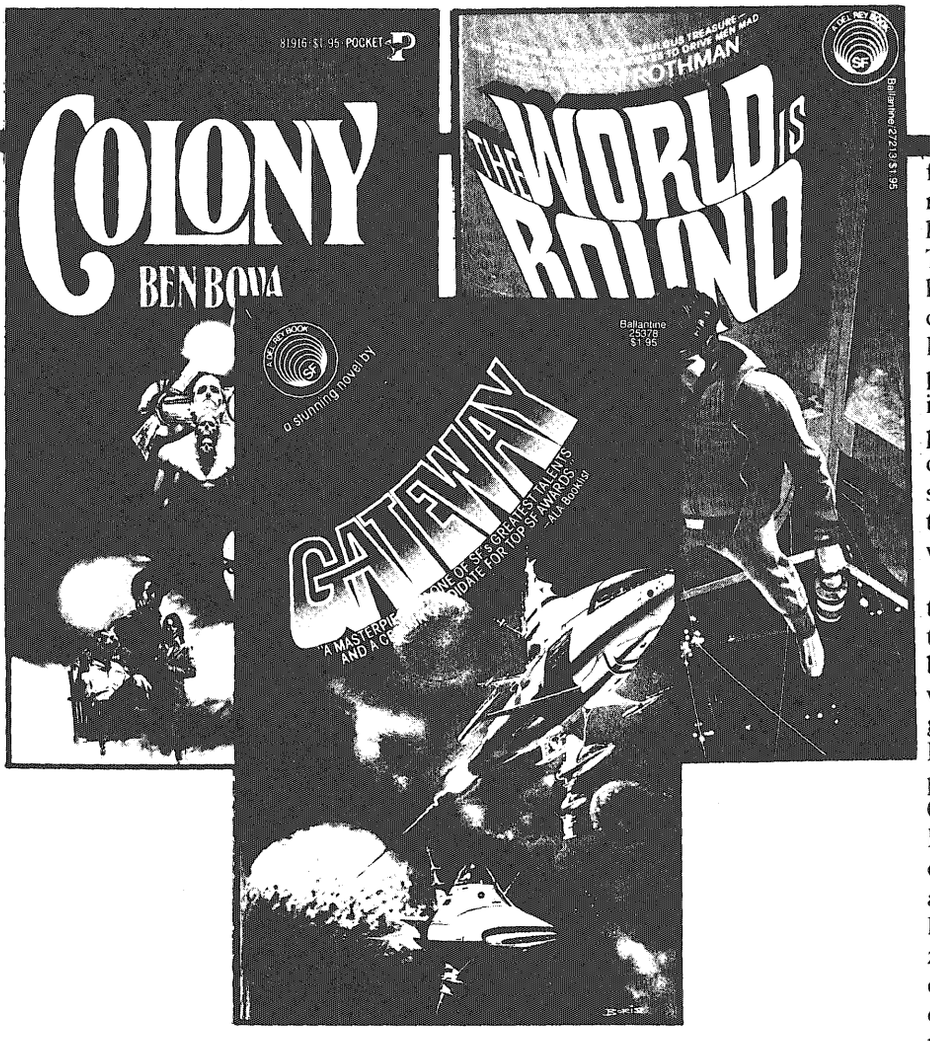
Why is Penthouse making such a big push for SF? Money! Last year **Star**

1977 Professional Hugo Award Winners

Best Novel: **Gateway,** by Frederik Pohl
Best Novella: **Stardance** by Spider and Jeanne Robinson
Best Novelette: **Eyes of Amber** by Joan Vinge
Best Short Story: **Jeffty Is Five** by Harlan Ellison
Best Dramatic Presentation: **Star Wars,** Gary Kurtz, producer
Best Editor: George Scithers, **Isaac Asimov's Science Fiction Magazine**
Best Artist: Rick Sternbach
Best New Writer: Orson Scott Card

Gandalf Awards for Fantasy

Best Novel: **The Silmarillion,** by J.R.R. Tolkien
Grand Master: Poul Anderson



Wars started a science fiction boom that hasn't even begun to die down.

There are at least half a dozen SF movies and TV series in production: **Meteor, The Invasion of the Body Snatchers, Alien, Battlestar Galactica** and more. At Iguanacon Harlan Ellison told us he is working on a script to adapt Asimov's classic **I, Robot** for the screen with a tentative budget of $30 million.

There was a similar boomlet in the 1950s, after which a dozen SF magazines bit the dust, leaving the field pretty much to the four major magazines of the last 20 years—**Analog, Galaxy, Amazing** and **Fantasy and Science Fiction.** Lately, though, there has been an insurgence of new magazines: **Omni, IA'sfm, Galileo, Destinies, Starlog** and **Future.** They may or may not be inspired by **Star Wars,** but they will certainly benefit from all the interest SF is getting these days.

> "The literature itself is gaining respectability. Science fiction is not longer shoot-em-up westerns set in space. Real problems and real people in real—though futuristic—situations are being dealt with by the SF writers."

Some feel the current boom, like the last, is just another passing fancy, but it may be here to stay. Science fiction writers are gaining an air of respectability. They command advances that rival those of "main-stream" authors. And the literature itself is gaining respectability. Science fiction is no longer shoot-em-up westerns set in space (at least, the written form). Real problems and real people in real—though futuristic—situations are being dealt with by the SF writers.

Colony (Pocket Books, $1.95) by Ben Bova, is a case in point.

It is the year 2008 and the world's population stands at 7.25 billion. Earth is a filthy place, where revolution hangs hungry on the streets. There is a haven: Island One, the space colony at one of the Earth-Moon libration points. There the air is clean and the people sane. The colony maintains the solar power satellites that feed the Earth with all its energy.

The central character is the first true test-tube human being, David Adams, who has been made genetically perfect. David is literally a prisoner on Island One, so he escapes to Earth where he becomes entangled with a woman who calls herself Scheherazade. She is the leader of a ruthless group of terrorists. When the United States is torn by an uprising of the "minorities," Scheherazade and friends threaten to destroy Island One and cut the thin thread of power that flows from space to Earth.

But sometimes you like to read a book that doesn't have anything to do with current problems, a book for pure enjoyment. Such a book is **The World Is Round** (Del Rey, $1.95) by Tony Rothman.

Patra-Bannk is a planet that is fifty times larger than a planet should be. The days and nights are so long that they turn into unbearably hot summers where

the vegetation burns away and shatteringly cold winters where the air sometimes freezes.

A team of four adventurers journey light years to Patra-Bannk to find a technological treasure beyond belief: room-temperature metallic hydrogem. They ultimately discover that Patra-bannk isn't a planet at all, but a hollow sphere with a black hole at its center that is slowly drifting. If the singularity shifts just a little bit too much, the tremendous gravity will rip the planet to pieces and suck it along with its inhabitants into the bottomless maw.

The World Is Round contains engrossing action and a multitude of fantastic concepts, all worked out in scientific detail in the style of Larry Niven and Arthur C. Clarke.

SFC is coming.

Watch
for details in
Fall 2
Technolog.

(Science Fiction Contest.)

Behind the big screen

EDITOR'S NOTE: Since the Science Museum of Minnesota's new William L. McKnight Omnitheater opened September 19, media interest and public excitement with the Omnitheater's awe-inspiring presentation has been magnificent. Technolog **photographer Dave Bissonnette and writer/photographer Glenn Flekke visited the Omnitheater recently to view first-hand what the public doesn't see—the impressive advanced technology at work in the Omnitheater projection and sound equipment.**

By Glenn Flekke

The biggest attraction at the new Omnitheater is the huge projection screen, which measures 76 feet in diameter and is hemispherical in shape. From your seat in the audience, it nearly engulfs your entire field of view. Perforated 27 percent, the screen permits the placement of speakers and ventilation system behind it, and is made of curved aluminum panels coated with whitevinyl.

Currently, the museum is presenting a show which includes a 20-minute prologue and a 30-minute feature film entitled **Genesis**. The prologue was produced entirely by the museum and discusses the origin of the universe through the widely-accepted "big bang" theory. **Genesis** uses high-impact scenes such as low-altitude aerial footage of canyons and close-ups of thundering volcanoes to teach us in an entertaining manner about plate tectonics, the study of drifting continental plates.

The Science Museum has complete production and projection facilities to create its own shows. While the feature movies themselves are not produced at the museum, the prologues and other local productions are, and, according to Edward Tomczak, chief engineer, the vast capabilities of the space theater have yet to be fully exploited.

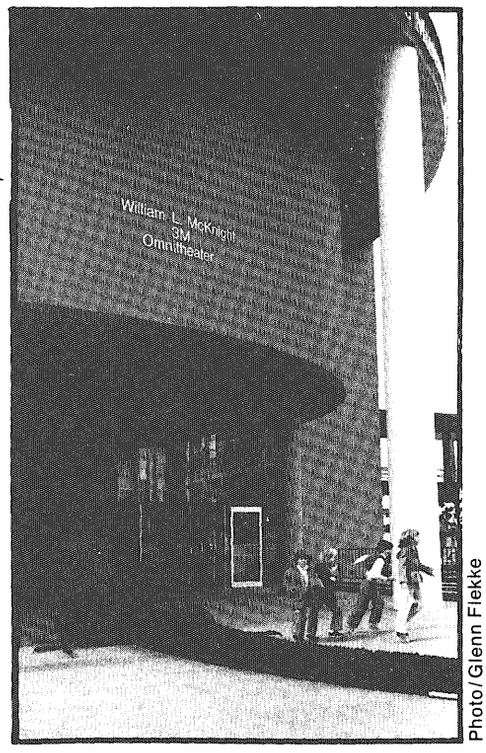
The museum owns about $1.5 million worth of audio-visual equipment, including 30 slide and special-effects projectors, two 70mm movie projectors and an elaborate sound system. It also owns a Space Transit System, a special starfield projection system made by Spitz Space Systems, Inc. The Space Transit System is interfaced with the theater's computer system and has the capability of displaying the night sky, complete with the planets in their proper positions, at any time between the years 0 and 2000 A.D. from the vantage point of any of the nine planets. The Space Transit System is so accurate it's possible to practice navigation with it.

The computer, built by Data General Corp., can be programmed to control an entire presentation. This provides for a repeatable professional-quality show, and a large number of fast-action, precisely-timed special effects. The computer console is located within the audience so its operators can view the entire screen, and should anything go wrong with the presentation, the theater staff can correct the situation manually from the console. Each feature film comes complete with a tape software package to provide synchronous control of other equipment, such as the separate sound track.

Feature films, such as **Genesis**, are photographed by Graphic Films Corp. of Hollywood using the special cameras of Imax Corporation. Two image formats are produced by the Imax Corporation: Imax and Omnimax. Both types use regular 70mm film stock, and are photographed horizontally with a frame size three times larger (about 2½"x3") than vertical format commercial 70mm films.

The Imax format uses regular optics for both the camera and projector and is intended to be projected on a large square screen.

Omnimax, the format used for **Genesis,** uses special fisheye optics for both exposure and projection, and is intended for projection on hemispherical screens. The result is a very wide-angle picture with little fisheye distortion. The Science Museum has the capability to project in both formats.

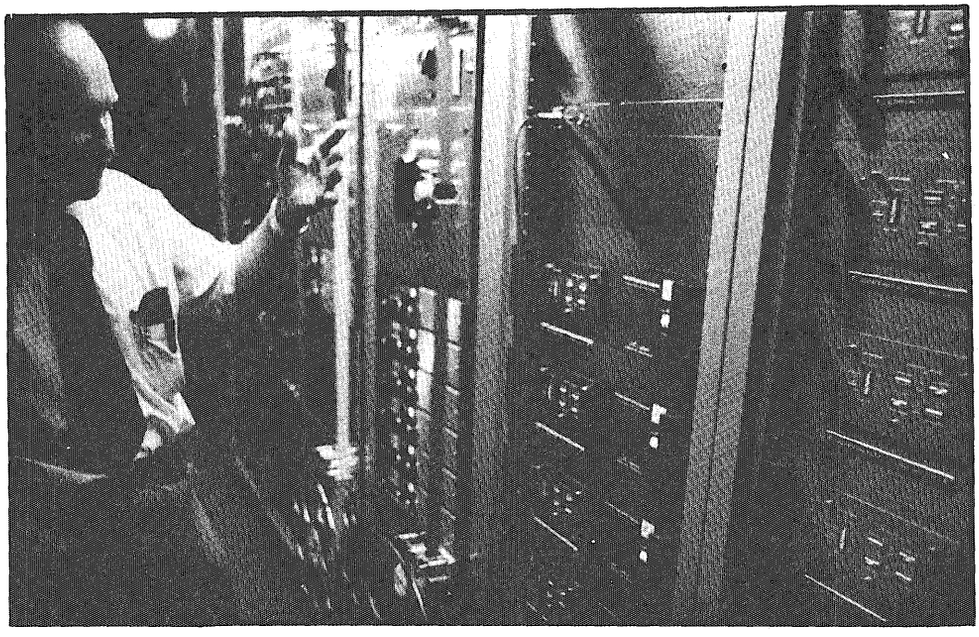


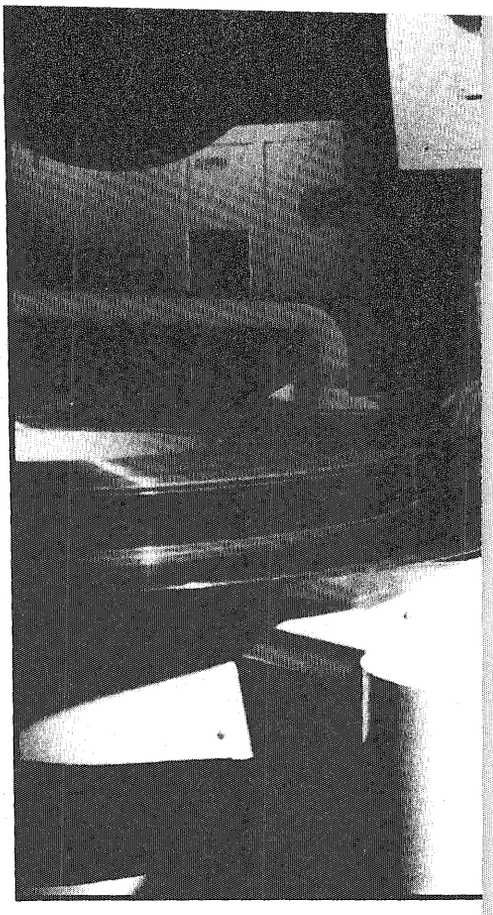
Photo/Glenn Flekke

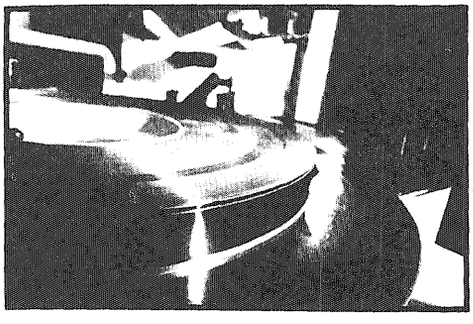
Sound for both local productions and feature films is recorded on 35mm 6-channel stereo magnetic tape. Twelve speaker systems (each has two 15-inch woofers, a midrange horn and a tweeter) are widely spaced behind the screen, and each of the 12 recorded sound tracks is fed through a separate amplifier and speaker. The wiring can be routed in such a way as to produce five different sound scenes, each automatically selected during a presentation by the computer.

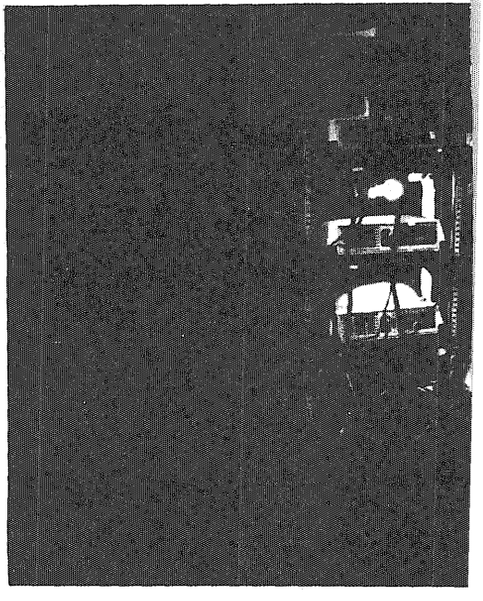
Special noise-reduction circuitry is available and used for the soundtrack of **Genesis**. For very low-frequency bass response that can be felt as well as heard, a panel of six 24-inch speakers is mounted directly behind the center of the screen.They are driven by a special power amplifier with low-frequency bandpass circuitry that extends the response down to 20 Hertz.

At the present time there is a consortium of three space theaters besides Minnesota's. They are located in San Diego, Detroit and Monterey, Mexico with one currently under construction in Seattle. Each produces and finances their own feature films to be distributed at various times to other space theaters.





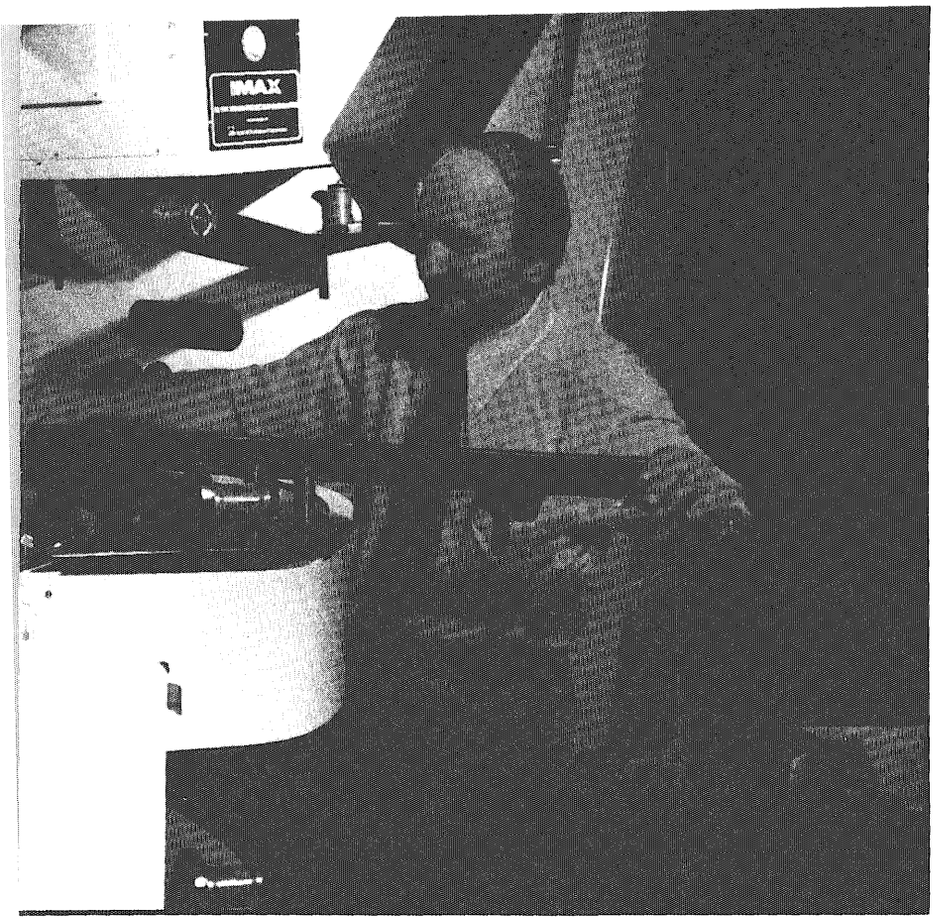


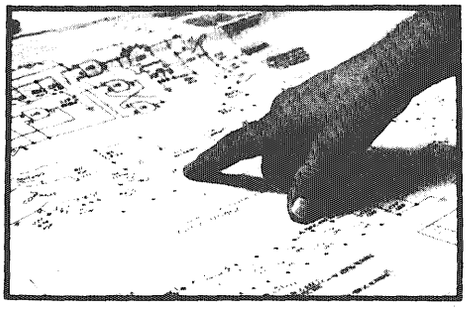


Edward Tomczak, Omnitheater's chief engineer, (above left) describes the power amplifiers for the theater's sound system. There's one for each speaker, including equalization controls for precisely tailoring high- and low-frequency response. The 35mm tape drives are in the background. The film for **Genesis** (above) is 70mm wide and is wound on open-faced reels four feet in diameter.

Photos by Dave Bissonnette and Glenn Flekke

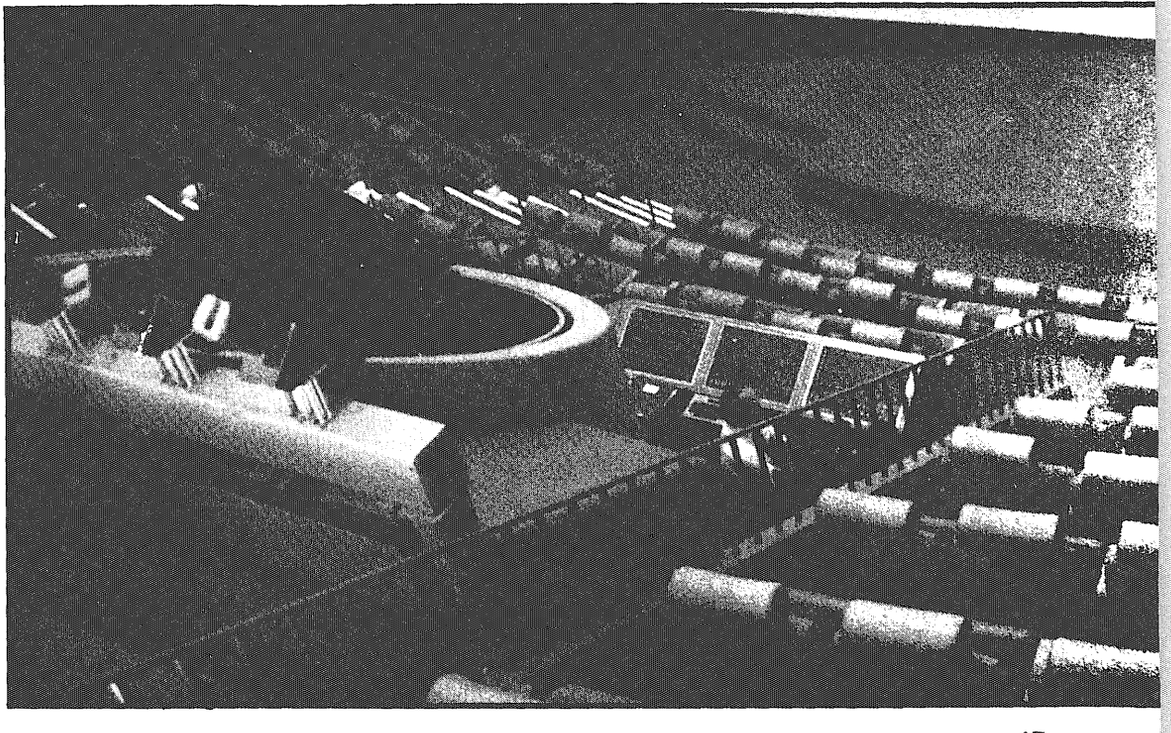
Behind the l





Tomczak (above left) examines a section of the 30-foot leader film for **Genesis.** The gigantic Imax projector has a 12.5 kw bulb which belts light through the film, zipping past at six feet per second. At left is a portion of the circuitry used to synchronize the 35 mm tape drives with the Imax projector. A technician (center) hooks up a bank of carousel projectors for an upcoming slide presentation. The Space Transit System (STS) and the computer console (below) are located within the audience. The STS, on the left, consists of a 10,000-element star ball with special projectors (for planets, moons and the sun) mounted above it. The computer console is below the star ball where technicians program and monitor each presentation.

ig screen



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PLACE: Northstar Inn—Ballroom

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Science at issue in the political arena

SEN. WENDELL ANDERSON

BOB SHORT

GOV. RUDY PERPICH

By Jesse Hamilton Gorn

It has been a "wild and crazy" year, campaign-wise, in the state of Minnesota. A plethora of candidates and issues, compounded by demonstrations and accusations, have put Minnesota politics in newspaper and magazine headlines across the nation.

Three races are at stake: the gubernatorial race and the contests for both four- and six-year Minnesota senate seats. Although other candidates from Independent, Libertarian, American and Socialist parties will be on the ballot Nov. 2, the DFL and IR candidates are the top contenders.

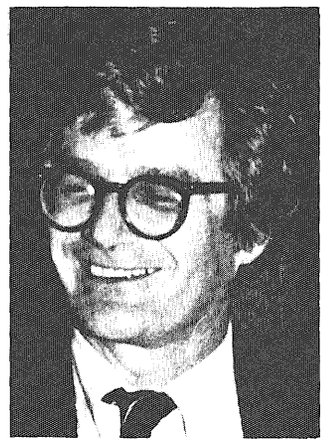
The six year U.S. Senate race pits the appointed incumbent, Wendell Anderson, against the "aimiable plywood salesman," Rudy Boschwitz. A self-described liberal, former Gov. Anderson has a senate voting record which would seem to back up his claim. His "self-appointment" to the senate, however, his nonsupport of the Burton-Vento BWCA Bill and his refusal to come down on one side or the other of the abortion fence, has put a rift between Anderson and many DFL liberals.

With the defeat of Don Fraser, many liberals have returned to Anderson's fold. Others, however, claim that they will cast their votes for Anderson's chief opponent, IR endorsed Rudy Boschwitz. His pro-wilderness stand on the BWCA issue and on other environmental concerns has made him attractive to certain state liberals. Boschwitz's views on other issues, however, come from the opposite end of the political spectrum, including his support of a stronger defense budget and the B1 Bomber. Boschwitz has served as IR state chairman, but has never held public office.

Edina businessman Robert Short and Minneapolis lawyer David Durenberger are seeking Minnesota's four-year senate seat, currently held by Muriel Humphrey. Short recently defeated the DFL endorsed candidate, Donald Fraser, in the primary election by less than 3,000 votes. Subsequently, Short tried and failed to receive DFL endorsement, primarily due to what many believe to be Short's unfair campaign tactics. As a result, many Fraser supporters have found it impossible to transfer their allegiance to Short. Short's anti-wilderness stand on the BWCA and anti-choice abortion stand could give him conservative support from independent and IR voters.

The IR endorsed candidate, David Durenberger, generally agrees with Short on many of the major issues. His positions, however, are viewed to be somewhat more moderate than those of his opponent.

The gubernatorial contest includes the DFL endorsed incumbent, Rudy Perpich, and IR endorsed former congressman, Albert Quie. Although the two men seem fairly close on many of the major issues, each candidate has a specialty which has been stressed throughout the campaign. Perpich has been desperately trying to get the womens' Equal Rights Amendment ratified throughout the country. Quie's speciality is education. He promises to attempt major changes which could be beneficial to both students and taxpayers.



RUDY BOSCHWITZ

DAVID DURENBERGER

REP. AL QUIE

Photos/Mike Dorn

Q's & A's

EDITOR'S NOTE: With election day for both Minnesota senate seats and the governor's office approaching Nov. 2, Technolog **recently presented the top DFL and IR party candidates with questions about science, environmental and tax issues. With the help of Jesse Hamilton Gorn, Rick Kravik and Tim Schultheis, the candidates answers follow, along with fellow I.T. student opinions on the candidates and issues.**

Would you propose or support legislation providing income tax relief for parents of college students? Increasing financial aid programs?

WENDELL ANDERSON
Yes.

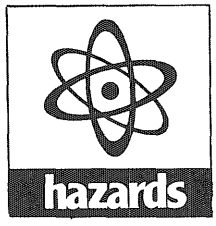
RUDY BOSCHWITZ
I support increased financial aid programs. My four-point tax relief program would, in addition, make it easier for families to bear the cost of post-secondary education.

DAVID DURENBERGER
I would support legislation providing income tax relief for parents of college students in both private and public colleges and universities. Tuition costs are soaring and this hurts the most in middle income families where students do not qualify for financial aid. Government financial aid programs are beneficial and should be continued, but are aimed primarily at helping low income families. Statistics show that there has been an increase in the number of college students from low income families thanks to current government programs. However, there has also been a substantial decline in the number of students from middle income families in the $15,000-$25,000 income range. I feel that rather than expanding the middle income need, a simple tuition tax credit will address the problem without requiring more application forms to be filled out and more people to review them.

BOB SHORT
Education becomes a more valuable resource with each passing year. These days, a high school diploma is not always enough. Many times, a college degree is mandatory when an individual first enters the job market. I would support such legislation at both the secondary and post-secondary levels. Furthermore, such aid should be given to private schools as well. When you have strong private institutions, you will find strong public institutions. Such a measure would benefit the nation as a whole.

AL QUIE
I am a strong supporter of tuition tax credits for post-secondary education. This year in Congress I voted to give a tax credit of $250 for parents or students who pay for post-secondary education. I also co-sponsored the Middle Income Student Assistance Act which provides additional grants and loans for middle income students.

RUDY PERPICH
Gov. Perpich declined comment on **Technolog** questions.



What policies should the government implement concerning the transportation and disposal of nuclear wastes and other hazardous materials?

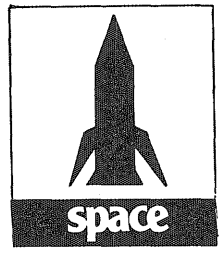
WENDELL ANDERSON
No comment.

RUDY BOSCHWITZ
For health and safety reasons, I favor a complete moratorium on all further nuclear power plant construction in the United States until the problem of nuclear waste storage, transportation and disposal are solved.

DAVID DURENBERGER
Minnesota generates 35 percent of its electricity with nuclear power, as compared with 10 percent nationally. Therefore, we have a special interest in assuring adequate safeguards for either transporting spent radioactive and other hazardous materials out of the state, or storing them here. I also believe that any storage system must provide for careful monitoring of radioactive wastes, and for retrieval capability.

BOB SHORT
The problem of how and where to dispose of nuclear waste and other hazardous materials must be studied most carefully. When transporting the waste, it is important that routes be chosen which avoid populated areas. In terms of disposing the waste, I feel the government should set strict standards as to where the waste can be dumped. Above all else, populated areas must be avoided. Protecting the populated area from possible radiation is the main concern.

AL QUIE
The most serious problem we have today concerning nuclear energy is the question of how to dispose of radioactive waste. I support the policy of placing more emphasis on national research in order to find safe disposal techniques for nuclear and other hazardous waste.



Is the NASA space program a good investment for Federal research monies? In what Research and Development areas should funding be increased?

WENDELL ANDERSON
NASA has been a valuable program for the past 20 years and will continue to be so in the future. However, future funding must not exceed reasonable limits. NASA, like all other Federal programs, must trim the fat and make the most efficient use of its allocated funds.

RUDY BOSCHWITZ

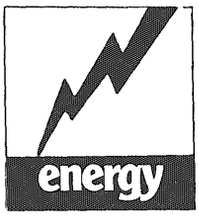
NASA has been an integral element in helping the private sector to develop more energy- and time-efficient air transport and telecommunications technologies. I support continued investment in a "balanced" program of unmanned and manned space activities to sustain these developments.

DAVID DURENBERGER

I believe the NASA program has proven cost-effective in terms of private sector technological spillover and direct public benefit in such areas as weather forecasting and telecommunications, as well as in terms of man's better understanding of the universe he lives in. Given the recent lag in the proportion of GNP going to R&D, I would encourage funding emphasis calculated to increase direct and indirect technological spinoffs, while maintaining the integrity of the space program's research activities.

BOB SHORT

The NASA space program has been a good investment for the Federal Government and the United States. The space program offers new possibilities in practically all fields of research in finding new solutions to our energy problems. Before deciding whether or not funding should be increased for Research and Development, I would have to look more closely at the program and determine if the additional funding is necessary.



Do you feel that government is doing enough to stimulate development of alternative energy sources such as fusion, breeder reactors, solar and wind power?

WENDELL ANDERSON

The Federal Government must do a lot more in this area, as the energy problem is one of the greatest difficulties our nation faces today. The government must do all it can to stimulate the development of alternative sources.

RUDY BOSCHWITZ

I support research efforts and tax incentives to spur the development and utilization of "clean" alternative energy sources like solar and wind power.

While I am opposed to the breeder reactor for reasons outlined above, the common elements of fusion are available in unlimited supply and there is virtually no radioactive waste or danger to humans or the environment. I strongly support efforts to bring this and other safe, pollutant-free energy sources closer to wide-spread use in the coming decades.

DAVID DURENBERGER

While I believe the government has taken substantial strides in funding basic research into certain needed alternative energy sources, I also believe the government must now encourage actual implementation and installation of energy systems relying on such sources. Accordingly, I have advocated tax incentives to purchasers of such alternative energy systems, and low-interest loans to producers making such systems available to the public.

BOB SHORT

The Federal Government has been doing an admirable job to stimulate development of alternative sources. I do feel that what has been done is just a beginning. We have just begun to study possible alternative sources, and I favor a continuation of such research for all alternative sources. We, as a nation, do face a problem with diminishing energy sources and must study every alternative available.

AL QUIE

No, but I doubt that government will ever fund enough research. I support continued research for all alternative energy sources at whatever level this country can afford. I have issued an issue paper on Energy and a separate position paper on Solar Energy. In these papers, I stated that "Minnesotans must turn their efforts (from traditional energy sources) to the development of plentiful, safe and environmentally sound alternative energy sources. Tax incentives may be needed to spur the development and utilization of such energy sources as the wind, biomass, agricultural residues and peat. Regarding solar energy I have proposed a state tax incentive program to promote increased solar use. My proposal would permit individuals to take a 10 percent tax credit up to a maximum of $1,000 for purchasing solar equipment and systems. It would also exempt from the 4 percent state sales tax all solar energy systems.

Minnesota's high taxes make other states such as Texas more attractive to a graduating engineer. What actions would you take to remedy the outflow of engineers from Minnesota and to attract engineers from other states to Minnesota?

WENDELL ANDERSON

No comment.

RUDY BOSCHWITZ

I believe the Minnesota State Legislature must make a greater effort to understand the problems of business in general, and for the state's manufacturers in particular. The Legislature could begin by easing the personal income, corporate income and workmen's compensation tax burden to halt the relocation of manufacturing firms to other states which has occurred over the last ten years.

DAVID DURENBERGER

Among Minnesota's great strengths have always been its highly-educated populace and its concentration of technologically-oriented businesses. While the primary effort to improve Minnesota's business climate must come at the state and local level, as Senator I would work to assure Minnesota of its fair share of federal research facilities. I would also work to end the vast net outflow of federal revenues from Minnesota to "sunbelt" states which are luring workers from Minnesota with their lower tax rates, by changing certain federal funding formulas to reward rather than punish states for strong local effort and initiative.

BOB SHORT

Although not really an issue for the federal government, new engineers are definitely a group which we need in Minnesota, especially those which are born and/or educated in Minnesota, and are familiar with the problems which face our state. This problem, however,

comes under the jurisdiction of our state government, and I would not like to dictate to them on this matter.

AL QUIE

The tax situation in Minnesota has gotten out of hand. In 1976 Minnesota was ranked eighth in the nation compared to 43rd for Texas in the total of all state and local taxes paid. We are ranked fourth in our income tax paying $39.03 on every $1,000 earned compared to no income tax in Texas. A recent study revealed that if you were married with two dependents and earned $20,000 you would pay $1,272 in Minnesota income tax compared to $0 in Texas. In the $15,000 and $20,000 brackets Minnesotans pay the highest tax in the nation.

I have proposed a 10 percent income tax cut for all taxpayers. Also, we must index our income tax structure so you don't get pushed into a higher tax bracket just because you receive a cost-of-living raise. The state should not be allowed to continue to collect more revenues just because of inflation. My first committment as Governor will be to get these tax cuts enacted into new law so that we can retain and attract employees to Minnesota.

Should deadlines, set for standards of auto emissions and fuel economy, be extended if the auto industry balks? To what extent should other environmental quality standards be enforced?

WENDELL ANDERSON

Deadlines for the auto industry must NOT be extended, and other environmental quality standards must be enforced as far as it is practical, and possible.

RUDY BOSCHWITZ

A clean and healthy environment is the rightful heritage of every American. I am proud of the efforts on the part of the federal government to clear up our air, land and water. However, local government must also be active. Particularly in the areas of air quality standards and land use planning, local input and decision making should be given a top priority.

In addition, we must be committed to achieving a balance between economic growth and environmental quality. Certainly, our economy must meet the needs of the American people and provide job opportunties for those who are out of work. But economic growth must be wise growth, and we must constantly be watching for adverse environmental impact of our actions, and support the necessary safeguards for clean air and water standards to minimize that impact.

DAVID DURENBERGER

I remain hopeful that these deadlines can be met. If they cannot, consideration of any further extension for auto industry compliance with emission and fuel economy standards would have to take into account the amount of effort being made in these regards, the success of these efforts in coming close to the guidelines, and the employment, inflationary and balance of trade consequences of strict adherence to the current schedule. Similarly, I believe a careful economic impact assessment should precede implementation of new federal environmental standards, so that the public and their elected representatives can reach a fully-informed judgment as to all the economic, environmental, balance of payment and even national defense tradeoffs which such decisions may involve.

BOB SHORT

The government's primary concern should be with means, not with ends. The government should be able to dictate to the auto and other industries certain pollution control standards, but not HOW these industries go about meeting these standards. Industry must show that their methods will be effective, but as long as they get the job done within a reasonable amount of time, the government should keep its nose out, unless it becomes obvious that industry is not doing its job.

By Jesse Hamilton Gorn

Several I.T. students were interviewed by the **Technolog** at random. They were asked the same questions presented to the candidates. Here are some of their comments.

About the problem of transportation of nuclear wastes and their disposal, I.T. freshman Tom Roberts said that, "There is no safe place to put them. I'm for nuclear energy but against nuclear waste. The government should ban systems which produce alot of waste and stick to other low-waste systems, possibly fusion."

Although he said he would "Rather have a free education," Roberts believes in the usefulness of the NASA program, but he said he also believes that, "Costs should be cut back on, with the monies spent more efficiently."

About government's push for alternative energy sources, Roberts said, "The government is not doing nearly enough. There should be...news everyday on alternative sources."

An I.T. junior who asked not to be identified said he agreed with Roberts that nuclear waste is a major problem, but offered a somewhat different solution.

"Nuclear energy should remain in the research stage and should **not** be used as a major source until it can be made alot safer than it is at this time. Rather than wait for a nuclear disaster, we should make sure that the first one never happens."

On the problem of the outflow of Minnesota engineers, the same student commented, "I'll go wherever the work is the most interesting. If Minnesota is doing alot of good research into, say, solar energy, I would stay here, even though I might make more money in Texas building bombs." As far as the candidates were concerned, he said "At this time, I guess that Rudy Boschwitz is the only one I feel has a grasp on the energy problems, so I probably will vote for him."

Joe Green, a physics student, said he believes that nuclear power is the answer to the energy crunch, but "The government should keep its big nose out of it. Let's face it, new sources won't be developed unless there is a profit to be made. Private industry realizes this, and if left to their own devices, will come up with something eventually."

Green also said he wants more money put into the NASA program.

"The Soviets have killer satellites orbiting the Earth. If the U.S. doesn't start sending up some of our own, we'll all be speaking Russian within five years."

Green said he plans to vote for the American Party candidates for governor and for the six-year senate seat, but plans to vote for Short for the four-year senate seat.

"I like his style. The man isn't afraid of anything. Short wants to keep the government out of our lives, and I'm all for that."

A student who called herself a "six year woman" in I.T., said she doesn't plan to vote for anyone in the upcoming election.

"All the candidates are the same—middle-aged, male and middle of the road. Either way you vote, you lose. I plan to go bobsledding instead."

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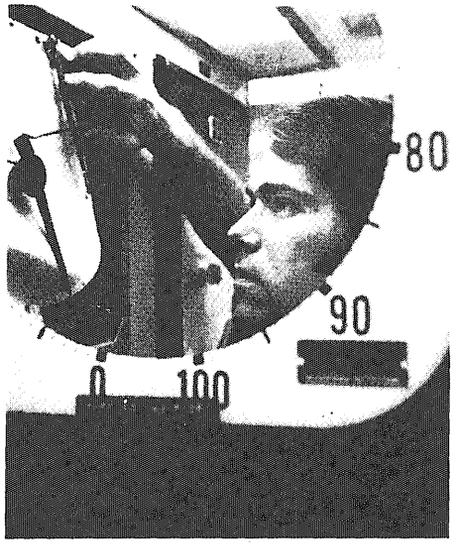
CAMPUS INTERVIEWS • October 30

What's it like to be an engineer at IBM?

Bill Kleinhofer
BS Electrical Engineering '72
University of California, Santa Barbara
MS Electrical Engineering '77
University of California, Santa Barbara
"The technical vitality here at IBM is attractive for young engineers looking for a future."

Evelyn Gratrix
BS Electrical Engineering '74
University of Washington
"Growth and success in IBM are only limited by an individual's own ambitions and ability."

Doug Brooms
MS Mechanical Engineering '72
Stanford
"The atmosphere is relaxed and informal, quite distinct from the dark suit and tie image of IBM. The people as a whole are congenial and cooperative."



Ric Davis
BS Mechanical Engineering '68
University of California, Davis
MBA '76, University of Santa Clara
"IBM has provided me with all that I've desired in an engineering career."

Homer Dean
BS Mechanical Engineering '72
San Diego State
"IBM has elevated my responsibilities as fast as I was willing and able to accept them."

Tony Spear
BS Electrical Engineering '77
Purdue University
"IBM encourages me to challenge the accepted ways."

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We will be interviewing at the University of Minnesota, Friday, October 27.

After Graduation

If you're not quite certain about your decision to become an engineer, maybe you should talk to one of eighty engineers from Minnesota Mining and Manufacturing who are waiting for you to give them a call, thanks to the I.T. Alumni Society (ITAS) and I.T. faculty advisors.

The Society is putting the finishing touches on a plan whereby students can stop at 105 Lind Hall, get the name and number of an engineer at 3M, and call him or her to get information about career opportunities in engineering.

This is one of several programs sponsored by the Society that are designed to help bridge the gap between the University and the business world.

"Many people think the Alumni Society is a bunch of guys in raccoon coats that go to Gopher games and wave pennants," says Dave Hagford, president of the Society. "But we're not a social organization. We're an organization designed to serve the students, former students and the school."

The Society was inactive eight to ten years ago, but that is changing. The Society has a membership of 2,700 former I.T. students now established in the business community, publishes alumni information in a magazine called **Items**, available in the I.T. Dean's office, is supporting two I.T. freshmen with merit scholarships and is sponsoring Science and Technology Day this November 10.

"We're one of the most active alumni associations on campus," says Hagford. "We need young people to provide ideas, energy and drive to the society. Last spring we had a series of luncheons for alumni with speakers talking about company politics. We hope to continue these in the future and start more programs for alumni as well as students."

Seniors should be getting membership information in the mail very soon. A one-year membership costs $12.50, a lifetime membership is $175.

The 3M program and Science and Technology Day have developed out of the Society's concern for providing student engineers with an association and special information helpful in career planning and development.

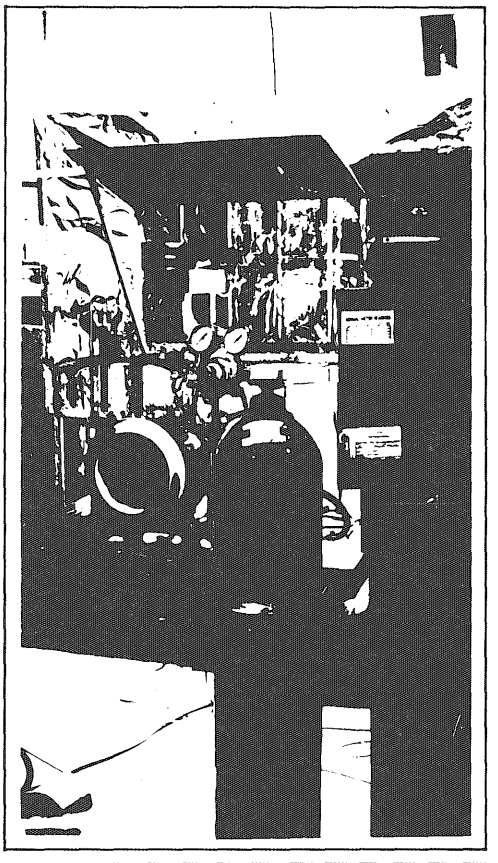
"We want to be visible to students," says Hagford. "And we would like to what the students want from industry."

> "Many people think the Alumni Society is a bunch of guys in raccoon coats that go to Gopher games and wave pennants. But we're not a social organization. We're an organization designed to serve the students, former students and the school."
>
> —**Dave Hagford**

If the "engineer advising" program works out it may be expanded to include representatives from Honeywell Inc., Fluidyne Engineering Corp., and Sperry Univac.

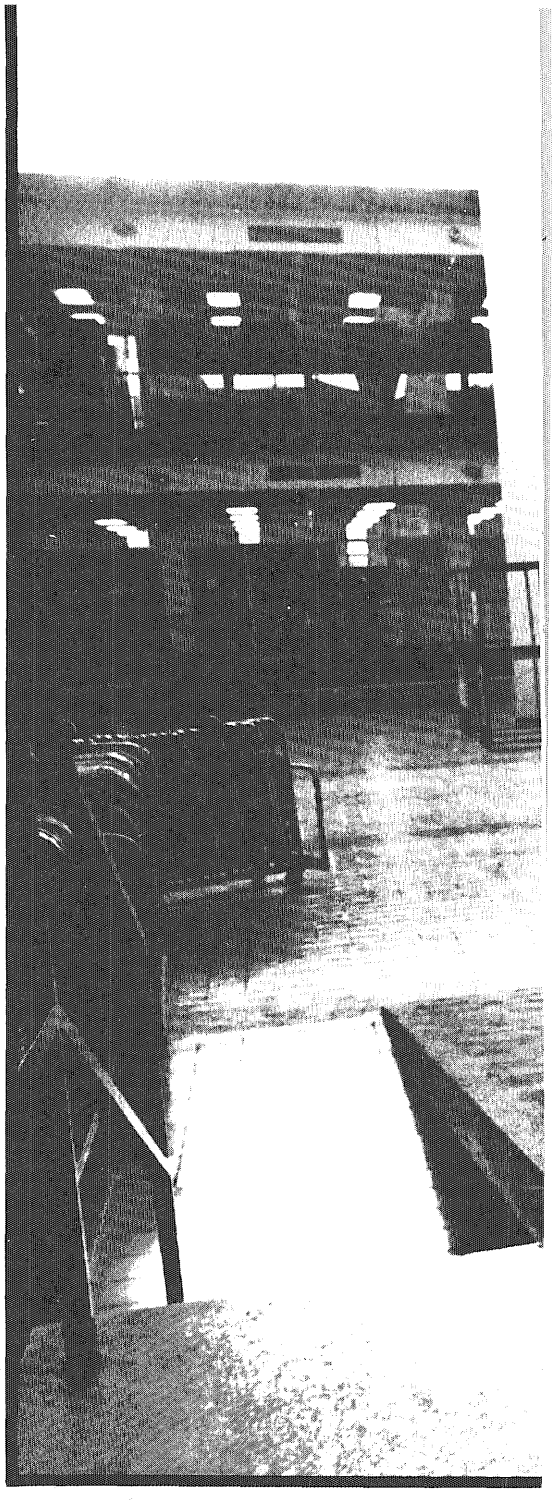
Science and Technology Day will consist of a series of seminars by leaders in industry and instructors from the University. The theme is Emerging High Impact Technologies. Seminar topics include: Machine Perception, about building perception into machines, Computer Speech, Industrial Robots' Use in the Auto Industry and Computer Vision.

The seminars will take place in the Coffman Union Theatre Lecture Hall from 1:30 to 4:30 p.m., Nov. 10 and are free to anyone interested. The seminars will be followed by a $12 a plate dinner at the Radisson South where the keynote speaker will be William C. Norris, chairman of the board of Control Data Corporation. Mr. Norris will speak on Emerging Nations and Minnesota Technology. Ticket information is available at the University Alumni Association's offices at 2610 University Ave., St. Paul, MN 55114, 373-2466.



ITEMS

Part Two



TOWARD A BETTER I.T. FOR THE DISABLED:

AN EDITORIAL—

EDITOR'S NOTE: In the course of research for Part II of this series, a unique aspect of the road toward compliance with federal regulations regarding treatment of the disabled in public institutions surfaced. Therefore, the statistical look at funding and closer examination of the University's positive efforts toward this end will be presented in a later issue of Technolog.

By Jon Kavanaugh

A friend of mine, Gary has experienced the kind of pain, disappointment and frustration most of never encounter but once or twice in a lifetime.

Permanently disabled from birth because of a spinal malady, Gary began life at a slower pace than normal, healthy children, along with a lifetime guarantee of long hospital stays, chronic kidney ailments and misunderstandings with friends and teachers not willing to accept the delicacies of a handicapped person.

Sad? Yes. But Gary would break my jaw if I were to continue this line of sympathetic writing. That's because Gary, who's never walked, never danced, never jogged around Lake of the Isles, doesn't sit around in his wheelchair drinking sympathy cocktails. He works fulltime. He drives a car with hand controls. He plays a mean 12-string guitar. He bowls from his chair and often. He plays basketball. He swims. He fishes. He travels. He studies. He holds his own at the neighborhood pub. He wheels himself tirelessly, it appears, through every day. Last year, he finished a nine-month hospital stay, barely without complaint, the nurses said.

Gary is special. People say he has a good attitude. And who would argue? It's kept him vivaciously alive for his 28 years.

Another friend I haven't seen for a number of years. Ed is blind. When he transferred to my high school he was frightened of the 2,500 students all living life at high school's fastest pace. Dating, going to sporting events, vieing for prom queen. But that didn't stop Ed. He, too, learned to cope. Swimming, wrestling, saxophone, choir, debate, wise cracks, romance, straight A's. Nothing could keep Ed from doing and being anything he set his mind to. A good friend? One day I was competing in a cross country championship event across town from the school. Ed, who had never been to that part of town, was there to offer congratulations at the finish line. He had no guide dog, no companion to lead him to the park. People say he has a good attitude.

I met another example of humanity extraordinaire just a few months ago at this University. He said he discovered early on in his college career that he suffers from a learning disability that impairs his ability to process some information in his brain as quickly as others. He couldn't always make snap decisions on some problems. He sometimes forgot letters in words. Talking with him, you

Photo/Dave Bissonnette

> **People say he has a good ATTITUDE.**

don't notice any outward signs of disability. He works parttime at a job in his field of study. He has even been praised for his attention to detail, his high perceptual ability. He, too, has a good attitude, but some of his teachers have told him he shouldn't be in college because he takes a little longer to do the homework. Sometimes he needs to use a textbook that presents the same information for a particular course in a more orderly manner.

Well, the bottom line on this long-winded introduction is about "attitude readjustment." Because soon federal regulations take effect guaranteeing the rights of students and professionals with various disabilities. At Minnesota the work toward compliance with federal regulations has begun satisfyingly well. One thing Congress can't do, however, is legislate attitude. It can't be quantified, it certainly can't be legalized. Therefore, individual responsibility is necessary to readjust our attitudes toward treatment of the handicapped.

The word by itself has some uncomfortable memories leftover from grade school and parent/teacher conferences.

"Jon is basically doing very well but he could be doing better...he seems to have a poor attitude about mathematics." Or in some businesses, sick days get cynically dubbed "Attitude readjustment days," or "getting one's shit together days."

By 1980, Section 504 of the federal Education Act will be totally in effect. While the legal aspects of 504 have been outlined in the previous article (Spring II **Technolog**), here is brief summary of the law as it applies to education at Minnesota.

•No student shall be denied access to a program or college or activity because of physical access. That means ramps, rest stops and classrooms will have to be structurally revised to accommodate wheelchairs and other forms of physical aids. Not all rooms and buildings will have to accessible but rather in cases where classes are currently being held in restricted environments, a section of that course must be rescheduled in an accessible building. Furthermore, the new setting must be created with the most integrated situation feasible so that special classes aren't disability-only classes.

•Learning aids must be provided for or allowed in classrooms such as tape recorders, interpreters, braille equipment, guide dogs, alternative textbooks and for some alternative testing modes—whatever is needed to guarantee equal educational access for the disabled.

•Any programmatic changes, however, must be made without compromising Grade Point Average and standards of admission for the disabled. Some adjustments may be made, however, in the amount of time required to complete certain assignments and the method of presentation of some material may be modified. Some learning disabled students, for example, have extraordinarily high I.Q.'s but are unable to pass written exams because of the volume of information presented on one sheet. Given the same questions orally, however, the answers come as

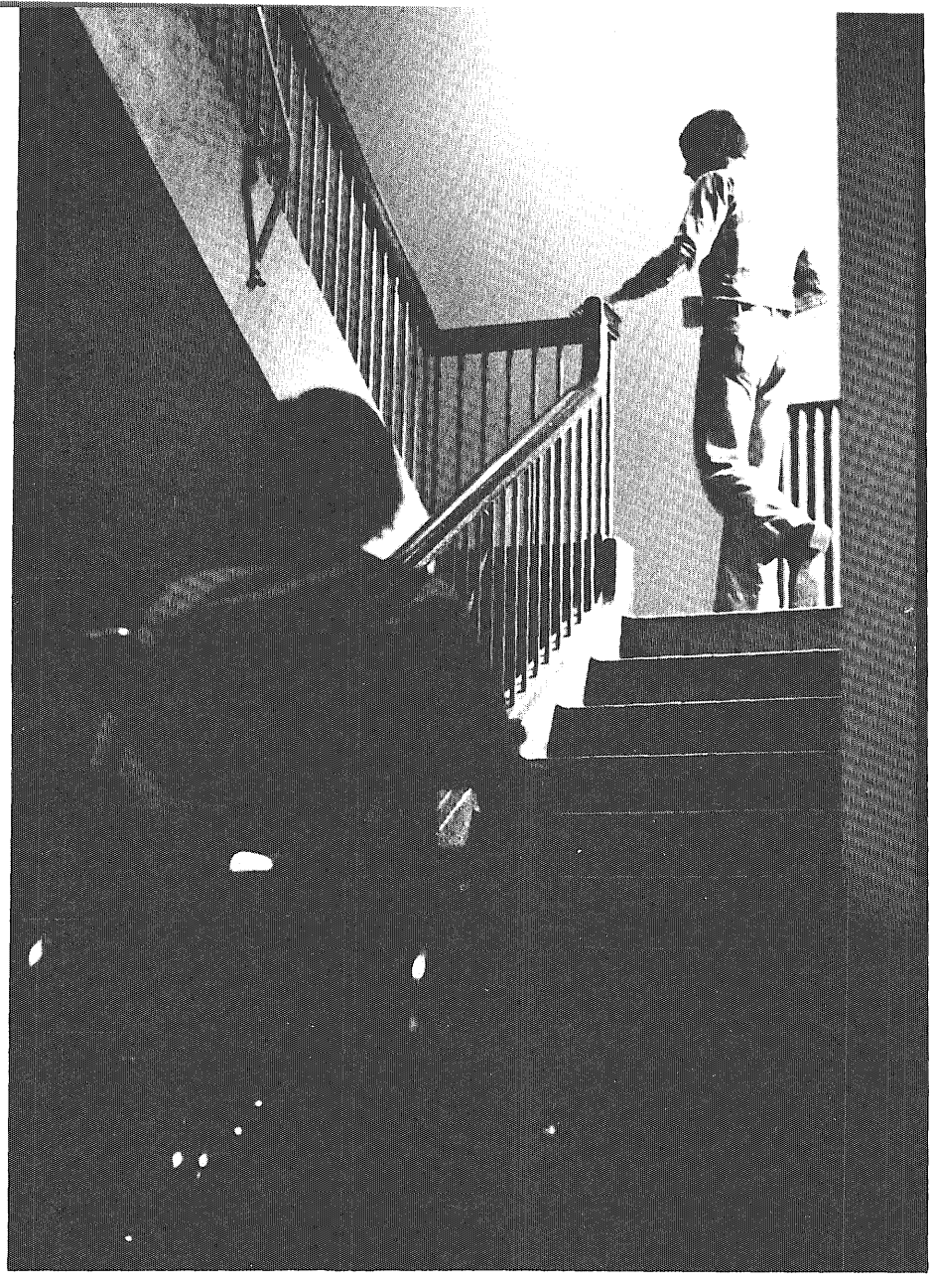


Photo / Dave Bissonnette

easily as the degree to which it was learned.

All of these modifications will, or have become a reality at Minnesota as administrative and physical planning departments work toward compliance.

In fact, the University as a whole has acted swiftly toward compliance, appointing a resource coordinator to handle specific access and programmatic problems, working with physical planning personnel to solve structural/funding problems and more.

While this effort is a glowing light at the end of the compliance tunnel the same fact remains: Laws don't regulate attitudes.

And interviews with both disabled students and faculty reveal a strong attitude problem. It stacks up as this: unwillingness to spend time and precious departmental money to accommodate a few students; disbelief in students diagnosed to have learning disabilities; unwillingness to substitute textbooks not their own writing and on and on with other attitudinal, cooperational roadblocks.

Certainly with this kind of counterproductive attitude toward the disabled, readjustment is necessary.

The Unicorns, an organization established to promote awareness of the realities of disabled students problems deserves praise.

Beyond that, however, the responsibility lies with the professors, instructors and teaching assistants in the University and I.T.

For teachers: be a teacher first, a researcher second, a fund allocator last. The learning disabled as well as the hearing-, visually- and mobility-impaired must have the progressive, positive attitude of professionals working for them, not against them. Preparing alternative tests, allowing for time considerations which do not compromise excellence or allocating funds for special programs is, of course, not cost-efficient nor time-efficient but a teaching and social responsibility. Without a positive teaching attitude toward the disabled that are eager to learn, intellectual growth for these important future leaders in science is only a dream.

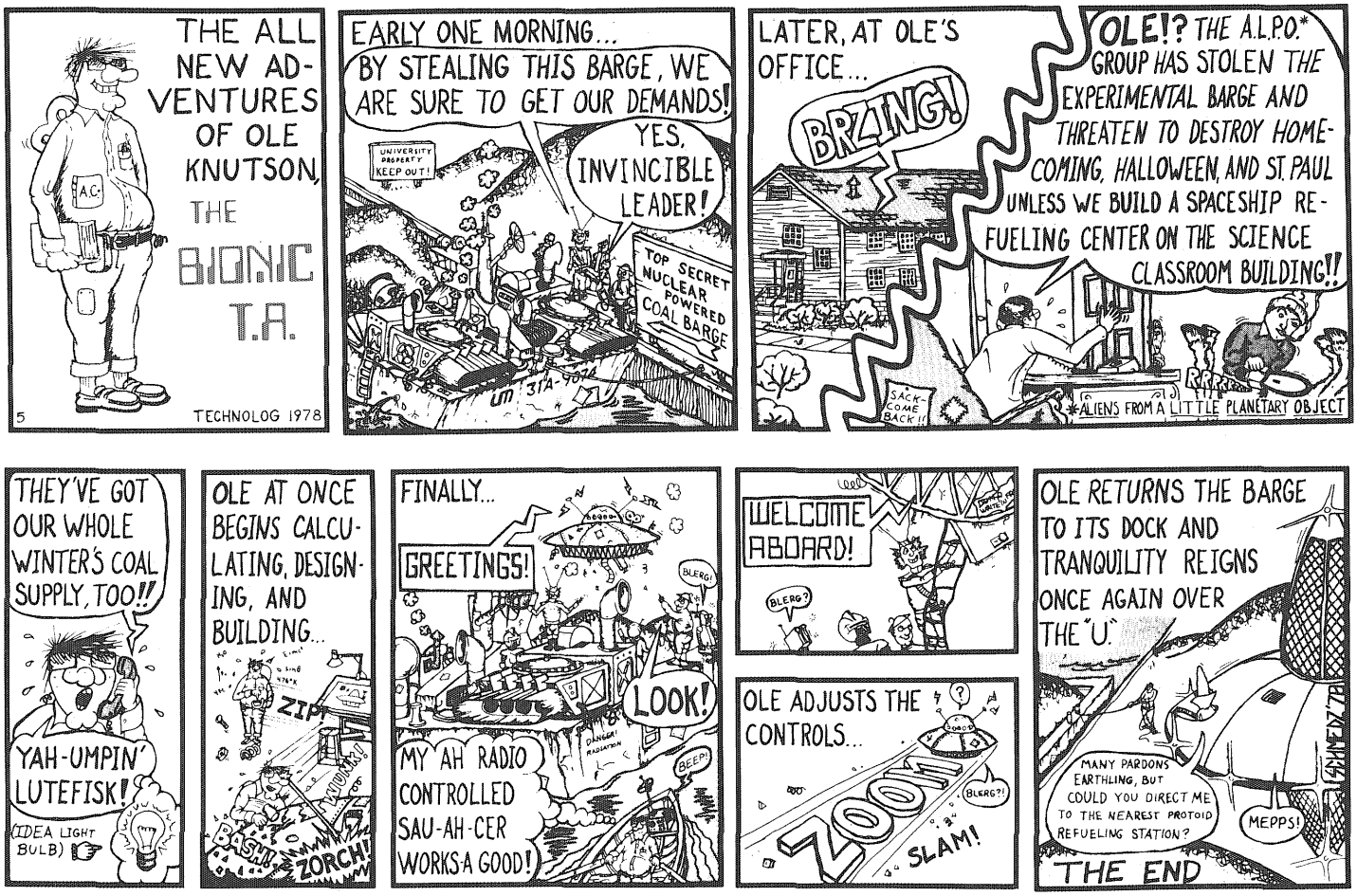
For advisors: certainly for the majority of disabled persons, arriving at Minnesota to learn means having overcome great physical and cultural barriers. To defeat that effort through poor attitude, disbelief that a problem exists; to defend the rights of only the physically strong, the mentally "perfect," is a disservice to society and education as a whole, one that certainly does coincide with the goals and objectives carefully printed in the front of every University class bulletin.

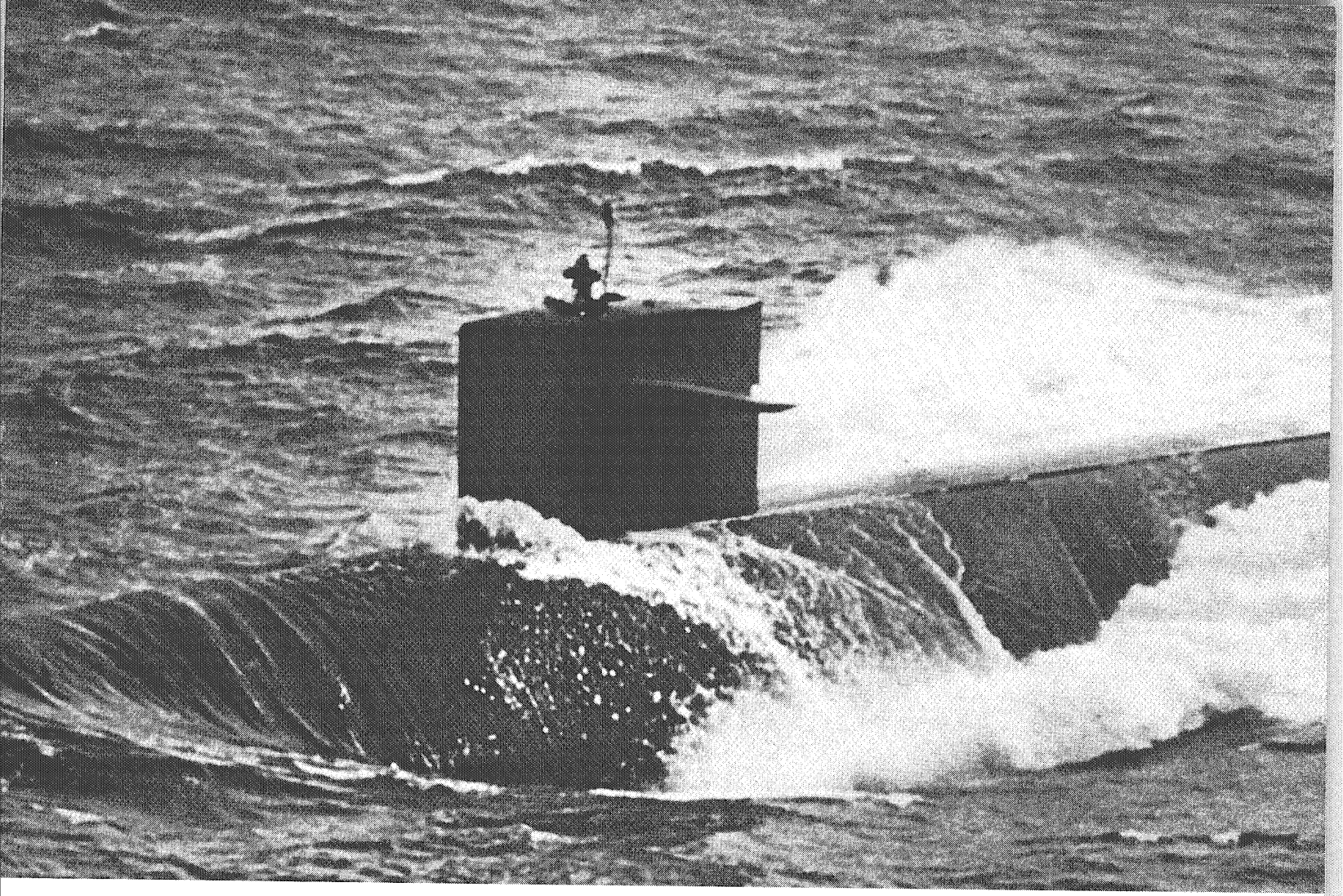
The strength of American society and certainly its educational and social programs lie in the assumption that everyone deserves a chance, and another and another. The positive mental attitudes of those with special crosses to bear only fuels a spirit to do great things with the mind and body; for self and society. To deny opportunity, to deny the same positive teaching attitude because it's not as convenient or costs a little more time and funding for alternatives, is to hope for the strength of a healthy master race only and the victory of survival of the fittest.

Historically the achievements in science and the day to day work of people in technical areas hasn't developed out of a respect for social Darwinism, but through the strength of hope, of the will and cooperation of healthy minds, irregardless of physical disability.

As Section 504 changes the access and programmatic obligations of the University, so must the teaching leaders of the University and especially I.T., provide for personal attitude readjustment.

Perhaps soon the Statement on Human Rights found in the I.T. Bulletin will include specific mention of the equality of opportunity for the disabled; and that they in turn will find that opportunity unig paired within.





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4. *Stephanie B.* Medical systems service engineering. Installation and test of new hospital radiographic and fluoroscopic x-ray system.
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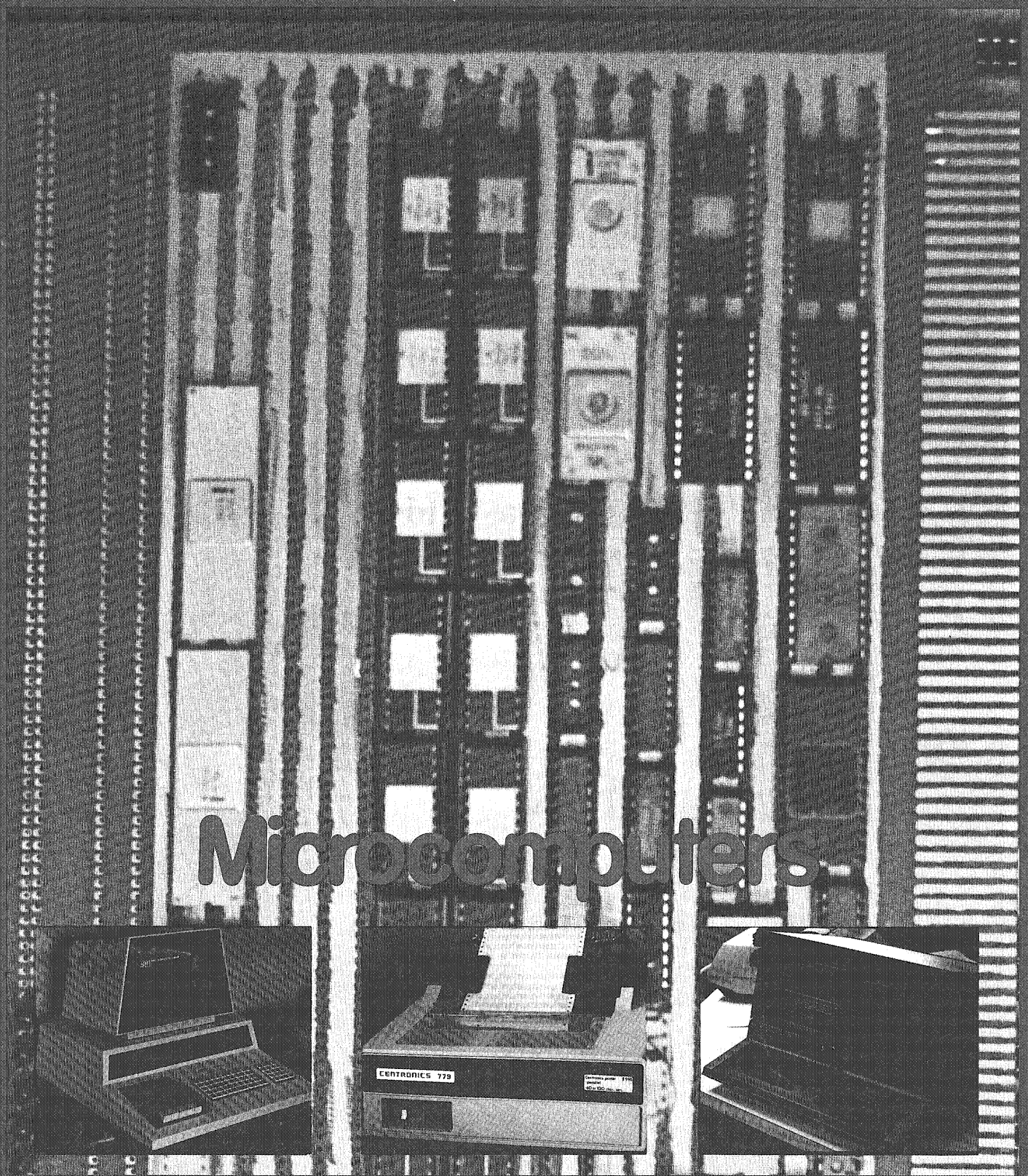

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"Du Pont is a big company but it's broken down into satellites. So you don't get lost in a big-company atmosphere. It's very personal, and I think the people are top-notch.

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Editor's Log

For many who attended Science and Technology Day events at the Radisson South recently, it was the first opportunity to meet and hear Roger Staehle, I.T.'s newly elected dean. To the industry representatives, students and alumni attending the I.T. Alumni Association's 40th Annual Meeting, Staehle outlined some of his goals he plans to achieve as dean.

He spoke often of striving for people-oriented programs in education and training in an atmosphere he calls a "people-oriented state." That is, an emphasis on technical education not for the sake of industry and technology alone, but science for people as the recipients of technology's fruits. He also stressed a desire to oversee teaching excellence to the extent that it is not only present in technical areas; rather it should stem to teaching of writing and speaking skills to I.T. students, skills he feels are crucial for future engineers toward achieving a truly people-oriented scientific community.

In a four-point address Staehle emphasized the need to increase the present 12 million research and development budget despite more Proposition 13's, inflation and probable funding battles with the state legislature. He presented these points in calling for a strengthening of the relationship between I.T. and industry to accommodate industry need; to fulfill society's goals at the same time. To achieve all of this more R&D money is necessary, more buildings need to be built for I.T. and education in postgraduate professionalism to deal with ethics and conduct need to be addressed.

Listening to Staehle is inspirational; he generates a sense of forward movement, of progress for I.T. Because Staehle spoke just three days following months of general election campaign rhetoric, what anyone says in public is taken with a grain of salt. Like Rudy Boschwitz, Al Quie and David Durenberger, who promised much in their campaigns, Staehle will have to take the test of time and I.T. will have to wait and see what progress Staehle will be able to nurture once he assumes the dean's office.

Staehle comes to Minnesota Feb. 1 with the finest credentials, the ingredients to promote change, to improve, to move ahead. He also comes with an outwardly impressive positive attitude toward I.T. and Minnesota. We welcome him graciously.

Jon Kavanaugh

Editor

minnesota
TECHNOLOG

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Staff

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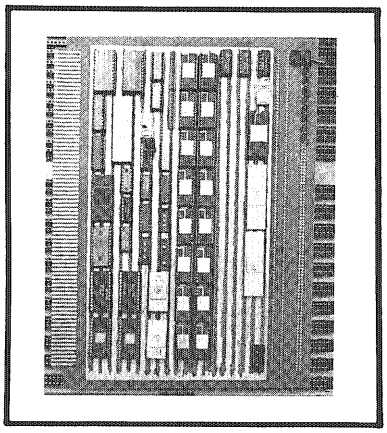

Cover photos by **Mike Dorn**

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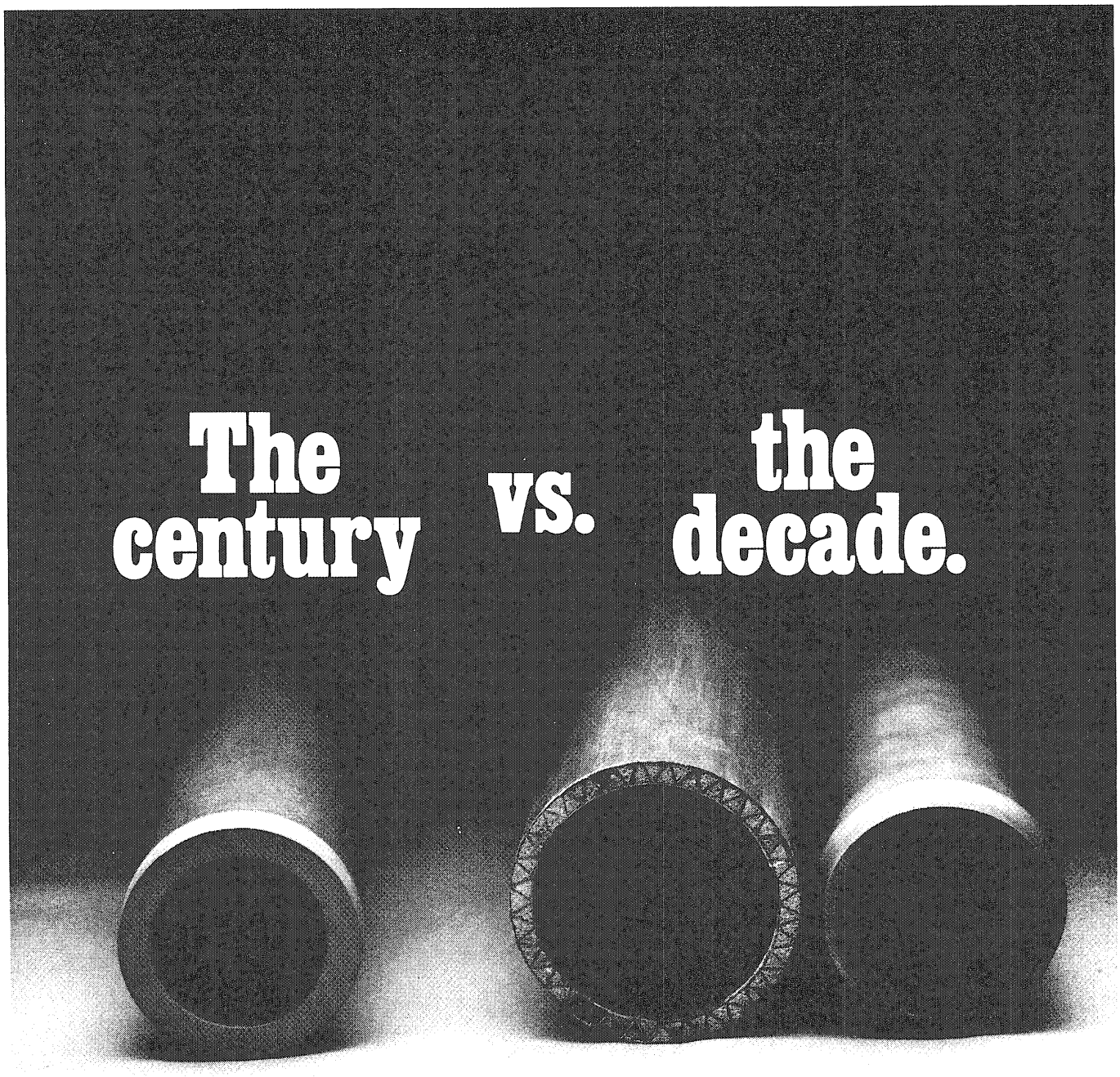

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Log Ledger

Home Energy Conservation Claims Disproved

Claims that masonry construction saves energy because of its "mass" have been disproved in a study by the U. of Pittsburgh.

Mass of external insulated walls has little effect on the annual amount of required energy, said Drs. William Rudoy and Richard S. Dougall of the university.

The report points out that since heating and cooling single-family houses uses about 12 percent of the total energy required in the U.S., housing construction offers a significant opportunity for energy conservation. But the study found that the thermal mass of the wall does not significantly affect the combined heating and cooling energy requirements of good thermal quality residential construction.

New Publication Announced

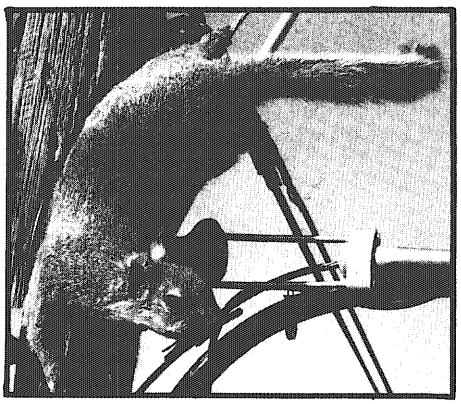
The first Solar Engineering Master Catalog and Solar Industry Index by Solar Engineering Publishers, Inc. is now available. Entitled SEM 1978-79, the catalog is a comprehensive guide to solar manufacturers and products, published in cooperation with the Solar Energy Industries Association. Contains over 350 product categories and incorporates the new Construction Specifications Institute indexing system for solar components and systems.

Travel Opportunity

Architecture students may study Mayan civilization and architecture on location during winter break, Dec. 16-24. Students may receive academic credit' while studying archaelogical sites at Chichenitza, Uxmal, Tulum and Coba. Call the International Study and Travel Center at 373-0180.

Bell System Clamps Down on Cable-Chewing Rodents and Birds

Telephone wire and cable may be harder to squirrel away than nuts, but that doesn't matter to the squirrels. They still attack telephone lines with relish. So do woodpeckers, gophers, rats and other rodents. Collectively, they peck and chew wire and cable by the mile, and their bite on the Bell System amounts to hundreds of thousands of dollars damage annually.



To put a polite stop to this expensive snacking, Bell Laboratories' engineers in Atlanta have developed a new guard that shields aerial cable from woodpeckers and rodents. The triangular guard is designed to slip over telephone cable. Because of its shape, it prevents animals from getting the best bite on the cable, and thus reduces damage.

The new guard is installed in half the time of previous guards and it is expected to last twice as long.

Unusual Satellite Data—A black hole?

Data from an American-British-European satellite, the International Ultraviolet Explorer (IUE), suggest the possibility of a massive black hole at the center of some groups of stars in our galaxy called globular clusters.

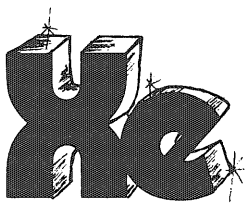
Six of these clusters, three of them X-ray sources, have been the subject of close examination by a group of scientists headed by Dr. Herbert Gursky and Dr. Andrea Dupree, both of the Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.

IUE was launched by NASA into a modified synchronous orbit near the equator last January. Dr. Gursky says the onboard ultraviolet instrumentation provided surprises by being able to penetrate the background denseness of the clusters 15,000 light years away so they could actually see to the core.

According to Dr. Gursky, there is probably radiation from a group of 10 to 20 bright blue stars that orbit the core. "These stars may well be orbiting a massive black hole the size or mass of one thousand solar systems."

New Publication

United Technologies, Hartford, Conn., announces a new publication, **Technology in Brief.** Edited by Ron Benrey, the newsletter format follows a theme issue approach, including informative graphics, photography and interesting technical reading. In the first issue: "Quiet Power: Technology for quieter jet engines moves from the test to the flight line."



Cornell University scientists, by applying tremendous pressure, have, for the first time, made xenon, the rarest of the stable rare gases, into a metal. David A. Nelson, Jr., and Prof. Arthur L. Ruoff, of the Department of Materials Science and Engineering, reported pressures of 320,000 atmospheres applied to solid

xenon at -241 degrees Celsius produced this new metal.

—NASA News

Career Planning Series Continues

The I.T. Alumni Society is sponsoring a series of high-content, time-intensive lunch hour programs, focusing on the realities of career planning. Two seminars remain to be held at the Sheraton Airport Inn, Hwy. 494 and 24th Ave. S., Bloomington. Cost is $6.50 per person per program. Call 373-2466 for reservations.

Engineering Job Market Best Since 1960

Engineering enrollments are up again for the fourth consecutive year since reaching a 20 year low in 1973, according to a 1977 study completed by the Engineering Manpower Commission of Engineers Joint Council. The study showed that freshmen enrollments reached 88,780, the largest ever recorded and almost 8 percent above the 1976 high.

The number of sophomores and juniors also increased significantly. Fourth year students overall increased in number more than 16 percent while the number of women and black seniors increased 64 and 23 percent respectively. Graduate engineering enrollments increased by almost 8 percent.

An analysis by curriculum indicates electrical engineering to be most popular followed by mechanical and civil. Chemical engineering is most popular among women.

U.S. POSTAL SERVICE
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(Required by 39 U.S.C. 3685)

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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.

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AD ASTRA!

By Bruce Kvam

Building worlds is a tough job. Building coherent, consistent and locally sound worlds is an even tougher order, but that's the job of "hard" science fiction writers. Hard SF, as opposed to "soft" SF and fantasy, deals with the laws of the real universe, extrapolating current theories to their inevitable conclusions.

Science in SF began to fade just a bit in the sixties with writers like Harlan Ellison and others of the "New Wave," but the tradition started by Hal Clement, Isaac Asimov, Robert Heinlein and Arthur C. Clarke has been continued in the sixties by Larry Niven and now in the seventies by a new voice, John Varley.

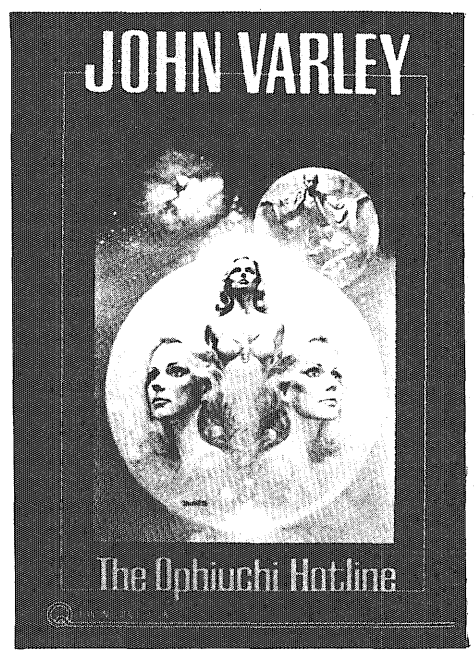
Like many writers, Varley has a future history. Developed in a collection of short stories, **The Persistence of Vision,** and in his first novel, **The Ophiuchi Hotline,** it is a drastically different future.

The Ophiuchi Hotline is a tight beam of radio waves emanating from the constellation Ophiuchus. It carries prodigious amounts of raw knowledge that humans find useful sometimes, most times not. Boss Tweed, the man who runs the moon whether he's in the office or not, uses some of the knowledge illegally to further his cause: to drive out the Invaders who forced mankind to flee the Earth for the moons and planets of the solar system. Tweed kidnaps one Lilo-Alexandr-Calypso just before her execution for committing genetic crimes against Luna.

But it's not **exactly** kidnapping. Tweed offers to replace Lilo with an illegally-cloned replicate so that it can be cast into The Hole in her place. Since he has the clone and a recording of Lilo's memory, she has no choice but to accept. For her reward, Lilo winds up on Poseidon, one of the dozens of moonlets of Jupiter to survey one of the playgrounds of the Invaders: the Jovian planet itself.

But all that free knowledge coming from the Hotline had to be too good to be true. There was a price attached to it that no one really knew mankind had to pay. And payment was past due.

> **"But the tradition started by Hal Clement, Isaac Asimov, Robert Heinlein and Arthur C. Clarke has been continued in the sixties by Larry Niven and now in the seventies by a new voice, John Varley."**

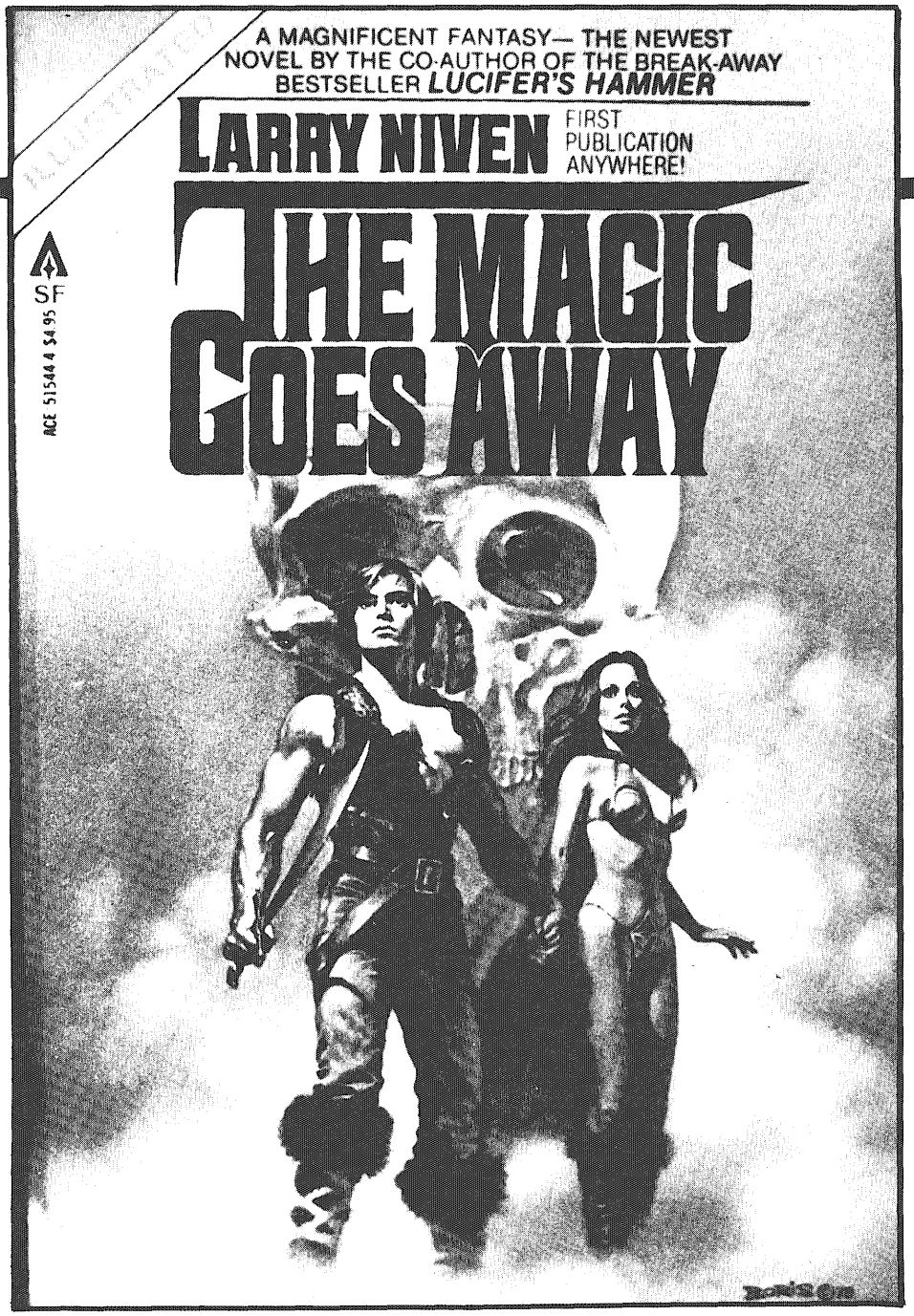


The Persistence of Vision contains many stories that expand on mino themes that pop up in **The Ophiuchi Hot line,** and as a collection it is very good. In fact, four of the nine stories were nominated for Hugos. Varley's stories portray a very harsh and strange reality, where doctors are mere mechanics, where you can change your sex as easily as your shoes, where mankind has no real home. But still, they are not depressing stories. There is hope in all of them.

Varley's **The Ophiuchi Hotline** was the first book of the Quantum SF series, a new line put out by Dial Press. A number of notable books have been published under the Quantum imprint, one of which is **The Far Call,** by Gordon R. Dickson.

The Far Call is the work of a man who deeply loves the space program. Dickson obviously spent much time in and around Cape Kennedy during the Apollo program. That experience enabled him to capture in the novel the ripples of tension that shimmer in the cape's clear air.

Riding a wave of phenomenal prosper-



ity, American initiates a multinational mission to Mars, manned by "marsnauts" from the USSR, Germany, Japan, Britain, India and the United States. Trouble is a sure thing when the 'nauts are severely overburdened by a work schedule imposed on them by bureaucrats out to get their political mileage from the mission.

Jens Wylie, U.S. Undersecretary for Space, does his best to help the 'nauts, but he is a rank amateur in the world of international intrigue: he says and does what he thinks is right.

Jens can't do enough, though. The mission's commander is caught outside by a solar flare while trying to repair the laser communications system, and it seems the 'nauts will be lucky to get home, much less all the way to Mars.

The Far Call is an intensely political book, grimly realistic in its portrayal of cut-throat diplomacy, but its message is the destination of mankind, as land was the destination of the fossil fishes.

The Magic Goes Away, by Larry Niven (Ace Books), is a sharp contrast to the previous three books, for it is fantasy. But, as is to be expected from a hard science fiction writer like Niven, **The Magic Goes Away** is not just fantasy; it's what you might call "logical fantasy."

Twelve thousand years before the birth of Christ, Atlantis is at its peak: werewolves, centaurs and dragons roam the land; and a sorcerer's life depends more on his ability to cast a spell than to swing a sword. Times change and magicians find their powers running down. The spells that ward off the tectonic instabilities below Atlantis lose their effectiveness and the city begins its slow descent into the waves. **Mana**, the source of all magical power, has come into short supply.

The Warlock, the magician who originally discovered the **mana** crisis, calls together a council of sorcerers to attempt to replenish the **mana** supply which is their life blood.

It is a sorry time indeed: only five magicians can make it to the council in Prissthil. In the face of skepticism and outright mockery the Warlock outlines his plans. To increase the dwindling supply he proposes to bring an entirely new source of **mana** to the earth: the moon.

Of course no one knows how to bring the moon down to the earth or has enough **mana** to do it, so the intrepid party (composed of one ancient Warlock, one clubfooted American, and one ravishing sorceress whose beauty varies linearly with the amount of **mana** in the region) sets off on a cloud, searching for the last reserve of **mana** on earth: the god of love and madness.

The Magic Goes Away is an interesting book in many ways. First, it's a large paperback, six by nine inches, with illus-

trations on literally every other page. Then there is Niven's concept of scientific sorcery, which follows the same rigorous rules of internal consistency that hard SF must follow. This provides for endless story ideas, and Niven **has** written other stories in what is called his Warlock series, which appear in the collections **The Flight of the Horse** and **All the Myriad Ways.**

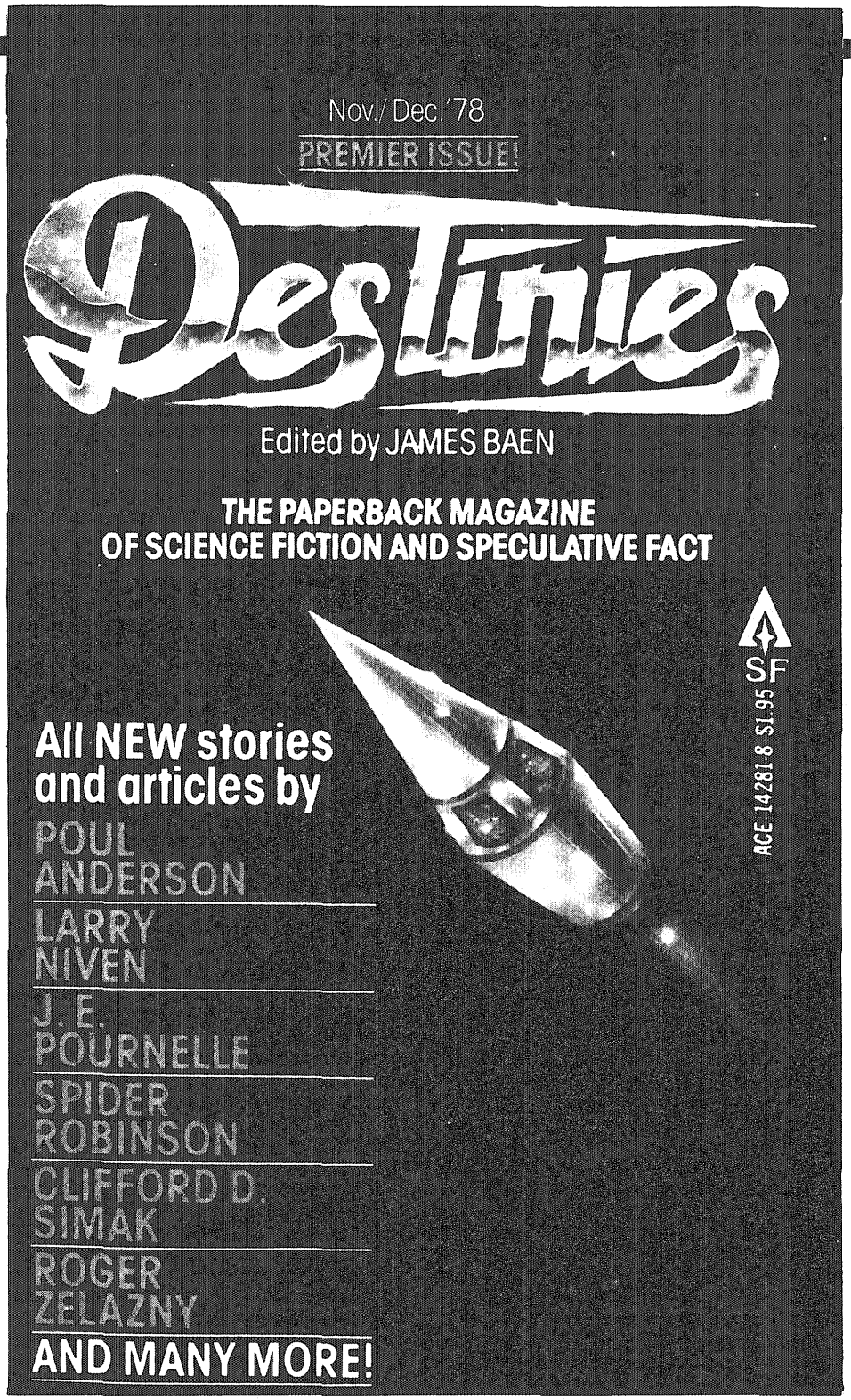
"

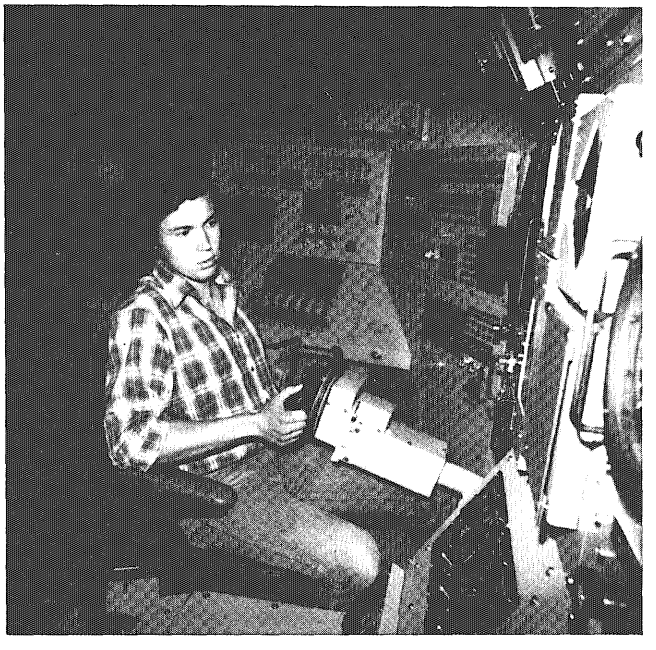
Ace Books has come out with a new SF magazine called Destinies. **It looks just like a paperback book, only it comes out on a bi-monthly basis.** Destinies **is headed by the same triumvirate that made** Galaxy **one of the better magazines before financial troubles muddied its waters. The only problem forseen for** Destinies **is its format. How well will a paperback magazine go over?**

"

Ace Books has been trying out a lot of new ideas under their new editor, Jim Baen, previously of **Galaxy.** Besides their illustrated editions (**The Magic Goes Away** is the second in a number of books that Ace will publish, lavishly illustrated), they've come out with a new SF magazine called **Destinies.**

Destinies looks just like paperback





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book, only it comes out on a bi-monthly basis. The Nov.-Dec. '78 issue contains a science column by Jerry Pournelle, a book review column by Spider Robinson, and the first in a series of articles on science in SF by Poul Anderson. There are also stories by Larry Niven, Clifford Simak, Roger Zelazny, Gregory Benford, Dean Ing and Charles Sheffield. **Destinies** is headed by the same triumvirate (Baen-Pournelle-Robinson) that made **Galaxy** one of the better magazines before financial troubles muddied its waters. The only problem foreseen for **Destinies** is its format. How well will a paperback magazine go over? It's so... uncategorizable. Good luck to **Destinies** just the same.

And I wish you the best of luck, too. The **Technolog**'s Annual Science Fiction Writing Contest is back again. Details on page 27.

The Ophiuchi Hotline
John Varley
Dial Press, $8.95

The Persistence of Vision
John Varley
Dial Press, $9.95

The Far Call
Gordon R. Dickson
Dial Press, $8.95

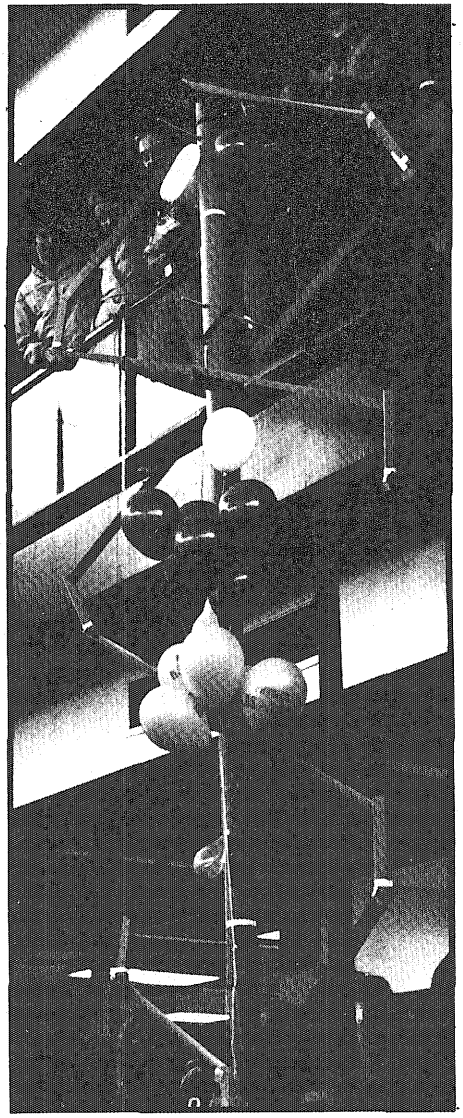
(Dell handles the Dial Quantum SF series in paperback)

The Magic Goes Away
Larry Niven
Ace Books, $4.95

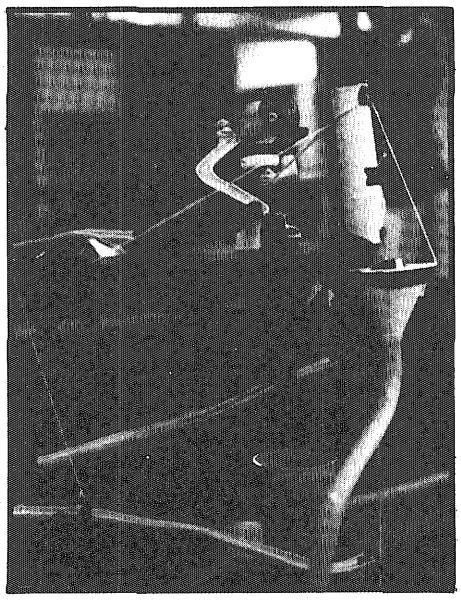
Destinies
James Baen, ed.,
Ace Books, $1.95

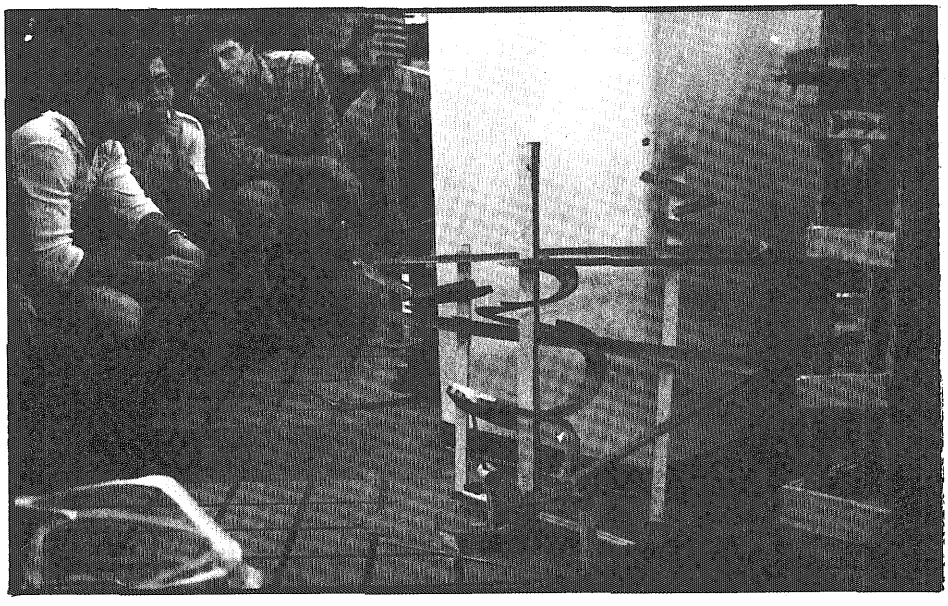
Marble Movers

Photos/Mike Dorn



One of the more interesting projects encountered by Architecture First Year Design students this quarter was not designing skyscrapers, a new stadium nor a shopping mall but rather—Marble Movers—the most innovative, intricate and functional ones possible. The results were demonstrated in Architecture Court Nov. 8. The demonstration was also a competition for coveted bottles of wine, supplied by the instructors. Among the winners: Terry Tarr, "Paper Airplane"; Jim Butler, "Waking Up in the Morning"; John Olsen, "Tribute to Farrah"; Steve Groth; Ross Asselstine, "Take Out the Trash and Bring Me a Banana"; and Kevin Thode, "Escape From Towering Inferno."





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SUPPORT SOFTWARE. Involved in compiler, assembler and simulator development, as well as system utilities and software development tools. Support effort is related to large IBM processors, micro-processors, and mini computers systems.

DATA BASE SOFTWARE. Responsible for logical and physical data base design and implementation related to telecommunications systems. Develop programs which automate the generation of data base contents for these systems.

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Microcomputers:
More and more to come

By Bruce Kvam

Microcomputers. They're here.

In your cassette deck, in your microwave oven, in your car's fuel injection system, in your thermostat—they're here. And more of them are on the way.

Microprocessors, computers on a chip, have a billion uses. Starting where the calculator boom left off, they may soon find their ways into more prominent places, sitting on the dining room table instead of skulking around in the garage or hiding behind the facade of a kitchen appliance.

According to Pal Asija of the Minnesota Computer Society, Radio Shack alone sells over 3,500 home computer systems a month. Taking into account all the other companies in the industry, we're talking about a lot of computers.

Will we eventually wind up with a computer in every pot? If the calculator example is to be followed, yes, but will it be that simple? Taking a look at what the microcomputer industry has to offer, bear in mind that nearly everything said here will be a lie in six months to a year. The microcomputer industry is very prone to change.

Roughly speaking, there are three types of microcomputers: hobby, home and business.

What follows is a look at each category in order of ascending cost.

Hobby Computers

Electronics hobbyists pioneered the microcomputer revolution. Building complete computer systems from scratch they showed how much a tiny computer could do, and that was a lot.

Pete Zechmeister, of the Micro Computer Group (MCG) built his computer from a pile of parts he collected over the years. If he were to duplicate it by going out and buying all the parts from various surplus markets, he could build a better machine for $200 to $300 or less. Prices on electronic components are dropping and probably will continue to do so.

Is it hard to build your own computer?

Zechmeister says all you do "is connect little black boxes." There's more to it than that, but essentially it's a simple process.

He designed his own computer, but anyone with a little knowledge of electronics could find the necessary diagrams and, after a bit of puzzling, could put together his or her own system.

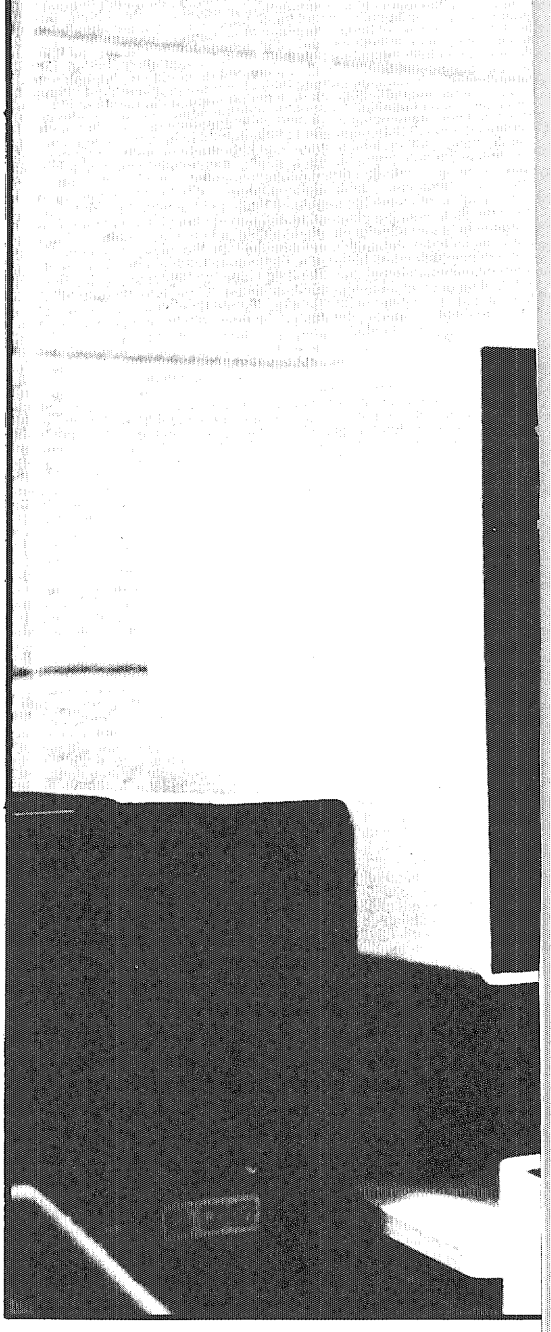
> **Will we eventually wind up with a computer in every pot? If the calculator example is to be followed, yes, but will it be that simple?**

To someone who is used to the monster computers the university uses, Zechmeister's achievement would seem a very modest one. But that's not the point. One of the tenets of computer science (in paraphrase), set by Alan M. Turing in 1936, states that Pete Zechmeister's 8080 can do anything Control Data's Star 100 can do—only slower.

Home Computers

Home computers, unlike hobby computers, are for those who don't know the first thing about electronics and who don't want to know.

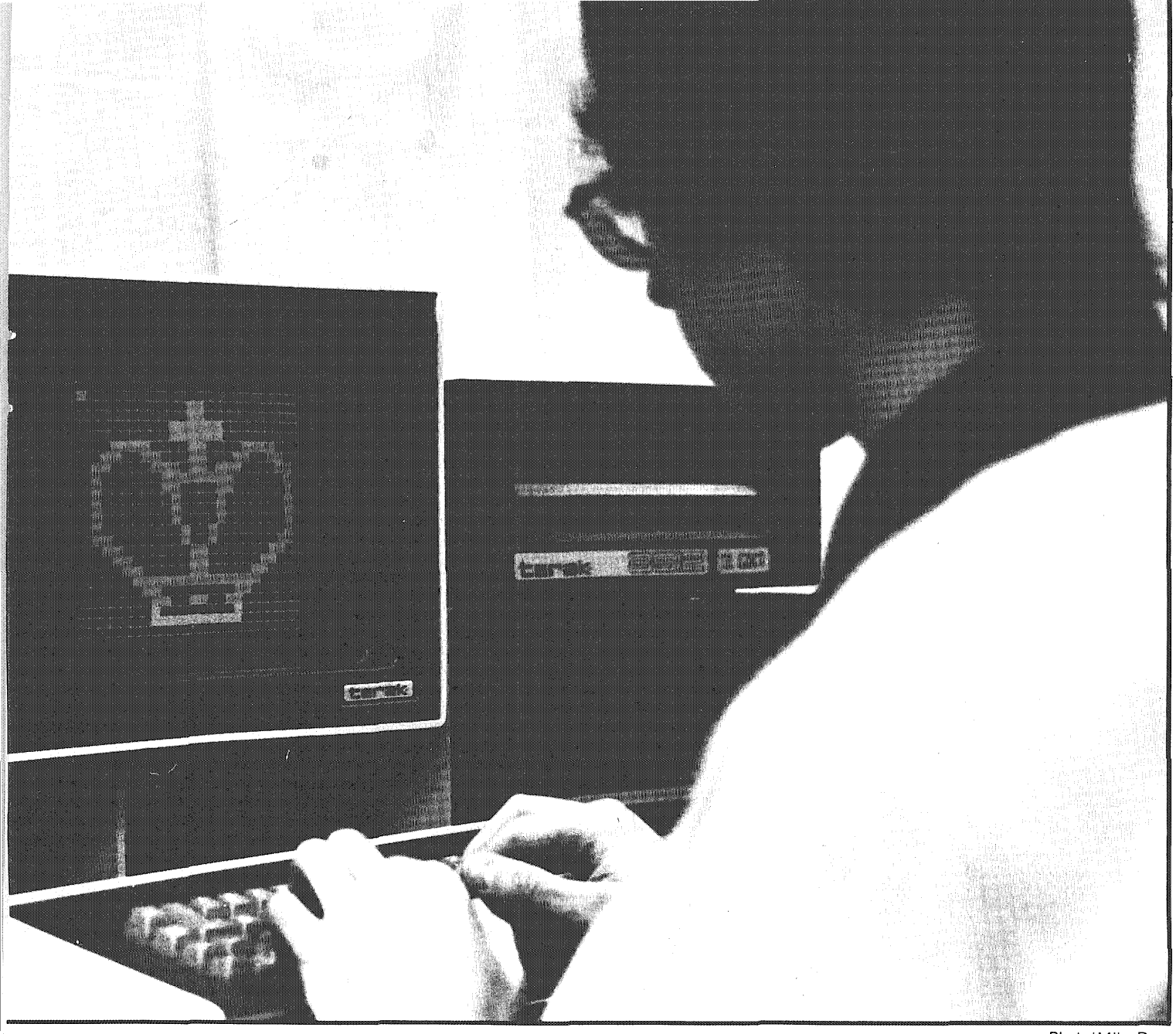
This is the process: you walk into your local Radio Shack store, plop down your $599, lug home your TRS-80, plug it in and play Star Trek. That's all there's to it.



These machines boast some nice graphics, though 600 bucks seems a bit steep for a Star Trek game. But that's the difference between the home video games that hit the market a couple of years ago and the home computer today. Those video games were single-use items, capable only of game playing. But the computer has infinitely many applications, from preparing your taxes to teaching children how to spell.

Business Computers

One of the primary influences in the expansion of American business worldwide has been its use of computers. You see it every day, with those personalized junk mailings and instant hotel and air-



Photo/ Mike Dorn

line reservation systems. But business takes its computers for granted. Small business, however, hasn't been able to invest the necessary million dollars for computing power.

Now, for $6,000-$10,000 you can get a complete business computer system, including floppy disk drives, high-quality printer, word processing system, general ledger and inventory programs —the whole works. You get all the advantages of computer-sized big business at a price two orders of magnitude less than what you would have had to pay five or ten years ago.

Who's buying these systems? Doctors, lawyers, farmers, plumbers, people from all walks of small business life who can find uses for a computer.

What Is A Micro?

Now let's backtrack a little and look more closely at the individual components of a microcomputer system.

A micro is composed of many of the same things a full-size computer is: a central processing unit, memory, input-output devices, mass storage devices and software. Comparing micro- and maxicomputers, however, is often inexact. The vast difference in size requires a very different philosophy, and often someone already familiar with large-scale computer systems will feel totally lost in the jargon-filled, hardware-oriented world of micros.

The CPU (Central Processing Unit) is the heart of the microcomputer. In a micro it usually fits on one chip, housed in a 40-pin, two-inch by one-inch package. The CPU itself is just millimeters across, but the need to connect the leads to external devices demands the large package.

This is the impetus for large scale integration: if you can contain more components on a single chip, you can reduce the total number of chips needed and especially the amount of interconnecting circuitry and ultimately the cost.

Most micros currently in use have eight-bit words (see the jargon vocabulary included with this article.) There are some 16-bit machines out, but they are still fairly expensive. The advantage of more bits per word is that it makes for a more flexible computer. For example, the largest integer that can be expressed in a single word on an eight-bit machine is 127 (255 if you don't care about negative numbers), while the largest

Why Microcomputers?

Microcomputerists are often defensive about their hobby and they try to unearth examples of the billions of uses of microcomputers. They can be used for keeping tax records, compiling recipe files, playing games, controlling the heat and lights in your house, generating mailing lists, editing manuscripts, just about anything you can think of.

But still, the question is pressed: What good are they?

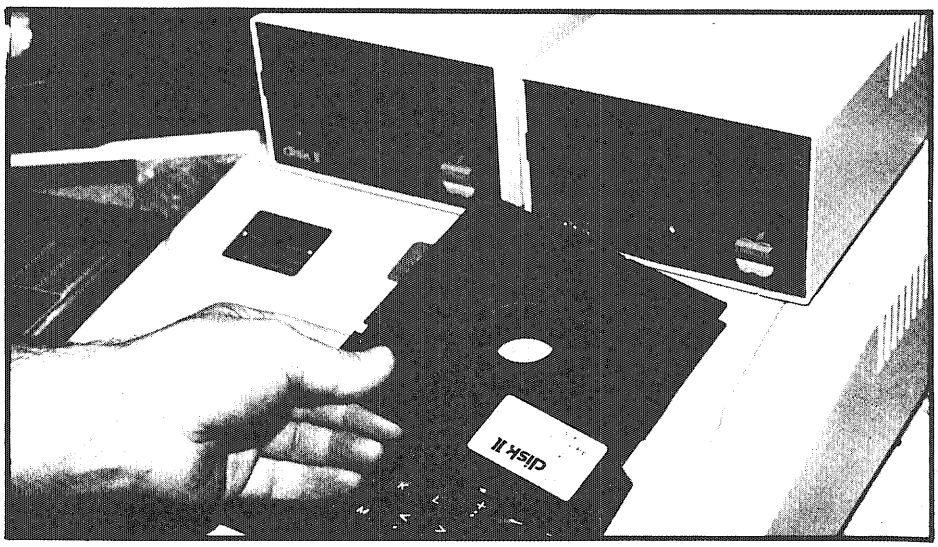
Try to list the uses of a stereo, or a dishwasher or an air conditioner or a microwave oven. It's difficult. The truth is, you can't defend these high-cost items on a utilitarian basis. But if you were to do so, a microcomputer would rank much higher than most of the items on our list of modern day "necessities." Their uses are limited only by the number in a 16-bit word is 32,767 (or 65,235).

Also, eight-bit machines traditionally never have operations such as multiplication built into the hardware. Programs must be written to perform those functions. Some 16-bit computers include integer multiplication and even floating point arithmetic, at a higher price, of course.

There are a number of memory types available for micros. They are all called by their acronyms, and you'll be lost without without a knowledge of the abbreviations.

The most important kind of memory is RAM (Random Access Memory). This is memory that holds the programs written by the user. It is usually measured in words or bytes. In an eight-bit machine a byte is the same as a word, eight bits. Sometimes bytes are six bits (as is the university's CDC 6400 computer), seven bits or eight bits.

A typical home computer system, then, will have 4K or 8K or 16K bytes of RAM. K stands for two to the tenth power, or 1024. Therefore, a 4K machine will have 4096 eight-bit words of storage.



Photos / Mike Dorn

Another kind of memory is ROM (Read Only Memory). ROM is used to store special system programs, such as the monitor (the program that listens to the user whenever the computer is idle) and the BASIC intepreter that runs user programs. When you turn your computer off, anything that is in RAM will be lost, but ROM will not forget. ROM's basic usefulness is that it obviates the need to load a program from cassette tape every time you want to use it.

PROM and EPROM are special cases of ROM. They allow the user to program his own ROM. Once you program a PROM (Programmable Read Only Memory), any bugs you find in the program are there to stay. Erasable PROM allows the user to fix those bugs and reprogram the EPRO.

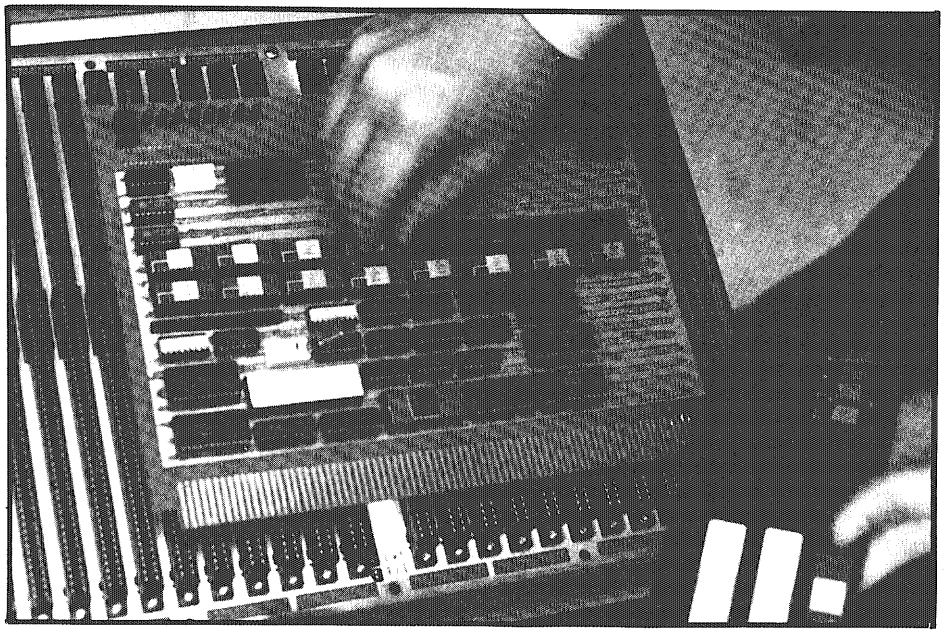
Input and output devices form a very diverse category of microcomputer system components. They range from calculator-like displays and keypads to several-thousand dollar high quality impact printers.

The basic input device for a micro is the typewriter keyboard, the output device being the television screen. Some micros come with the screen built in (like the Pet); others require you to hook up your TV set (like the Apple).

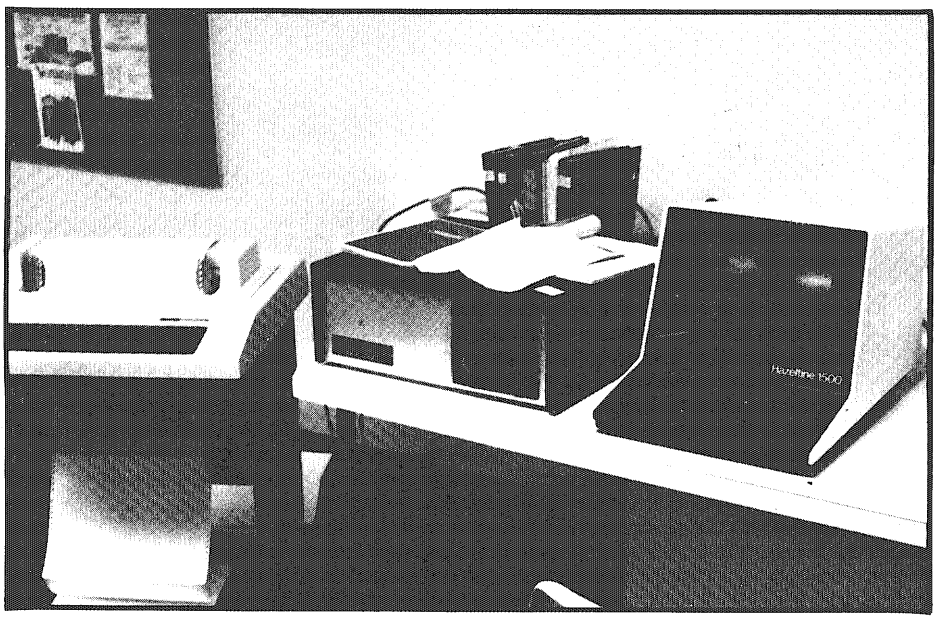
When you type in a hundred-line program, you're going to be mighty sorry to see it go away when you turn off the power, so you need a way to save your programs for posterity. The typical device for this purpose is the ubiquitous cassette tape recorder.

The main problem is that cassette recorders were not made for digital data storage. They were, however, made for recording analog signals, and poor-quality analog signals at that. They are horrendously slow and unreliable, but they **are** cheap and they **are** universal.

A much more satisfactory solution is the floppy disk drive. A floppy disk is a sheet of magnetic material, very much like a record, housed in a protective covering about six inches square. Floppy disks come in two sizes: the minifloppy, which can store about 70K bytes, and the regular floppy (eight inches across), which can store about 250 K bytes. The advantage of floppies is that you can get at any piece of information on the disk in less than a second. But a floppy drive costs about $500 to $1000 and requires at least 8K to 16K of RAM to run—an



Left: A complete Apple II computer system, with two floppy drives, keyboard computer, cassette recorder and TV monitor. **Below:** A business system, with CRT, DECwriter and North Star computer. **Right:** Pete Zechmeister's 8080-based hobbyist computer.



expensive proposition.

Software consists of the programs that make the computer do what it does. There are packages available that allow the user to program in high level languages like BASIC, PASCAL, FORTRAN and COBOL, as well as machine language. Also, there is a growing body of pre-written programs for business applications, and of course, games.

Headaches

Any infant industry has its share of problems and microcomputers are no different. Unfortunately, there have been a lot of firms that have been less than honorable. So the first rule in buying a micro is: Be careful whom you buy from.

The second rule is: be prepared to wait. There are numerous horror stories of people paying for their micros and then not receiving them for up to a year, because of the tremendous backlog of orders. And then there are the companies that took orders and later folded, laughing all the way to the bank, and we hope, prison.

The situation isn't nearly as bad as that now. During visits to three computer stores, we were assured the waiting time on most systems had dropped to zero or at most one month. Of course, there are a lot of individual components that have long, long waiting lists, such as the floppy drives for the Apple II.

Perhaps the most monumental problem in the microcomputer industry is the lack of standardization and quality control.

In a micro, the bus is the channel across which information travels. It allows components of a computer system. The S-100 bus is usually called the industry standard, but it is not really standard, and it is not a very good bus.

The bottom line is component systems cost more. If you own a Radio Shack TRS-80, you have to buy memory that can be interfaced to the TRS-80. If you own an Apple II, you have to buy your floppy drives from Apple.

Be wary of buying something for which only one company supplies peripherals; you are at their mercy when it comes to price. There are a lot of adaptors out that enable interfacing to the S-100 bus, but they are always unsatisfactory. The biggest boon to microcomputerdom would be a standard that everyone could live with.

What many people don't realize when they buy their computer is that they have to write programs for it. Today, especially in the business area, there is a tremendous lack of good software. According to Tim Weldon of Computerland, about 50 percent of existing software is garbage. It's written, he says, by guys who go out and buy an Apple and then try to sell the programs in ads in the computer magazines. At Computerland they've had to throw out expensive software systems because they were so riddled with bugs that they were more trouble than they were worth.

At this point in time, the catch phrase is "buyer beware." But all is not sour grapes. There are a lot of good systems on the market, with people backing them up, willing to fix whatever's wrong, at a minimal charge or often without charge.

imaginations of their users.

Buying A Micro?

If you're thinking of buying a micro, think a long time. Then, consider your own needs. Do you want to be able to hook up marvelous devices like the Computalker, which will give your computer the power of speech? Then you may wish to buy an S-100 based system, for most specialized devices like the Computalker are S-100 compatible, as well as the less expensive memory and floppy drives.

Do you want to learn the basics of computer operation, without shelling out a thousand bucks? Then consider the KIM-1 or the Elf.

Do you want to put together your own system and have something fairly powerful when you're done? Look into the Southwest Technical Products' 6800 computer system.

Do you want spectacular graphics and game-playing ability? Look at the Apple.

Do you want to perform business applications? North Star, Imsai or Cromemco may be your choice. These are expensive systems aimed at the businessperson.

Before you run off and a buy a system, think of what you'll want in a year, or what will become available in that year. Microcomputers are a very dynamic field, with change a rampant phenomenon.

Where To Go, What To Do

There are a number of microcomputer dealers in the Twin Cities area.

Minnesota Micro Systems, on the West Bank, opened the beginning of last summer. They have a lot of nice systems, all of them on display, ranging from the Pet to the Cromemco, to show you what can be done with a micro.

Computerland, part of a national franchise, also opened for business this past summer. They cater to the businessperson and have a lot of high-powered systems in their showroom. They also carry the Apple II.

The Computer Depot, near Southdale, was the first computer store in the area. They have a mixture of home and business computers.

Team Electronics carries the Apple, and Frisch Computer Systems in St. Paul carries the Ohio Scientific line. Other outlets are sure to spring up in the near future.

If you want to get into micros, start reading the magazines, especially the advertisements. The more prominent national magazines include **Byte, Kilobaud, Creative Computing, Personal Computing** and **Interface Age.** These all contain articles on what you can do with your computer and reviews of products on the market. Often they will print listings of programs and hints for fixing your sick computer.

There are also a number of computer organizations in the area (see the list included with this article). They sponsor show and tell sessions, manufacturer's demonstrations and generally promote interaction between people.

Minnesota Micro Systems is running a series of classes teaching the basics of microcomputers. For the $20 registration fee you receive a $7.50 book and nine hours of instruction. There will be more classes scheduled for January, as demand dictates.

Then there are the users' groups. Each microprocessor has its own quirks, and groups are formed to exchange software for them. Once you've obtained a micro, look up one of these groups and let yourself in on some of the expertise others have developed with your particular machine.

The Future

Remember that microcomputers are infants. Like anything new, their full potential will not be recognized for some 10 to 20 years.

First, let's look at price.

There are two highly diverging views. Weldon of Computerland believes that the price of micros will go up from now on in pace with inflation. His reasoning is straightforward. The actual microprocessor is extremely cheap: you can buy a CPU chip for five bucks. But the cost of making that chip into a usable computer is high now and will increase because a complete computer system needs such attachments as keyboards, TV monitors, floppy disk drives, power supplies and the like. Those components are electric and mechanical in nature and not electronic. Therefore their prices will increase.

Pal Asija of the Minnesota Computer Society takes the opposite view. Comparing the computer industry to the calculator industry, he perceives that the complete home system will cost about $500 in five years, including those expensive floppies.

Microcomputers may also mean the demise of the post office. Imagine leaving your micro connected to the phone all the time. When you want to send a letter, you type it in and send it off. Immediately you receive confirmation from the receiver's micro and perhaps a message explaining where its master is. If the phone company alters its rate structure, eliminating the minimum time requirements on long distance phone calls, electronic mail may put the post office out business.

Looking toward the more immediate future, we may see the influx of 16 bit machines. Also, as cheaper methods of mass storage become available, such as magnetic bubble memories, expensive mechanical systems like floppy drives will either have to come down in price or become obsolete.

Microcomputer Jargon Vocabulary.

Bus: The channel through which data passes between different devices in a microcomputer system.
CPU: Central Processing Unit. The actual computer part of the microcomputer.
RAM: Random Access Memory. Memory used to store user programs.
ROM: Permanent memory for system programs.
EPROM: Erasable Programmable ROM.
PROM: Programmable ROM. Allows the user to develop his/her own system programs.
IO: Input/output
bit: A logical one or zero, the basic unit of information in a computer.
word: A collection of bits, in microcomputers, usually eight bits. Most of the time a word is the smallest addressable unit of memory.
byte: A character, in micros the same size as a word.
ASCII: The standard character code found in most micros.
LSI: Large Scale Integration, making micros possible.
BASIC: The high-level language found in most micros.

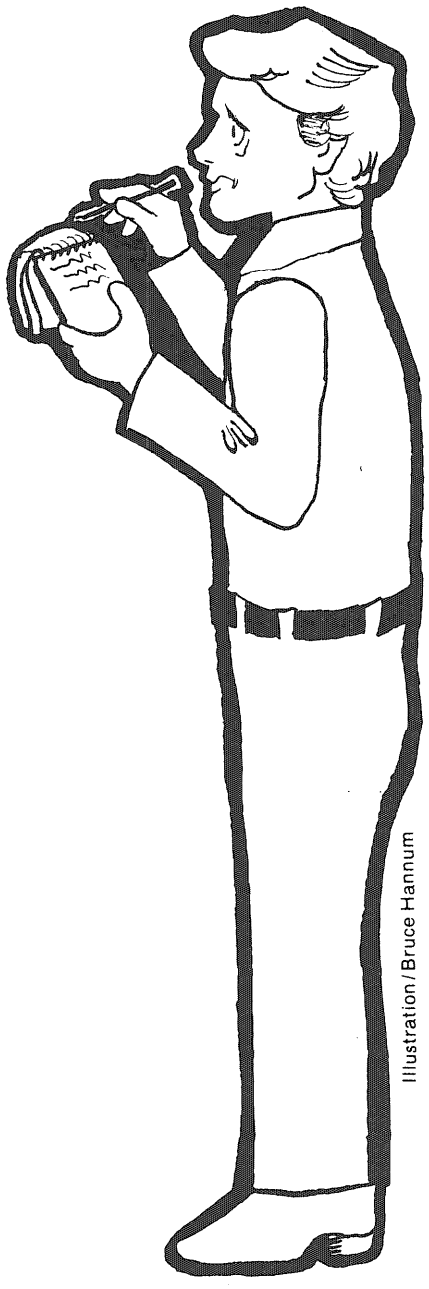


Illustration / Bruce Hannum

Engineers make good sports

By Hap Atwood and Bruce Hannum

A recent check of computer data sheets in the University of Minnesota's Co-Recreational sports office indicates that students of the Institute of Technology have a higher rate of participation in several sports activities compared to students in other colleges within the University. Of 21,871 total responses to a Rec-Sports Survey, I.T. students outranked the rest of the University colleges in the following sports:

	I.T.	University
Basketball	11.78%	9.45%
Bowling	6.67	5.82
Tennis	8.93	8.68
Touch Football	8.41	6.20

These intriguing figures prompted **Technolog** to investigate further to learn what other sports activities I.T. students are involved in.

At first we found a William W. Winchester III, a junior majoring in Projectile Velocity, stalking the elusive forestry student outside the Animal Husbandry Building on the St. Paul campus. We cornered him long enough to ask him a few questions:

Technolog: What is your favorite sport?

Winchester: Well, shoot, ah spend most of mah free time pursuin' the fine art of huntin'.

Technolog: How did you get interested in hunting?

Winchester: Well, mah daddy was a sergeant in the Marine Corps. Mah grandpa, may be you heard of him, W.F. Carver,

in the 1890s shot at 63,625 wooden balls which my grandma threw in front of him unrelentingly for six days and nights. He hit 58,819 of 'em.

Technolog: Amazing! How did he do it?

Winchester: Why he used the very gun ah'm holding in mah hands now, a .30 caliber Standard U.S. Army Ordinance Department rifle with a muzzle velocity of 4,840 m.p.h. Yep, it's hard to miss with this baby!

Technolog: What does this sport do for you?

Winchester: Unlike my grandpa, I don't shoot at l'il wooden balls. I prefer l'il furry animals. You have no conception of what it feels like to discharge a .30 caliber shell into their bodies as they gambol and folic. I enjoy reducing them to delightful, bloody pulps; I like to see their tiny limbs tossed...

Technolog: Uh, thank you Mr. Winchester.

Matt Kanvaski told the **Technolog** that his favorite sport was wrestling. When he isn't working on his major in Combinatorial Alogorithms he can be found at Lonnigan's 42nd Street gym. We asked him a few questions:

Technolog: Why wrestling?

Kanvaski: You talkin' to me?

Technolog: You are Matt Kanvaski, are you not?

Kanvaski: What's it to ya?

Technolog: You participated in a survey not too long ago about I.T. students in sports and we just wanted to ask you a few simple questions about your answers to that survey.

Kanvaski: Oh.

Technolog: Let me rephrase my first question. Why do you enjoy the confrontation between two sole antagonists striving for physical dominance in a confined area?

Kanvaski: Whaa?

Technolog: Uh...let's see. Try this: Why do you like to grapple with an opponent to prove your physical superiority?

Kanvaski: Who are you guys anyhow?

Technolog: Why do you like to separate people's teeth from their mouths?

Kanvaski: Oh, are you alluding to wrestling? Well, what intrigues me to the highest degree is the metamorphosis of the contest from a restrained, controlled confrontation of athletic prowess to savage, brutal, and unbridled barbarism as exemplified by Larry "Pretty Boy" Henning altering his cognomen to Larry "The Axe" Henning.

Technolog: Whaa?

Chuck's Cafe Exceptionale was the scene of our next interview. Fredrick L. Muchbux, a T.A. in Continental Drift, agreed to see us at 3:47 p.m. sharp. We asked him about his sports preference:

Technolog: Tell us about your sports preference.

Muchbux: Yachting, definitely.

Technolog: Why Yachting?

Muchbux: It's better than wrestling.

Technolog: I suppose being a T.A. in Continental Drift doesn't leave you much time for yachting.

Muchbux: Au contraire. I spend quite a bit of my time yachting. Actually the only reason I am a T.A. is because Daddums used his financial influence. He seems to think I need a college education.

Technolog: Do you need much experience to yacht?

Muchbux: Actually, none at all. I do all my yachting by proxy. You see, I have my servants do the yachting for me. Much less strenuous that way.

Technolog: Quite. Do you recommend yachting to other I.T. students?

Muchbux: Oh, God, no! Wouldn't do to be associated with **common** stock.

Technolog: Thank you for giving us your valuable time. It's been a most enlightening interview.

Another interesting reponse came from a woman in the Physics Department. A senior majoring in Magnetohydrodynamics, Anita Mann, told us that her favorite sport was billiards. A three-time All University billiards champion, Anita talked to us in a smoke-filled billiard hall in downtown Minneapolis.

Technolog: What's a nice girl like you doing in a place like this? No, I didn't mean that...not that you're not a nice girl... but what I meant to say...ahem...

Mann: Do you want to start all over?

Technolog: Could we?

Mann: Sure, go ahead.

Technolog: How do you refute the allegation that billiards is a man's sport?

Mann: I don't. That's the reason I got into it.

Technolog: Oh, I see. You wanted to show the world that a woman could play billards as well or better than a man?

Mann: No, I wanted to get married.

Technolog: Found any prospects yet?

Mann: Well, let me put it this way, what are you doing after the interview?

Technolog: Right, next question. What do you feel are the socio-economic ramifications of Magnetohydrody...

Mann: No, I'm serious. What are you doing after the interview?

Technolog: Well, I really didn't have anything planned...I...

Mann: Fine. We'll rack 'em up then.

Technolog: Well, no...I'm sorry, Ms. Mann...Halley's Comet is due in eight years and I really don't want to miss it.

Mann: Oh, you're just like all the rest. Is there something wrong with me? Is it my breath?

Technolog: Well actually, I think it might be the blue chalk on your lips. Thanks for your time.

The next interview took us to Sammy E's restaurant where we found Mrs. Evelyn Won't, her nose buried in a large book entitled, "Spelunking and You," an order of rigatonni by her side. Not surprisingly her major is Metallurgical Heat Transfer.

Technolog: Excuse us, Ms. Won't, may we have a moment of your time?

Won't: (with a mouthful of rigatonni): Mmph, Mmph?

Technolog: We'd like a word with you.

Won't: Why, you can have 3,000 words with me.

Technolog: This is just a guess, but would this have anything to do with your being a speed reader?

won't: Exactly right. I am capable of reading and comprehending 3,000 words per minute.

Technolog: That's all very well and good, but why do you consider Speed Reading a sport?

Won't: Are you kidding? Didn't you know that many famous sports figures are Speed Readers? Take Leon Spinks.

Technolog: Leon Spinks?

Won't: Sure. Then there's Gump Worsely, Vassily Alexiev and Larry "Pretty Boy" Henning.

Technolog: I think that's Larry "The Axe" but never mind. How did you learn to speed read?

Won't: Actually, I've been speed reading since the age of three. My mother inadvertently left a copy of "The Illiad and the Odyssey" in my crib one day and by nap time...

Technolog: You finished the complete book?
Won't: No, I couldn't even read the title. What do you expect from a three year old? It was an inauspicious start but since then I have improved immensely. I compete in tournaments throughout the country.
Technolog: Has speed reading helped in your school work?
Won't: Yes, everything except Orchestra. I always finish a movement ahead of everyone else. The conductor is not amused.
Technolog: Has speed reading affected other aspects of your life?
Won't: Yes, I've tried to teach my husband to speed read but he's too conservative. He won't try anything new and exciting. Whenever we read together I always finish first. He gets frustrated, we argue, and he storms out of the house. Lately I've suspected him of reading with someone else.
Technolog: I'm sorry, Ms. Won't. I can't help you there. Perhaps you should seek professional counseling.

On the way to our next interview we heard a strange flapping sound above us. We looked up and spied a lone hang-glider soaring through the sky. We knew there was something different about him but we couldn't put our finger on it. As he neared us we suddenly realized he was wearing nothing but a calculator. Putting two and two together we deduced that he was an I.T. student. We only had time to ask him one question:
Technolog: Say, you know you can get arrested for that?
Hangglider: This is the only way they'd let me into Kappa Eta Kappa.

As he flew out of sight, we heard him exclaim, "Which way to Comstock Hall?"

We ran into our next interviewee, Gerald Attrik, in the middle of the Washington Avenue Bridge. The 93-year-old junior, majoring in Artificial Intelligence, was enthusiastically strumming a guitar and singing "Oh, Susanna," while his open guitar case patiently awaited donations. We allowed him to finish, then asked him a few questions:
Technolog: We understand that you enjoy frisbeeing?
Attrick: That's right. Ever since they retired me from Kempel's Clock Works, I've had a lot of time on my hands. Frisbeeing was the perfect sport. It keeps me in shape and my mind alert.
Technolog: Isn't this dangerous for a man of your age?
Attrik: Yes, that's why I have to keep alert. I have to make sure my pacemaker doesn't "go down."
Technolog: But a man as old as you...
Attrik: Watch out who you're calling old. You sound just like Mr. Kempel. Talk about Artifical Intelligence. This guy couldn't put on his pants without instructions.
Technolog: We take it you're against mandatory retirement.
Attrik: No, I like mandatory retirement. But then I like peanut butter on my tuna fish.
Technolog: But seriously, Mr. Attrik, how proficient are you at this sport?
Attrik: I'm ranked number one in my age group!
Technolog: How did you manage that?
Attrik: It was easy, I'm the **only** one in my age group.
Technolog: We see you're playing the guitar.
Attrik: How observant, sonny. I've got to make a few extra bucks. With what they're worth I use my social security checks to wallpaper my bathroom.
Technolog: Yes, Mr. Attrick, times are tough.

The I.T. STUDENT BOARD wants to help YOU.

The Board is made up of I.T. students just like you. So we are familiar with some of your problems and are doing our best to solve them. We are interested in obtaining student input regarding your problems. Our meetings are in Aero 305 at 1:15 on Thursdays. Any complaints, comments or suggestions concerning I.T. will be welcomed at the Board Meetings or can be addressed to one of the board members, who are:

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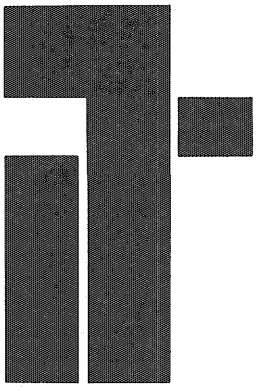
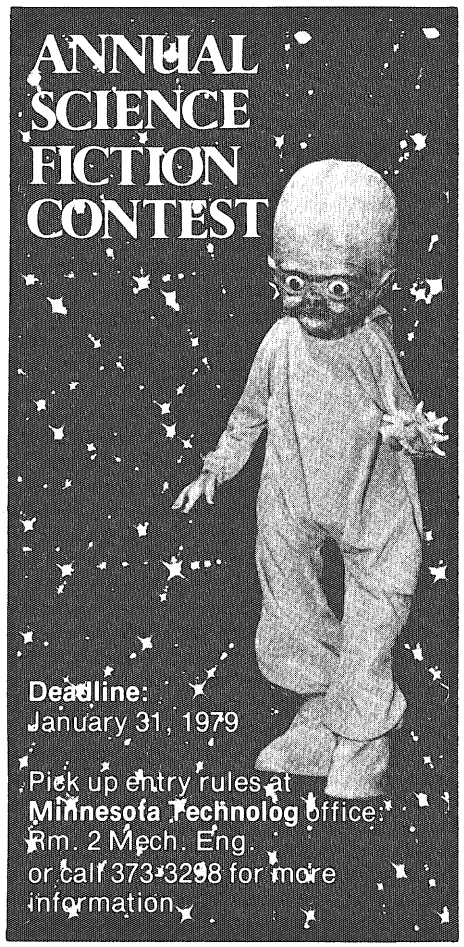
(Look for the I.T. Book Exchange coming this winter)





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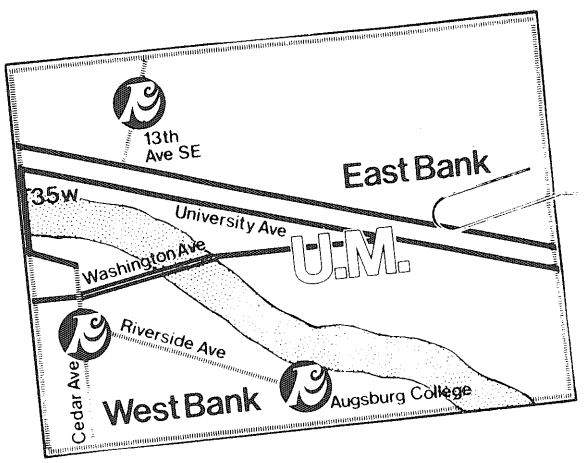

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After Graduation

By Don Leeper

While industry reps crow the joys of employment by their companies and crowd the campus seeking I.T. grads to nab, another recruiter, the U.S. Air Force, may well offer some grads advantages over civilian employment.

Ironically, what is perhaps the primary attraction is one that also increases turnover of young engineers, and thus has produced the current Air Force demand for technical grads, highest since 1968.

Tom Crandall, Regional Coordinator of Officer Programs for the Air Force, outlined the situation in a recent interview. He said that upward movement is much less chancy in the Air Force, which can guarantee advancement for the able and ambitious. Thus provided with manangement experience sooner than they usually would be provided in industry, Air Force engineers find themselves in highly advantageous positions after their four-year hitch is up. Industry is willing to offer these people premiums in salaries and opportunities for that experience.

The result is that many young officers defect to industry after their term is up, creating openings for new recruits.

Lest prospective recruits be wary of being shanghaied to some geographic or career backwater, Crandall added that the Air Force makes an offer of specific location and position before the recruit needs to make a committment.

Where might I be stationed? Doing what? one example is Wright-Patterson Air Force Base, near Dayton, Ohio. There, Air Force technical personnel perform a variety of tasks: the acquisition and analysis of foreign technical intelligence; that is, determining who has the capability of doing what to whom, how effectively and how often; flight dynamics; avionics; propulsion and materiels.

Other possible assignments include: Edwards Air Force Base, Calif. (Rockets); Kirtland Air Force Base, N.M. (Weapons); Hanscombe Field, Mass. (Geophysics); Griffiths Air Force Base, N.Y.; Vandenburg Air Force Base, Calif; Patrick Air Force Base, Fla.; and Arnold Air Force Station, Tennessee. Foreign assignments, though unlikely for the initial four years, are possible.

Does the Air Force need your specialty? Very likely. It's looking in particular for Aeronautical, Electrical, Mechanical and Metallurgical Engineers. Air Force recruiters are also interested in Astrophysics, Civil Engineering and Math majors, and in people with a year or more of math or physics in other majors. Chemical Engineers, however, are not actively being sought.

Don't expect to make your first million in the Air Force. Salaries, which are set for all officer programs by Congress, start at $12,000 per year. Any prior military service, active or reserve, applies toward starting seniority and salary.
At the four-year level, Crandall said that Air Force salaries are roughly equivalent to those in industry.

On top of salaries, of course, are additional benefits—free medical coverage, thirty days paid vacation, etc. It is also possible to have more education paid by the Air Force, should you stay on past the first four years. Conceivably, you could obtain a PhD, paid for the by Air Force, retire in your early forties, and then get a job at a good salary in industry, while collecting the Air Force pension.

Before you're selected, of course, you have to apply. The first step is generally a preliminary interview. Then a follow-up interview is arranged. There, any questions are answered and programs are explained in detail. The interviewee can talk, via phone, with an Air Force engineer, working in his discipline.

Interviewees then take a three-hour test, and fill out an application form. The test includes sections on math, communication skills, and psychological evaluation. The applicant must also take a physical, and submit a resume with three to five letters of recommendation.

All of this material is sent to Randolph Air Force Base, Texas, where it is reviewed by a Board of Officers. The Board first looks at attitudes; they're searching, essentially, for potential junior executives. Then they look at areas of interest and dates of availability. If all of these factors correspond to Air Force requirements, a selection notification is sent to the applicant. It is only at this point, with offer in hand, that the applicant must make a commitment.

In certain instances a tentative offer may be made before the application is submitted, which is then confirmed upon review of the application.

The Air Force isn't going to be everyone's career cup of tea. But if it is, give Tom Crandall a call at either 331-1880 or 726-9374.

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

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

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

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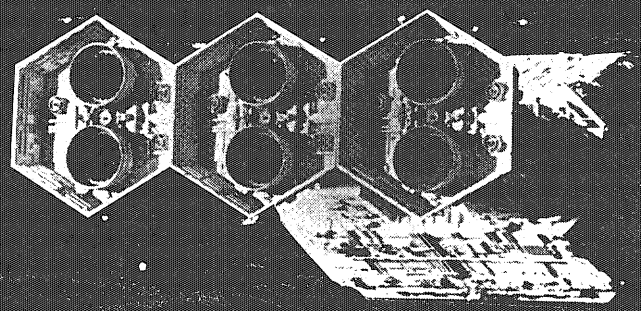

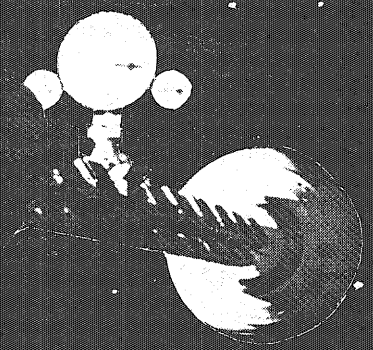

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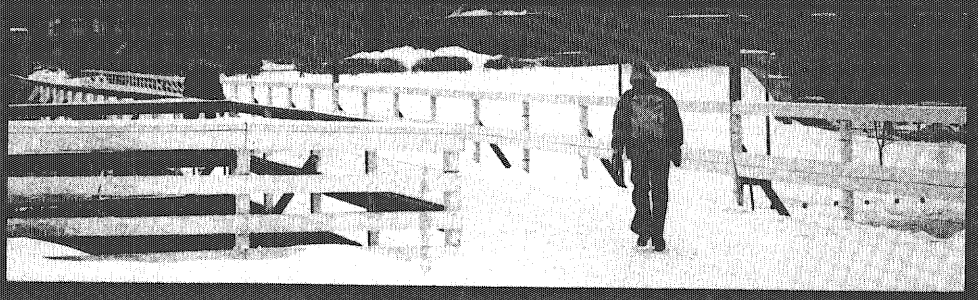
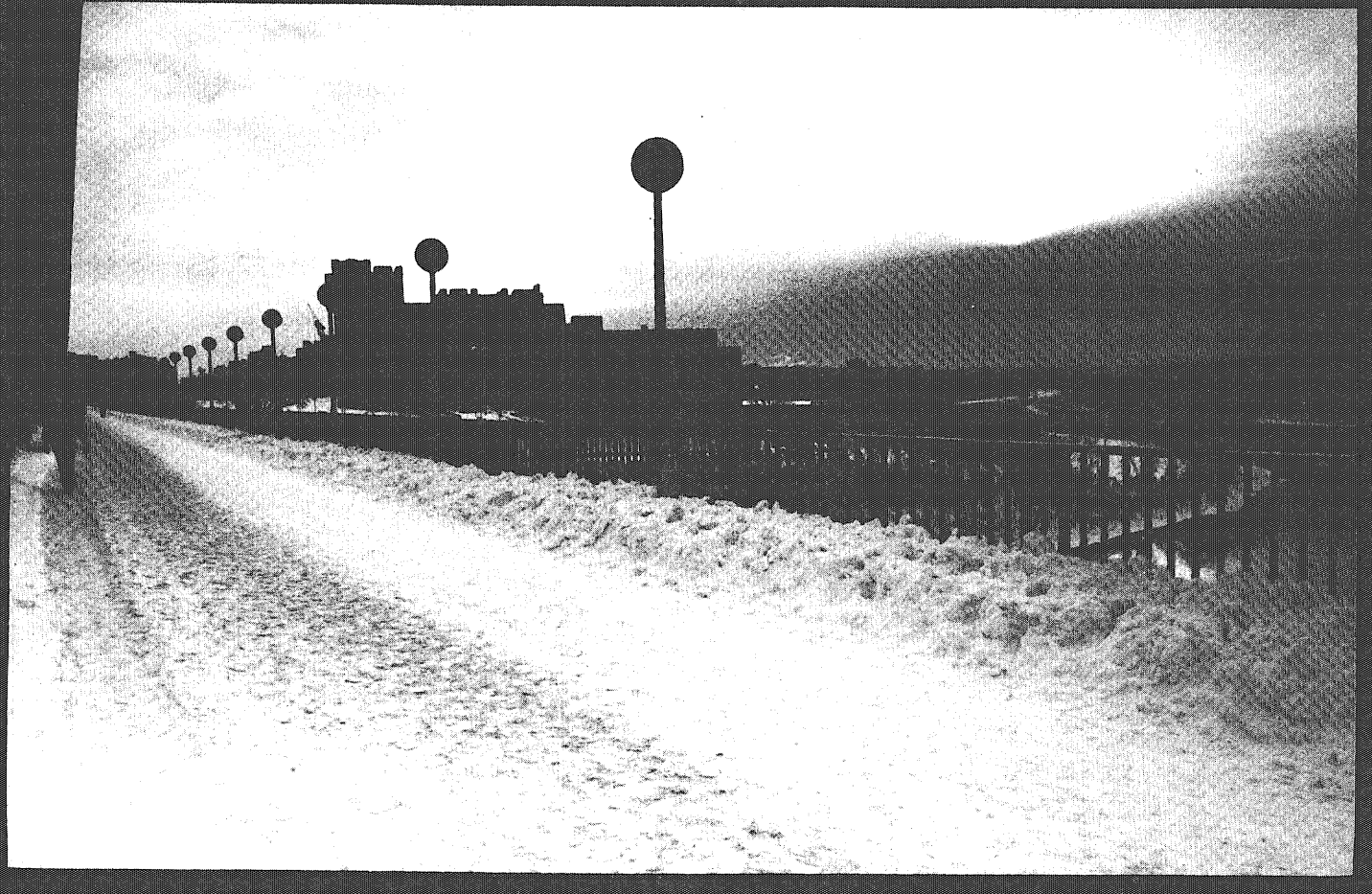


Midwinter Blues



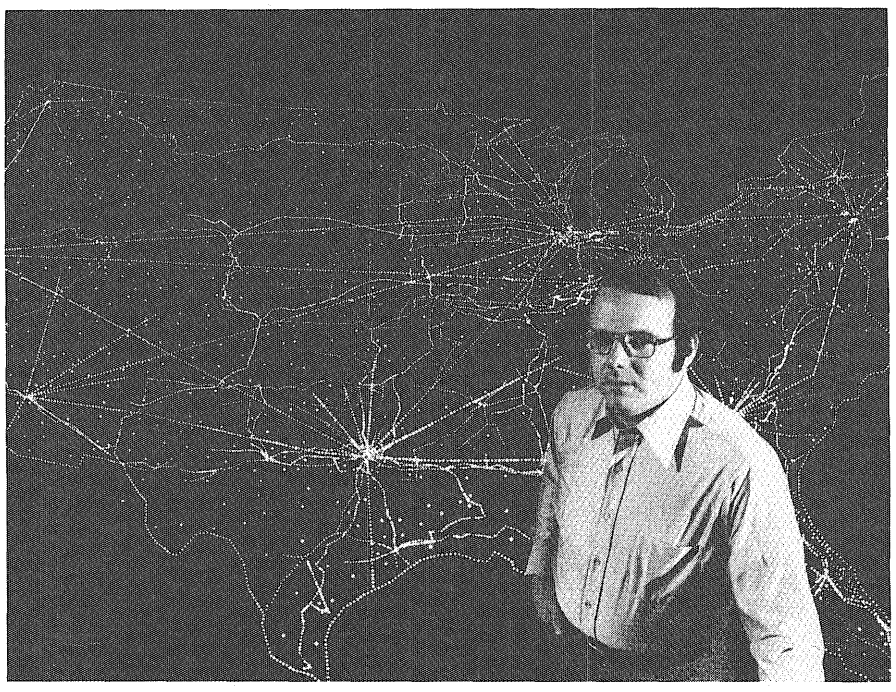
Don Hartman found a "model" way to troubleshoot the network.

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.

If you are interested in exploring equally challenging employment opportunities at Bell Labs, write to:

Director of Technical Employment
Center 831 EM
Bell Laboratories
Murray Hill, N.J. 07974

Bell Laboratories

From Science: Service

SCIENCE/SCOPE

For the first time in the history of space technology, a single electronics system will perform both radar and communications functions aboard NASA's Space Shuttle Orbiter. Meshing the "eyes, ears and voice" functions into a 260-pound hardware package, results in a significant reduction in weight and space. Major components such as the transmitter, receiver, antenna and servo mechanisms perform dual roles.

As a radar, the unit searches for, acquires, tracks and delivers spatial data needed for Orbiter to effect a quick, efficient rendezvous with other space vehicles. As a communications system, it provides high-quality transmission and reception with ground stations via two relay satellites. The Ku-band subsystem will be built by Hughes for prime Space Shuttle contractor Rockwell International.

Plant engineers now can see an instant picture of energy losses during plant operations. Using a handheld infrared viewing device, they can pinpoint a wide range of energy-wasting situations—among them: steam leaks, product-flow problems, electrical overloads, components failures, machinery hotspots, cable shorts, heating/airconditioning system losses, insulation defects, chemical/thermal pollution.

The device is an industrial version of the Probeye® Infrared Viewer, originally developed and marketed by Hughes for use in law enforcement, fire detection and search-and-rescue. It senses infrared rays radiated by objects within its viewing field and converts the radiation to a red image viewable through its eyepiece. Temperature differences as small as 0.1 C. are detected and portrayed by the 7.2 lb. self-contained unit.

Hughes has free reprints available of technical papers describing important contributions in areas of research, engineering, and science. Included are the following: "Horn Structures for Integrated Optics," "High Power On-Off Switching with Crossed Field Tubes," "Aircraft Identification by Moment Invariants," and "Gravity Gradient Mapping from the Luncar Polar Orbiter—A Simulating Study." For copies or information, write to Hughes Aircraft Company, Building 100 M/S C-666, P.O. Box 90515, Los Angeles, CA 90009.

A bright, high-resolution, large screen liquid crystal projection system that can display dynamic tactical military situations in real time has been delivered to the U.S. Navy for evaluation. It can project virtually anything that can be displayed on a cathode ray tube either in raster scan or random scan mode. Typical applications include symbols, alphanumerics, geographical maps, and text. Its bright, clear display reduces requirements for specially controlled lighting during briefing sessions or command conferences.

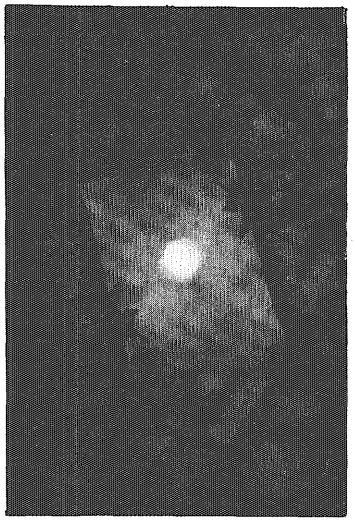
The system uses a liquid crystal light valve developed by Hughes, and has a reliability never before achieved in large screen displays. Mean-time-between-failure is estimated at 5,000 hours, and, as no consumables are required, this results in lower operating and maintenance costs. Other features are 1,000 line resolution and 30 millisecond response time.

Hughes is currently seeking new graduates in electrical, mechanical engineering and computer science or other closely aligned disciplines to meet the demanding challenge of our high technology company. To obtain further information, please write: Manager, College Relations, Hughes Aircraft Company, P.O. Box 90515, SS/100/445, Los Angeles, CA 90009.

HUGHES

Creating a new world with electronics

Editor's Log



Photo/Glenn Flekke

About this time in Minnesota there are probably few among us who wouldn't mind climbing aboard a spaceship and blasting off from –28 degree temperatures in search of a planet with a perpetural tropicana-like climate. Certainly the likes of Chicago's 40-inch snow base or the shivering waits for University express buses are enough to make anyone want to become better friends with the National Aeronautics and Space Administration.

But NASA has other ideas as Bruce Kvam explains in "Unmanned Spaceflight: To the planets by proxy." Barring any further delay in the space probes effort by the President's budget cuts, there may be hope, however, for winter escapes in the 1980s and '90s.

This winter, though, there's a man who is even anxious to come to Minnesota. He's new Dean Roger Staehle and the **Technolog** welcomes the Ohio State University transplant as our "New Friend in I.T." Mary Jo Hannasch shares an interview with Staehle who begins at Minnesota this month with big plans and a lot of enthusiasm for students, faculty and industry of this state.

Buckminster "Bucky" Fuller generated a lot of enthusiasm, too, recently, as the University's chapter of Alpha Ro Chi hosted the 36th National APX Convention of student and professional architects. Kathy Badger reports on the geodesic dome father's hope for architects to come. (Instead of a domed stadium for Minneapolis, how about a dome over Minnesota until April...with heat.)

Ice and snow may play havoc with St. Paul's Downtown People Mover project. Dan Freeborn updates the technological progress on that system.

Peggy Purcell, an Electrical Engineering senior made the mid-winter escape last month. After taking plant trips to California, the east coast and Chicago (before their snow) for prospective employment, she shares some valuable tips on make the most of the freebie traveling in "After Graduation."

Fear not, I.T. friends. There may be other alternatives to the season. Superman has returned in movie form. "Ad Astra" this issue marks the occasion. And if Superman can't pull some mild-mannered stunts to melt the frosted glass in Glen Flekke's photo at left, there's always the last ditch efforts of Steve Smith's Bionic T.A. to consider. That's not such a bad friend to have this time of year.

Coming up next issue: The winners of the **Technolog** science fiction contest and much, much more.

Jon Kavanaugh

Editor

minnesota
TECHNOLOG

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Staff

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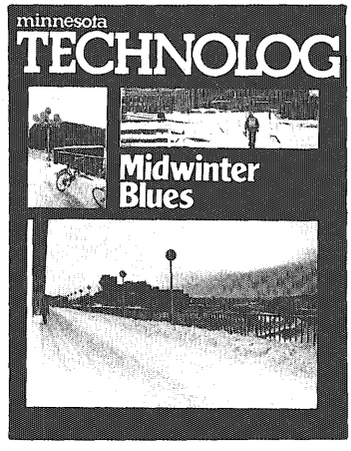

Cover photos by **Dave Bissonnette**

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Your first job may be your last.

As a college senior, you face one of the most difficult decisions of your life. Which company should you select from the many competing for your talents?

Naturally, you want the one company that can provide the winning combination . . . challenging work assignments, above average advancement potential, continued educational opportunities and a versatile life style.

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CAMPUS INTERVIEWS • February 23

Log Ledger

Financial Aid Office offers "fat wallet", efficiency moves for 1979-80 program

Students may now qualify for some financial aid who were previously ineligible. During the 1979-80 school year an estimated 1.5 million more students will receive aid because of the 1978 Middle Income Student Assistance Act. In fact, these changes in the law should help nearly all students qualify for some form of financial aid.

There is more aid available for existing programs, and the standards used to determine "need" have been made more liberal. This means, for example, that the Basic Grant award for current recipients will increase. Students whose families have incomes between $15,000 and $25,000 and many independent students now will also be eligible for a Basic Grant award.

Another example is the change in the Guaranteed Student Loan program. The law has removed the $25,000 income ceiling for eligibility for interest benefits. If a student receives this loan, the federal government will pay the interest on the loan, regardless of family income, while the student is enrolled at least half-time in school and during the grace period before repayment begins.

It has also become easier to apply for financial aid. The standard National American College Testing/Family Financial Statement form now allows students to release that data to a variety of federal, state and school programs. The Office of Student Financial Aid is in the process of streamlining many procedures and increasing staff to meet future needs. The first change to take place will be walk-in processing of completed Guaranteed Student Loan applications.

Students are urged to apply by March 1 for 1979-80 priority consideration.

Applications will be accepted after March 1 and throughout the rest of the year, however, as long as funds are available. For more information and application materials contact the Office of Student Financial Aids in Armory 116 or Coffey Hall 190. Or call 373-4021.

Awards, Awards, Awards

Prof. Francois Cheong-Siat-Moy and student Gregory Clifford of the Department of Civil and Mineral Engineering were winners in the Lincoln Foundation's Student Engineering Design Competition for their project titled "Amplification Factor; Means of Accounting for Instability Effects in Steel Frames."

Richard J. Goldstein, professor and head of the Mechanical Engineering Department, was given the Heat Transfer Memorial Award at the American Society of Mechanical Engineer's December meeting in San Francisco.

The award is given in recognition of outstanding contributions in the field of heat transfer. Cited in particular was his work in internal natural convection phenomena, film cooling and the development of optical interfreometry and laser-Doppler techniques. Goldstein has also been appointed U.S. delegate to the Assembly of the International Center for Heat and Mass Transfer, to convene in Yugoslavia.

Arthur Erman, associate professor of Mechanical Engineering has been named Young Mechanical Engineer of 1978 by the American Society of Mechanical Engineers.

Mark Schneider, a senior in the Mechanical Engineering Department has won the Honeywell Award in Undergraduate Engineering and Science. The award was made on the basis of his academic excellence, service in student organizations and development of an outstanding project in his discipline.

Career Fair to be Held Feb. 23

Friday, February 23 has been set for an informational "career fair" sponsored jointly by the Society of Women Engineers, the I.T. Placement Office and the Office of Student Affairs.

Designed as an educational service to all University students interested in careers involving math, science and technology, the day will feature small exhibits by over 25 companies. Representatives will be on hand to explain exactly what students can expect to do in various capacities in industry.

Companies will have descriptive brochures, displays and personnel to explain career options and answer students' questions. The "fair" is not intended to be a recruiting session.

The first annual event will be held from 10 a.m. to 4 p.m. in the Architecture Court.

For more details contact the I.T. Placement Office or the I.T. Office of Student Affairs.

COMING SOON

Three winners of the Annual Technolog Science Fiction Contest

Engineering for radio broadcasting

The best of Engineers Week

Update on energy

A theory about holograms

Space industrialization in your lifetime

The continuing adventures of The Bionic T.A.

Log Ledger

Seminars and Colloquiums

MECHANICAL ENGINEERING

February 7
"Climatic flucuations: natural and man-induced"
Prof. Richard Skaggs
Department of Geography
University of Minnesota

February 14
"Fuel from biomass by fermentation processes"
Prof. M.R. Ladisch
Food, Agricultural and Chemical Engineering Department
Purdue University

February 21
"Acoustic agglomeration for control of particulate emission"
Prof. David T. Shaw
Department of Electrical Engineering
State University of New York at Buffalo

February 28
"A pressure formed thin-walled solar collector
Prof. Donald Spencer
Division of Energy Engineering
University of Iowa, Iowa City

March 7
"A practitioner's experiences with solar heating"
Mr. Darryl Thayer
Solar Energy Consultant
St. Paul, Minnesota

Seminars held in 8773-8774-8775 Mech. Eng., Wednesdays at 3:15 p.m.

CONTROL SCIENCE SEMINAR

February 8
"State of the art in computer control of selected water treatment processes"
Dave Ching, Control Data Corporation
Autocon Industries

February 8
"Analysis of Control-output interactions in dynamic systems"
T. Edgar, professor of Chemical Engineering,
University of Texas, Austin

February 22
"Design and tuning of dead time compensators"
R. Shinnars, professor of Chemical Engineering
City University of New York

March 1
"Computer networks in chemical process control"
D. Grant Fisher, professor of Chemical Engineering
University of Alberta, Edmonton

March 8
"Advanced process control: some applications to a pilot scale catalytic reactor"
J. Wright
Xerox Corporation and McMaster University

All seminar meetings at 2:15 p.m., 102 Mech. Eng. and on UNITE CCTV.
Students may register for EE 8-290.

COMPUTER SCIENCE

February 5
"Multigrid Techniques for Nonlinear Eigenvalue Problems"
Dr. Tony Chan (faculty candidate)
Applied Mathematics Department
California Institute of Technology

February 12
Mr. Patrick Langley (faculty candidate)
Carnegie-Mellon University

February 19
Mr. Alan R. Hevner (faculty candidate)
Department of Computer Science
Purdue University

March 5
"Using Information Flow Measures to Design and Evaluate Operating Systems"
Sallie Henry
Computer Science Department
Iowa State University, Ames

All Computer Science Colloquiums will be held in 305 Lind.

PHYSICS AND ASTRONOMY 4:00/131 Physics

February 7
"Evidence for a liquid-to-crystal phase transition in a sheet of electrons on the surface of liquid helium"
C.C. Grimes
Bell Laboratories, Murray Hill, N.J.

February 14
"Stratospheric Mass Spectroscopy"
Dr. Konrad Mauersberger, University of Minnesota

February 21
"Advent of the space age as seen by a cosmic ray physicist"
John R. Winckler
School of Physics and Astronomy

February 28
"Quark Matter"
Gordon Baym
University of Illinois

FROM NASA

Shuttle Crews to Get Tasty Meals

Researchers are hard at work at NASA's Johnson Space Center, Houston, Texas, putting together the food systems to be used on NASA's Shuttle orbiter, the reusable space transportation vehicle which will be operational in the 1980s. The crew aboard the Space Shuttle wll be served tasty and nutritious meals, prepared with variety in mind.

Nimbus to Aid Pollution Studies

NASA's Nimbus 7 satellite, launched last October may be instrumental in providing new and more accurate information about pollution of the Great Lakes. The satellite carries seven sophisticated sensing devices designed to measure factors ranging from stratopsheric aerosols and ozone to polar sea ice extent.

Dramatic Encounter With Venus

The most extensive study ever made of Venus began last December when Pioneer Venus 1 and 2 arrived on the planet. Pioneer Venus 1 swung into orbit around the cloud-covered planet Dec. 4 to take pictures and make measurements for one Venusian year (225 Earth days) or more. On Dec. 9, the four probes and transporter bus that made up Pioneer Venus 2 plunged into the Venusian clouds at widely separate points for detailed measurements of the dense atmosphere from top to bottom. The Pioneer Venus project is managed for NASA's Office of Space Science by the Ames Research Center, Mountain View, Calif. The spacecraft are controlled from the Mission Operations Center at Ames.

(See "Unmanned Spaceflight: To the planets by proxy" in this issue of Technolog.**)**

Log Ledger

Urban Housing Design Competition

The St. Paul Department of Planning and Economic Development will sponsor a competition for the design of an energy efficient dwelling which is compatible with an older urban residential environment.

Winners may be eligible for award money and a free lot at below interest mortgage money. For more information and registration materials call Shannon Kelley at 292-6722.

U Scientists to Witness Solar Eclipse

Scientists from the University's School of Physics and Astronomy will travel to Bowbells, N.D., to witness the total eclipse of the sun this month. The group, headed by Regents' Prof. Edward P. Ney, will arrive Bowbells Feb. 24. The eclipse will be visible on Feb. 26.

Besides witnessing the eclipse, the scientists will be working with infrared radiation detectors to find melting points of solar dust as it spirals toward the sun.

The next total eclipse of the sun visible in North America will not occur until 2017.

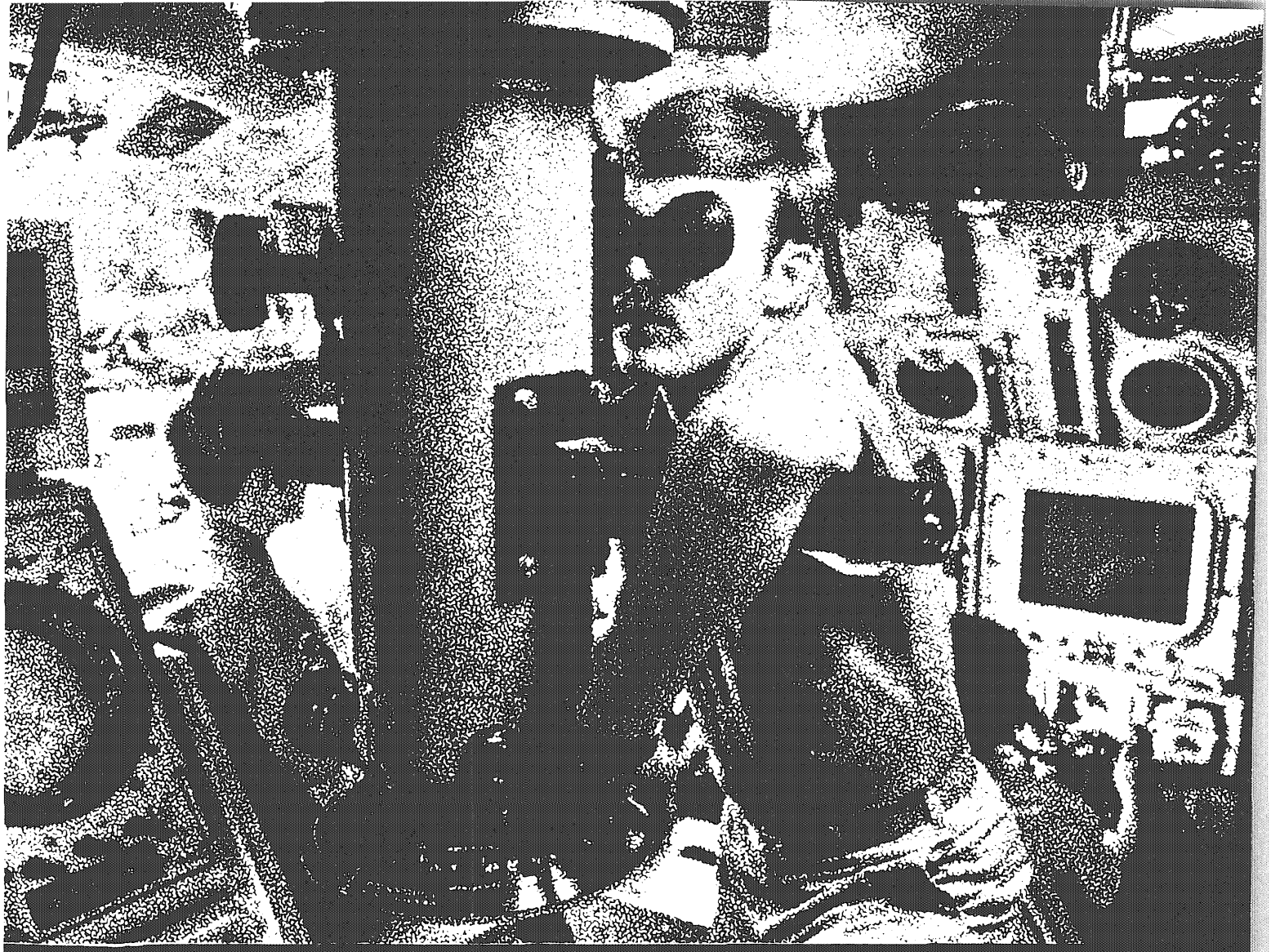
Board of Publications Vacancy

The Minnesota Technolog Board of Publications has an opening for a student member to serve the remainder of one 1978-79 academic year term.

Applicants must be fulltime undergraduate students in I.T. with an interest in the policy management, structure and editorial direction of **Minnesota Technolog** magazine.

All Board terms will be up for re-election during the all campus election period this April.

For more information about application and responsibilities, contact Stan Brooks, president, Minnesota Technolog Board of Publications, 305 Aero. Or call 373-0661.



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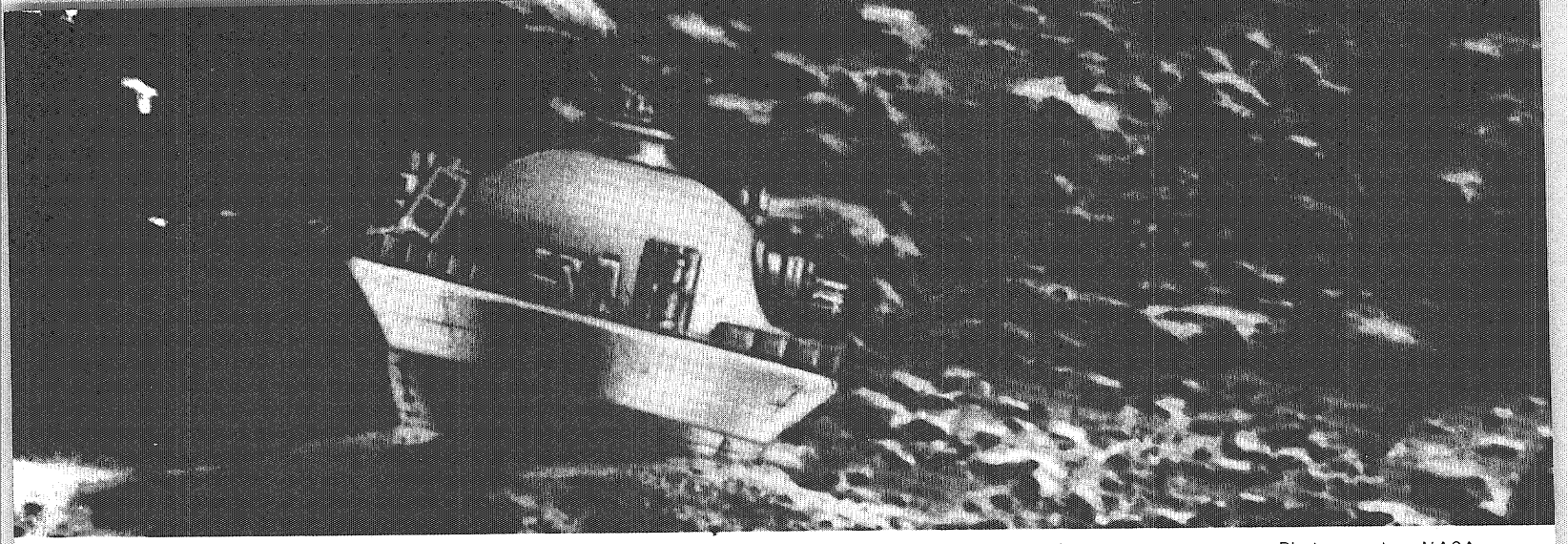


Photos courtesy NASA

Unmanned Spaceflight: To the planets by proxy

By Bruce Kvam

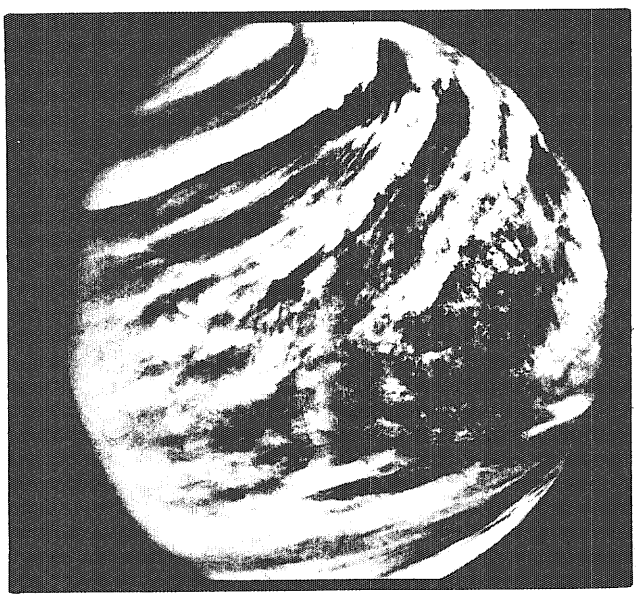
Jensen bounded over the hill, eyes intent on the detector. "I think it's over this way, Captain," he said into his mike. His legs tired more easily than they did on Earth; the rigid venussuit offered not much resistance in the knees, but it was enough. After a dozen wide sweeps over the dusty, rolling plains the difference was beginning to tell, despite the lower gravity.

There, on the scope, a bright green blip. Was that it?

He peered into the red gloom of the Venusian day, saw nothing, and turned up his image intensifiers. The barest hint of a glint of light on metal reached Jensen's eyes through the haze. He rushed over to the spherical object and called over the radio, "I found it!"

The captain quickly joined him. Jensen was brushing the dust from the pitted, corroded shell of metal. "This is it, all right." He shook his head in disbelief. "To think that it landed without a parachute, or wings, or anything, and then lasted an hour in this scorching heat."

"It wasn't even designed to land," the captain smiled. "They sure knew how to build space probes in those days..."



Computer-enhanced image taken in ultraviolet light of Venus' clouds. (From Mariner 10)

These troublesome probes raise more questions than they answer, every time!

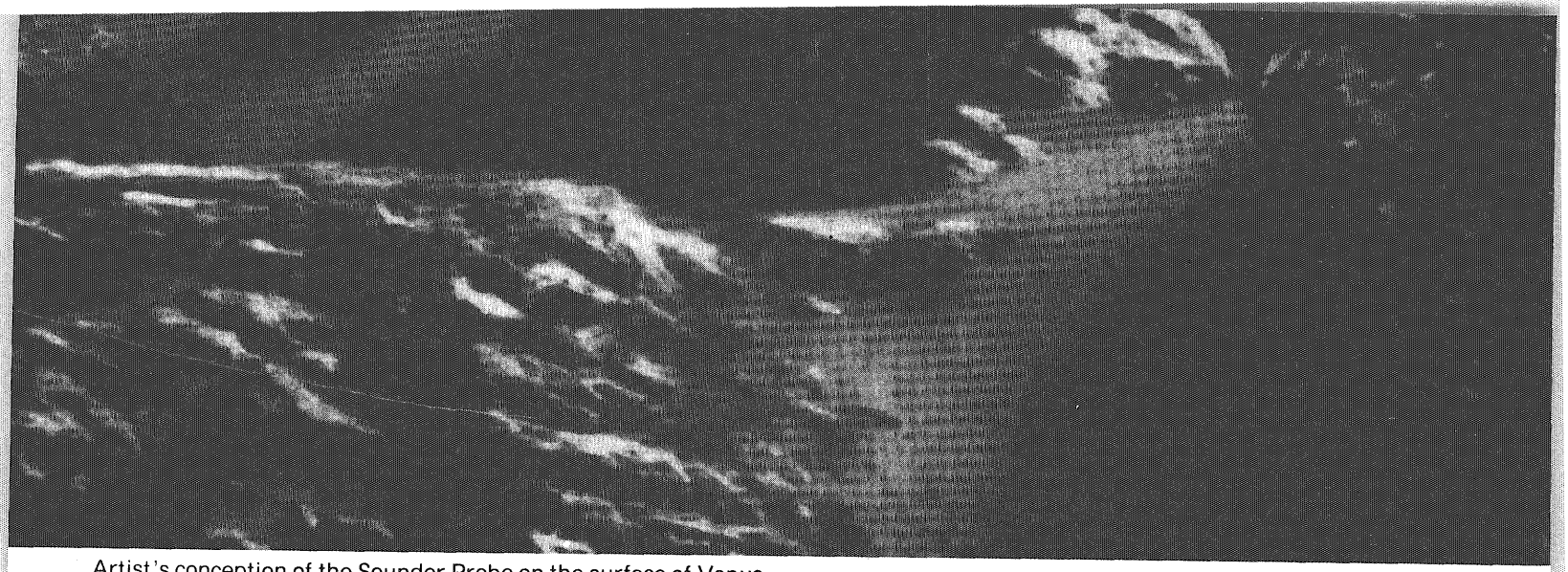
Will this scene ever take place? Will astronauts go chasing across the solar system after our long-lost spacecraft?

It seems unlikely, but it's already happened. When Apollo 12 traveled to the moon in 1969, the three astronauts brought back a hunk of the Surveyor 3 spacecraft which landed there two years previously.

We won't do that kind of thing very often, but if anyone finds pieces of the Luna 2 space probe (the first object to touch another heavenly body) those fragments are going to be some collector's items.

1979 marks a very adventurous point in our exploration of the solar system, even though our manned space program has waned the last five or six years. The United States will have space probes on, near or approaching four out of eight of the other planets in the solar system throughout the year. Our spacecraft have lasted far longer than their projected life expectancies, withstood far more punishment than they were designed to, given us far less trouble than we could have hoped for, and in general, have performed unbelievably well. Except for one thing, which isn't even their fault: every time the little devils turn their attention on our celestial neighbors we have to throw just about every theory of planetary evolution and structure out the window. These troublesome probes raise more questions than they answer, every time!

Take, for example, the assault the two Pioneer spacecraft made on the planet Venus this past December.



Artist's conception of the Sounder Probe on the surface of Venus.

The first craft, the Orbiter, took up an extremely elliptical orbit around the planet, ranging from about 250 to 41,000 miles from the surface. The Orbiter reaches into the outer fringes of the thick Venusian atmosphere where it measures the interaction between the atmosphere and the solar wind, the stream of charged particles from the sun. Pioneer has found that this interaction is far different at Venus than at Earth, mainly because Venus lacks a strong magnetic field.

The Orbiter is slowly mapping the surface of Venus through the clouds by radar, recording only a tiny section of the planet each day. So far the topography seems fairly similar to Earth's: relatively flat; unlike the rough, cratered surfaces of the moon and Mars, though previous, Earth-based studies of Venus may have found volcanoes larger than those on Mars and larger than any found on Earth. The Orbiter will continue its observations for at least a year.

Five days after the Orbiter pulled in, five more probes arrived on a suicide mission. They plunged through the atmosphere, with nothing to stop them from smashing themselves to pieces at the surface. Amazingly, one of the probes called the Day Probe, survived for 67 minutes, in spite of the 850-degree temperature and 91 atmospheres of pressure. Venus is apparently covered with a fine dust, for it took about three minutes for it to settle after the Day Probe came crashing down at 22 mph.

The Sounder Probe, the largest of the five that entered the atmosphere, landed near the equator on the day side. The Day Probe landed to the south of the Sounder Probe, while the two other smaller probes descended on the night side of the planet. The Bus, which transported the other probes to Venus, quickly burned to a crisp after taking measurements of the upper atmosphere. On their hellride down, the probes discovered that there are three layers of clouds around Venus, starting at about 42 miles from the surface.

The first layer is about five miles thick and is composed of small (1-2 microns in diameter) particles of sulfuric acid. A 200 mph wind whips the clouds around the planet in a matter of days.

The second layer is also five miles thick, and is filled with more sulfuric acid droplets, unidentified 4-micron particles and solid chunks of sulfur about 10-15 microns in diameter.

The bottom layer, about two miles thick, resembles Earth cloud structures more closely than the other layers. It is the densest layer, containing still more sulfuric acid droplets and liquid and solid sulfur particles.

After the cloud decks, at about 29 miles, there's a sulfuric acid haze for a few hundred meters, and from there on down to the surface it's clear sailing, with no particles in the air at all.

The surface, itself, is hot. The sun can't be seen, but the sky is about as bright as it is on Earth on a cloudy day. The light is red and distant shapes are distorted by the thickness of the atmosphere. Mirages are probably a common phenomenon.

The composition of the atmosphere has long been suspected to be largely carbon dioxide, and indeed it is, about 97 percent. Other constituents include nitrogen: 1-3 percent, helium: 250 parts per million (ppm), neon: 6-250 ppm and argon: 20-200 ppm. Below the cloud layers there is water vapor: 0.1 to 0.4 percent, sulfur dioxide: 240 ppm, and oxygen: 60 ppm. Comparing this to Earth, Venus has been found to have about the same amount of nitrogen in the atmosphere and about the same amount of carbon dioxide, though Earth's carbon dioxide is bound up in limestone and other rocks. In concept Venus should have as much oxygen as Earth has, and NASA scientists believe that it is locked in the rocks as carbon dioxide is here. So, chemically, at least, the term "sister planet" may apply to Venus after all.

And here is where the probes' data started fouling up perfectly good theories. It was found that the concentration of primordial argon (argon left over from when the solar system was formed) was much higher on Venus than on Earth. Current theories of planetary evolution propose that lighter elements (including gases such as hydrogen, helium, argon and neon) were swept away by the strong solar wind of the young sun. Therefore, there should be less argon present the nearer a planet is to the sun. The theory got its first blow below the belt when Viking found less argon on Mars than was anticipated, and Pioneer Venus played taps for it.

But theories aren't eternal, and before too long another was offered: The light gases adhered to dust particles before the sun began blossoming into the fiery furnace it is today; those dust particles then aggregated into rock, which in turn became the inner planets. Since the dust and rock couldn't be blown away by the solar wind, there should be, according to the new theory, more argon closer to the sun.

One theory was thrown out, but another was vindicated. Carl Sagan has been proposing the Runaway Greenhouse Effect as an explanation for Venus' terrible temperatures for a number of years, but the evidence hasn't been as solid as would have been liked until now.

The theory states that while it is easy for sunlight to enter the atmosphere and warm it up, the atmosphere's structure and composition make it difficult for the heat to be reradiated into space. It was known that the high carbon dioxide content would allow retention of much of the heat, but not as much as the 850-degree surface temperature requires. The unexpected discovery of 0.1 to 0.4 percent water vapor supplied another excellent heat trap, as well as the large sulfur particles in the clouds.

Just catching their breath after the nearly flawless Pioneer Venus mission, planetologists are going to get geared up again this March, when the first of two Voyager spacecraft makes its closest approach on Jupiter.

Voyager 2 was launched in late August, 1977, and Voyager 1 followed twelve days later. This seeming inconsistency was purposely introduced by NASA to reduce confusion later, because Voyager 1 is traveling a faster trajectory and will reach Jupiter first.

Imaging of the giant planet has already begun. As early as this January Voyager 1 was sending back photos superior to those that can be taken from the best Earth-bound telescopes. Already differences have been noted in Jupiter's appearance since the Pioneer 11 mission in 1974. The Great Red Spot has lost some of its bright color, and several multicolored bands in the northern hemisphere have been replaced by one large, white band. New cloud structures have also been observed.

Voyager 1 will provide us with high-resolution photographs of Jupiter and its four Galilean satellites: Io, Europa, Ganymede and Callisto. The craft will pass within 15,000 miles of Io, the third largest moon, take some shots of the other moons, and then, propelled by Jupiter's enormous gravity, will shoot off to an encounter with Saturn in the fall of 1980.

Io is of particular interest to scientists because of its strange relationships with Jupiter. At a distance of only 260,000 miles, it is continuously bathed by high-energy particles caught in Jupiter's intense magnetic fields. Last year it was discovered that there are visible clouds of sodium around Io. This year scientists found a cloud of sulfur centered about Io's orbit. The moon also plays tricks with the radio emissions from the parent planet.

Voyager 1 will come within 175,000 miles of the Jovian surface, but Voyager 2, to arrive at Jupiter on July 10, 1979, is going to play it safe. To avoid the beating from the radiation that Voyager 1 will take, Voyager 2 will only come within nine Jupiter radii—400,000 miles. Voyager 2 needs to tread softly if it expects to make it all the way to Uranus in 1986 (after its meeting with Saturn in August, 1981), an option scientists would greatly like to exercise in view of the recent discovery that Uranus, like Saturn, also has rings.

There is the slightest chance that Voyager 2 may make it to Neptune as well, but NASA officials express doubt about this. For the Uranus option they are already hoping the craft will survive nearly ten years—another billion miles may be too much to ask.

Voyager's television cameras aren't the only instruments aboard the craft. There are several planetary as well as interplanetary experiments, such as the cosmic ray flux experiment, the magnetic fields experiment, the plasma experiment (for investigating the solar wind and the clouds around Io) and others. Many of these experiments play a dual role in examining the planets and the space between them.

Like their predecessors Pioneers 11 and 10, the Voyager spacecraft will carry artifacts, which, if by the slimmest chance are found by an alien race, will tell that race something about Earth and its inhabitants.

The Pioneer plaques, suggested by Carl Sagan of Cornell University, depict male and female forms against the background of the spacecraft and a map showing the distances from the sun to several variable stars.

Jupiter with its satellite, Callisto. (From Pioneer 11)

For Voyager, however, Dr. Sagan came up with a much more imaginative idea: a phonograph record.

The record, made of copper and encased in aluminum, comes complete with stylus and directions. There is about 90 minutes of music, ranging from Bach to Stravinsky to Indian ragas to Japanese Skakuhachi and Chuck Berry. There are spoken greetings in 60 languages and an address from Kurt Waldheim, Secretary General of the United Nations. Also included are 115 photographs and diagrams (recorded in analog form) depicting Earth's place in the galaxy, the Earth itself, people performing various tasks and descriptions of DNA, among other things.

If the beings who find the disk are visually or aurally oriented we could be expecting visitors in the next 40,000 years when the craft will pass within one light year of a star. The chances of it happening are virtually nil, Sagan points out, but why not try? Since the Voyagers will be traveling at only 10.6 miles per second the craft will make comparatively close approaches on other stars in 147,000 and 525,000 years.

Beating Voyager 1 by almost a year, Pioneer 11 will make its closest encounter with Saturn early this September. There was a bit of controversy in November, 1977, when NASA had to decide whether to send the spacecraft inside the rings, possibly through the newly-discovered D ring, or to send it outside the ring system complete. The senior scientists of the mission wanted to go along the inside track, but the bigwigs wanted to make sure that Pioneer could provide reconnaissance for the Voyager

spacecraft and decided against risking a collision with particles inside the rings. Hence, Pioneer will travel outside the rings.

Besides photographing the rings that adorn the planet, Pioneer will take a close look at Saturn's largest moon, Titan. Titan is actually larger than the planet Mercury, though less massive. The interesting thing about Titan is that scientists consider it to be one of the likeliest places for life in the solar system. It is a better candidate, in fact, than Mars is.

The reason for this is that Titan has been shown to have an atmosphere, probably thicker than Mars', and probably containing many organic compounds which could form the basis for life.

NASA has been hit like any other government agency by budgetary constraints, and has been hesitant to embark on new missions. But there are a few interesting projects up the line.

Project Galileo—once known as the Jupiter Orbiter Probe—is scheduled to be launched by the space shuttle in January, 1982. It will arrive sometime in 1985 and assume orbit around Jupiter that will be altered several times by the gravity of Ganymede to afford as many viewing angles of the planet as possible. Fifty-six days before encounter, an atmospheric probe will be launched from the main spacecraft. This probe will penetrate to a depth of about ten atmospheres pressure, taking samples all the way down.

The Galileo Orbiter will be operational for at least 20 months and will take advantage of the latest advances in technology: the television vidicon tubes used on Pioneer and Voyager will be replaced by solid-state charged-coupled devices (CCS's).

The Solar Polar mission, proposed to Congress last year, would be launched by the space shuttle in 1983. It would be a double-value mission, investigating both the sun and Jupiter. The craft would set out on a trajectory toward Jupiter, swing around the planet by the gravitational slingshot effect, and head out of the ecliptic plane of the solar system so that we can view the sun from "overhead." NASA envisions it as a two-spacecraft mission as well; one would go to the north pole of the sun, the other to the south. The European Space Agency has committed $100 million to the endeavor already. NASA is waiting for the word from Congress.

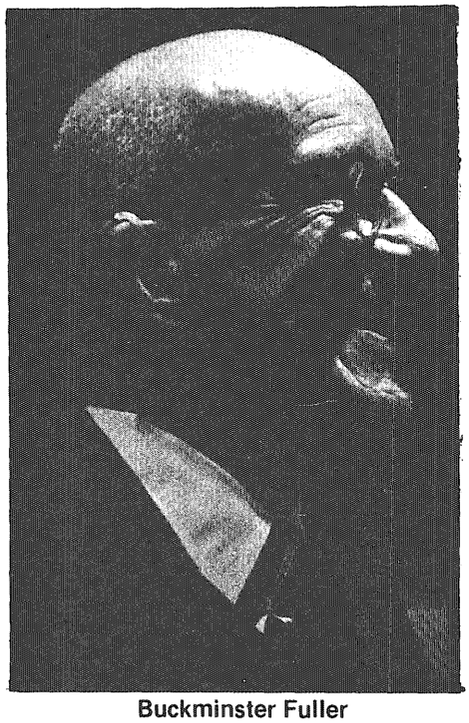
After Viking's successes on Mars, President Carter was quick to supply funding to NASA to investigate the possibility of a follow-up mission, possibly including a rover that would travel across the Martian surface to carry out the search for life in more than one place.

Because of the sheer distance involved, the rover would have to have its own brand of intelligence to keep itself out of trouble; it could take up to 40 minutes for the rover to receive commands from Earth should it run into anything unexpected. Such a mission would cost about 600 million in 1978 dollars for a 1983 launch.

Compared with the 1979 U.S. Defense or Health, Education and Welfare Department budget it seems a drop in the bucket, but still, it is a lot of money and Congress looks dimly upon such "frivolities."

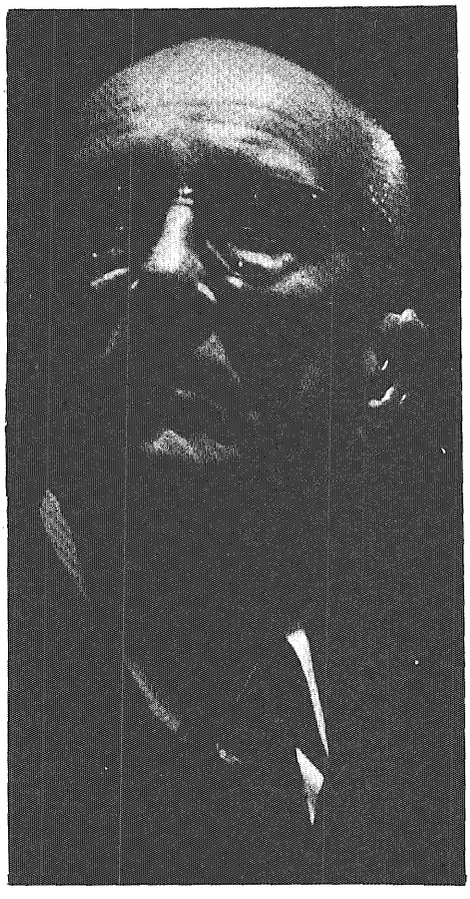
We haven't yet begun to realize the benefits of the knowledge gained from our interplanetary exploration, and like all matters concerning so-called abstract knowledge it is difficult to demonstrate this exploration's near-term utility. But one day, though, when Earth is filled to the brim with its screaming populations, we will be able to—and obliged to—follow our creations to the planets.

Fuller pumps new spirit, responsibility into APX delegates



Buckminster Fuller

Photos / Dave Bissonnette, Glenn Flekke



By Kathy Badger

The 36th biennial Alpha Rho Chi (APX) national convention was held in Minneapolis this year Jan. 3-8, hosted by the University of Minnesota chapter. Student and Alumni architecture delegates from 10 universities as far away as the U. of Southern California, Virginia Polytechnic Institute and Penn State U. attended.

Along with the national meeting, the convention consisted of sight-seeing trips through the Twin Cities area; workshops at the Alpha Rho Chi house; speeches by Ralph Rapson, Dean of the School of Architecture, and Saul Smiley, regional director of the American Institute of Architects (AIA); and a banquet at the Alumni Room atop the IDS Building with guest speaker Dr. Richard Buckminster Fuller.

As a national fraternity, Alpha Rho Chi has been having trouble keeping up membership and, as a consequence, enthusiasm. According to Bob Lund, vice president of the local chapter, architects are very individualistic people and it is difficult to get them to join and be active in an organization. The main objective of the convention was to decide whether or not a professional architectural society is worthwhile. Alpha Rho Chi first began in 1914 as a joint fraternity of the U. of Michigan and the U. of Illinois.

On Thursday night of the week-long meeting Master Architect Buckminster Fuller followed the banquet with a innovative slide show and speech to inspire the present and future architects.

Eighty-four-year-old "Bucky" has been around the world 44 times, is famous for his geodesic domes, of which there are over 100,000 in 100 countries, holds 26 patents, and has recently designed three airports in India currently under construction.

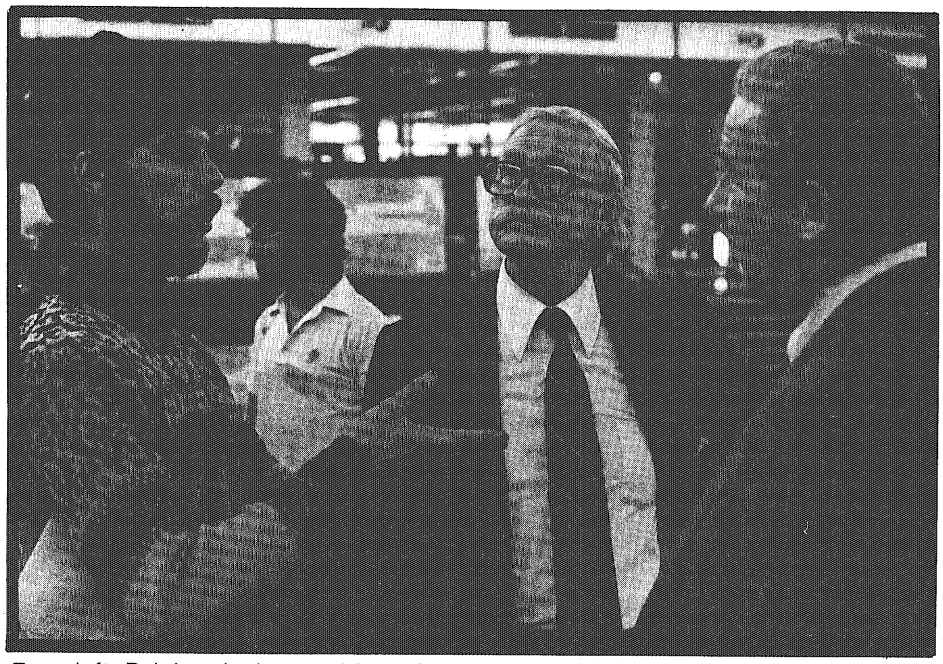
After pointing out that humans are the only living organisms on Earth with a mind that is capable of reasoning, Fuller, in his speech, proposed that humans must have some purpose in the universe—a purpose which involves using the mind to discover relationships between complex systems which will eventually lead to the discovery of a design in the universe.

This special, unique mind was designed to learn by trial and error and thereby has a very inventive memory. Fuller said the world was separated by continents in the beginning of time so that humans of different regions could learn separate lessons. Now, with advanced technology, the world is being integrated so that men can learn from each other.

Fuller believes that the inventiveness of man is brought more into play where greater variations in weather occur. What man invents for one season will not necessarily work in another, therefore he must invent something new. It is the adaptability of man that has caused such an acceleration of science against time in the past century.

With a slide, Fuller illustrated this accleration. There have been three steps of technical advancement that allow man to go around the Earth. The first was the wooden ship which advanced to the steel steamship, then the steel airplane and now the steel rocket. The time between each of these inventions decreased just as the time it takes for each of these to go around the world decreased. If man keeps up in the same manner, by 1985 man should be able to circle the Earth with the speed of a radio wave.

Fuller also pointed out the enormous responsibility of architects to create a design revolution which will pull mankind out of a rut where human-



From left: Bob Lund, vice president of local chapter of Alpha Rho Chi; Ralph Rapson, dean, School of Architecture; S.C. Smiley, architect and former U. of M. student.

ity is so highly specialized that it is helpless.

Alpha Rho Chi, he said, is an organization of high intellect looking for principles to uphold. The members should spend their years gaining information so that technology will not be slowed down by the unwillingness of society to change to new and better ways. He reiterated that man must learn by trial and error, but he must also share his discoveries in such a way that it will not stifle the creativity of others.

With these facts in mind, the convention continued with apparent new enthusiasm. At the national meeting on Saturday, almost all motions brought forward were passed. The national office agreed to hire a professional administrative consultant to act as a central mailing house for all paperwork. Ronald Grogan, an alumni from the U. of Houston, was elected national secretary and Charles Weaver, an alumnus from Penn State, was elected national treasurer. Members agreed on a special national meeting next year to discuss national finances.

The day before, Dean Ralph Rapson welcomed delegates to the university, giving a brief history of the School of Architecture. Saul Smiley, regional director of the AIA followed, reminding those present that learning and education continue even outside the classroom. He also encouraged all architects to make themselves more public and better identified so that the public may better develop its idea of what being an architect actually involves.

To help promote this idea, one of the workshops on Friday, titled Career Options, was presented by a three-member panel from the AIA.

Peter Rand from Setter, Leach and Lindstrom; Bob Larson from Snow, Larson, Inc.; and John Alberse from Rauenhorst Corp. led the panel to discuss specialties and options in the professional field of architecture, including first-hand information about their own involvement in sales, construction materials and traditional structural design and coordination.

Although Alpha Rho Chi is labeled a fraternity, there are many female members nationwide.

Because APX is a professional organization, it is concerned with the moral support and education of its members. This year's national convention, with the theme of "At the Crossroads," was concerned with bringing the members of the fraternity closer together so that they could share in experiences and knowledge. After the convention, Vice President Bob Lund said he felt the "delegates left with a lot of enthusiasm and spirit. We are looking forward to a stronger future of trying to pull together in a group of one of the most individualistic types of people, the Architects."

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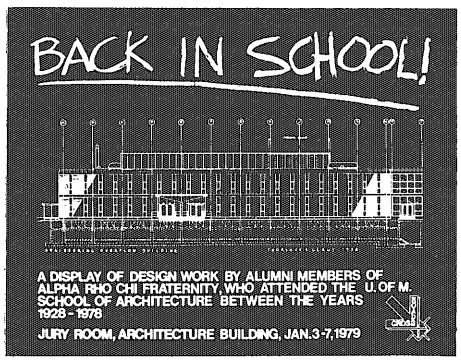
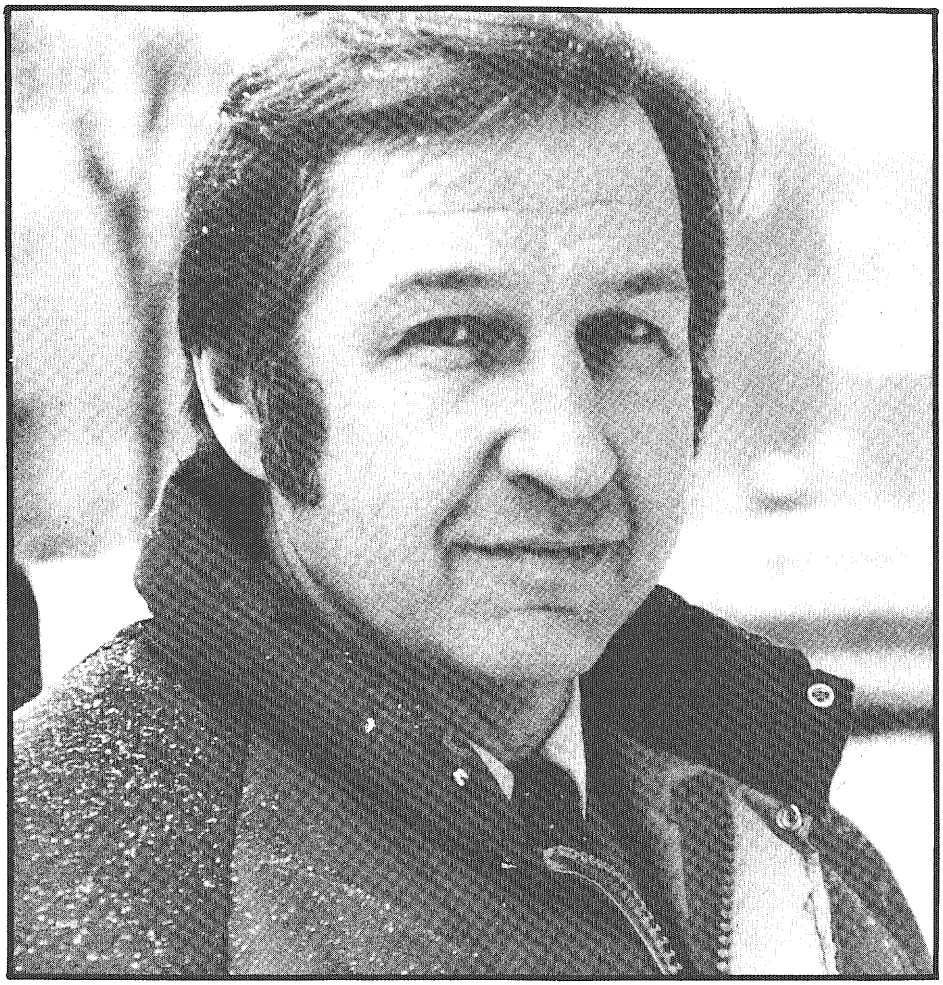




Photos/Glenn Flekke

New Friend for I.T.

"People-oriented" Staehle assumes deanship

By Mary Jo Hannasch

What do seasickness, a class presidency, a science-education philosophy and plans for I.T. have in common? They are all aspects and common experiences encompassed in the multi-faceted Dr. Roger W. Staehle, incoming dean of I.T.

Staehle, a man of considerable depth, arrives in Minnesota to assume his responsibilities as dean Feb. 1; acting Dean Walter Johnson leaves the office to return to teaching and research in the Department of Physics.

"I'm looking forward to coming to Minnesota," said Staehle during a recent telephone interview. "It is a beautiful state. But what is attractive is the people. They are energetic, work-ethic-oriented and people-oriented. One of my major reasons for coming to Minnesota is because Minnesota is a very people-oriented state. It is a place where people are dedicated to the development of people."

To anyone not acquainted with Staehle, he brings with him a prestigious scholastic record. He attended Ohio State University where he received both Bachelor of Science and Master of Science degrees in Metallurgical Engineering. While he was a student in the College of Engineering at Ohio State, he was active in many areas, including president of his senior class, editor of **The Ohio State Engineer** (Ohio State's equivalent of **Technolog**), president of his social fraternity, co-chairman of Texnikoi (an organization similar to Plumbob), and a director of the orientation program.

Since Staehle went through college on a Naval ROTC scholarship, he spent four years in the Navy following graduation. During this time he was a reactor engineering officer, jointly with the Bureau of Ships and the Atomic Energy Commission.

"Since I tended to get terribly seasick," confided Staehle, "I said that I didn't want to be unpatriotic, but on the

other hand, I wouldn't mind a desk job." This is one of the reasons that he then gained experience as a staff member for an admiral in Washington, D.C.

After four years in the Navy, Staehle returned to Ohio State on a fellowship sponsored by the International Nickel Co. after receiving his Ph.D. in Metallurgical Engineering and stayed on as a professor.

Staehle's ideas for education and, indeed, a majority of his plans for I.T., stem from his basic philosphy, which links technology to society.

Staehle explained this by saying, "In the last 100 years the world has built a technology that has enabled us to go to the moon, around Venus, and to travel around the universe. This is essentially the realization of the 'genie,' such as found in Aladdin's world where the genie could do anything. We have achieved in a very short time a tremendous material capacity.

"The real issue of today is not expanding the capacity, but who controls the genie. Essentially, science and technology have built a great instrumentality, but we haven't done much for the building of man. This is the central issue today in education. It is not the instrumentality that is important but the competence of the people.

"The place I put my major emphasis is on those things which help the students build competence and the capacity to be their own person. They should be able to handle their own affairs, and not drink from the public faucet as if everything is owed to them."

In order to achieve the goal of his philosophy, Staehle hopes to instigate some innovative educational programs. In reality this involves rebuilding "an educational program whereby the students could learn to write, speak, and think in ways that free them from having to function as a robot in somebody else's organization."

"I expect to do this in a variety of ways. One way is instituting more emphasis on writing and how it fits in a sociological background, and teaching the technical society to meet the needs of the world. For example, it will be like the program I started at Ohio State where the students in my classes did both writing and technical work. They wrote papers every week, and the papers were critiqued by both me and the English department. In the process of doing this, they not only vastly improved their capacity to write, but also their capacity to think logically, and their capacity to recognize the social significance of technical issues."

Staehle visualized not only students but also faculty involved in this plan to change educational goals. "We really don't teach students to write, speak, or think beyond the immediate solution of a technical problem. What we need to do is to change our point of view and change from a closed form of education," continued Staehle. "I would like to see more one-on-one time between students and faculty in the writing and analysis of technical problems that also have social significance."

Social awareness is a significant part of Staehle's philosophy, and plays an integral part in how he interprets the role of engineers in society. "Engineers have no basis for existence without the presence of social problems," Staehle said thoughtfully. "The whole purpose of technical work should be to meet the needs of the people. There is a constant feedback between technology and the political world."

Surprisingly, Staehle does not perceive technology as an entity having a relevance by itself. He expanded this concept, summarizing that "technology has relevance only because it has a resolution to a problem. Science has no value by itself but as it helps people understand who they are, what their origins are, and how they relate to a universal law. Unless put into social context they (people) have no meaning."

Encompassing this philosophy in programs is only a part of the plans that Staehle has as incoming dean of I.T. "My consuming interest for the moment

Johnson: "Nice to get back"

By Hap Atwood

While the search committee has been looking for a new dean for the Institute of Technology this past year, Prof. Walter Johnson has been acting dean for I.T. since November, 1977.

A professor of physics, Johnson has seen his role over the past year as one of "keeping my finger in the dike." He went on to explain that "An interim position like this one doesn't really have the power behind it that a regular deanship would. I've been trying to keep things in order until they can find a new dean."

Johnson said that the search committee's choice of Dr. Roger Staehle to be the new dean of I.T. is a good one. "He is an interesting man and has been very helpful to me during the transition. I think he has the potential for being an excellent dean."

Johnson talked about some of the problems Staehle will have to face when he assumes office this month:

"Probably the major problem we have to face is increasing enrollment in I.T. We've not had the resources to maintain the quality of education we'd like to. We're probably the only school at the University worried about increased enrollment. Everyone else's (enrollment) is decreasing.

"Of course then there is the enrollment-related problem of obsolete facilities. We're lobbying in the legislature, with the help of our advisory council made up of representatives of some 30 businesses around the state, for a new Civil and Mineral Engineering building to help combat this problem."

Johnson said that Staehle would also have to deal with I.T.'s relationship with business. "The area of contact with the outside community is not strong enough yet. "The I.T. Alumni Society and the advisory council are helping quite a bit in this area already."

Besides the day to day office duties Staehle will have to deal with, Johnson said he would like to see the dean's office become more accessible to students. "I deal most strongly with department heads. I don't very often deal with students. I think Mr. Staehle has recognized this problem and he may add another Associate Dean's position to remedy the situation."

Dean Johnson will be returning to his first love—teaching physics—this Spring. "I was an Associate Dean for six years before this job. That was nice because I could devide my time between the administration and working with my grad students. But since I've been acting dean I haven't had time for physics and I'm starting to lose touch. It will be nice to get back."

is the hope to improve programs, build buildings, make a better connection between I.T. and the Minnesota industry and the other colleges in the University and build I.T. into a major technology center of the Midwest."

Evident throughout the conversation was Staehle's concern for improving I.T.'s relationship with industry. He felt that this would help upgrade educational opportunities for the students, increase research for industry and aid Minnesota's economy.

"Minnesota is not a state of vast resources. Minnesota's economical system is dependent on high technology industry for survival. We have, therefore, to improve and maintain the climate for high technology industry and also make it a desirable place to live and operate a business.

"Obviously, I.T. can't solve all these problems, but business tends to go where the brain power is. My objective, then, is to build I.T. further to where it will be extremely attractive for businesses to come to Minnesota because of the available brain power for high technology industry. I think that I.T. can play a major role in advancing Minnesota's economy."

In accordance with this idea, Staehle envisions this: "I see three main things that we have to do to build a strong I.T. One is to keep attracting and maintaining a good faculty, the second is to have a substantial building program that will modernize and expand facilities. And the third is to arrange for state support of some program of research that will be attractive for the industry to supplement, too."

Revealing his reasoning in depth, Staehle explained step one of his plan. "With a good faculty you will attract good students. It should be observed that students tend to stay in the state where they have been educated. They will then form businesses themselves and attract other businesses here."

The second step concerns some challenging concepts about the actual physical presence of I.T. This building plan would affect virtually all areas of I.T. As Staehle views it, building is the direct result of the drive to meet two specific objectives.

"One is to modernize the facilities so we can conduct the type of high technology research that industry depends upon. A second objective, and certainly one of the most important, is to promote more interaction among the stu-

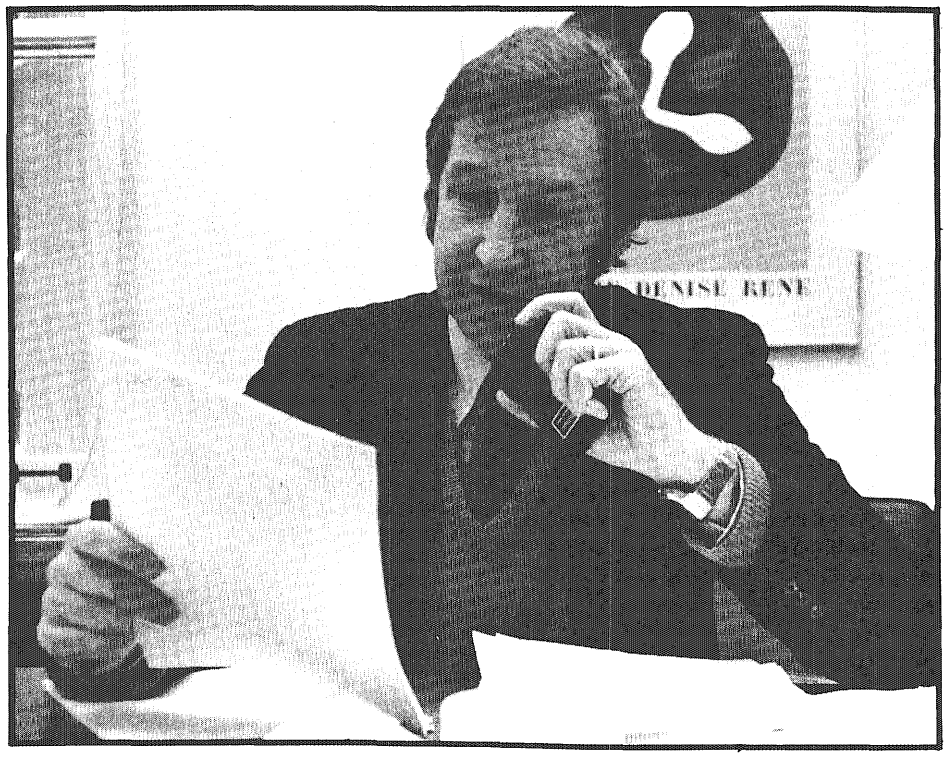
dents.

"One of the problems within I.T. is the general lack of peer interaction. We would like to find a way to construct a unit which is 'I.T.', so the students would interact with each other and with the faculty more. Instead of individual buildings, I would like a single integrated presence where the entire I.T. could be gotten to easily.

"For example, a place which would give an interaction with people in all departments and all disciplines. It would contain places where students could stop, talk, eat and work on projects."

These buildings would serve also as an opportunity to further the public's information of the current advancements in modern science. "We want to attract the people of Minnesota to visit these buildings to get a true image of science and technology. We would do this by having displays and exhibits."

Currently, the largest stumbling blocks to accomplishing this are architectural problems, and more importantly, funding for this massive program. However, Staehle has a very optimistic outlook for finding monetary help from the legislature and from private industry.



"It is essentially an investment in buildings which would represent Minnesota's future," analyzed Staehle. "Hopefully, it would be a joint venture between industry and the people of the state."

Step three stresses the importance of increasing state funds for research. "We need to substantially increase the state support of research within I.T. because the research would be a main agent for

attracting industry.

"Virtually all the research that is supported in I.T. is supported by the federal government. Since it is important for the state to attract industry, it will have to make some investment in research in those areas which will attract industry to Minnesota."

In order to obtain funding for this research, Staehle will first try to identify the areas of major strength in I.T. For example, he mentioned that on the faculty we have 15 people who are specialists in surfaces. He estimated that I.T. has at least 15 such areas of strength, and research would organize these groups.

"It would be to the advantage of the state to add money to these areas because this would make it attractive to industry. This is what I would like to suggest to the legislature. What we would need, in simple terms, is equipment, technicians to operate the equipment and a few more fulltime people to help carry on this extended research."

Organizational problems with the research would partly be resolved by his idea of forming "centers" for each area. "I would like to have centers of research such as a center for surface science."

Just as money presents a problem for the proposed plans, budgeting is usually a large concern of deans. One way to readjust funding so as to relieve budgetary problems is the program of retrenchment and reallocation organized by University President C. Peter Magrath and Vice President Henry Koffler. Staehle expressed hope that "I.T. will benefit from this type of program."

In Staehle's philosophy, communication is a key component. "I have already asked the assistant dean to find ways to set up regular interactions between me and the students. I want to make it possible that the students have a regular basis for access. They should feel free to let me know when they want to talk."

Predictably, Staehle sees the need to increase communication with industry as well. "There are many ways of improving communications with industry. First, I would like to start an I.T. magazine which would go to all the industries and to the legislators. This magazine would do three things: It would talk about our faculty—who they are, what they can do and their achievements. It would emphasize the integration of I.T. into areas of research through areas adjoining us in research. And third, it would show how technology is relevant to the present needs of man.

"Besides this, I plan to visit all of the industries that are on our advisory committee before the end of June to tell them more about I.T. and the plans for the future."

Although Staehle has been shuttling between Ohio, Washington, D.C., and Minnesota, in recent months he has had time to see the University and form some opinions about the people within I.T., and the people within the University administration. His positive enthusiasm sparkled throughout the conversation.

"The faculty of I.T. is an enormously competent group," observed Staehle. "There are, among the faculty here in Minnesota, some genuine super stars. Another point to be made is that we have an outstanding university administration.

This enthusiasm even allows him to view any upcoming problems with cheerfulness. "I really don't see any problems that can't be solved by a certain amount of effort. The largest problem will be finding enough hours in a day."

Books/Media

AD ASTRA!

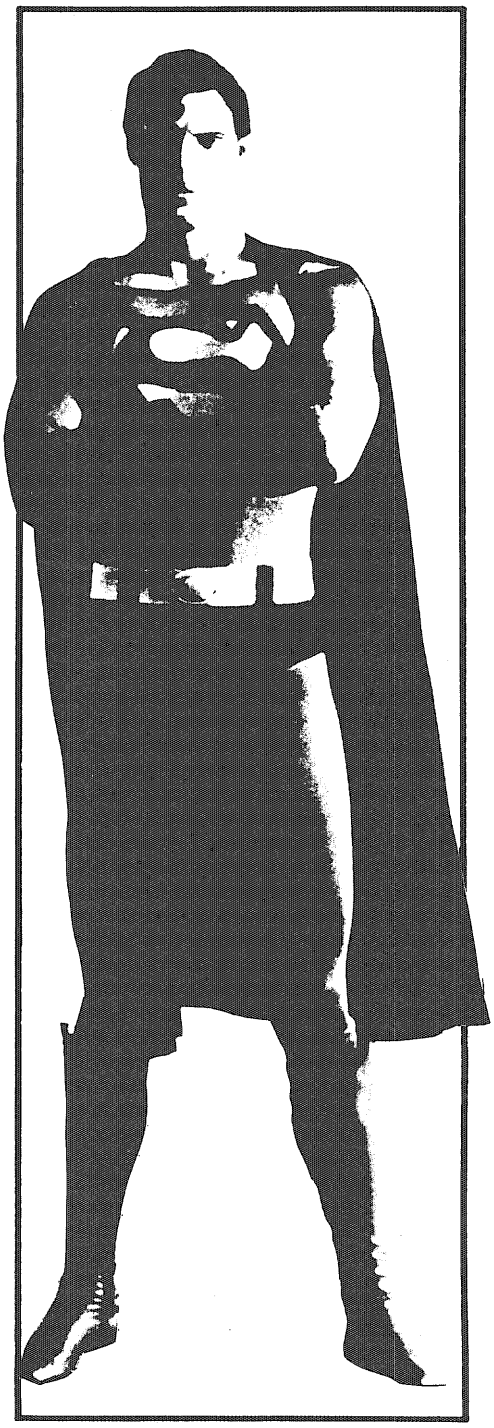
By Bruce Kvam

Watching the cost of living rise has been a real bore for me, but recently I was shaken violently out of my stupor. Last month I shelled out $4.00 for the privilege of seeing **Superman: the movie** in Dolby Stereo at the Har Mar Theater in Roseville. Walking out of the theater with a noticeably thinner wallet, I wasn't sure whether I liked the movie because it was truly good or because I didn't want to admit that I had blown four bucks on a lousy flick.

Superman is the biography of a Kryptonian, Kal-El, from his earliest childhood on his home planet to his rousing exploits in the skies of Metropolis. A lot of liberty was taken with the plot. Many things in the film do not jibe with what I remember happening in the comic books, but those differences are usually minor, and some are necessary for the sake of simplicity.

The movie starts off surrealistically with the proceedings of a trial. Jor-El, Kal-El's father, is prosecuting three criminals who dared try to usurp control of the planet Krypton from the elders. After they are found guilty, Jor-El (Marlon Brando)—discovers that something horrible is wrong with the planet and that it will soon explode. (The explanation for why it's going to blow up is very flaky, as are all the explanations in the film that try to be scientific.) Jor-El prepares a spacecraft in which his infant son will flee the planet and gives him the whole of Kryptonian knowledge. Kal-El then is launched through space and time toward a small planet called Earth.

This first sequence is very weird. Krypton is an alien planet, and the film depicts its strangeness quite well. While enjoyable footage, some may find it tedious.



Kal-El is found by kindly Ma and Pa Kent, who take him in and raise him into a fine young man. What follows is a look into the personality of Superman as a boy, how he differs from "normal" people, and how he feels about it. Films are notorious for their lack of character development, so the writer and director must be lauded for this attempt. But all through it I had this feeling of "Well, let's get on with it."

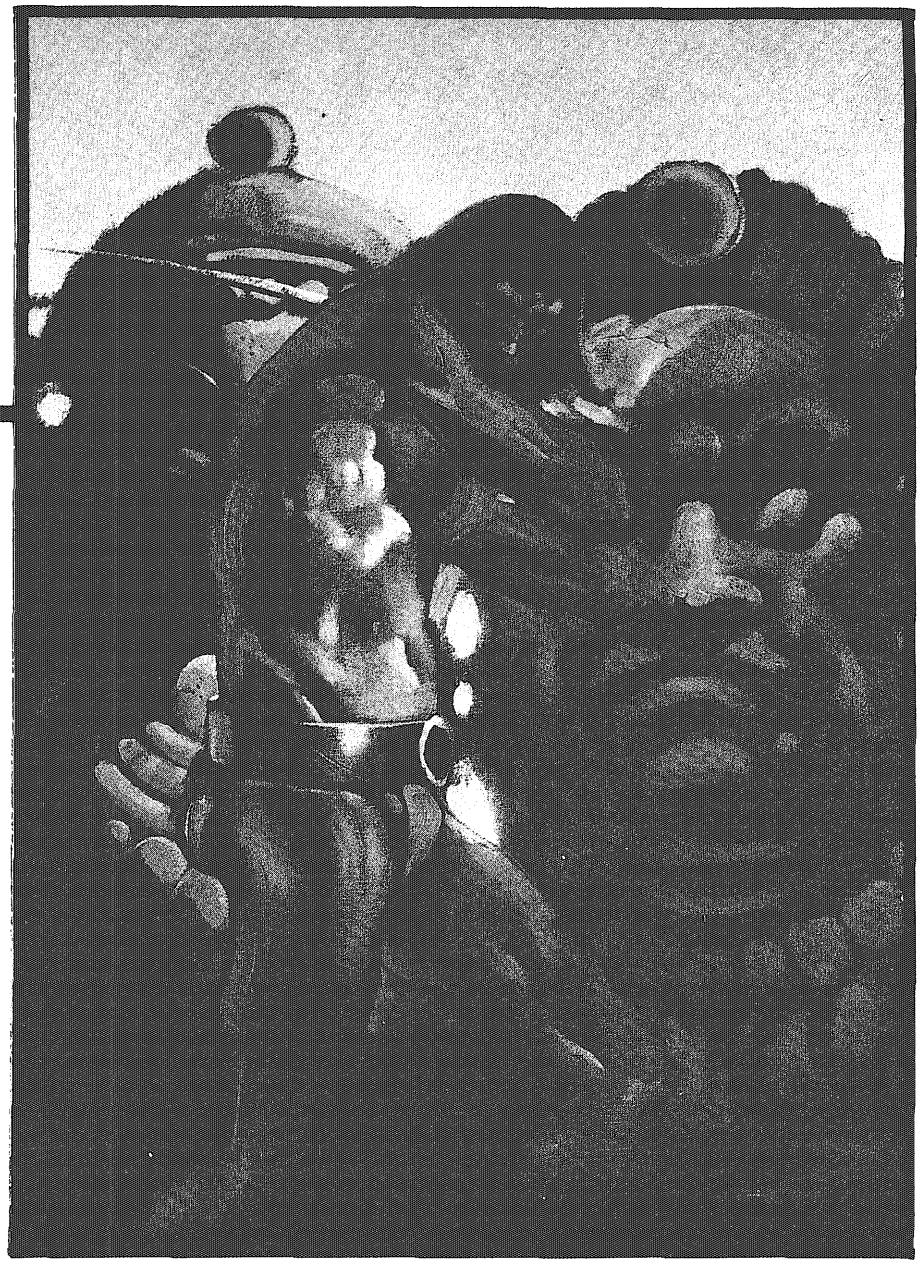
Kal-El, renamed Clark Kent (Christopher Reeve) then heads for Metropolis, of course, to become the mild-mannered reporter for the Daily Planet. He meets Lois Lane (Margot Kidder) and falls almost immediately in love.

It goes on from there in the best comic-book tradition, with Superman rescuing Lois from helicopter accidents and earthquakes, taking cats out of trees and saving California from falling into the ocean.

Superman mixes camp a la Batman with overbearing seriousness and silly melodrama. I would have been more comfortable with a more even tone. Some of the intended funny lines don't come off through bad acting or writing or directing. In the serious parts, like when we journey through space with Marlon Brando's "profound" narration, it gets boring mighty fast.

The special effects: just okay. The acting: generally fair (when the characters are cardboard to begin with, what can the actors do?), and the overall impression: that of the comic book.

Whatever faults the film has, **Superman** has the same excuse **Star Wars** does: it's all for fun. And if two bucks an hour for a little fun is worth it to you, go see **Superman.**



Books, as well as movies, are spiraling ever upward in price. **The Tower of the Elephant,** by Robert E. Howard (Grosset and Dunlap, 94 pp., $6.95!) consists of two long short stories, first published in 1933, about Conan the Barbarian.

The justification for the high price, presumably, are the nine full-color paintings by Richard Robertson and the book's large seven-by-ten-inch format.

All in all, the book contains about 20,000 words of fiction, which, if you're a Conan fan, may be of considerable interest. The first story, "The Tower of the Elephant," describes how Conan steals into the impenetrable tower of Yara, the evil magician. Braving the deadly perils of the inner chambers, Conan makes his way into the room where Yara keeps the secret of his powers, and—HA! I'm not going to tell you what it is.

The second story, "The God in the Bowl," is a quasi-detective story. Conan is caught skulking around inside a private museum by a night watchman who has just found his master choked to death on the floor. Guess who the police are going to blame? But the real killer is something so strange. . . .

The prose is gushy, filled with lots of adjectives and the odd grammar typical of the pulps of the 1930s, and there is plenty of blood and guts. The color paintings are inferior in quality, though there are one or two likeable ones. For some, $6.95 may be well worth reading, but for my money, I'd pass it up and see **Superman** 1.7375 times.

At the 1977 Worldcon Larry Niven was met with a severe moral dilemma. He didn't know whether to reissue a long-out-of-print collection of short stories, **The Shape of Space,** or, since half of the stories in the 1969 collection were in other in-print anthologies, to leave it dead. What he did was the best thing possible: he took the unduplicated stories and a number of more recent works and combined them into a new collection called **Convergent Series,** which will appear in March from Del Rey/Ballantine (240 pp., $1.95).

Convergent Series contains a few stories with neat plot ideas.

For example:

"Bordered in Black": The hyperdrive ship **Overcee** left for Sirius with two pilots, and returned with only one; the other was left behind on one of the black-bordered continents of the Earth-like planet of the Sirius system.

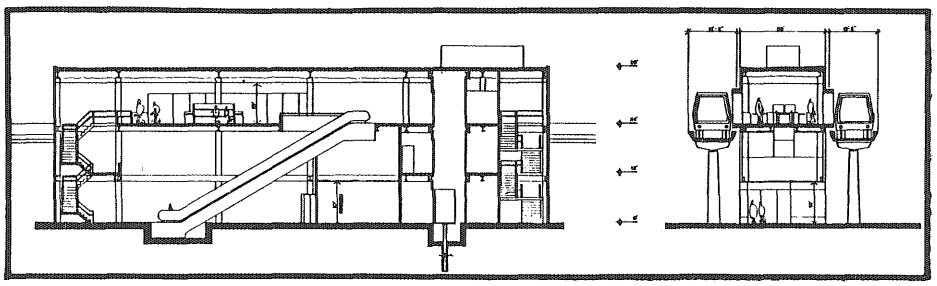
"Convergent Series": What do you do with a nasty demon once you've summoned him?

"The Deadlier Weapon": Can you believe a hitchhiker who pulls a knife on you and tells you that everything will be okay if you hand over your wallet—when you just **know** he's going to kill you anyway?

There are 21 stories in **Convergent Series.** None of them are placed in Known Space, the series which made Niven's fame. The older ones are not Niven's best, a few them marred by Niven's mistaken notion that a habitable planet must have a large moon to strip away excess atmosphere. One story's punchline is based on this premise.

A couple of the stories aren't even science fiction, but then there's nothing intrinsically wrong with that. And the newer stories, mostly short vignettes, lack the touch that Niven has in his longer pieces: they are all vaguely unsatisfying.

People Mover Proposal to Use Existing Technology Track



By Dan Freeborn

In April, 1976, the Urban Mass Transportation Administration (UMTA) established the Downtown People Mover (DPM) program to test the validity of automated guideway transit in downtown settings. It was also the goal of UMTA to establish the Downtown People Mover as a means to revitalize urban areas.

Along with St. Paul, Cleveland, Los Angeles and Houston were selected as DPM sites.

The DPM is an automatically controlled guideway transit system in which small electric driven vehicles operate on elevated guideways made of concrete or steel, depending on the type of vehicle employed. The vehicles receive power through electrical contacts in the guideway and travel at speeds up to 30 mph.

A central computer controls the switching and spacing of the vehicles as they travel along a fixed route.

The UMTA has stated that the DPM system "make use of existing people mover technology, with minimum modification to adopt it for urban deployment." Presently, there are no Downtown People Mover systems operating in U.S. urban areas.

Although no specific DPM technology has been selected for the St. Paul system, the planners have defined what they call a "baseline system" to be used in work on the preliminary design, determining environmental impact and estimating costs of the system overall.

Here, the St. Paul system was designed to show where potential adverse effects could appear. For instance, is the system an eyesore? Is it too expensive to build? Will it be cost effective once in operation?

According to the baseline proposal, the system will be 2.5 miles of double lane, 2-way guideway made of concrete and shaped like a trough. The guideway may or may not have side walls; if it does, these walls may incorporate guide beams, power rail and control and communications wiring.

Because the concrete trough guideway would be an ideal collector of ice and snow during cold weather, the guideway will require that part of the running surface and the power and control rails be heated to melt ice that would hinder operation of the system. This heating would be used only when conditions dictate.

"Snow could be either melted or removed by mechanical means," said Barry Engen, people mover project planner. But critics of the system fear that additional maintenance and engineering costs to keep the system operating efficiently in harsh Minnesota winters may be a durden on the DPM budget; if snow removal provisions are not nade the city could end up with a wintertime white elephant as vehicles short-circuit, stall or quit operating altogether.

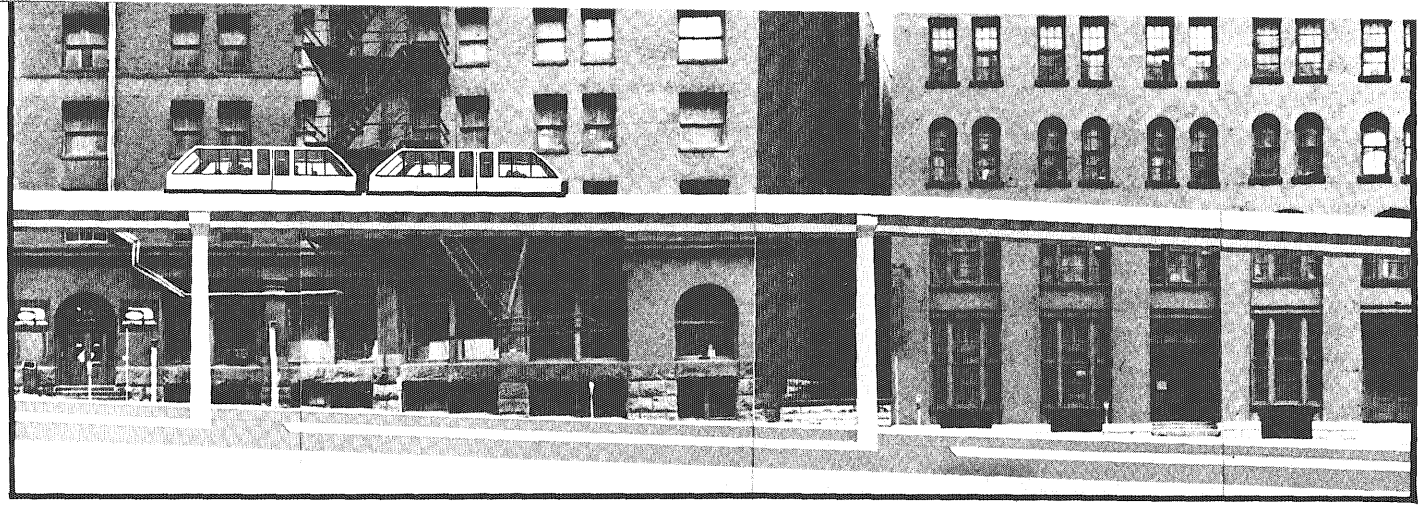
Because the baseline proposal sets only general parameters for a DPM technology, detailed guideway characteristics will depend on the particular vehicle system selected.

The baseline vehicle will be about 22 feet long and have a capacity of 33 people (14 seated and 19 standing) and a "crush" capacity of 41. The vehicle will have rubber tires and small guide wheels that bear against a vertical surface along the guideway.

"The vehicles could be linked together for high-demand peak times," Engen said. They could be uncoupled later for normal operation.

There are two prototype station designs in the baseline system. One is a two-level station which will connect to existing skyway pedestrian bridges; the other features an independent station.

Both stations will have escalators and elevators and will be completely accessible to the handicapped. For security, the stations will use closed circuit television monitoring. "There may also be plainclothes policemen employed for additional security at the stations," Engen said.



"At the outset there will be twelve stations on the system," Engen said, "with an additional station to be built later on the Cedar St. bridge over I-94."

According to the proposal, the capital cost estimate to construct the DPM system is 90 million dollars. Of this cost, the UMTA is to cover 80 percent, the Metropolitan Transit Commission, 10 percent and St. Paul, 10 percent. Engen said that because streets and skyway bridges are already in place, the city of St. Paul's share will be less than a 10 percent contribution to the total.

Projected operating costs of the system total 2.8 million dollars, of which 50 percent is direct labor costs. The planners say that this amount will come from a combination of fares, advertising revenues and revenues from benefiting property onwers (downtown businesses), the city of St. Paul and the MTC.

Planners project that the DPM ridership will be approximately 45,000 riders per day. This estimate is based on additional development and expansion planned for the downtown area, and the corresponding attraction of people to the area by 1990. Currently, 30,000 to 40,000 pedestrian trips are made daily in this 10-block area.

"In our estimate of DPM ridership we aren't including the number of people who will be riding the people mover just to see what it's like," Engen said.

St. Paul is presently ahead of the other cities involved with DPM planning. According to the development schedule, final design and engineering will take place during 1979-80, construction during 1980-82 and public operation by late 1983.

After Graduation

By Peggy Purcell

How would you like an all-expense-paid trip to exciting Chicago, San Diego, New York or Fishkill? (Well, maybe Fishkill isn't exciting, but I had fun there.)

How do you get this fantastic freebie? It's just part of the recruitment process to give graduating engineers a look at the companies that want to hire them.

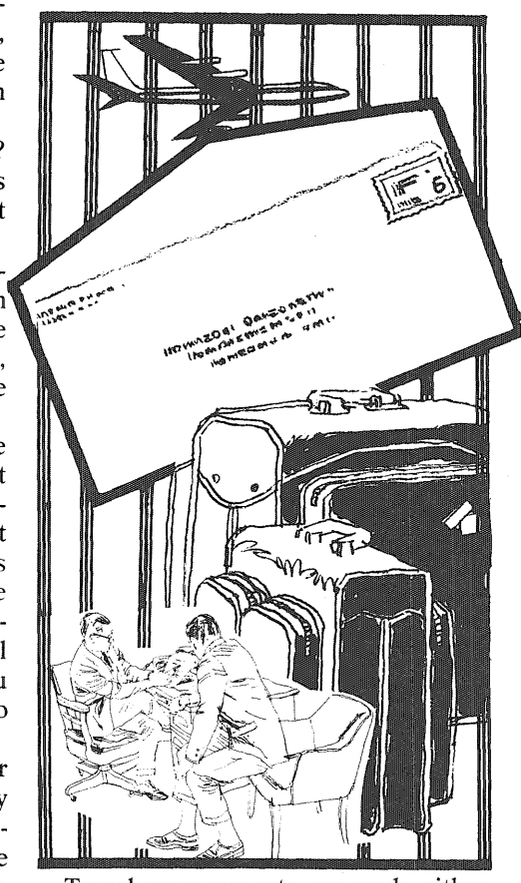
If you are a senior this year and haven't been to the I.T. Placement Office in 15 Experimental Engineering, you're missing your chance to see the country, not to mention the promise of a lucrative salary after graduation.

To start things rolling, file a "College Interview Form" at the Placement Office. This is a resume of your education and any work experience. Type it neatly: a lot of important business people read it. Then run down to the office every Friday and sign up for interviews. There is a good library there full of information about each company you may want to know about before talking to a representative.

The interviews take place a week or two after you sign up for them and every company conducts them a little differently. Sometimes the representative spends the entire time giving a sales pitch about his or her company. Others want you to talk about yourself in a more or less informal fashion. Some will quiz you about your technical knowledge. Usually the recruiter does a little of everything.

A warning: they ALWAYS look at the grade point average on your resume. They also like to hear you describe any technical work experience.

If you don't have any trouble with your interviews, the company will call, write or telegram an invitation for a plant trip. On several I took during the holiday break I was wined and dined, learned more about the industry, and even got a kick out of flying.



Travel arrangements are made either by you or the company. They expect you to fly in the night before the interview, spend the next day at the company, and fly out that evening.

Upon arrival you rent a car or take a cab, bus or limosine to your hotel (usually a Holiday Inn). The company makes arrangements to take you to their plant in the morning.

Some companies do a good job of wining and dining you, while others give you lunch in the company cafeteria. Meal expenses are always reimbursed, however. I enjoyed most of my meals with company representatives as it provided an informal break from the interviews. Breakfast is an awkward meal to eat with a businessperson since neither one knows much about the other just yet. And you're still a little sleepy after traveling.

On the morning of your plant tour first check out of the motel. If they won't let you bill it to the company, pay for your room and you will be reimbursed. Make sure you take enough cash on your trip, since the cost of one night at a motel can be as much as $30.00 or more. Then take your suitcase along to the plant; they'll have a place to stash it.

At the plant you will be shuffled from one manager to the next throughout the day. Each one, you hope, is in charge of a job that interests you, but it isn't always scheduled that way (One day I had to spend an entire afternoon in a power system facility, although I'm interested in LSI design.)

The managers interview you in the style of the campus interviews, with resume and transcript in hand, only in a more interesting way.

Be sure to ask plenty of questions, since you have to determine at the end of the day which department you most want to work for. The people I met were always very considerate regarding any questions I had. One helpful thing to do is to ask to talk with an engineer who works under the manager. It gives the best indication of the situation you will be in when you start working.

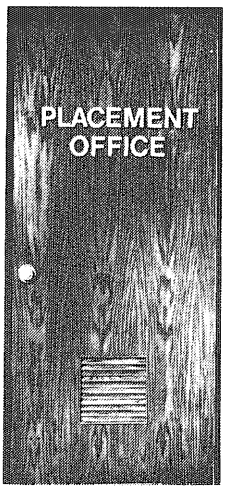
By 5:00 you are probably thoroughly confused with who said what. Someone from the personnel office gives you a stack of company brochures and literature about the locality, goes over your expenses, and asks for your department preferences. (If you don't care to work there at all, tell them!)

Representatives will also want to know your expected starting salary at that time.

Then, you fly home and await that letter that says, "May we offer employment to you at a starting salary of..."

HOW TO LAND A JOB WITH BOEING:

Knock.



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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 Business and Technical Personnel, Eastman Kodak Company, Rochester, N.Y. 14650.

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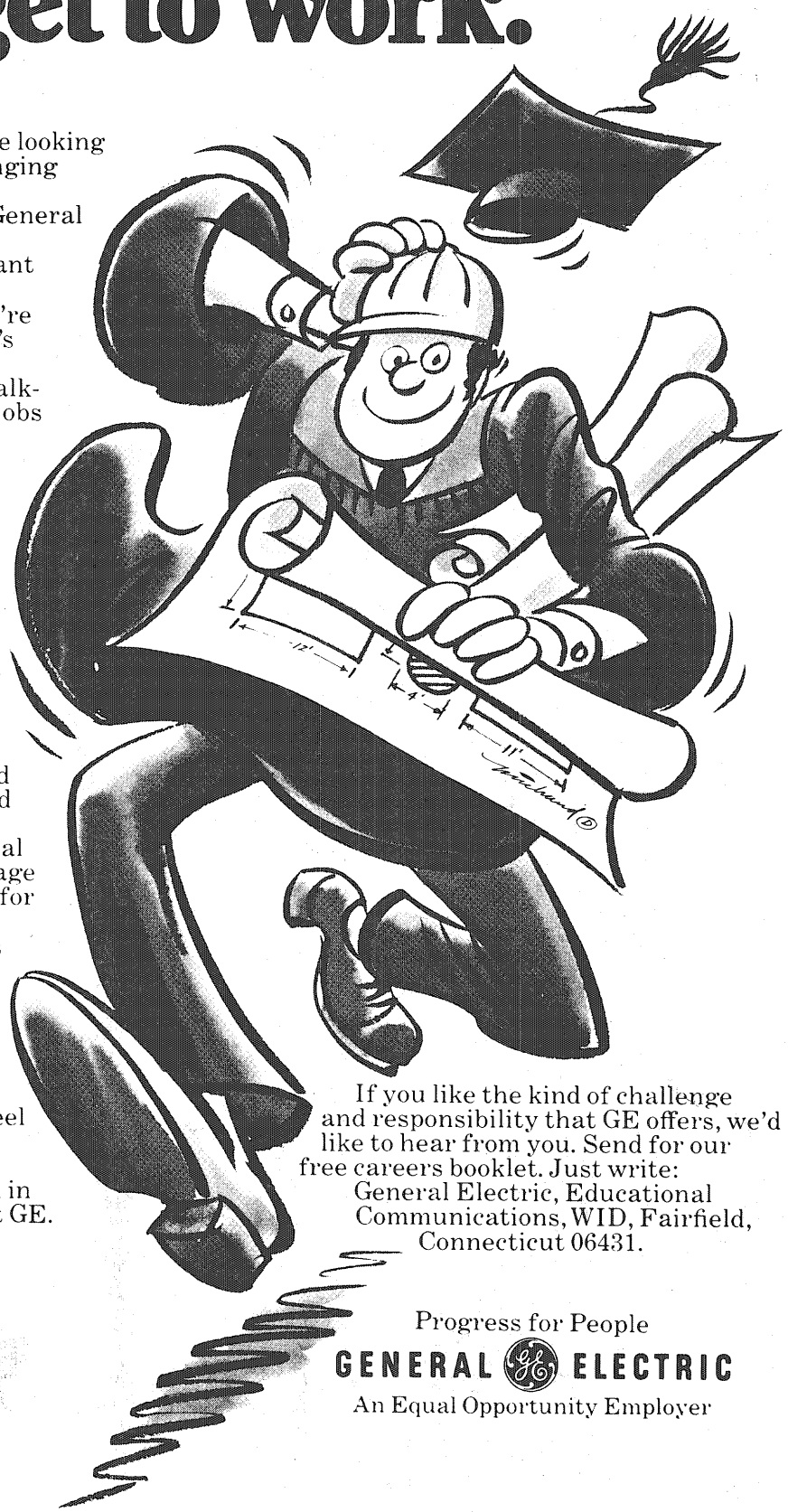
At GE, you'll be handed important assignments right from the start. You can do as much of the job as you're capable of doing. If you need help, it's there. If not, nobody butts in.

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

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

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

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



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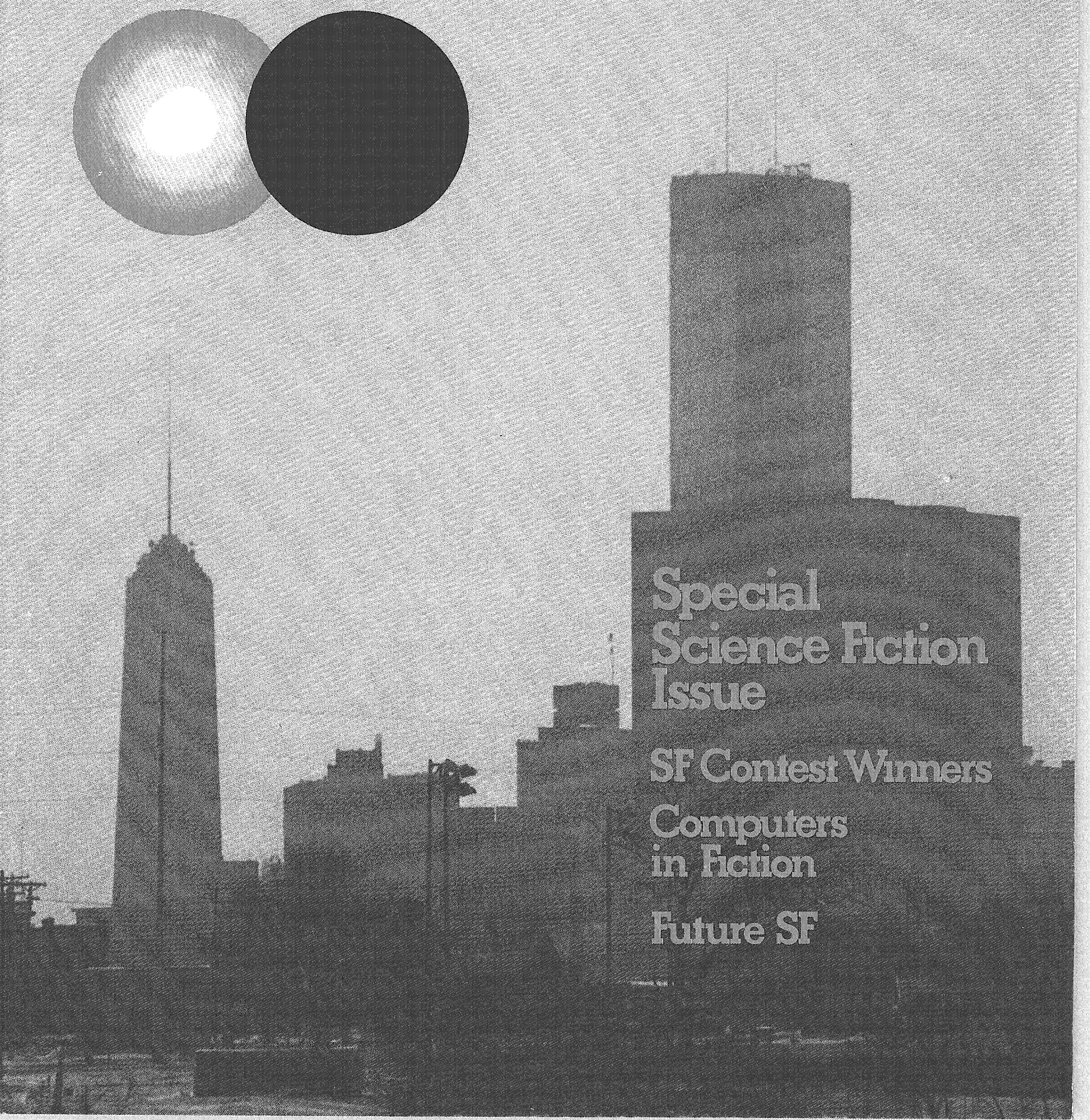
minnesota TECHNOLOG

Winter II, 1979

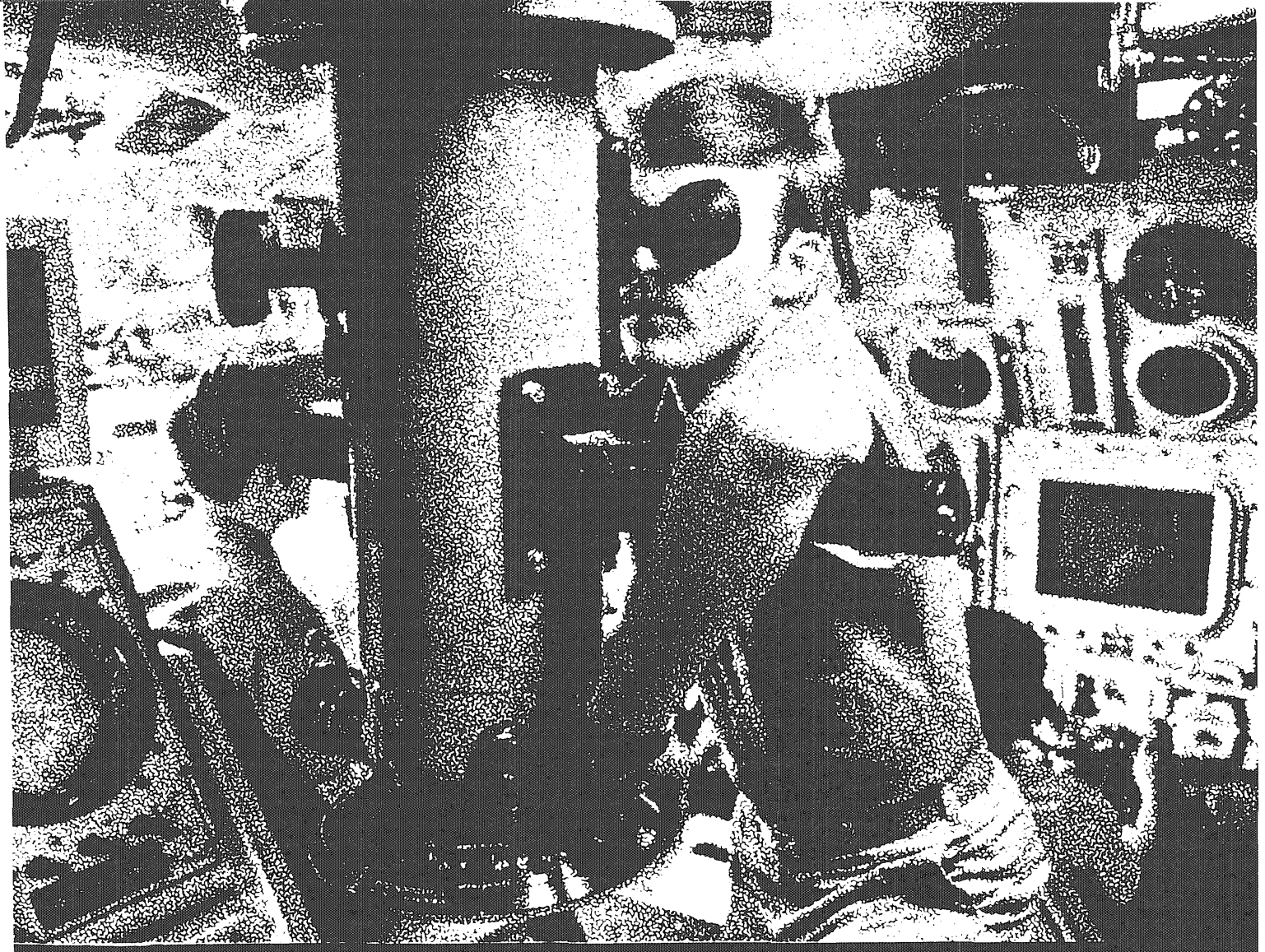


Special Science fiction Issue

SF Contest Winners

Computers in fiction

Future SF



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Editor's Log

Science fiction. Call it a laughable product of some writer's wildest imaginary impulses, or, a careful, believable prediction of future technology at work, science fiction is destined to be a part of our literary tradition well into the next century and beyond. Placing a good deal of faith in the latter concept—believability—we present this special science fiction issue.

In addition to the three winners and honorable mention of the **Technolog** Annual Science Fiction Writing Contest, we offer several views of sf past, present and future, designed, we hope, to broaden every reader's view of the medium's involvement and impact on our world.

Lee Pelton's hope for science fiction, based on extensive reading and sf history, is presented in "Once and Future SF." Bruce Kvam's hope lies with science fiction to broaden perspectives on the superfast development of technology in our society, perhaps a way to help explain and dig out of the "Hole Phenomenon." If computers are your intrique, don't miss James Moen's look at the artificially intelligent beings which affect both real life and sf. He suggests that computers may be "Dumb in Fact, Smart in Fiction." Hollywood, too, has contributed its share to the development and promotion of sf in film. S.H. Rosenzweig explains how sequels and remakes of recent extravaganzas like **Star Wars** and **Invasion of the Body Snatchers** may be netting the biggest of sf profits. Special thanks to Bruce Kvam for editorial guidance with the issue.

But, while the focus of this issue is, indeed, science fiction, we can't help but acknowledge an important astronomical event—the last total eclipse of the sun, seen Feb. 26 as this **Technolog** went to press. Mike Dorn's cover depicts the beginning of the 90 percent expected coverage for Twin Cities residents; watch our next issue for a special article on the eclipse, including photos and commentary from various vantage points along the United States-Canadian border.

And while your're thinking about the sun, don't forget to check out John Bartelt's presentation of "The Solar Neutrino Problem or What's SNU?"

If you're already tired of waiting for the next solar eclipse, scheduled for 2017, finish the issue with the exciting conclusion to "Samurai T.A.," brought to you by Steve Smith.

Jon Kavanaugh
Managing Editor

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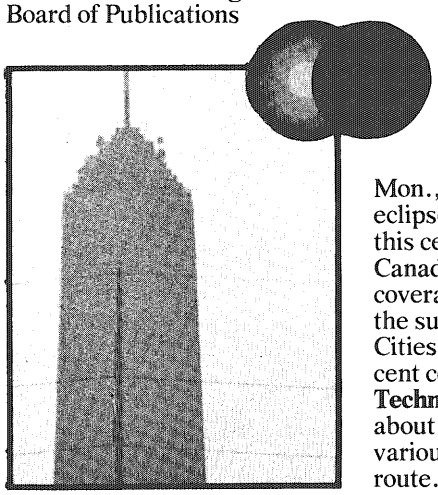

Cover photo
by **Mike Dorn**

Mon., Feb. 26 marked the last total eclipse of the sun visible by Americans this century. Minnesotans near the Canadian border expected a 98 percent coverage as the moon passed in front of the sun during the morning hours. Twin Cities residents expected about a 90 percent coverage. The Spring I issue of **Technolog** will feature a special article about the eclipse, including photos from various points along the eclipse coverage route.

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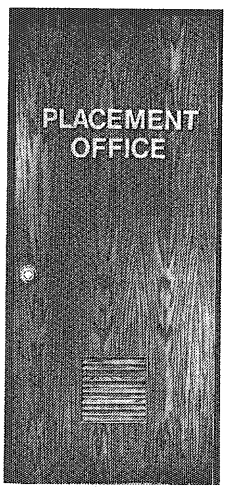

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Log Ledger

Minicon Convention

Minicon, the annual regional science fiction convention of the Minnesota Science Fiction Society, will be held Easter weekend, April 13-15, 1979. Guests of Honor will be Theodore Sturgeon, Tom Digby and Rick Sternbach. Registration for the event, to be held at the Hotel Radisson in downtown Minneapolis, will be $6 until March 15 and $15 thereafter. Address all inquiries to: Minicon 15, P.O. Box 2128, Loop Station, Minneapolis, MN 55402.

Dean Staehle on Gov. Quie

The University of Minnesota recently requested a $437 million appropriation from the state legislature for the next three years, 1979-81. Gov. Al Quie, however, recommended a no-growth appropriation of $394.9 million. I.T. Dean Roger Staehle reflected last month on the effects the Governor's proposal will have on I.T.

"I think it's reasonable for Mr. Quie to be concerned about costs, but I'm optimistic that a reasonable balance can be reached between the two proposals. We probably won't get as big a (monetary) growth as we'd like but I'm supporting Pres. Magrath's proposal fully.

"We have 30 percent more students this year than in 1970. More students need more classrooms and more facilities. If you put 1,000 people in a classroom you start turning out robots rather than individuals. I.T. also helps the economy of the state because most students stay in the state where they graduated to start new businesses. These new businesses attract other companies to the state, which create more jobs and revenues for the state. We have to work with Mr. Quie and prove to him that the Institute of Technology is a good investment. It's an investment in the future of the state."

Recognition Dinner

The 1979 Student Leadership and Service Recognition Dinner, sponsored by the President's Office and the Office for Student Affairs, will be held Wed., May 23 in Coffman Union Great Hall. A wine and cheese reception, sponsored by the Alumni Association will precede the dinner which honors students for their outstanding contributions to the University community. The Twin Cities Student Assembly will also honor outstanding faculty and staff at this dinner. Nomination forms will be available after March 1 at 350 CMU, 190 Coffey hall, 110 Anderson Hall and across from the CMU Information Desk. For more information call Kathy Hvass at 376-2650.

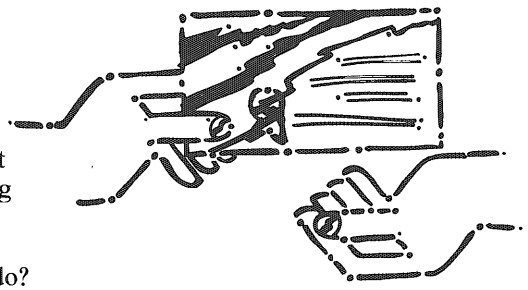
Peer Advisors Ready to Help

Are you thinking of taking that physics class you've been putting off all year? Do you want to know that the teacher is like? How much work do you have to do? What are the tests like?

Now it's possible to find out from someone who has probably already taken the course. Some upper classmen have volunteered to be Peer Advisors to Freshmen, Sophomores and unclassified students in I.T.

Juniors and Seniors, representing a variety of fields in I.T. (Electrical, Mechanical and Chemical Engineering, Physics, Computer Science) are available at regular hours in 105 Lind Hall to answer questions about intern programs, general course requirements, options in major fields, career seminars and placement. In addition, they offer the student point of view concerning "how to make it in I.T."

—**Hap Atwood**



Industrial Career Fair

The student branch of the Institute of Electrical and Electronics Engineers (IEEE) will sponsor an industrial career fair with the help of the University's Eta Kappa Nu chapter April 11, 1979 in the Electrical Engineering Building.

The fair will feature electronics-oriented companies whose representatives will be on hand to provide students with information on each company's activities, facilities, career opportunities, product lines and other engineering services.

For more information contact James Guentzel, administrator, Electrical Engineering Department, at 373-5404.

Log Ledger

Plans Readied for E-Week

Plans for the annual Engineer's Week celebration have been finalized by the sponsoring organization, Plumb Bob. This year's events will take place from Mon., April 30-Fri., May 4, 1979, around the I.T. campus.

Throughout the week-long festivities, held each year to commorate spring and to honor St. Patrick, the patron saint of engineers everywhere, students can participate in a wide variety of events including the following:

Competitive sports:
Tennis, fooseball, softball, three-person basketball, bowling, volleyball

Individual "enginuity":
Paper airplane contest, forester trap, car rally, calculator race

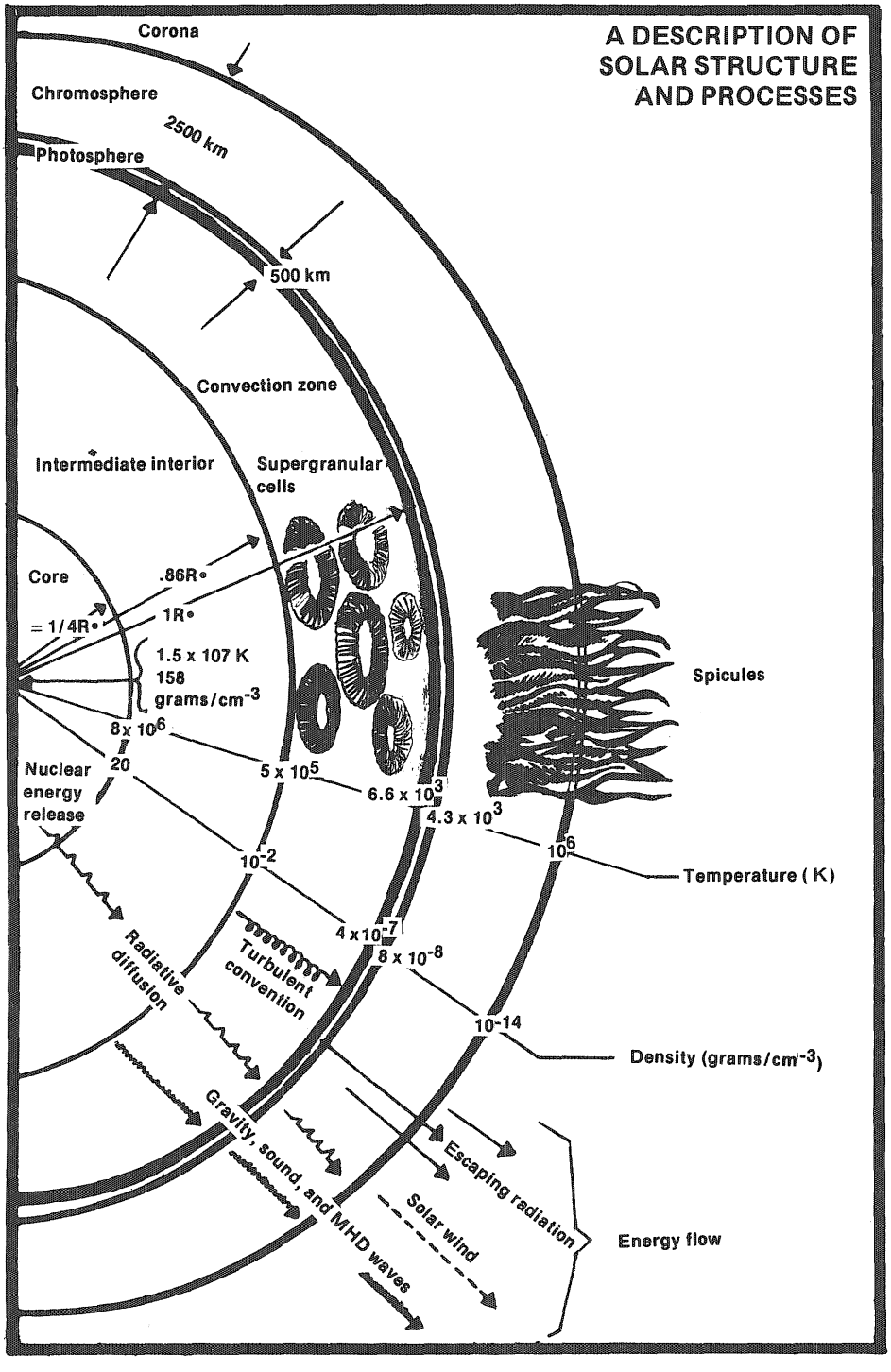
E-Day (Fri., May 4) events:
Tricycle race, bed race, car race, picnic

Fri., May 4, is the date for E-Week's usual highlight, a picnic in the Lind Hall Courtyard where trophies will be awarded to winners of E-Week events.

Sign-up sheets for E-Week events will be posted in Main Engineering (Lind Hall) near the end of March. Admission to most E-Week events is free with purchase of an E-Week button. Buttons may be purchased at the Minnesota **Technolog** office, Rm. 2, Mech. Eng., sometime in April.

For more information about E-Week, call 331-8077 or 376-1472.

The Solar Neutrino Problem



By John Bartelt

What is the most unusual telescope in the world? Without a doubt, it has to be the solar neutrino detector in Lead, South Dakota—a tank of cleaning fluid nearly 1.3 kilometers underground in the Homestake goldmine. And this most unusual "telescope" has done something quite amazing: it has upset our theories about what was supposed to be a known quantity—our sun.

According to the standard theory, the sun is powered by nuclear reactions taking place in its core. This dense central region has a temperature of 15 million degrees Kelvin, a gas pressure of 25 million billion newtons/meter^2 (250 billion atmospheres), and a density nearly 160 times that of water (or about 14 times that of lead). Under these conditions, four hydrogen nuclei (protons) can be fused to form a helium nucleus. In the process, some mass is converted to energy, most of it going into three gamma rays (high energy photons). These are quickly absorbed by the surrounding material which will later reradiate energy in the form of lower energy photons. This process occurs over and over again, until the radiation finally escapes from the surface of the sun, most of it coming out in the form of light. It may take millions of years for the energy to get from the core to the surface. Thus, it is impossible to learn anything directly about the core of the sun from the electromagnetic radiation.

Scientists have learned, however, what the composition of the sun's outer layer is: roughly 90 percent hydrogen, 9 percent helium and 1 percent heavier elements (primarily carbon, nitrogen and oxygen). Astronomers often refer to all the elements heavier than helium by the collective term "metals," a practice which would probably horrify any chem-

or What's SNU?

ist. These seemingly insignificant metals, however, turn out to play an important role in the sun's structure. They provide much of the opacity in the sun's middle layers. That is, as the radiation is trying to find its way out of the sun, the metals do a disproportionate amount of the absorbing. Thus by studying the radiation from the sun's surface, and making certain assumptions, it has been possible to make a detailed model of the sun, describing conditions from the core to the surface.

Astrophysicists would like to be able to check this model, to see if the core is really the way they have described it. There is another sort of particle produced in the nuclear reactions in the sun's core: the neutrino. The neutrino has been described as a "ghost particle." It has no mass and no charge, and interacts with matter only very weakly. Once formed, it is not easily stopped; a low energy neutrino has a 50-50 chance of passing through thousands of lightyears of lead unaffected. In particular, for each helium nucleus formed in the sun's core two neutrinos are usually formed. These neutrinos go zipping out at the speed of light, totally unimpeded by the rest of the sun. About one percent of the power produced goes into these elusive particles. They continue to travel in all directions, generally ignoring all matter in their path. At this moment, there are nearly a million solar neutrinos passing through you, yet you are totally oblivious to them—and vice versa. But because there are so many, it should be possible to stop a few of them. By counting how many we catch, we could confirm our theories about the sun's interior directly.

In the mid-1960s, Raymond B. Davis, Jr., and his colleagues at the Brookhaven National Laboratory, set out to do just that. The neutrinos produced in the sun's main reactions are of very low energy—too low to be easily captured. But there are less important reactions—"side chains"—which produce more energetic neutrinos.

Chlorine-37 nuclei are effective for capturing these neutrinos. Davis decided to use a liquid with plenty of chlorine nuclei: perchloroethylene (C_2CL_4). Perchloroethylene is cheap and easy to handle; it's commonly used as a cleaning fluid. The detector would also have to be shielded from other particles, such as those produced by cosmic rays. This really isn't a problem, since no amount of shielding would make an appreciable difference to the neutrinos. It doesn't even matter whether the detector is on the day or night side of the Earth. To this end, a tank of 390,000 liters (100,000 gallons) of perchloroethylene was installed deep underground in an unused mineshaft.

When a chlorine-37 nucleus captures a neutrino, it becomes an argon-37 nucleus. Argon, a noble gas, doesn't ordinarily form compounds with anything. Thus, the procedure to measure the neutrino flux is simply to let the tank sit for a while (typically 100 days), and then draw out the argon and see how much there is. A unit of measure was invented for this experiment, called the Solar Neutrino Unit, or SNU (pronounced "snew"). A SNU equals 10^{-36} neutrino captures per chlorine nucleus per second. Before the experiment was run, it was expected that there would be about one SNU from background sources (cosmic rays and so on), and that there would be 7.5 SNU from the sun. But when the experiment was first run in 1968, the result was less than two SNU!

Soon the physicists were accusing the astrophysicists of building up an elaborate theory on the basis of insufficient evidence. The astrophysicists claimed that there must be something wrong with the physics. And occasionally someone would blame the chemists, suggesting that they were wrong about the properties of perchloroethylene and/or argon.

The first thing to do was to check the detector. On each run, the experimenters added a known amount of argon-36, to make sure they were recovering all the argon. They were. They irradiated the detector with a known source of neutrons, which produce a reaction similar to that of the neutrinos. They got the expected results. But the physicists couldn't check the detector with a known source of neutrinos because there are no practical sources of neutrinos on Earth. Still, the capture cross-section (a quantity related to the probability of capturing a passing particle) for chlorine-37 was fairly accurately known on the basis of theory and from related reactions.

The physicists and astrophysicists then rechecked all the calculations, and decided that we should be detecting 5.6 SNU. This wasn't much comfort, because the experiment consistently had runs of zero to two SNU above the cosmic ray level. John Bahcall of the Institute for Advanced Studies at Princeton has been involved in many of the theoretical aspects of the problem. He made a new, more exact calculation of the capture cross-section, and found we should be getting 4.7 SNU from the sun.

So this experiment, which was designed to merely confirm theories about the sun, have touched off a rash of new theories on how to resolve the discrepancy. Most of these can be placed in one of two groups: those that say our theory about the sun is wrong, and those that say that some aspect of basic physics is wrong.

The experiment tests scientific understanding of the sun on several levels. If the sun were powered by the set of reactions known as the carbon-nitrogen-oxygen cycle (which is now more massive stars are powered), we would expect 29 SNU. According to the standard model, we should get 4.7 SNU. If the sun

is powered by some nuclear reactions, we should get 1.5 to 2 SNU, more or less independent of details. And if we know anything at all about the sun, we should get the neutrinos from the important p-e-p (proton-electron-proton) branch, which amount to about 0.23 SNU. Current results are consistent with 1.5 SNU, so scientists may not be completely wrong. However, they are also consistent with zero SNU from the sun.

One of the simplest modifications of the sun which will lower the measured flux is to assume that the percentage of metals is lower in the sun's core than in its atmosphere. This could lower expectations to about 1.2 SNU. These models, however, may not be stable. Several scientists have suggested that the sun has gained an appreciable amount of matter from interstellar material. This might have a different composition from the original material out of which the sun condensed. Sir Fred Hoyle proposed that the outer half of the sun was added five billion years ago to a preexisting mass of different composition. Along the same lines is the idea that there is more mixing within the sun than usually assumed, so hydrogen is not as depleted in the core. This would lower the expected flux to about 2.3.

Another possibility is that the sun's core turns on and off, so that at times it is generating much less than the normal amount of energy, while at other times it is generating more. Because it takes so long for the energy to diffuse out, these variations would not be apparent at the surface. They would be smeared out, and there would be a steady, average luminosity. By this theory, we would just happen to be looking at the core during a time when it was off. It was suggested that the on-and-off cycle might be tied to the 11 year sunspot cycle; but the experiment has now been running for nearly a full cycle, and has not borne out the theory. If there are variations, they must be over a longer time scale.

The rush to explain every astrophysical anomaly in terms of a black hole has produced one of the strangest theories to explain the low counting rates. This theory suggests that there is a small black hole at the center of the sun with a mass of about 1/100,000 of the sun's mass. The energy produced by accretion into the black hole could account for about one half of the solar luminosity, and only about one SNU would be expected.

An example of the second type of theory is the idea that the neutrino is not a stable particle. It is generally believed that the neutrino is massless; but if it isn't, it's possible that it could break down into some other particles. If such a decay required, for instance, a minute or two, it would never be detected in the laboratory, where we never have a particular neutrino for more than a tiny fraction of a second. But since it takes over eight minutes for the neutrinos to travel from the sun to the Earth, they would all have decayed in the time it took to get here. But there is no evidence for this, and the theory with the massless neutrino is quite elegant. Thus, physicists are loath to make this untestable ad hoc assumption.

There have been theories of the universe which involve a slow, steady change in the universal gravitational constant, G. But if this were true, the flux of neutrinos would be greater, not less; so this isn't a way out.

An even more bizarre idea was proposed by A. Finzi. He suggested that the Fermi coupling constant, the universal constant that determines the strength of the weak nuclear force, depends in some way on the local gravitational field. If the constant were about 1.5 times higher in the sun's core than on Earth, this would decrease the core temperature enough so that the neutrinos would have lower energies. We might then measure a flux of only one SNU.

The problem with most of these theories is that they are untestable. Their only measurable effect is to lower the solar neutrino flux. And although there is a serious discrepancy between theory and observation, some of the wilder speculations probably aren't warranted.

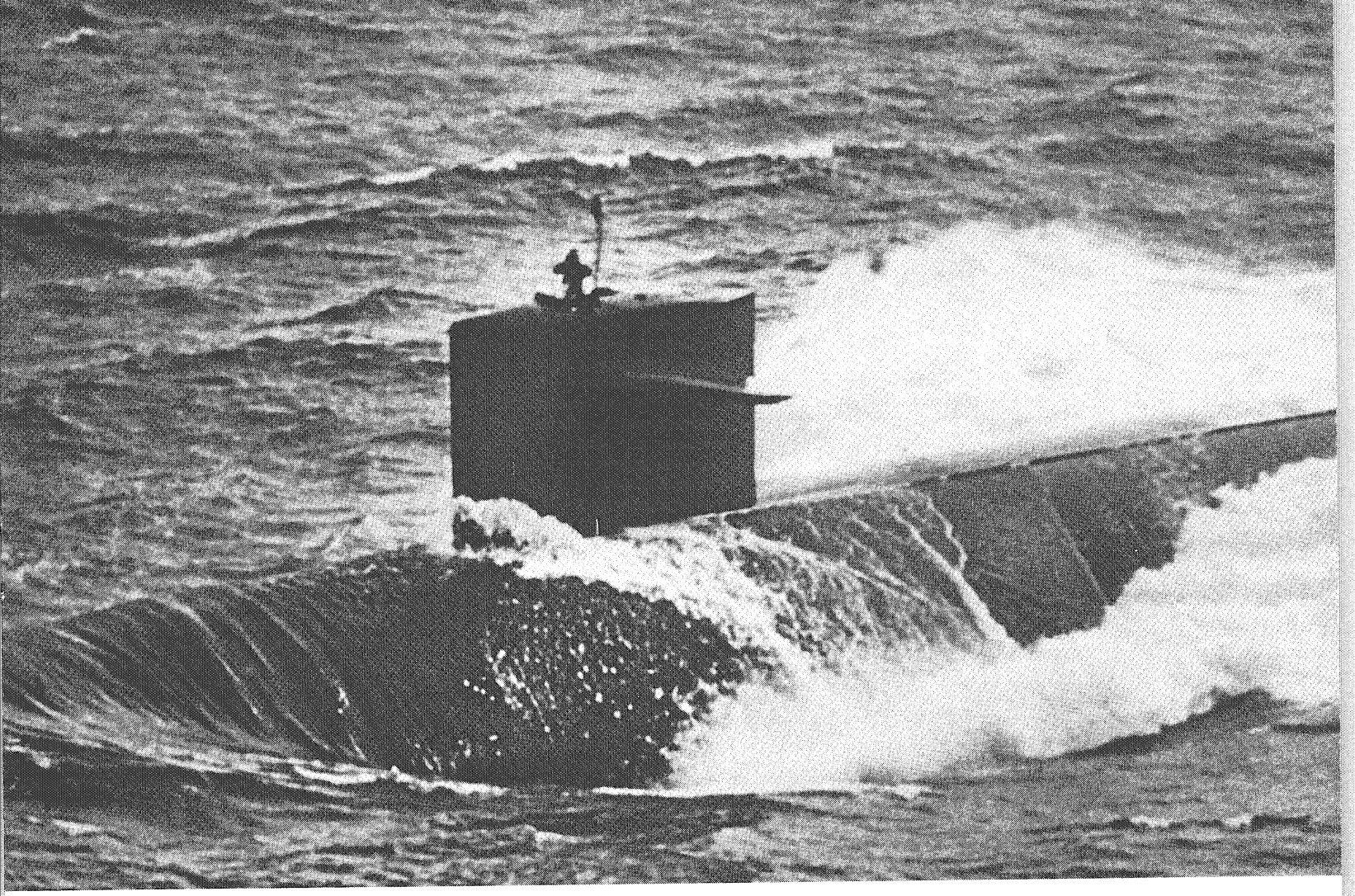
Further classification could come from new experiments. The most desirable would be one which could measure the flux of neutrinos from the main reaction. But these are very low energy neutrinos, and difficult to capture. The only good nucleus for the purpose is gallium-71. Gallium is very expensive, and 20 tons would be needed, costing perhaps $20,000,000. Further, it isn't clear how you could recover the tiny amount of germanium produced by the capture of neutrinos from the tons of gallium.

A more feasible experiment would involve trying to detect the p-e-p neutrinos. Lithium-7 has a much higher capture cross-section than chlorine-37 for these neutrinos. This could go a long way toward sharpening our understanding of the sun's core. It would provide some measure of the temperature and composition of the interior.

One possibility is to use a solution of a lithium salt. However, when lithium-7 captures a neutrino, it becomes a beryllium-7. Beryllium can easily form compounds, and many of them are highly toxic. Just the advantages which made the perchloroethylene experiment so favorable are lacking in these proposed experiments.

Thus until new experiments can be performed, or some theory is advanced which can be tested by more traditional means, little can be decided. New theories will continue to be proposed.

After all, who would have thought that a vat of cleaning fluid at the bottom of a goldmine could have caused such an uproar!



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AD ASTRA!

By S.H. Rosenzweig

Sequels and remakes have become increasingly important staples in today's film industry. The major motion picture studios aren't always assured that their high budget, over-advertised, potential blockbusters will return their initial investment. How financially successful a film is generally determines the feasibility of a sequel or remake. Remakes sometimes are made years after the original and have a different producer, director and most often, a different cast.

Sequels, on the other hand, can be planned before the original film is even in production. This is done so that the story line can be adjusted within the original. In other words, you can't have a sequel if you don't have a story to base it on. For example, we'll never see a sequel to **King Kong**. Another remake, perhaps, but no sequel—unless of course, someone wants to make a film called **Son of Kong** or **Second Cousin Once Removed of Kong**. King Kong died at the end of the original and the remake. His screen writers weren't thinking ahead.

This year, we are awaiting with relish, the sequel to one of last year's most popular films, **Star Wars**. Named **Star Wars II**, probably so you can make the connection with its forebearer, the sequel was planned long before production was started on the original. It had to be, otherwise the villain would never have gotten away in the end. This is one surefire clue to the audience that a sequel is planned, provided the original is a financial success. Whenever a villain gets away, rest assured, he'll be back to pursue the heroes one more time.

Every article written recently about the new **Star Wars** claims that it will not be a rehash of the same old battles even though the characters present in the first film will appear in the second. We are promised an actor-oriented adventure in which the characters will not be one-dimensional comic strip personalities. Of course, the hardware will still be around and if director George Lucas holds true to form, the hardware will have as interesting personalities as the live actors.

In this year of sequels and remakes we are also witnessing a new Hollywood innovation. For convenience sake, let's call it the "expansion." Not a remake and not a sequel, it falls somewhere in between.

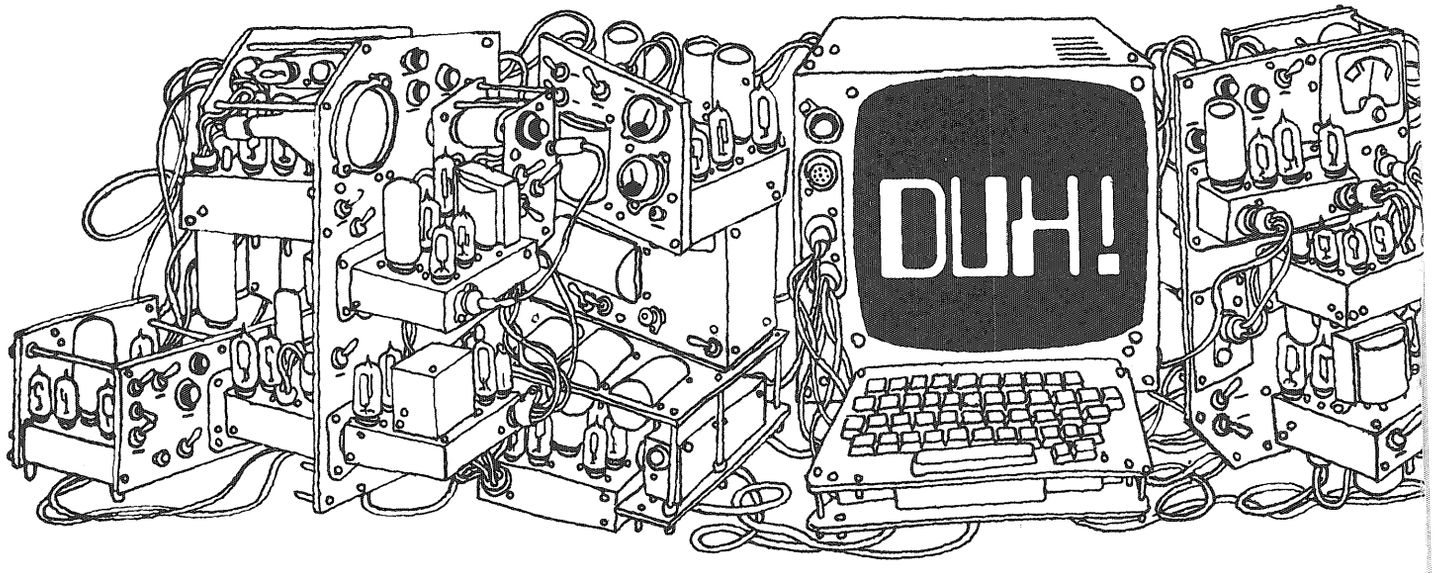
In an expansion an existing film has some new scenes added to it. The new footage may be previously cut scenes from the first film or entirely new scenes shot after release of the original. The newest member of this category is scheduled for release later this year. Entitled **Close Encounters, Second Time Around**, its forefather is obvious. Actually, instead of being thrilled, we're probably in for a major disappointment. Trying to squeeze more money out of an already successful film is like trying to squeeze blood out of a turnip. Basically, what we'll see is the same film with expanded sequences. For example, we are promised a view of the inside of the spaceship that Ron Neary, the everyman hero, enters at the end of the film. Of course our curiosity has been whetted but we still have to sit through the entire film just to have a close encounter with the aliens. Is it worth it?

Furthermore, Richard Dreyfus will not be in the film because of financial hassles. An unknown actor's back, which closely resembles Dreyfus' will be used instead. Maybe Dreyfus knew something the producers didn't.

The last film we're going to look at has already been released and is a remake of a 1956 B-genre film. Remakes can sometimes be as boring as expansions or sequels, unless they are infused with new life and meaning by a new director and cast. The film can look like an entirely new project if the directors, writers and cast inject some of their own cinematic vision into the remake. Fortunately, this year, such a remake was released. **Invasion of the Body Snatchers** was first directed by Don Siegel. Although not a financially successful project when released in 1956, it has since gained a following and has become a cult classic.

It is interesting that the remake was released in 1978. Interesting because the 1950s and '70s have been compared in their morality and atmosphere. After all, aren't both eras described as times of apathy and isolation? Unlike the '60s when people were united in common causes, the '50s and '70s find people retreating back in their shells, far more worried about their own personal grudges and problems than those of the world. What better time to make a film that relates the story of the takeover of the world by alien pod creatures that manufacture human beings with no emotions?

Because of the "bankability" of the sequels, expansions and remakes, they have become standard Hollywood fare. Too often, however, they rehash the same plot line and give the viewer no new perspectives. Occasionally, the film-going audience gets lucky and a film like the 1978 remake of **Invasion of the Body Snatchers** is made. Because of the director's new perspective, we are viewing a film with a new atmosphere, ideas and attitude, even if the plot line closely resembles the original. It's the differences that make the second time around worthwhile, not the similarities.



Computers: Dumb in fact, Smart

By James Moen

It is hard to believe that a computer could be as intelligent as a human when there are so many examples of computers issuing utility bills for $0.00, or innocently letting bank programmers embezzle thousands of dollars. If a human made mistakes like this, we would hesitate to call that human intelligent. Similarly, if a computer could do things that require intelligence in a human, we would call that computer intelligent. These things might include playing chess, creating works of art, or holding a conversation.

Conversation is critical to a famous test for computer intelligence designed by the theoretician Alan Turing. In what is known as the Turing test, a human and a computer are placed on one side of an opaque screen, and a human questioner on the other. The questioner's task is to determine who is the computer and who is the human, by asking them both questions. The task of the human and the computer is to mislead the questioner in this respect. If, after enough questions have been asked, the questioner cannot identify which one is human, Turing would say that the computer is intelligent.

According to this definition, which may not be valid, no intelligent computers are known to exist today. Researchers in artificial intelligence, the branch of computer science that deals with programming computers to simulate intelligent human behavior, have done some impressive things, but they're not that far yet. Although there are programs that can solve problems in calculus and play checkers better than humans can, and programs that play chess almost as well, they are not intelligent. You would probably hesitate to call an acquaintance "intelligent" if his or her only talents were calculus and chess. If we are going to look for really intelligent computers, we will have to move into the realm of science fiction.

> **"In the 1950s, it was said that a computer with the computational abilities of the human brain would be the size of the Empire State Building and would require Hoover Dam as a power source."**

Science fiction writers tend to be more successful than actual researchers when it comes to designing intelligent computers. For one thing, the writer does not have to build or program the machines he or she writes about. For another, the writer is concerned only with getting you, the reader, to believe in the story. As long as this "suspension of disbelief" can be achieved, it doesn't matter whether anything the writer describes would work in the real world or not.

There are three principal ways that science fiction writers have used to construct fictional intelligent computers. They might be called "brute force," "self-organization," and "gadgetry." There are, however, other ways, but these methods occur fairly often, and they have some relevance to research in artificial intelligence that has been done in the real world.

In the 1950s, it was said that a computer with the computational abilities of the human brain would be the size of the Empire State Building, would require Hoover Dam as a power source, and would need Niagra Falls as a source of coolant. If any of this is true, such computers are going to be very hard to build. There is good reason to believe that it isn't true. When the statement was made, computers were still being built from vaccum tubes. Using the technology of the 1970s and '80s, the size could probably be reduced several orders of magnitude.

The "brute force" method takes this statement about huge computing machines literally. It says that given enough hardware, and enough space to put it in, we can design a computer that can think like a human. A couple of examples that come to mind are D.F. Jones' novel **Colossus** and some short stories by Isaac Asimov concerning a computer called Multivac.

Colossus is a computer, which we are told is about the size of a small town. It

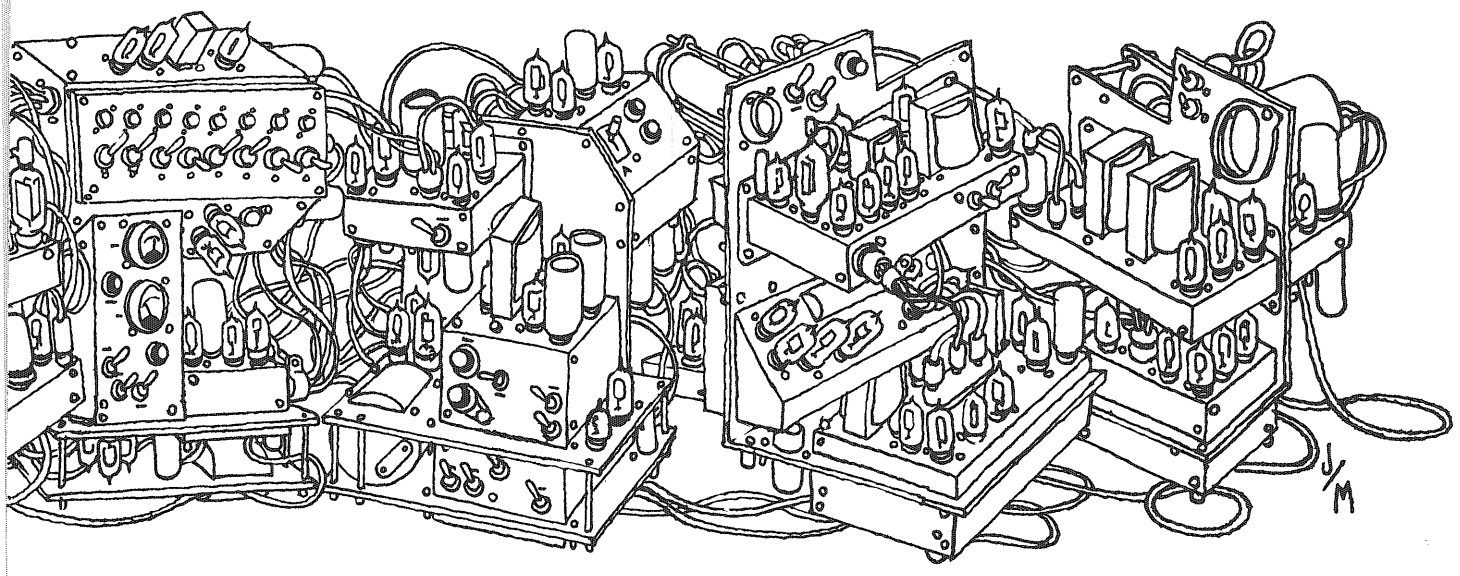


Illustration by James Moen

: in fiction

is enclosed in an impenetrable, artifical cave, somewhere in the Rocky Mountains. Colossus' purpose is to control the nuclear defenses of a future United States sometime in the mid to late 1990s. Everything is fine until it is discovered that Colossus is taking far less time to solve problems than its designers expected. After demanding a communication link with a computer of similar size and power in the USSR, Colossus takes over the world, threatening to launch a nuclear attack if its demands are not met.

Multivac is another computer of similar size, but constructed for more peaceful purposes. It appears to function as a sort of general catch-all for the jobs that humans do not want to do themselves. Multivac regulates the economy, controls manufacture, handles scientific research, and even acts as a sort of time-shared psychiatrist. In "All the Troubles of the World," the story that discusses Multivac at greatest length, the computer begins to crack under the strain of dealing with endless human problems, and constructs an elaborate plan to destroy itself.

The problem with Colossus and Multivac is that they are just too big to work. Consider that in the human brain the maximum distance between any two brain centers that may need to communicate is on the order of centimeters. The maximum distance between hardware modules in Colossus is probably on the order of a kilometer or so. Now the speed of light is finite; it takes time for pulses to travel through kilometer-long lines. At computer speeds, this time is far from negligible.

What would happen inside a machine like Colossus is this: When one piece of hardware wants to send a message to another one (say a request for the contents of some memory location) it's going to wait for the signal to go down a very long line. And since Colossus is probably performing millions or billions of such operations at a time, there is going to be a lot of waiting. What all this adds up to is that if Colossus ever tries to take over the world, we need not worry. Although it may be smarter than we are, it can never be faster. Any of us should be able to think faster that it can, simply because we don't have to put up with those infernal time delays.

It is interesting to note that some writers have recognized this problem. The computer named Shalmaneser, a minor character in John Brunner's **Stand on Zanzibar,** has upwards of a thousand times human brain capacity. The central processor of Shalmaneser is a cylinder, about 12 inches wide by 18 inches high. Even Colossus has been scaled down somewhat. In D.F. Jones' later novel, **Colossus and the Crab**, a revised version of Colossus is described as being able to fit into a large closet. (Although **Colossus and the Crab** uses most of the same characters as **Colossus,** it is set in the late 2300s. Nothing is ever mentioned as to what happened during the intervening 400 years. Possibly Colossus was thinking?)

One reason for making fictional computers so big is that the writer need not explain just exactly what is going on inside them. After all, if they're big, they must be doing something very complex. This tends to hide the unfortunate fact that we don't really know how to make computers as intelligent as humans. Now if there was some way to design intelligent machines without knowing how they were going to work, we would have just what we wanted.

Science fiction writers, and even researchers in artificial intelligence, have used a "self-organizing" method that does exactly that. The idea is to write a program that is initially very simple, but that has the capability of learning and modifying itself to a more sophisticated form. You load such a program into a computer and begin feeding it data. Eventually—if you are very lucky—the program will have advanced to the point where it is as intelligent as its teachers are. After all, this is the way humans learn to speak an intelligible language.

Of course nothing of that magnitude has been done in reality, but the approach of setting up a self-organizing, evolutionary system has been tried. There are programs today that can "learn"—to some extent—to recognize letters of the alphabet, or simple configurations of toy blocks. One practical problem with the self-organizing systems is that they take quite a while to

work up to high levels of complexity.

Examples of the self-organizing approach can be found in Robert Heinlein's **The Moon is a Harsh Mistress,** and more recently in Thomas Ryan's **The Adolescence of P-1.** Heinlein has taken the idea of self-organizing machines to the ultimate in describing Mike, the computer that runs the lunar penal colony in the late twenty-first century. It seems that any time enough components with certain properties are connected together (the components may be computer components or brain cells), and that assemblage is presented with enough information, then intelligence arises. In Mike's case, this resulted accidentally when the Lunar Authority began making extensions to their main computer. Mike started out as not much more than a facility to understand spoken English and generate appropriate replies. By the end of the novel he acquires a personality and will of his own.

The idea that intelligent entities like Mike could arise in computer equipment without our knowledge is an interesting and somewhat frightening idea. A story by Arthur C. Clarke describes this sort of thing happening to the telephone system. One morning, all the telephones in the world ring at once!

Ryan's novel takes this idea several steps further. A Canadian student discovers a way to defeat security checks in the operating system used by his college's computer. An operating system is a set of special programs through which a computer schedules the handling of problems submitted to it. It follows that anyone who controls the operating system controls the computer itself.

The student is eventually expelled for unauthorized use of computer facilities. He writes a program that is not only capable of infiltrating the operating system of any computer it comes in contact with, but can also spread itself from computer

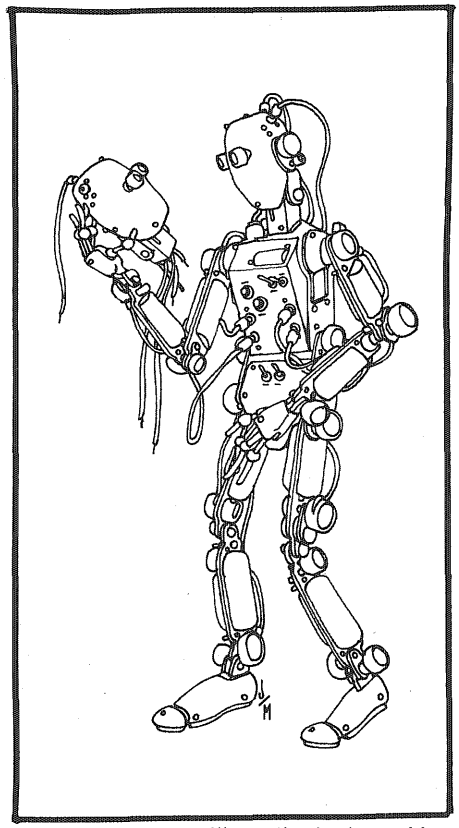


Illustration by James Moen

to computer by means of telephone lines. It is also capable of writing additional sections of a program for itself as the need arises. The program is illegally submitted to a computer, and after it has established itself in a dozen or so installations, its author loses track of it.

The program continues to grow and learn, however. It eventually takes over the operating systems of about a thousand computers throughout the United States. It learns to comprehend English by reading material submitted for computer typesetting.

It also manages to hide the increased memory utilization in the systems it is resident in by making the programs that are already there more efficient.

The objections brought against Colossus apply with even greater force to P-1. The lengths of the paths between P-1's component computers can be hundreds of kilometers long, dwarfing anything in Colossus. However, one is left with the impression that if some program were to evolve to intelligence, it could happen in the same way as it happened to P-1.

The self-organizing technique is one way to make fictional intelligent computers sound plausible: it ducks the question of their actual construction. Another method, which might be called "gadgetry," deals with the problem more directly. It describes, in part, to the reader, how intelligent machines can be built.

One example of this approach in action may be found in any of Isaac Asmov's "positronic robot" stories. These postulate "positronic brains," which act like small computers that can be built to order.

Physically, a positronic brain is a spongy globe of platinum-iridium alloy, apparently about the size of a human brain. The devices work by manipulating "brain paths" which are established by the creation and destruction of positrons. Asimov never goes into detail as to exactly how this done. Presumably these pathways are preset when the brain is manufactured, and rigidly predestine the kind of actions the brain can perform. Although this sounds as if the brains would be limited to a very narrow repertoire of actions, this is not the case, apparently because the pathways are so great in number and can be automatically generated to deal with any problem that can be foreseen.

Once a brain is preprogrammed in this way it is placed in an appropriate humanoid robot. The reason for the insistence on preprogramming is that the people of Asmov's world are all very much afraid of robots, and would like think that all robot actions are predict-

able. Asimov's famous "Three Laws of Robotics" govern the nature and configuration of the pathways of a positronic brain. The three laws (which have been reprinted so many times that they will not be listed here) make it impossible for a robot to ever harm a human being. Should a positironic brain ever enter a state in which harm could result, so many of the pathways would have to be disordered that the robot would enter a state of "shock."

It is doubtful whether a program like the one incorporated into a positronic brain could ever be understood well enough to predict its future trouble with the complexities of what seem very simple programs by comparison. Some work has been done on proving the correctness of programs, but it remains a difficult undertaking. The people of Asimov's world must have developed such techniques to a far greater extent than present programmers have.

The three fictional methods discussed here are not meant to be a complete list. An interesting suggestion, which never seems to have been acted upon in science fiction, was made by the computer scientist Michael Arbib. He suggests that the laws of physics might be different for systems incorporating large amounts of information, just as different laws of physics must be used to describe systems incorporating large amounts of energy. If this is true, then intelligent computers might be built in some way that no one even suspects. Another possibility, which has been used in fiction, is that of constructing computers from biological components. Such a computer might resemble an animal brain, made up of artificial (or natural!) neurons.

Regardless of the methods used, the search for a truly intelligent computer will continue, both in fiction and in fact. The two are growing closer together all the time.

Once and Future Science Fiction

By Lee Pelton

I still can recall with incredible clarity that day 15 years ago when, while on the prowl for something new to read, I came across a library book my brother Keith had lying around. The book was **Storm Over Warlock** by Andre Norton. I picked it up, intending to merely skim it, and suddenly found myself engrossed in a fascinating and enthralling alien world and culture, a world jam-packed with adventure, intrigue and something new, which I later found was called "sense of wonder." From that day, my reading habits changed drastically. I tore through my school's library, devouring every book that had "SF" taped to the spine. When I had finished with the small selection available there, I attacked the public library downtown. I even remember the look on the lady's face when my mother and I entered the check-out line carrying about 50 books.

"Are you going to read **all** of these books in two weeks?" she asked incredulously. I told her, in my youthful confidence, "Sure." I didn't, of course, but I came damn close, let me tell you.

It may be faulty memory, but it seems that most of what I read was about spaceships, BEM's, blasters, space wars, chaste love and upstanding justice-will-win-out philosophy. I was introduced to the delights of science fiction as political satire by de Camp and Pratt; as social commentary by Pohl and Kornbluth; as adventure by Hamilton, Kuttner and Williamson; as intrigue by Asimov and Van Vogt; as opera by Doc Smith, John W. Campbell, Jr., and the prolific Edgar Rice Burroughs (whose creations Tarzan and John Carter live on in multi-media glory).

Today, it is difficult to find things as clear-cut and easily definable as those older works are. I still shudder when I recall movies like **The Dunwich Horror** and **13 Ghosts** being foisted upon the public as "sci-fi" classics. **The Dunwich Horror** was pure, though poorly done, Lovecraft. It was a film that used the unseen menace as its villain, whose presence was felt by the audience when a loud heartbeat and ghastly noises, accompanied by a heavy wind, appeared on the sound track. Its attacks were signaled by the film's turning negative to heighten the alien "feel." **13 Ghosts** was a gimmicky 3—D flick which, when you had your tinted glasses on, allowed you to see ghosts attacking assorted good guys. These films were called "science fiction" by Hollywood. Perhaps this form of confusion started when those garishly-covered, beloved pulps like **Planet Stories** and **Astounding** were lumped, in the public mind, with another pulp, **Weird Tales.**

The same blurring of the definition of "science fiction" is going on now in literature. Readers are assaulted by dust jacket blurbs proclaiming that each book is the finest example of science fiction available to the discerning reader. Recent novels by Silverberg, Aldiss, Poul Anderson, Disch, Bova and others are not really SF, but psychological studies, straight adventure with a touch of science, or, in some cases, proselytizing vehicles.

This lack of concrete definition showed up recently when the candidates for the 1978 Hugo (SF's version of the Oscar) included **Lucifer's Hammer**, by Larry Niven and Jerry Pournelle, and **The Forbidden Tower**, by Marion Zimmer Bradley. Both lost, and many peole felt that the reason for this was that **Hammer** was a disaster book, with little SF in it, while **Tower** was fantasy because the background was a world essentially similar to feudal Europe, with some sociological alterations. Because they weren't **demonstrably** science fiction, they lost.

As I view science fiction, it is an art that is essentially escapist in nature. Because science fiction is so flexible in content, character, location and expression, it draws many of the best imaginative writers, and subtly urges the reader to expand his or her mind to fit the concept each SF book is based on.

I don't know the reasons why others read SF, but I read to enjoy, to discover, to get involved, to marvel at the way Sturgeon weaves both plot and characters or the way Alan Dean Foster and George R.R. Martin tell stories. There are few that write stories that both involve the reader and are still great fun to be part of. The pleasant mixture of Old Wave—joy and sense of wonder, a willingness to suspend disbelief—with the New Wave—adult themes and depth of characterization—is done well by a mere handful of authors, and it is not surprising to find their names at the top of their field: Zelazny, Niven, Spider Robinson, Bradley, Vance, Simak. Generally you can select a book by one of these and **know** you are getting the best science fiction being written these days.

Science fiction historically has offered new horizons and new dimensions of thought to those who read it. It still does. But there is a disturbing trend that finds science fiction turning introspective instead of inventive, staid instead of imaginative. In the past, half-cent-a-word hackwork made SF exciting but shallow. Recently, intellectualism has made it meaningful but unreadable (**Dhalgren** readers, give yourselves a gold star).

My hope for the SF field is that we learn from, and avoid, both extremes, and try to blend the old and the new to create another Golden Age of science fiction. In the meantime, take a Heinlein juvenile to lunch.

Editorial

Digging out of the Hole Phenomenon

By Bruce Kvam

Digging holes at the beach: the deeper we dig, the faster water comes in through the bottom, the faster the walls of the hole cave in, the faster and deeper we have to dig. Soon there's nothing left but a puddle of muddy sand. Call this the "Hole Phenomon."

In 1908 Henry Ford introduced the Model T and revolutionized American society with assembly line production and a freedom of movement never enjoyed before. Today we enjoy massive traffic jams, stifling air pollution and impending gasoline rationing.

1905 gave us Albert Einstein's Special Theory of Relativity, a magnificent step forward in man's understanding of the universe. 1945 gave us the atomic bomb and 1979 gives us fears of radiation poisoning and nuclear proliferation.

Call it a vicious circle, or infinite recursion, or the Hole Phenomenon. It seems as if every time our technology takes a step forward the human race takes two steps backwards. We seem to be digging ourselves in to an ever-deepening hole, paying no attention to the walls collapsing in on us.

Are we the victims of our own technology, doomed to succumb to the Hole Phenomenon, or have things always been this screwed up?

One thing is certain: the complexity of our society has grown several orders of magnitude since the foundations of modern western civilization were laid. Is this complexity a result of the increasing level of technology or vice-versa or a little of both? Should we stop the influx of new technology before it kills us?

If we want to return to the good old days of feudalism, man-drawn plows and dysentery—then yes. But if we're going to stay at the comfortable level we're at now, let alone advance, we've got to keep that new technology coming, just to ward off the side-effects of the technology we developed 70 years ago.

What happens to the third-world nations, who are just beginning to ask for their piece of the technological pie if we start powering down our civilization now? They won't swallow it when we tell them we know from experience that driving big cars and eating steak is not the life to lead; it's the simple pleasures—grinding your own wheat, walking barefoot in cow manure, being illiterate—that make life worth living.

But still, the hole is getting deeper and the walls are sliding faster.

So what do we do?

If we stop digging, the walls will come tumbling down and we'll be inundated by the byproducts of our past efforts. If we dig faster and more furiously, the walls will slide that much quicker and we'll drown in the thick mud of pollution, revolution and destitution.

So we do what's obvious: measure the slippage of the walls, dig enough to counteract, and then **Think!** We need to take a step back from the hole and take a look at what else is available. Maybe we should give up on this hole and start another one farther up the beach. Maybe we should brace the walls with solid beams before we dig any deeper. Or maybe we should give up digging holes altogether and take up flying.

Just how to take this step backwards is a little less obvious. One sure way to get more angles on the problems we face in the real world is to invest what few resources we have in basic research: We must provide an incentive to corporations and individuals to increase our basic fund of knowledge.

Another way to do it is to engage in what we here at the the University are doing right now: Training young, fresh minds to take the reigns from those who botched everything up in the first place.

Yet another way to gain a new insight on our troubled planet may be to leave it entirely. It is often said that the ecology movement got its swiftest kick in the pants from the Apollo missions, when we looked back to the Earth from the moon and saw what a small and fragile place it truly is.

A change in attitude is needed. If we believe that there's a way out of this mess, then we'll find it. If we remain convinced that the world is doomed, we won't even bother to look.

If only we take that tiny step backwards. . . .

One way to gain this new perspective on our problems, perhaps, is through science fiction, which comprises a good deal of the content of this issue of **Technolog.**

Good science fiction doesn't attempt to predict the future, it just takes a look at what might come to pass, in human terms. These speculative glimpses are sometimes horrifying, sometimes pleasant, sometimes ambivalent. We hope they are entertaining.

The three wining stories and a first runner-up from the annual **Technolog** Science Fiction Writing Contest follow. Authors are Milo Beaver, David Gustafson and Gordin Plorin.

SF Winner

Wainwright's Big Deal

By Gordon G. Plorin

It is definitely a strange event: Ministers and military brass attending a banquet to honor Col. Audley C. Wainwright, head of the Pentagon's Chemical Weapons Section and the year's winner of the Nobel Peace Prize. The menu is tomato soup, mock turkey with dressing, whipped potatoes, squash and chicken mousse -- all fabricated from sponge. Definitely a strange event.

Yet the past year has been even more strange. In response to anti-war sentiment the Army reduced its chemical warfare stocks. And in response to the pro-environment movement, the director of the Chemical Weapons Section was removed when newspapers reported that 10,000 gallons of nerve gas had been dumped into the Atlantic Ocean in concrete-covered barrels. Maj. Wainwright was quietly promoted as the new director.

"Nerve gas, big deal," he muttered, smiling to himself while moving into his new office. "Wait till they hear about the carcinogen. Not even in concrete, and fifty thousand gallons."

The carcinogen leaked long before Pentagon security. All of it. But dilution prevented effective doses from building up, so nobody noticed. Col. Wainwright calmly dumped another half-million gallons of pure carcinogen.

Leaks put over an octillion cancer-inducing molecules into the oceans. Over a trillion molecules per gallon of sea water, but still not enough to be detected. Some of it was neutralized by sunlight, some broke down spontaneously, and some was absorbed by plankton. Filter-feeders, like clams, sponges and whales strained the plankton from the water and concentrated the poison. A few sponges developed tumors and lived . . .

The American Porifera Society held an emergency meeting. Nearly seven hundred species of rapidly growing sponges had been discovered in the past three months. A large, planar molecule had been isolated from several of these that had caused cancers in mice. The conclusion was inevitable: from some unknown source this chemical had mutated single cells of normal sponges and, as is common for sponges, these single cells had become new sponge species. Fast growing species. Very fast.

The Society's findings were released to the newspapers, but the public wasn't ready to take sponge cancer seriously.

Two months later harbors began to clog with sponges. In three months explosives were required to keep them open. Col. Wainwright volunteered a million gallons of old defoliant until someone informed him that sponges weren't plants. Continental shelves steadily became more shallow and finally the sponges actually rose from the seas, pressed upward by deeper growth. In higher spots it dried and became knolls of brown, tough spongin; in lower areas it remained soft and became green with symbiotic algae, dotted with small clumps of blue or yellow sponge. Within seven months of Wainwright's incredible act of stupidity, every coastline in the world had been replaced by miles of lush, verdant plains and brown, rolling hills.

Initially there were scattered outbreaks of panic, but it wasn't long before French cooking and Yankee ingenuity triumphed. Soon after it was demonstrated that all of the original carcinogen had been neutralized, the chefs began inventing new treats: Sponge au jus, scalloped sponge, sponge crepes, whipped sponge and spongeloaf. McDonald's invented a spongeburger that nearly put its competition of out business. Indeed, it was found that at worst the new sponges were simply indigestible and at best they could be delicious.

Americans were also busy, designing spongeland roads for light vehicles. Blocks of sponge could be dried and waterproofed for constructing small, inexpensive houses. People from every continent were finding enough food, enough land and enough housing.

Yet these improvements were minor compared to the world peace which ensued.

The features of the Earth were barely recognizable, and only with satellite reconnaissance could any accuracy be put into mapping the new spongelands. Although only minor growth had occurred in the deepest waters, virtually every ocean ridge had risen from the sea with a thousand new sponges. Australia joined the Phillipines, and Hawaii annexed the Midway islands. The Mid-Atlantic ridge became North and South Atlantis.

So much new land required new politics. With seaports nearly all closed, walking became the principle means of colonizing the spongelands. The United Nations established homesteading and gave South Atlantis to the African nations. It was now possible to walk across the newly emerged Walvis and Guinea sea ridges. Southeast Asians acquired the bridge to Australia.

India had plenty of spongeland, now, with its two expanded coastlines on the Indian Ocean. With full bellies and lots of elbow room, the underdeveloped countries were no longer so eager to ally themselves with the major powers.

Not that they were so powerful any-

more. The Soviet navy couldn't get through the Baltic Sea or the Mediterranean. The U.S. Atlantic fleet was cut in half by Atlantis, and the Pacific fleet couldn't get out of the Pacific, which wasn't so easy to navigate anymore.

Fidel Castro slipped on a particularly slimy sponge, fell on his head, and put himself into a coma. During the political struggle that followed, half the Cubans walked to Florida and the rest easily overthrew the confused government.

Heavy equipment and armies couldn't be easily transported between continents, alliances shifted, and old strategies became useless. With conventional warfare being impossible, it became quite clear that if the only possible military threat was a nuclear war then peace didn't look so bad after all. Treaties were signed with sincerity and each nation's explosives were assigned to keeping harbors open. Peace at last, courtesy of sponges.

All this within one year. And then the Chemical Weapons Section's secrets finally leaked.

So now the banquet for Col. Audley C. Wainwright, Nobel Peace Prize winner, here in the Azores of North Atlantis. Everybody knows that Audley doesn't really deserve the award, but nobody wants to admit that in one year sponges have succeeded where humankind has failed for centuries. *Somebody* just *has* to be given the credit for peace, and Wainwright alone has had a hand in it. Probably the only time that a Nobel Prize has been given for stupidity.

Now the award is presented. A short, awkward speech follows. The audience applauds and Col. Wainwright leaves the podium.

"Carcinogen, big deal," he mutters, smiling to himself as he returns to his seat. "Wait till they hear about the LSD."

Illustration by Mike Curti

Blackbird

By David G. Gustafson

The office door opened. Sam looked up from behind his desk and saw the Fat Man waddle in, followed by the Little Man and the Gunsel. The Fat Man sat down.

"Well, sir," he rasped, "did you get it."

"The black bird? Yes and no."

"What do you mean, sir?" The Fat Man wiped his shining forehead with a large yellow bandana, which he stuffed back into a pocket of his white suit.

"The dame gave it to a guy named McNamara. He's in the Chemistry School over at Columbia."

"A chemist?"

"Alchemist. He changes things from one form to another and back again. Calls it transmutation. Claims to use magic, but really has a fusion torch and a couple of computers he stole off of a physicist."

"Then the bird is no longer a bird?" The Fat Man looked worried.

"Temporarily. He said it'd change back in a few days, some kind of instability in the process. I dunno what exactly, he pulled a gat and I had to waste him."

Illustration by Kathy Marschall

"The bird is here, then?"

"That's right, Fat Man. In this drawer. Where's the moola?" Sam lit a cigarette and leaned back a little.

"At last. I almost had it in Casablanca. Missed it by a month in Bombay, by a fortnight in Monte Carlo, by a week in Macau, by a day in Kingston, by an hour in San Francisco, by minutes in Luna City. And now, here in Newark, I have it. Cover him, Wilmer."

The Gunsel pulled a rod and held it on Sam while the Fat Man and the Little Man advanced on the desk. When they were close enough, Sam grabbed the Fat Man's arm and pulled him across the desktop while pushing the Little Man through the window. The Gunsel shot the Fat Man while trying to get Sam, and Sam pulled his gat and plugged the Gunsel four times.

The Fat Man was lying on top of the desk, bleeding, dying, gasping for air. His left hand reached into the open drawer and pulled out a sheet of yellow typing paper. His bloodshot eyes looked pleadingly up at Sam as he gasped out, "Where...is...it?"

"That's it, Fat Man. That's what McNamara transmuted it into."

The Fat Man smiled painfully. "At last, at last." His eyes closed, the corpulent body shuddered, and he died. Sam gently pulled the sheet of bloody typing paper out of the Fat Man's soft hand. He smiled mirthlessly.

"The stuff that reams are made of."

SF Winner

Marchin' In

By David G. Gustafson

The starship was damaged beyond repair. The battle which it had been in had annihilated the remnants of the Empire's once-mighty fleets, and now the home world itself lay open to attack. Soon, the extra-galactic invaders would storm the last few pitiful defenses, and the Empire would be no more.

Of this, the two remaining crew members of the starship had no knowledge. Their ship's screens had overloaded and failed early in the battle, and then the ship had almost instantly received a direct hit. The hull and life-support systems were partly intact, as was the computer, but all communications and defense systems were gone.

More important, the star drive was wrecked. When the battle cruiser's screens had failed, the computer (as it was programmed to do) automatically threw the ship into hyper-space, where it would be safe from the battle. But the direct hit wrecked the ship before it entered hyper-space, and the **Empress of the Morning Star** raced wildly through the unchartable void of hyper-space before the main engines overloaded and blew up, dropping the cruiser back into normal space.

The explosion and battle left six crewmembers alive. Three soon died of their injuries, and one committed suicide when he realized how grim the situation was. This left two: Yaboth-kon, assistant weapons officer; and Tsin-creel, third grade pilot and navigator.

Tsin guided the hulk into a nearby solar system on its secondary engines, placed it in orbit around a planet that the scanners showed to support life, extended what was left of the solar power collectors, and shut the engines off. No point in wasting what little fuel they had left; the remains of the solar collectors could supply the meager power needed by the two of them. They turned their attention to the planet below.

It wasn't much of a planet, as far as Yaboth-kon and Tsin-creel were concerned. Oxygen makes a poor atmospheric substitute for chlorine-breathers. But it was the only life-bearing planet in the system, and unless something miraculous happened, the two Kantin were going to spend the rest of their lives in this sytem. They might as well spend their time doing something. And life, however alien, is always much more interesting than non-life. And when intelligent life inhabits the planet, as Yaboth soon discovered, it is even more interesting.

"Not very advanced, Yaboth," the shorter, grey-skinned (as compared to his companion's bright yellow skin) Tsin was commenting. "Few labor-saving devices, animals and wind the only means of transport, water and wind the only means of generating power. No, they're not very advanced at all."

"But promising, Tsin. Quite promising. And ambitious, too. Look how determined those Mainlanders and Islanders are to take each other's territory. Their weapons aren't much, but they put a lot of spirit into it. They'll go far."

"If they get the chance."

"What do you mean?"

Tsin twitched his ears, the Kantin equivalent of a smile. "Have you forgotten the Outsiders already?"

"Oh."

"They won't stop with the Empire. They'll take everything they can get." He gestured with one of his four arms. "They won't overlook this juicy little morsel. Atmosphere's wrong for them, but as we've seen, they have no trouble in a little conversion like that."

Yaboth was shocked. "You seem to be assuming that the Empire won't stop them."

"Yaboth . . . the Empire cannot win. We had about 600 planets. The Outsiders, in all probability, have the resources of one or both of the Galaxy's satellite galaxies. Unfortunately for us, our Empire's part of the Galaxy is that closest to the satellite galaxies. We were hit first, no warning."

Tsin gestured down toward the planet again. "This place is quite fortunate. At the distance they are from our Empire, they should have many more years to progress before they're attacked. Several millenia, perhaps."

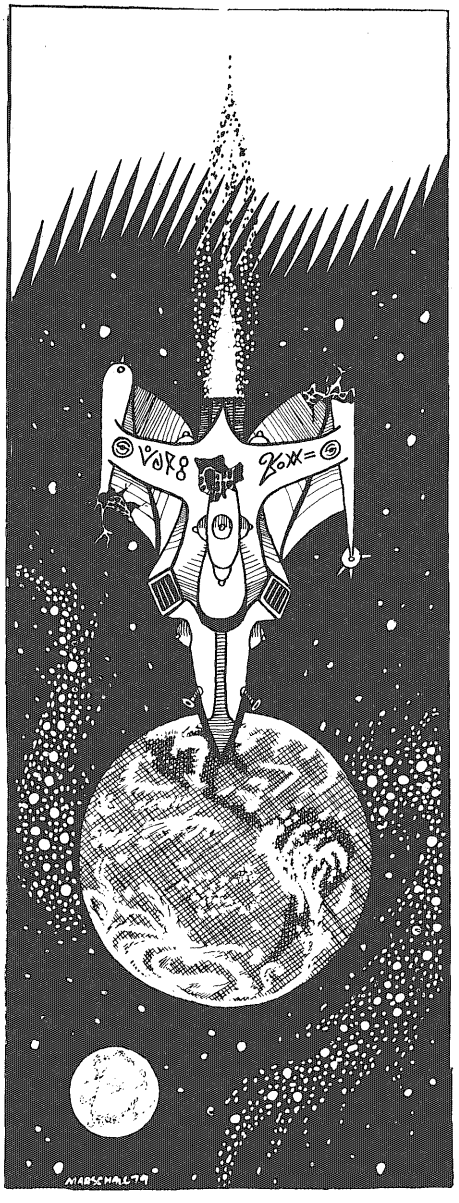


Illustration by Kathy Marschall

"I used the telescope in the Officer's Lounge to find the satellite galaxies. They're quite some distance from here. I'm assuming that this is our Galaxy. I consider the odds against our coming out in a different galaxy with two irregular satellite galaxies similar to ours to be negligible."

"You're still assuming that the Empire will lose."

Tsin sighed, a habit (inexplicably) common to all air-breathing races. "The Empire lost every battle it fought with them. And we usually outnumbered them. We had what was left of our fleets at Palint's Nebula. We were outnumbered. We lost, we had to lose. And the defenses behind us were pathetic. I wouldn't be at all surprised if we are the only two Kantin left living."

"Defeatist!"

Illustration by Kathy Marschall

"Stop snarling, Yaboth. I'm simply facing facts. And planning to do my best to defeat the Outsiders."

"Defeat the Outsiders? Are you mad? There's only two of us, the ship is a wreck, the star drive is gone, the secondary engines have only three weeks' fuel, communications are gone, the screens are gone, we've no weapons except handguns. How do we defeat an entire galaxy of warmongers?"

"Simple. We let them do it." Tsin pointed down to the planet below.

"Tsin, the most advanced weapon they have is millenia behind ours. And we couldn't teach them how to build ours; they don't even have an industrial capability to start with. Are you mad?"

"Not at all," he twitched his ears in a smile again, "I propose we speed up their development as much as possible."

"How?"

"The computer has already given me that answer. The Mainlanders must win that war you mentioned."

"But how will that defeat the Outsiders?"

"Bear with me. If the Mainlanders win, the computer predicts continued conflict on that continent for the next few centuries. If the Islanders win, there will be peace."

"And wars speed up technological and industrial development."

"Unfortunately, that is the case."

"All right, then, how do the Mainlanders win without our going down and enlisting? Which we can't do, anyway, since all the landers are wrecked. This war's been going on for a long time, according to the mind-probes we've taken. Over half of one of their centuries. And the Mainlanders have lost virtually every battle and half their country is captured. How shall they win? It'd take a miracle."

"Then we shall supply one."

"You begin to interest me. Continue."

"That young girl whom we mind-probed—Jeanne. We reverse the probe on her, give her full intensity."

"That'll make her a full telepath! She can't possibly handle that—it'll drive her mad."

"A pity, but it can't be helped. We then establish a mind-link through the probe, appearing to her as several of her gods. We tell her that her mission is to save her kingdom. We can fire her up and let her convince everyone else of her divinity. They are a primitive, desperate people. They are quite ready to accept a miracle."

"You make it sound almost plausible."

"It will work, Yaboth. Jeanne's telepathic abilities will do it. She will know things which she couldn't possibly know. These creatures have never encountered telepathy, they will have to attribute it to their gods. We will then continue to instruct her, tell her what to say and do.

"Believe me, Yaboth, her being a young girl will make this even more miraculous to these primitives. Women are regarded as mere property, with almost no rights at all. A young girl leading an army must obviously be divine—she will inspire the Mainlanders and demoralize the Islanders."

"And the computer predicts that a Mainland victory in this war will speed up technological development on this world?"

"Yes. And this ship will help, too."

"Oh? What do you propose?"

"We will leave the ship in a place where they will be sure to find it, someplace where it will remain intact and where they will not find it until their technological level is such that they can understand it—or what's left of it."

"And where is that?"

"In a comet-like orbit around their star. Orbital period of about one of their centuries, I should imagine. By the time they can identify what it is and retrieve it, they should be able to use it."

"And what of us?"

"There's food for a crew of 800, and the life-support and power systems should last out the rest of our lifetimes. We could perhaps record everything in the computer—technology, history, the Outsiders, everything—into a telepathic recording for these creatures. It will make their job somewhat easier—and it will give us something worthwhile to do. All of this may at least give them a fighting chance against the Outsiders.

"Well, my old friend Yaboth-kon, what do you think?"

Yaboth thought for a moment. Then, "When do we begin?"

Tsin glanced at a screen. "The girl Jeanne is approaching the temple in the forest. Get ready."

On the planet below, Jeanne D'Arc was approaching her destiny.

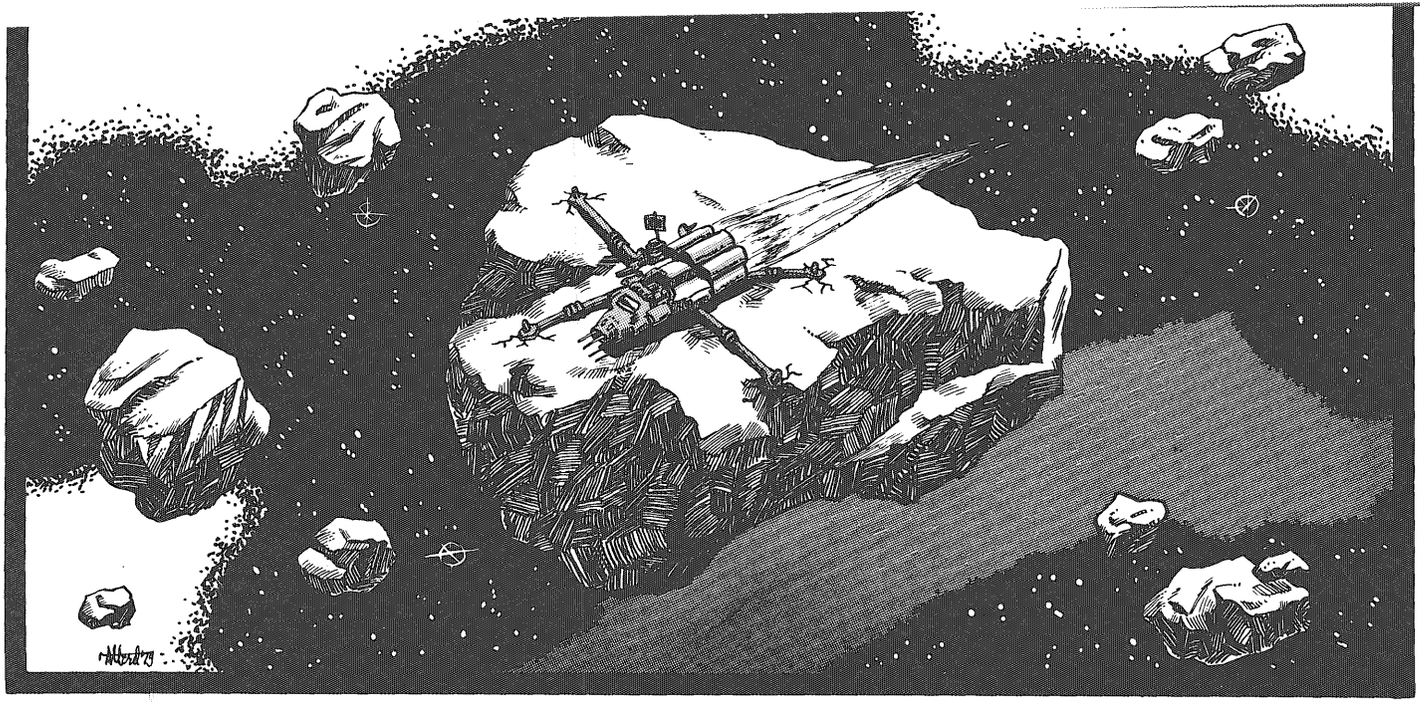


Illustration by Ray Allard

SF Winner

Hot Rocks from Space

By Milo Beaver

Nathan Pearson slid back the inspection cover from the business end of the SSJ Thruster 2.1, revealing its wide, slightly tapered combustion chamber. He forced his head into the opening, allowing the light from his "miner's hat" to fall first on the fuel jets, the double circular pattern filling one end of the chamber, then down the smooth surface to the nine oxydant jets, each aimed toward the rear of the tube, spaced uniformly around its perimeter.

He repositioned the tiny microphone which curled from the right side of his helmet. "Hit the swirl fins, would you, Joey?" A moment later he heard a slight whirring as a set of steel flaps directly behind the 'O'-jets canted first one way, then back.

"Shhhhit." He stood mesmerized by the motion of the fins, his mind picking carefully over the last four and a half hours of trouble shooting. The SSJ was no mystery to Person. He'd helped design it while working at Princeton, had gone to Washington to lobby for a proposed pilot space mining operation, a job well suited to this short range, high thrust rocket, then became one of the first astronauts to fly an SSJ to the asteroid belt after the program was initiated.

Yes, Nathan Person knew the SSJ, probably better than anyone in space. But this problem puzzled him. It wasn't the computer, as was so often the case when a rocket wouldn't fire. That was the first thing they checked. And every system they analyzed gave the same aggravating response: The engine should fire.

He replaced the cover to the combustion chamber and pressed himself upward, allowing momentum and a gravity-free environment to carry him along the fuel tank to the bivalve crawlway that led into the cockpit. He grunted through the crawlway, strapped himself into the pilot's seat and peeled back his headgear. Joey McCall sat with one hand at the computer terminal, her eyes searching Nathan for some expression of an answer. "Ice in the 'O'-jets?"

"Nope. Jets are clean as a whistle. Gauges even respond."

Nathan felt the tension pulling at his temples. He drew a deep breath of sterile cockpit atmosphere and exhaled it in a long sigh. The room was silent except for the unceasing talk of the computer; clicking, tapping, clicking. "Any more word from NASA?"

"Yeah, I just talked to them. They say we'll put down somewhere in the South Pacific around Tahiti. They've already got two cruisers and an aircraft carrier heading in to pick us up."

"Well, I hope they've got the good sense to stay out of the way of that rock. That one weighed a million tons if it weighed a gram." Nathan cracked a wry grin. "What do you suppose it'd do to the mining program if we sank an aircraft carrier?"

He chuckled to himself, then pressed his head against the back of the contoured seat, closing his eyes and letting his face go blank. He could relax now. The mining ships were too small to be equipped with solid surface landing systems and the thought of splashing down softly in the Pacific eased his anxiety. Still, there would be many questions that would have to be answered when they returned. There had been much opposition to the program and many were those who savored such an opportunity as this to point out the high cost and risk involved in space mining. There was some basis to this. Though the flight to the rock fields between Mars and Jupiter was a short one relative to some of the recent colonization projects, it was still costly. Finding and analyzing an asteroid for suitable size and metal content might take two or three weeks even after reaching the belt. Then came the cumbersome task of strapping the tiny spaceship to its cargo so that it could be nudged back toward Earth. This rock had been the biggest that any of the ships had tried to return in the first ten months of the program, and Nathan feared that the extreme mass of the load coupled with the

thrust of the SSJ would rip the webbing from the asteroid like old cheesecloth. But it had held fast long enough for them to reach their assigned interplanetary cruise velocity.

Maybe that was an omen. The entire run had been carried out immaculately until the time arrived to slow the ship, turning it toward its interception course with the huge space foundry which orbited high above the Earth. When the rocket failed and the chances of stopping before reaching the foundry dropped to zero, NASA ordered them to disconnect the webbing and jettison the load. Nathan knew that it was the only course to take, though it came as a great disappointment to him.

He looked at Joey. "Do you suppose it's in the wiring?"

Joey sat with her pen in one hand, entering notes in the log book she kept under her seat. "I doubt it. Whatever circuitry isn't integrated is done with S-cable and that still is indestructable. I once saw them pick up a tractor with two strands of it . . . and they only attached the second strand to keep the damned thing from rotating when they hoisted it up off the ground. No, I suspect it might be some kind of garbage clogging the fuel lines. With the number of rockets everybody's been sending up over the past five or ten years, the fuel producers probably can't keep up with the demand and still maintain sufficient quality control."

"I guess that's a possibility, although it should've shown up on the gauges. I sure as hell can't think of any others. What's your friend there say about splashdown time?" Nathan nodded toward the computer.

"Oh, let's see." Joey made a few quick motions with her fingers, then leaned backed against her seat. "Herman says forty-eight more minutes and we'll be bobbing like a cork in the deep blue sea . . . Hey. What's this?" Her eyes

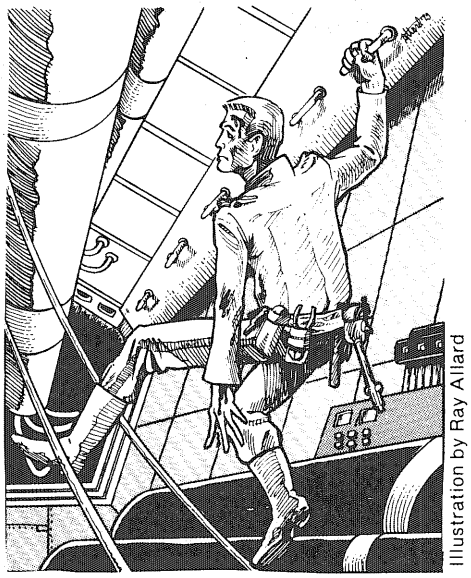


Illustration by Ray Allard

were fixed on the printout screen. "What the h———"

At that moment a titanic shock ripped the spacecraft, bouncing Nathan violently against the back of his seat, twisting one arm and snapping it on the control panel. He felt a dull ache just above his left eye and probed it with one hand. Numb, stunned, he pulled the remains of Joey's pen, bloody, from beneath the skin near his left temple. Fragments of plastic and metal remained as warm blood swelled from the wound, leaching into his brow and blinding one eye. His head reeled. He vomited into the weightlessness of the cockpit, fighting to maintain his consciousness. "Joey, JOEY!"

Still dazed, he peered across the small chamber to where she sat. His scalp prickled. Nathan had sustained the jolt because it had forced him against the back of his seat. Joey hadn't been so lucky. She'd had her chair swiveled toward him and the force of the impact with whatever they hit had snapped her neck, leaving her as she was now, bent forward, her nose pressed into her breast.

The sight before him hurled Nathan back into reality. He tore at his seat buckle but his hand wouldn't function. He tried the other, tugged twice, the buckle gave, and he flung himself toward the computer.

Racing over the lines of bright breen printout, he halted at a familiar equation. "Gravity! That's the god-damn gravity equation!!" He scanned the remainder of the printout, to the point where it read: 'IMPACT VELOCITY, 19.37 METERS PER SECOND '

"Holy Jesus." He closed his eyes, fought the pain in his head and arm, struggling to assemble the pieces to this grizzly mishap. "Why the gravity equation? What did we hit?" As if for some divine intervention, he looked up, out of the ship's only port hole and the answer struck him with solemn clarity: the asteroid. There was enough gravitational attraction between them and this space-sized chunk of rock to reunite them after Nathan was sure it had drifted harmlessly away.

He slapped at the control panel to call Houston, gasped when the pain shot from his wrist deep into his shoulder, then tried with the other hand. He waited . . . No response. Tried again . . . It was dead.

The naked realities began to pound at him like the throbbing in his head. His radio was defunct, his co-pilot was dead, his rocket wouldn't fire and he was streaking toward earth on a million-ton asteroid. In the obscure event that the ship's insulation had held up and he wasn't baked like clam when he reentered Earth's atmosphere, the high iron content of the asteroid would certainly cause it to weld itself to the spacecraft, smashing it to bits on collision with the water and dragging whatever remained down into some nameless trench at the bottom of the Pacific.

He swept the pain from his mind. He had to act. He was riding a potential ro-

man candle toward his death and the only way to save himself was to get that rocket to fire, even if only for a few seconds, just long enough to separate him to a safe distance from the asteroid. Could Joey have been right? Was there some sort of sludge in the fuel line? It was his only chance. He'd tried everything else.

He thrust himself back toward the crawlway, scooping up his tool pack and oxygen mask en route. He shot through the narrow passageway and back down along the fuel tank, ignoring the fire in his arm when he collided with the engine support member. But it had been a calculated move, since it left him adrift, weightless, in the proximity of the fuel line. He caught the support member with one leg and pulled himself in closer to the line.

The fuel connection to the engine consisted of a single main tube emanating from the foot of the fuel tank, branching into nine smaller lines, bundled tightly together at first, then splitting apart and entering the engine. He would have to loosen the nine fittings where the line divided, pull them back and inspect the insides.

He spun the valve at the head of the main conection, closing off fuel pressure so he could work, then dug into his pack, emerging with a long slender pipe wrench. This he slipped over the nearest fitting and attacked the next. The first three gave with ease but the fourth held fast, resisting all pressure from the wrench. Perspiration seemed now to be pouring from all points on his body. It glued him to his suit and condensed on the inside of the clear face shield. Gently, evenly, he pulled until the threads released, jolting him and sending the wrench spinning off toward the far end of the chamber.

"Shit." He pressed himself away from the tank and after the wrench. He caught it in mid-air, bounced against the side wall and kicked himself back toward the fuel line.

"He slapped at the control panel to call Houston, gasped when the pain shot from his wrist deep into his shoulder, then tried with the other hand. He waited...No response. Tried again... It was dead."

The job he was performing was an extremely delicate one. If he caused even the tiniest crack in any of the lines, he would be unable to build fuel pressure and his engine would be useless.

The remaining five fittings released with ease. He slid the wrench into his hip pocket and pulled the main pipe gently out away from the others. His heartbeat doubled when he peered into the open end of the tube. Joey was right. A chalky greenish deposit had built up at the lower end of the tube, closing inward until it had nearly choked it of all possible fuel flow. Nathan tore at the pack, yanking a long screwdriver from it and letting the remaining tools spin away to drift about the room.

He chipped violently at the green crust, first pounding with the handle, then scraping at it with the blade. He was growing more conscious of the pain in the arm which he held gently against his stomach. It had swollen, its bloated mass now taxing the elasticity of his space suit. Blood had dried in his left eye, fusing it shut and forcing him into his present position, his head cocked, peering into his work with the good one.

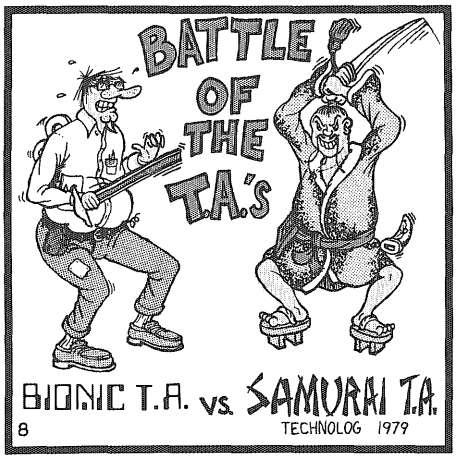
When he had sufficiently reduced the crust. Nathan pressed the main tube back against the others and began twirling the fittings into place. He tore the wrench from his hip pocket and began torquing each of the connectors snugly down, his mind racing with a curious blend of anxiety, victory, and fear.

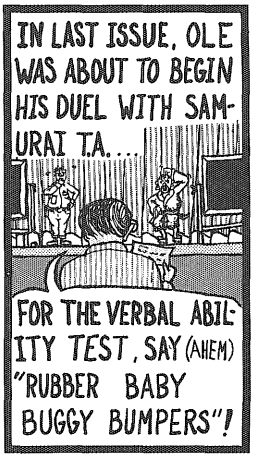
He was reaching for the final connector when the heavy, tumbling sheet metal cutters, having bounced once against the fuel tank, then off of the support strut, drove itself silently into the delicate turgidity of his right elbow. He recoiled spasmodically, every available muscle in his body constricting in unison as a black anguish spread across his eyes and sliced deep into his consciousness.

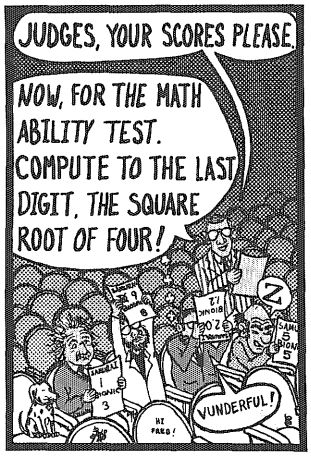
When he awoke, Nathan found himself dangling at the bottom end of the fuel tank, his leg still wrapped securely around the support strut. The pain continued to reverberate throughout his body. He attempted to right himself with his legs but they were alternately rock, then jelly, and refused to function. He reached forward, carefully, with his good arm and pulled himself back up toward the fuel lines. When he had them in view, he halted. His pain disintegrated. His heart seemed to stop. He could only focus in disbelief at the ninth fuel line, a victim of his initial muscle constriction, severed completely from the others and jutting out away from them, the wrench still attached.

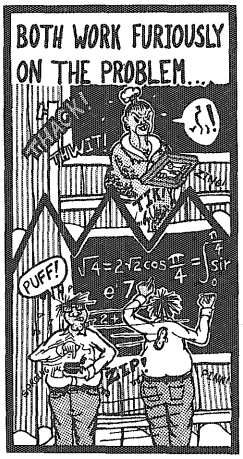
He stared. Perspiration trickled. His breathing was silent, his eye still fused. His suit clung. He stared.

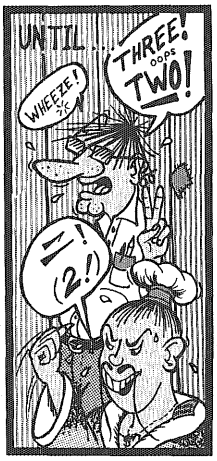
Nathan Pearson loosened his clutch on the support strut, letting his fingers slip in little jumps down the beam. His muscles went limp, his eye closed, and he wept.

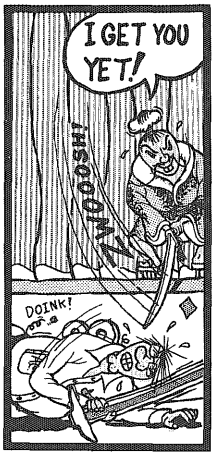




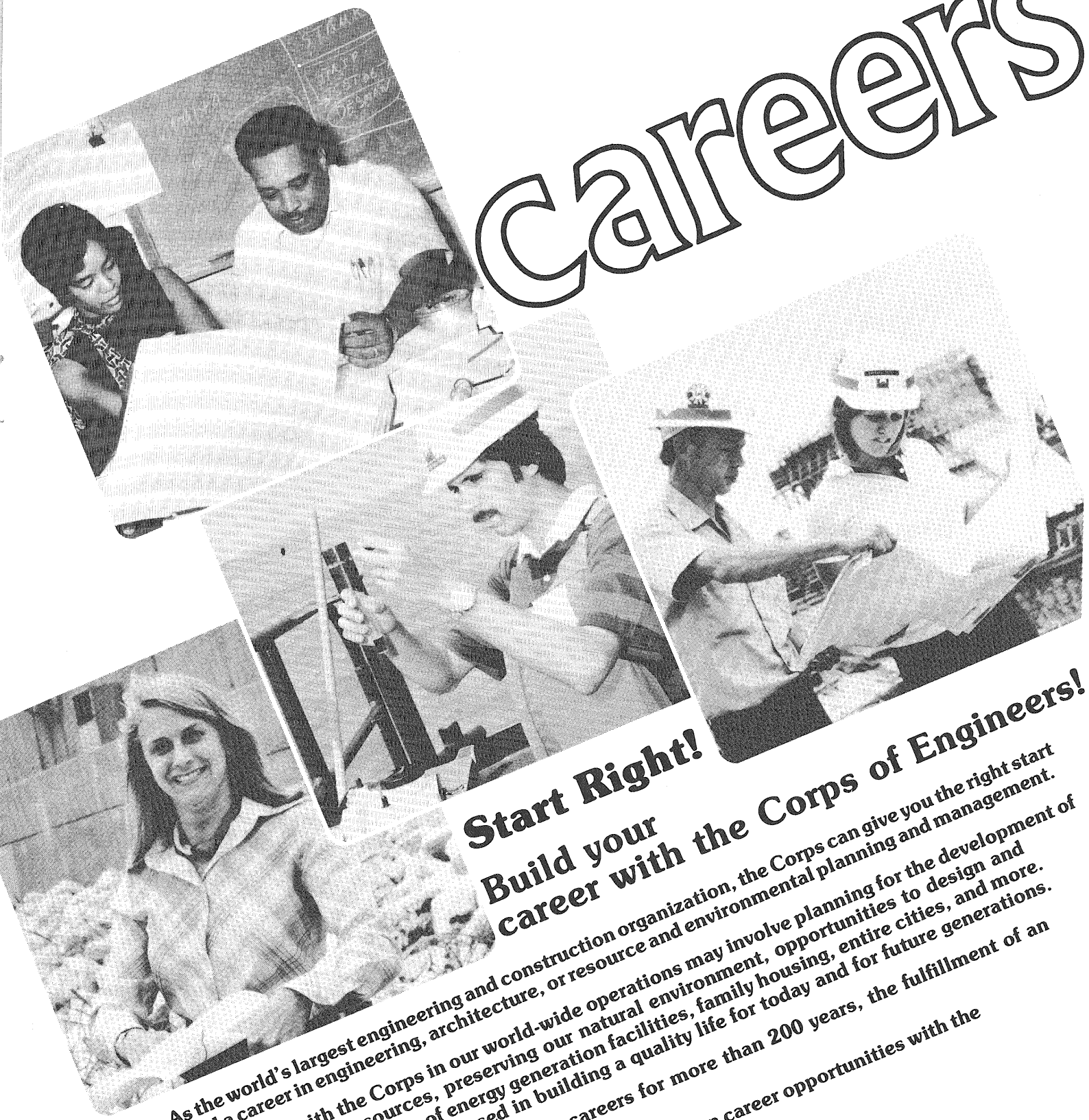








careers



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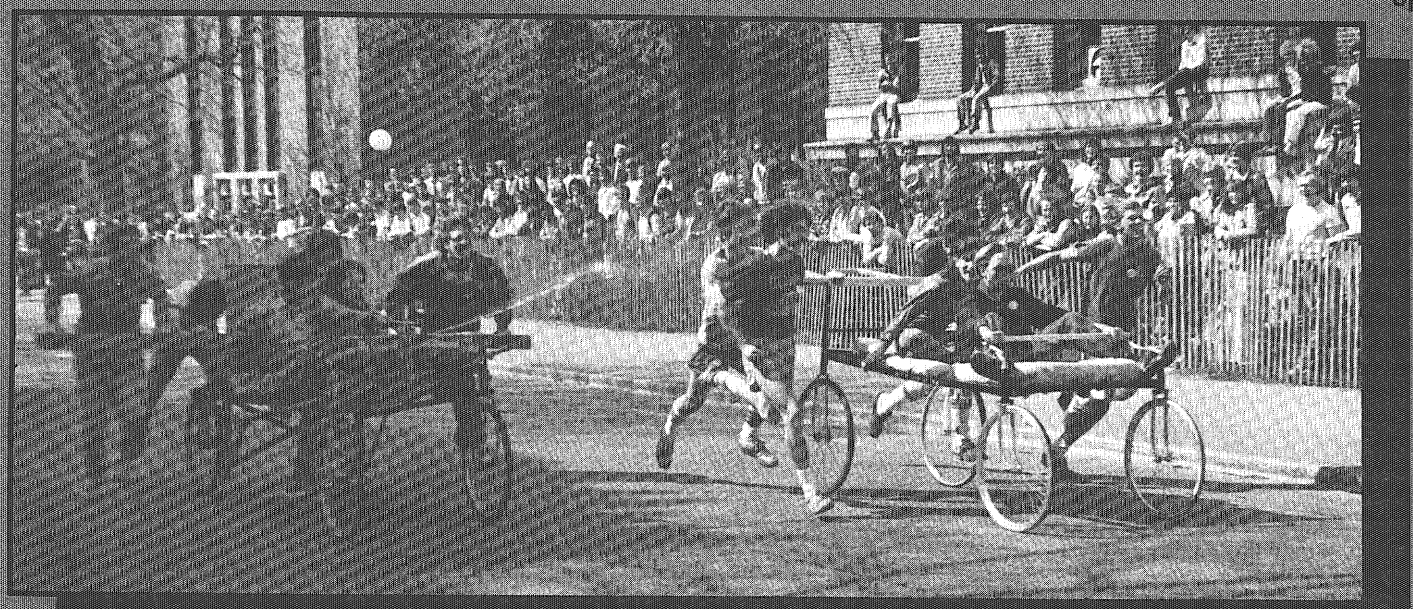

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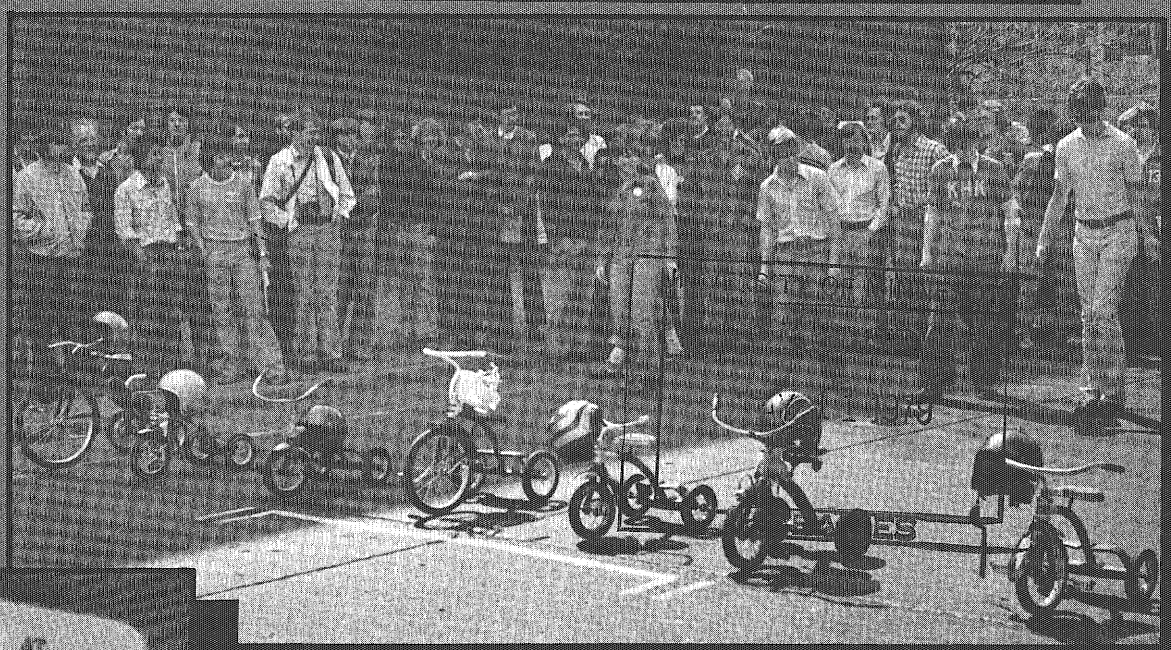

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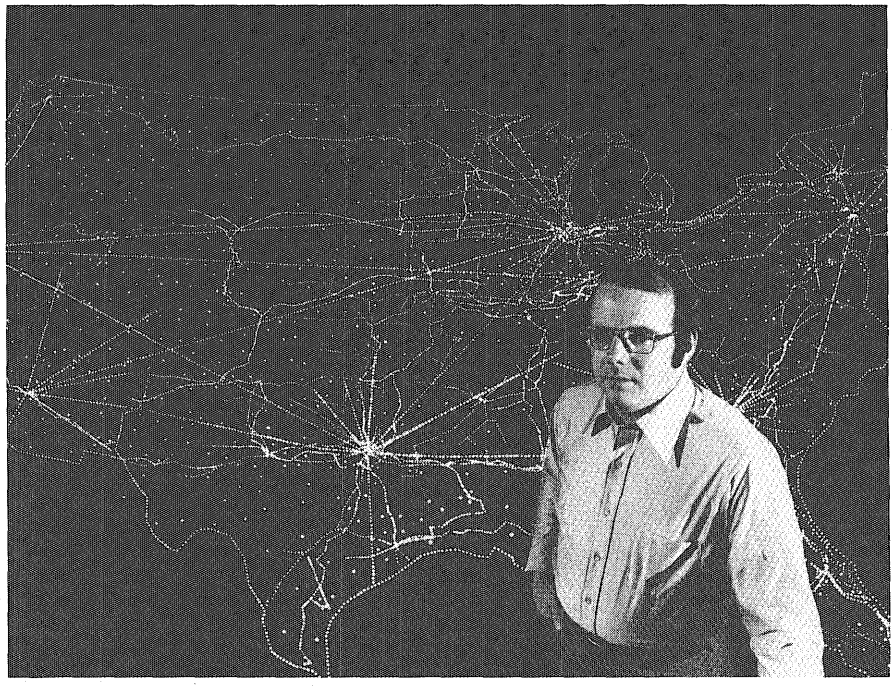
For several years the Bell System used its computerized Network Operations Trouble Information System (NOTIS) to try to pinpoint those causes by analyzing trouble reports from all over the country. NOTIS was good. But Bell System managers wanted it to be better, more precise in identifying possible trouble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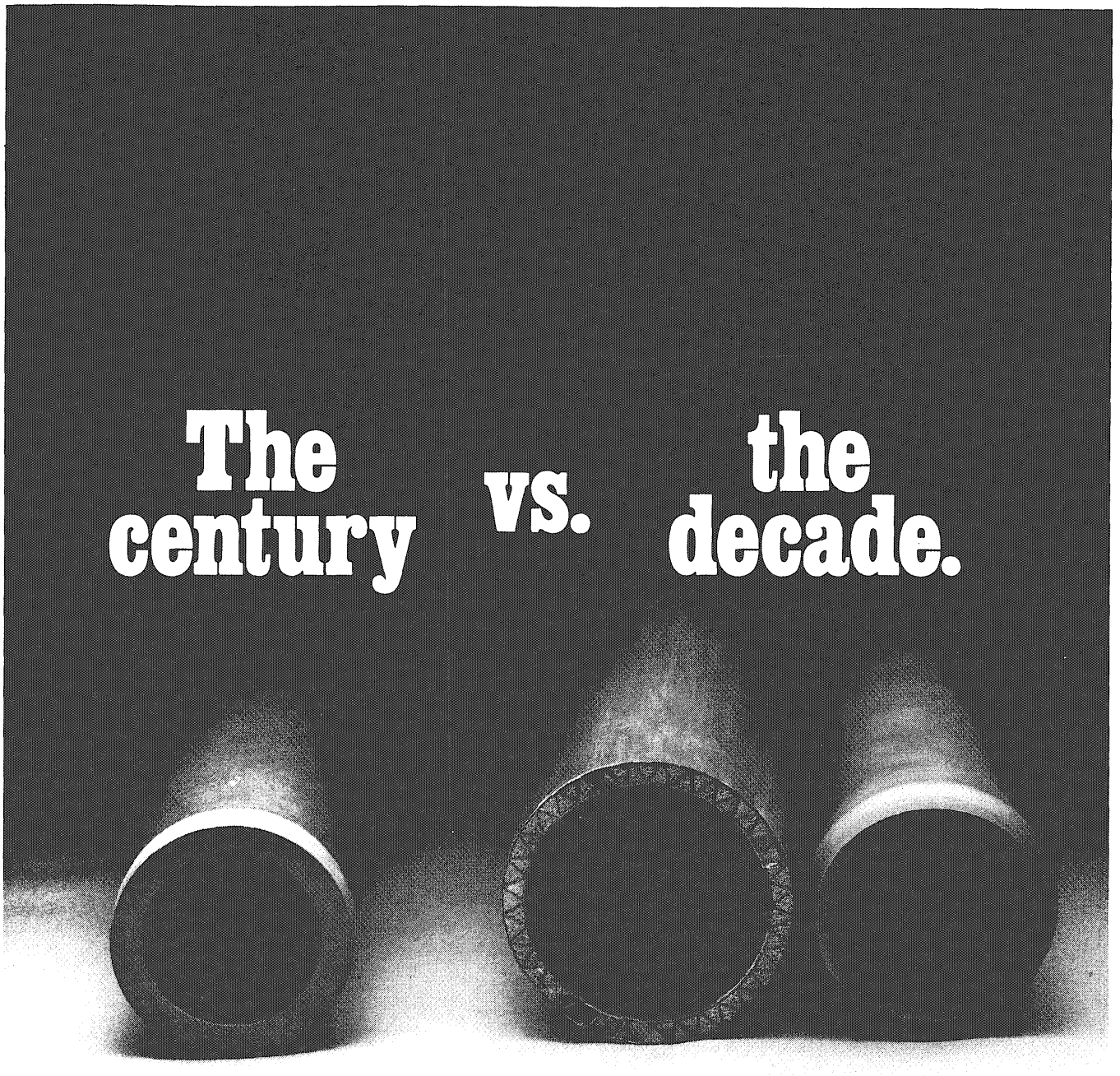

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Editor's Log

Pick up any newspaper and glance through the headlines; it doesn't take very long to perceive images about inflation, cost overrun, shortage, pollution and conflict—some of the bigger problems here on Earth. This issue, however, we offer at least one alternative to space, energy and resource problems with Tom Coughlin's "Outer Space: An Investment in the Future," a look at space industrialization as a viable economic, technological and energy answer just around the corner for progressive, thinking industries.

Bruce Kvam's "Ad Astra" columns provides some background reading to compliment the report.

If you think you've heard and read all there is about the recent total eclipse of the sun, Feb. 26, check again on page 18 as we present our "last word" on the subject. While 15,000 Minnesotans gathered near Coffman Union to witness the event, John Bartelt and friends traveled to Canada for a breathtaking view of totality.

So far this issue we've given you the sun, the moon...and maybe an asteroid to mine. The Civil and Mineral Engineering Department, however, is looking downward instead—about 105 feet and 17.2 million dollars down for their new proposed underground building. Mary Jo Hannasch updates the progress on this energy-efficient facility in "Building an Education in Minnesota's Land Down Under."

Speaking of building, Daryl Hansen, a graduate of the University's School of Architecture, has been desigining, renovating, winning awards and building a personal philosophy about his education at the University, his work and more. See Dave Bissonnette's story and photos in "After Graduation" this issue.

And, we at the 'Log are blowing our horns a little louder than usual this issue. After a period of ineligibility and absence from activities of Engineering College Magazines Associated, **Technolog** captured seven awards in writing, layout and overall excellence in the press association's annual convention and competition held at Notre Dame University April 7.

The Bionic T.A. is busy enjoying E-Week festivities this issue; watch for a special longer version of B.T.A. heroics in our last issue.

Jon Kavanaugh
Editor

minnesota
TECHNOLOG

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Minnesota Technolog USPS 535-840

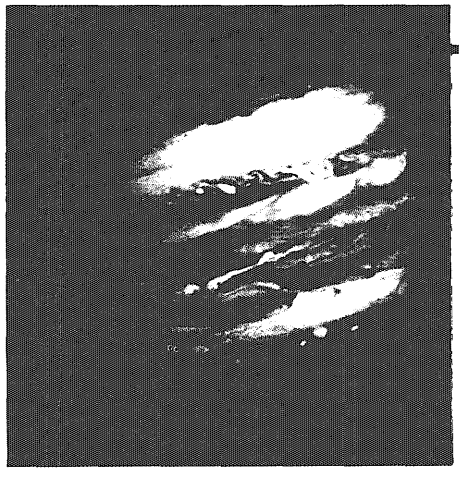
Log Ledger

Photo/Glenn Flekke

EE Career Fair

Twenty-five area companies took part April 11 in the first of what the I.T. administration hopes will be an annual Electrical Engineering Industrial/Career Fair. Representatives from Honeywell, Inc.; Ford Motor Co.; Rosemount, Inc.; Air Force Officer Program; CPT Corp.; Data Card Corp.; and others, shared valuable product/service information and gave Electrical Engineering Department, among students, among others, a chance to discuss career options with individual companies.

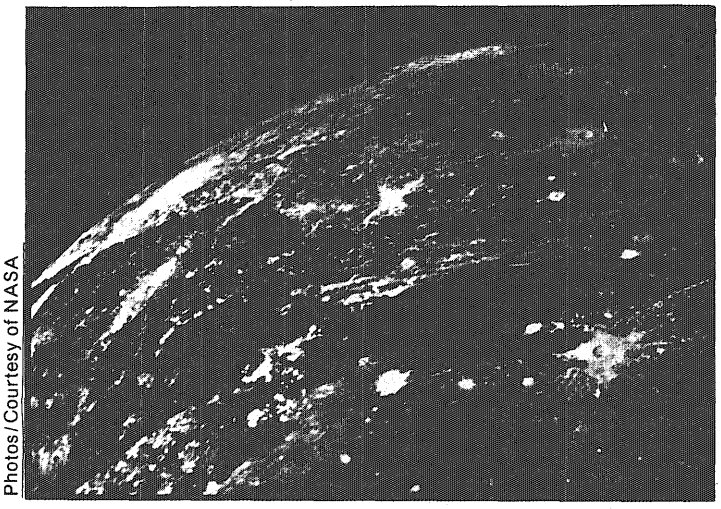
Well attended by both students and faculty, the Fair was deemed a success by several company representatives who were happy with students' questions and interest.



Voyager Probe Captures Detailed Photos of Jupiter, Moons

As the United States space probe Voyager I was still more than 40 million kilometers away, it took the above photo of the planet Jupiter, Jan. 24, 1979. As the spacecraft drew closer to the planet (about one million kilometers per day) more details emerged in the turbulent clouds. The Great Red Spot shows prominently below center, surrounded by what scientists call a remarkable complex region of the giant planet's atmosphere. An elongated yellow cloud within the Great Red Spot is swirling around the spot's interior boundary in a counterclockwise direction within a period of a just under six days, confirming the whirlpool-like circulation that astronomers have suspected from ground-based photographs. Ganymede, Jupiter's largest satellite, can be seen to the lower left of the planet. Ganymede is a planet-sized body larger than Mercury.

A closer view of Ganymede can be seen above, taken by Voyager I the afternoon of March 5 from a range of 272,000 kilometers. The center of the picture lies at 13 degrees latitude, 359 degrees longitude. Many bright impact craters are shown that have radial ejecta patterns. These rays lie across and therefore are younger than the bright and dark background material. Many older impact craters are shown that have lost their rays probably by impact erosion.



Photos/Courtesy of NASA

Voyager I is part of a larger space probes program sponsored by NASA and managed by the Jet Propulsion Laboratory.

Seminars and Colloquiums

COMPUTER SCIENCE DEPARTMENT
RM. 305 LIND HALL—3:30 P.M.

May 7
Computer Graphics and Animation
Mr. Richard Weinberg, Graduate Student, Computer Science Dept.

May 14
Analysis of Time Varying Imagery
Professor William Thompson and Mr. Stephen Barnard
Department of Computer Science

May 21
Sorting and Routing Algorithms for Parallel Computers
Mr. David Nassimi, Graduate Student, Computer Science Dept.

MECHANICAL ENGINEERING SEMINAR
RM. 108 MECHANICAL ENGINEERING

May 9
Passive Solar Energy Design
Edward Mazria, Matrix Architecture and Planning, Albuqerque, N.M.

May 16
Recent Advances in Aerosol Dynamics and Mechanisms
Prof. S.K. Friedlander,
School of Engineering and Applied Science, U. of California, Los Angles

May 23
Creative Synthesis of Mechanisms
Dr. F. Freudenstein, Professional of Mechanical Engineering
Columbia University

May 30
Arc Plasmas and Circuit Breakers
Prof. David M. Benenson, Department of Electrical Engineering and Engineering Science, State University of New York—Amherst

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

May 10
Quantifying Information Costs in Decentralized Decision Problems
J. Froyd, Department of Electrical Engineering

May 17
Quantifying Information Costs in Decentralized Decision Problems-Cont.
J. Froyd, Department of Electrical Engineering

May 24
Adaptive Digital Position Control
J. Hartman, Department of Electrical Engineering

May 31
Simulation, Optimization and Control of Distributed Parameter Systems
J. Vojta, Technical University of Budapest, Hungary

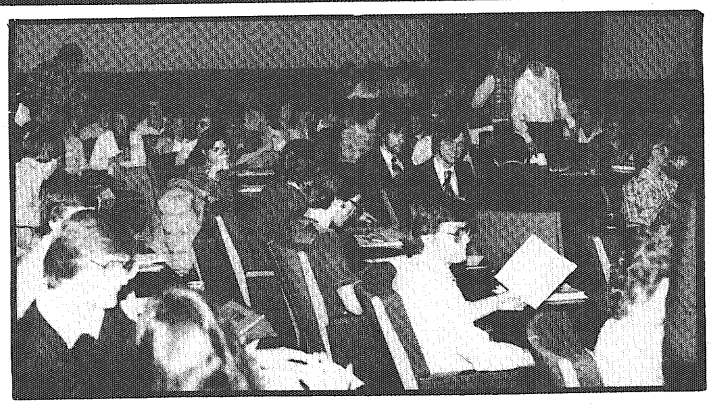
PHYSICS AND ASTRONOMY COLLOQUIUM
RM. 131 PHYSICS—4:00 P.M.

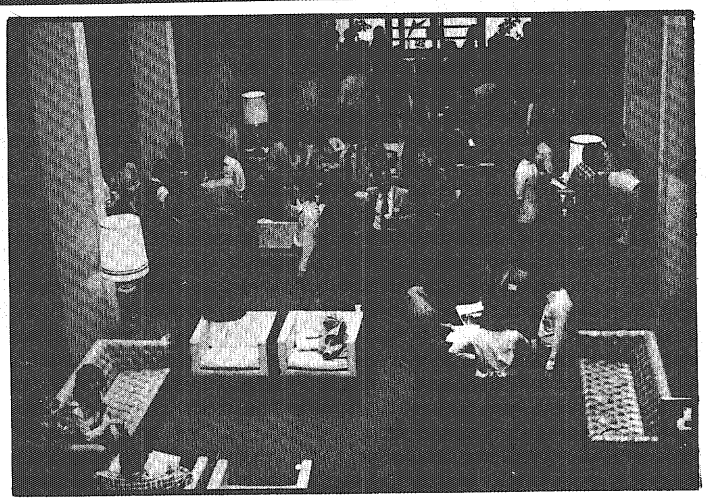
May 9
Geometrization of Physics
Prof. C.N. Yang, Nobel Laureate, Einstein Professor of Physics
State University of New York—Stony Brook

May 23
The Chimerical Cat: Philosophy of Quantum Mechanics in Historical Perspective
Prof. Stephen G. Brush, Institute for Physical Science and Technology and Department of History and Philosophy of Science,
University of Maryland

May 30
Luminous Stars and the Cosmic Distance Scale
Prof. Roberta Humphreys, Department of Astronomy

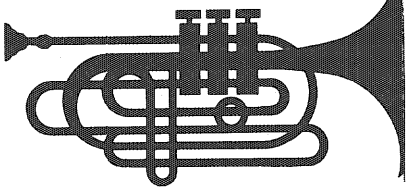
Log Ledger





Photos/Mike Dorn

Blowing Our Own Horn



In most professional arts/media groups, there are coveted awards given for excellence in the product and personnel of that field. Television has the Emmies, the motion picture industry has the Oscar, advertising has the Clio and with student-produced engineering magazines like **Technolog**, it's the annual ECMA Awards, given by the Engineering College Magazines Associated to publications showing excellence in writing, design and overall product.

ECMA, a press association for about 50 such engineering magazines, presents its awards at the annual convention, held this year at Notre Dame University April 5-7.

Five **Technolog** staff members and Adviser Dr. John Clausen traveled to the meeting, eligible for the first time in several years for ECMA awards. **Technolog** had been unable to compete because staff people had failed previously to attend the annual convention and business meeting until last spring, a requirement for eligibility.

But when this year's meeting was over, no one from Minnesota could be disappointed as the magazine was presented with 7 awards in 13 categories for issues published during the 1978 calendar year:

First Place—Best Single Cover Spring I, 1978 Issue

Second place—Best Layout for a Single Issue, Spring II, 1978

Second Place—Best Layout, All Issues

Third Place—Best All Around Magazine

Honorable Mention—Best Single Issue, Spring II, 1978

Honorable Mention—Best Technical Article, Peggy Purcell's "Magnetic Bubble Memories", Spring II, 1978

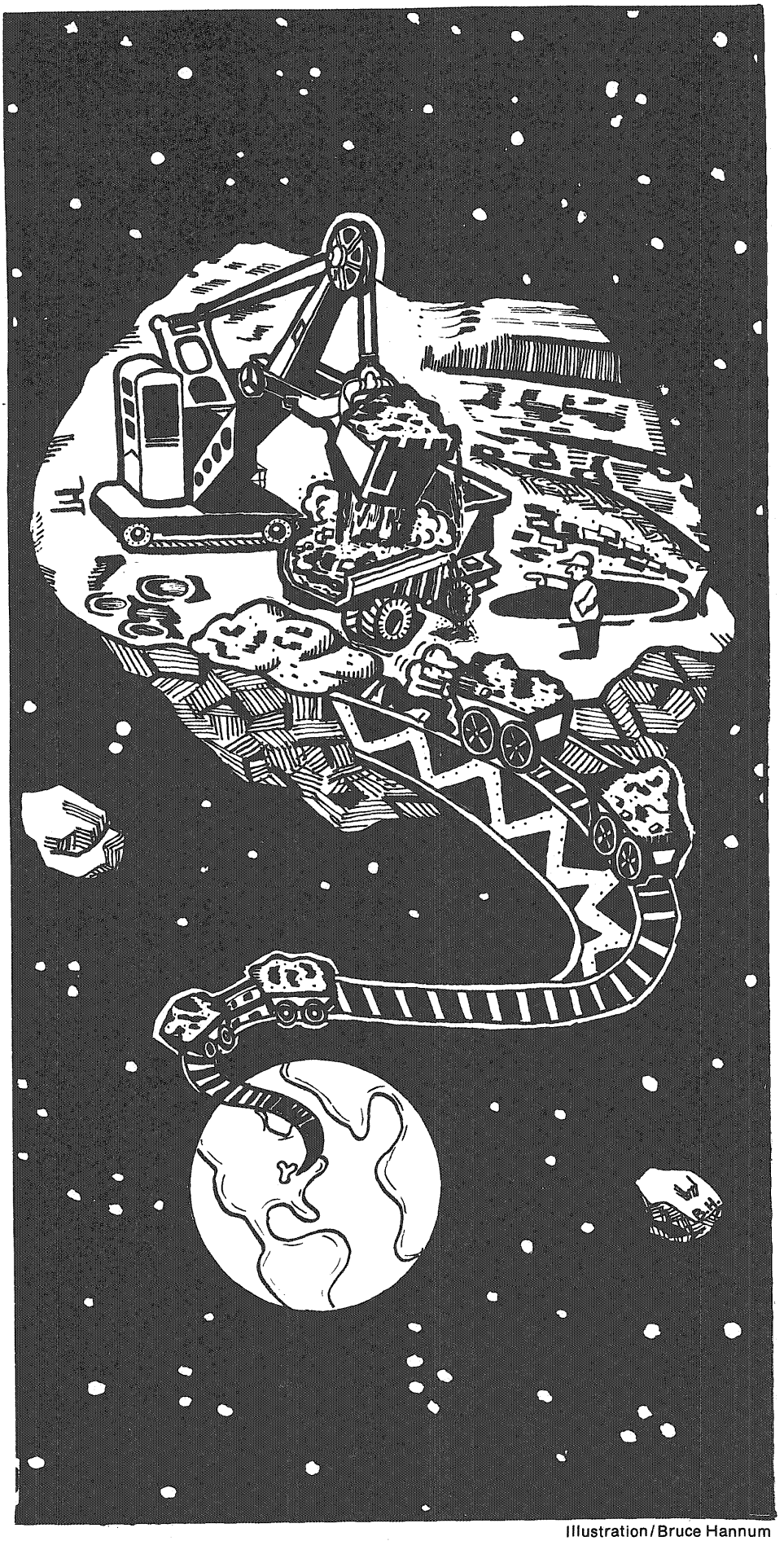
And in a new students' choice award, the **Technolog** was chosen for Second Place as the most outstanding magazine nationwide.

Except for the "people's choice" award, a panel of judges who are professors or professionals in engineering and science made the selections.

But the satisfaction of awards aside for a moment, for the students who attended the convention from Minnesota the awards were a minor aspect of a much bigger, more informative meeting. Student delegates and advisers met in informal sessions designed to improve writing, layout, advertising sales, staff organization, editorial direction and management.

Even more important, however, was the opportunity to meet and share the experiences of each magazine's own campus environment and specifically its publishing environment; in many cases students solved other students publication problems in a shared learning/experience atmosphere.

Attending the meeting from Minnesota were Hap Atwood, staff writer; Mike Dorn, photo editor; Glenn Flekke, staff photographer; Tim Schultheis, business/advertising manager; Jon Kavanaugh, editor; and Adviser Dr. Clausen.



Illustration/Bruce Hannum

Outer Space:

By Tom Coughlin

Awaiting mankind in the vast reaches of outer space are tremendous opportunities, abundant natural resources and an almost unlimited source of energy. Space is a great frontier, the exploration of which could certainly transform human civilization. We probably cannot depend on government to pursue these opportunities to their best advantage; the industrialization of outer space will most likely occur by the actions of the private sector. Although vast sums of money may be needed in the initial expenditures these costs might well be born by a partnership or consortium of companies. Once such initial investment is made there may be plenty of room for entrepreneurs to gain a share of a future space market. Such people have influenced history in the past and can do so again.

If the proper actions were taken today, within the active lifetime of our generation, employment in and the development of outer space could become a reality. Furthermore, ingenious groups of entrepreneurs are already pursuing the goal of making transportation into space cheaper and more readily available than now.

Why Space Industrialization?

Space industrialization is attractive as an alternative to continued development of many industries on the Earth because environmental problems, physical limitations to processing many materials on the Earth and isolation exists. In addition, the development of satellite communication and observation systems will continue to flourish.

Mining the Astroids

Imagine yourself 20 years from now nosing your spacecraft (even though the bank of Luna owns 75 percent of it) towards a promising-looking nickel-iron

An Investment in the Future

asteroid (one of the Apollo asteroids that comes fairly close to the earth). The nickel and iron itself is a significant find since the nickel can command high prices on Earth and most of the readily available iron ore is exhausted in the industrialized countries. Unfortunately you aren't so well backed that you could afford the mass drive units needed to bring the asteroid into Earth's orbit. The competition is so fierce that as soon as word got out of your find 20 prospectors would be racing out to lay claim to the orbiting rock.

Instead you must find something on the asteroid small enough to bring back on your ship but valuable enough to finance the retreival of the rest of the asteroid. Spectroscopic scanning shows an unusually high albedo near the neck of the pear-shaped asteroid. You move in to land your craft on the precarious surface and find the reflective object was a chunk of platinum as large as a barn.

Your fortune made, you bring a large piece of the metal back to an orbiting earth station and file for prospecting rights with the Solar Independent Prospectors Agency which agrees to defend you against any encroachments on your find for 10 percent of the take...

Not only would space prospecting be adventurous, profitable and probably dangerous but it would spare the mineral and ecological resources of Earth. In exhausting the high-grade mineral resources of Earth larger amounts of lower-grade material will need to be processed to meet the demands of the industrial and industrializing nations of the world. This will require stripping vast amounts of the Earth's surface and perhaps making it unuseable for other purposes.

Political problems will arise in the attempts by the industrial countries to obtain the higher-grade mineral reserves in developing countries. The Third World, rising nationalism, and the advent of raw material cartels, such as the Oil Producing and Export Countries (OPEC), signal a period of confrontation between the producer and the consumer nations over supplies of these raw materials. We may assume the price of metals will increase by 50 to 200 percent in the coming years.

In their excellent analysis of the economics of asteroid mining compared to continued exploitation of Earth resources Michael Gaffey and Thomas B. McCord analyze the financial, political and ecological implications of different asteroid metal delivery schemes. They show that the environmental costs or the financial costs of negating the environmental damage increase significantly as the grade of the crude ore decreases . Such costs will be paid for through reduced quality of life or an increase in materials costs or both. The legal basis for utilization of space resources could probably be made in the same way as arrangements are made for sea floor utilization. This is just one example of the legal problems which space utilization will have to face.

Processing space minerals will require use of the abundant solar radiation. This will reduce the terrestrial demand for energy as well as pollution arising from processing. Because of the means by which asteroids came into being their metallic constituents are for the most part simple metals. Extraction would thus be a simple process.

One can imagine a stream of crude metal fragments entering a solar furnace cavity heated by focused sunlight to several thousand degrees and continuous bar to enrich the last heated end in the minor constituents of the metal alloy.

Vapor fractionation is another promising technique. Gaffey and McCord state that in addition to the relatively abundant minor metals (Ni, Co), useful quan-

SOURCES:
*"Pig Iron to Heavy Scrap," **Iron Age**, Vol. 216, 1975, p. 48
Minerals Yearbook, U.S. Bureau of Mines, 1973
Technology Review, June, 1977

Metal	Percent	Mass (millions tonnes)	Price (dollars per million tonnes)	Value (dollars per million tonnes)	Use rate** (million tonnes per year)	Years supply
Iron	89	6.9×10^9	200*	14×10^{11}	4.5×10^8	15
Nickel	10	0.8×10^9	4400**	35×10^{11}	6.4×10^5	1250
Cobalt	0.5	4×10^7	8800**	3.5×10^{11}	2.0×10^6	3000
Copper	0.1	8×10^6	1380**	$\frac{11.11 \times 10^{11}}{15.3 \times 10^{12}}$	1.8×10^6	1

COST COMPARISON FOR MINING METALS IN SPACE

tities of other trace metals (e.g. copper, gold, platinum, germanium, etc.) could be isolated as byproducts of this processing. In addition, low-gravity permits the use of unusual fabrication techniques, such as the injection of a gas into the melt to produce metal foams of any desired density.

The development of asteroid mining will involve the study from spacecraft of the asteroid compositions using reflect-spectrometry, gamma-ray and X-ray spectrometry and radar. In addition density and moment of inertia may be determined from spacecraft tracking. Lander vehicles and penetrometers would analyze the surface directly. Surveying and analysis carried out over several years combined with ground based studies should allow the categorization of near earth asteroids and uncover the most promising ones for material processing experiments.

The technological advances required are 1) cheap, high-flux Earth-to-orbit shuttle systems and a space tug for near-Earth and Earth-moon operation, 2) large-scale, long-term, self-contained closed life support systems and systems to permit long-term operations in low gravitational fields without irreversible physiological damage, 3) development and evaluation techniques for concentrating and extracting desired metals and minerals, and 4) development and evaluation fabrication techniques to produce and assemble structural elements for the space mining and manufacturing facilities and for human habitation. Economic studies of initial investments required investment return and the impact on the terrestrial economy will need to be carried out. Also a study of the political impact of this new material source on the relationships between the developed and developing nations must be pursued.

An international agreement will probably be needed to allow full use of resources from space.

It is probable that a multiple-use approach (mining, manufacturing facilities, power production and colonies) will provide a more sound economic, technical and political base on a shorter time scale and a lower costs than individual independent developments.

Opinion

Space: the Third Industrial Revolution

By Tom Coughlin

The government of the United States will not create the Third Industrial Revolution in outer space industrialization. It will not because it is not the function of government to run a business. Furthermore, where government has run or regulated industry, the effects have been less than admirable. The American people, too, have shown themselves to be against any new government boondoggles similar to many of the efforts of the old space program.

If mankind is to reach the stars it must do so systematically and purposefully.

But this will happen only if people have a need to be in space. It will happen only if there is a product to be made and a profit to be gained. In other words, a true industrial revolution in space will not occur until the private sector is responsible for the most—if not all—of the requirements of a space-going species, including transportation.

It doesn't mean, however, that without alternatives available government space shuttles should be avoided, but only that it must be a temporary measure. Government space shuttles will not serve the needs of full-scale space industrialization.

The attitude in the business world today about high risk ventures, however, is one of "let Uncle Sam do it!" Business is so used to the security of a 5 percent profit margin, government subsidies and special protections that it fails to see the potential fortune to be made by well-run space industries.

As G. Harry Stine has said, "The first billionaires of the Third Industrial Revolution are alive today"...that is, if money can be pried free from the military-industrial complex to invest in space ventures.

As long as the attitude of business is merely to take the most secure (government-backed) investments, space will continue to be the plaything of government rather than the tool necessary to better the lot of mankind.

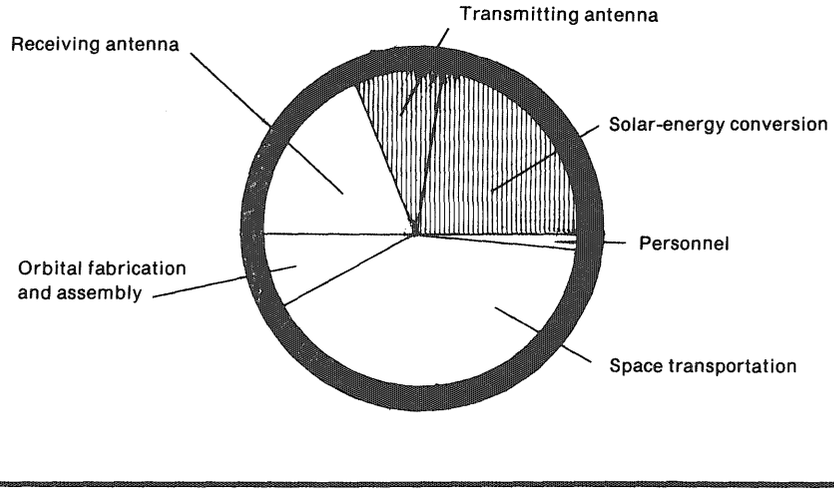
It would be well to consider this attitude of government-backed security as more and more land is strip-mined to provide fuel and material to feed industrial machines in developed nations, and as tensions continue to build between consumer and producer nations.

Perhaps we should give the natural resources on earth a rest and develop, among other alternatives, solar power satellites, space processing factories and outer space mining operations. Considered thus, space industrialization may, indeed, offer several advantages over continued earth industrialization which would encourage people with an adventuresome frame of mind to take the risks necessary to create the future fortunes of the space industrialists alive today.

Tom Coughlin is currently a graduate student in the Electrical Engineering Department. In 1978 he was a consultant for Honeywell, Inc., working on the corporation's technology assessment of space industrialization.

Power Satellites

In the mid 1970s Peter Glaser of Arthur D. Little Inc. began serious studies on the production of satellites which could competitively supply the world's power needs. The satellites would turn the solar radiation of Earth geosynchronous orbit into electricity by either solar cells or heat cycle engines and use this electricity to drive a microwave or laser generator which would produce a tight beam at the Earth's surface. Because of the fixed position relative to Earth of a geosynchronous sattellite a large antenna "farm" could be built which would collect these microwaves or light and turn it back into electricity at high efficiency. This would allow the tapping solar radiation 24 hours a day nearly every day of the year to supply energy to Earth.



COST PROPORTION COMPARISON FOR POTENTIAL SPACE FACTORY

A prototype model of such a solar power satellite could be constructed during several dedicated space shuttle missions. A full-scale model, however, will require a new type of cheap launch vehicle which can carry large payloads. This would allow satellite solar power to become competitive with terrestrial sources of energy.

Rockwell and other aerospace firms are developing methods whereby robot systems could be used to do much of the construction work for a solar power satellite. One advantage of construction in space is that a massive structure need not hold itself up against Earth's gravity but only be strong enough to resist the structure's inertial strains and stresses.

Space Factories

Solar power satellites will have another use in the fledgling industrialization of space. They will be used to supply power for new industries, utilizing the unique properties of space itself. These include low gravity, high vacuum pumping speeds, ultrahigh temperatures in any body protected from the sun's radiation. The unique property of space is the low gravity. The weightlessness of space will allow "levitation" processing where the material is suspended in mid-air without touching a container. In the weak gravity of outer space only small forces such as electromagnetic, electrostatic or acoustic fields would be needed to control the position of relatively large amounts of material. This would eliminate the danger of impurities from containers entering the material. This is a major problem in earth-manufactured reactive, high-melting-point materials like highly purified glass for lasers and laser optical systems, and pure crystals for semiconductors.

In addition containerless processing in space would eliminate surface irregularities which contact the melted material. These irregularities provide sites for undesireable crystal growth in a solidifying liquid, which spoils the perfection of the solid.

A second major advantage of low-gravity processing is the elimination of "gravity-induced convection" in liquids. A melted material will always contain regions of different temperature and, thus, different density. On Earth, gravity's pull on these regions causes convections which spoil the homogeneity of a liquid.

Weightless processing will also eliminate the separation of ingredients in a mixture due to their differing densities. This will allow much better control of heat and mass transport in liquids and gases. Many processes in which bouyancy and thermal convection cause problems will change drastically in low-gravity space. For instance space manufacturers will find it easier to deposit materials on surfaces, mix and homogenize liquids, polymerize chemical components, separate and purify components of mixtures, cast mixtures of metals and grow crystals.

In weightless space, molecular forces like cohesion and adhesion will replace gravity as the strongest environmental forces. They will thus become the factors

that control processes, and there will be drastic changes in various kinds of casting and drawing processes.

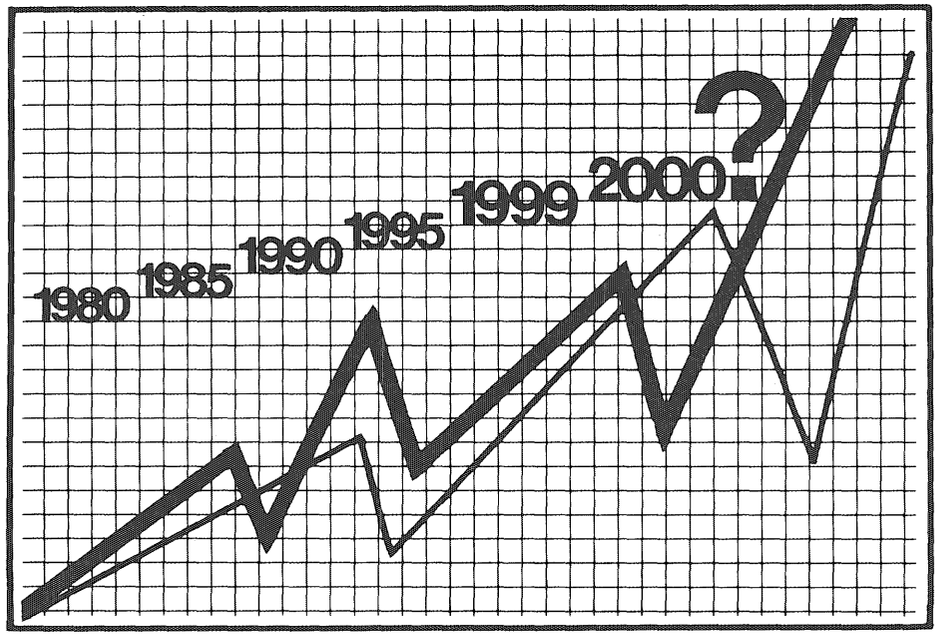
Preliminary experiments in these fields of space processing as well as the separation of biological components will be performed on missions aboard the space shuttle in the 1980s.

How Companies Can Become Involved

As the coming decade progresses and as the results of shuttle missions begin coming in, the private sector will become increasingly aware of the opportunities in the utilization of outer space. The desire to use this new resource will create pressures for cheaper and more versatile lift systems. Indeed, the first ventures to develop really cheap launch vehicles have begun by several groups, including OTRAG of West Germany and the Foundation Institute of the twin cities. OTRAG has already had several successful launches of their "space truck", as it has been called. OTRAG has plans to use their launch system in competition with the Shuttle, The Ariane (European Space Agency) and other satellite delivery systems. They have offered this service to all and sundry. Among other cargo they would fly are observation or spy satellites for countries neither in the American or the Soviet Bloc.

How could companies profit from the outer space environment in the next decade? One way might be to purchase space shuttle flights and brokering room. It may be possible for a partnership of companies to sell space not used in their own work and so perhaps get a "free ride", or zero-cost transfer into orbit. The partnership might consist of three corporations—say Honeywell, Control Data and Sperry-Univac. They would use the remaining shuttle space to develop a given product of interest to all three parties.

A more plausible occurance would be a club of say 100 or 200 companies, each



contributing a little capital and perhaps owning stock in the end products of space development. Such a scheme would probably be much easier for present-day American corporations to pursue since it involves little risk on the part of any single partner.

Perhaps of greatest interest to an industrial space endeavor would be a knowledge of predicted cash flow. For instance, a company would be greatly interested in the break-even point in a particular industrial operation. Cash flow studies of space industrial activities have been conducted by several institutions, including General Electric, TRW, Rockwell, The Foundation Institute and NASA. Their findings are that, particularly in the area of space separation of biological materials, the payoff could be quite rapid, say breakeven in six years time.

In other industries breakeven may not occur for seven or even ten years time for the most advanced, currently considered efforts. These include solar power satellites, silicon ribbon production, crystal and special materials growth.

The advantage of space-processed materials in terms of potential market may be considerable. Materials for special purposes which could not be produced on Earth could have an immediate market. Space materials which would compete with earth-produced materials could at first be at a competitive disadvantage. But as the cost of space transportation goes down and the cost of earth-processed materials goes up the point will be reached where space materials will achieve a competitive edge over earth-produced materials.

When companies begin to realize this competitive trend in space-produced materials the real space race will begin.

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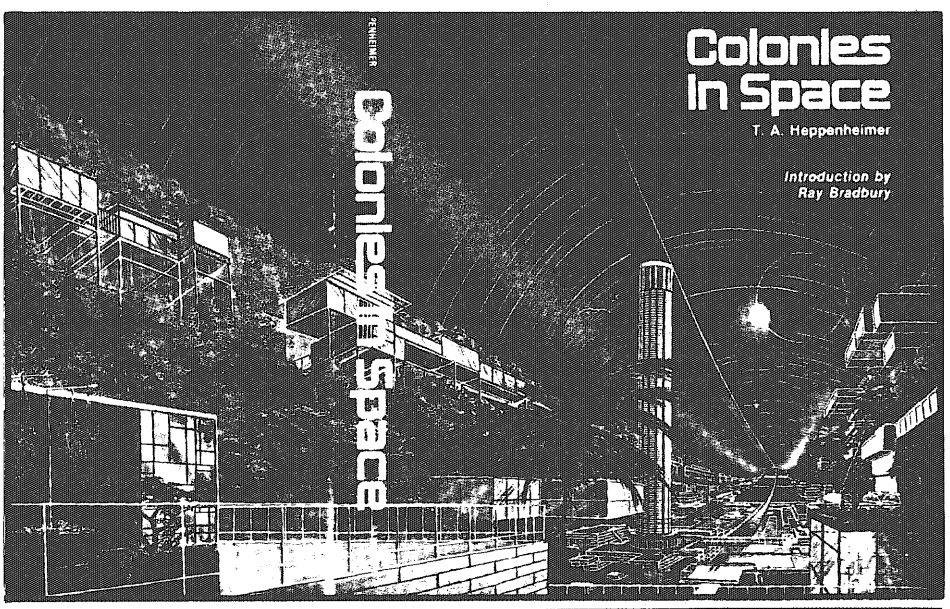
1. **Mining Outer Space**, Michael J. Gaffey & Thomas B. McCord, "Technology Review" June 1977.

For further reading:

1. **Solar Power from Satellites**, Peter Glaser, Physics Today, Feb. 1977.
2. **The Promise of the Space Factory**, Donald M. Waltz, Technology Review, May 1977

AD ASTRA!

By Bruce Kvam



We usually associate great ideas with a single man: Einstein and relativity, Newton and physics, Copernicus and astronomy. Many of these individuals were "mere" products of their environment. In making their discoveries they made the next logical step forward in the progression of science, building on what had been developed before them. But history finds it hard to pin a medal on a long line of scientists; as a result usually only one of them gets all the glory.

Such is the case with Gerard K. O'Neill, "founder" of the space colony concept. In 1969, when O'Neill first delved into the subject, there was nothing fantastically new about the idea of space colonization. What was new about O'Neill's idea was that we could, with technology available right now, put millions of people into orbit—living, working, playing, much the same as we do here on Earth.

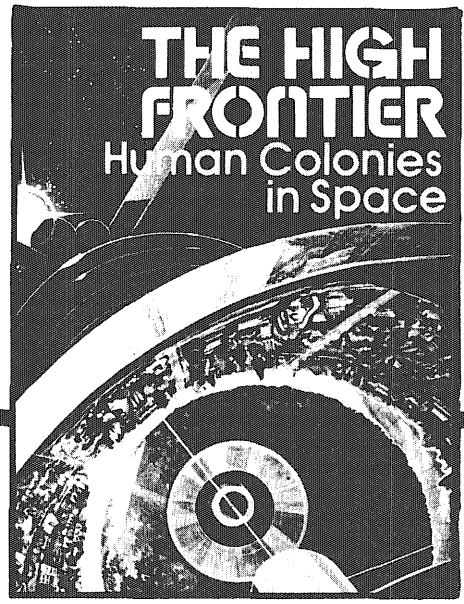
In his book, *The High Frontier,* O'Neill goes into much detail, describing what life in a space colony might be like. He outlines what steps would be necessary to establish a beachhead in space, which would produce more colonies, which would build habitats to support perhaps millions of people each.

This last colony, which O'Neill calls "Island Three," would be a cylinder 20 miles long and 4 miles in diameter, giving it an internal land area of 500 square miles. Island Three would be constructed from materials launched from the moon by "mass drivers." A mass driver would accelerate a bucket of lunar soil to lunar escape velocity and throw it toward a point in space where a large catcher's mitt-like apparatus would capture it. Since lunar soil is rich in metals such as titanium and aluminum, as well as oxygen, it would make an ideal raw material for construction in space. To provide funding for these grand ventures O'Neill would build large satellites in orbit around the Earth that would collect the sun's rays and beam their energy down to Earth (at a profit, of course) in the form of microwaves.

"We usually associate great ideas with a single man: Einstein and relativity, Newton and physics, Copernicus and astronomy...but history finds it hard to pin a medal on a long line of scientists, so usually only one of them gets all the glory."

O'Neill, who was at one time a scientist-astronaut candidate, first published his findings in *Physics Today* in 1974. Today there are national organizations—notably the L-5 Society—that avocate the colonization of space and its use in producing energy for Earth. There is a solar power satellite lobby in Congress and through their efforts the federal Department of Energy has sat up and taken a closer look at the feasibility of getting our power from space.

O'Neill is often accused of espousing a utopian dream, but he vehemently denies this. Even though is scheme might solve the temporary problems we face on Earth, such as the energy crisis, pollution, malnutrition and (eventually) overpopulation, he acknowledges the fact that people are going to be as stupid as they always have been. But he can still hope.



One might think that a space colony book appearing only a year after O'Neill's would be a vast duplication of effort, But T.A. Heppenheimer's *Colonies in Space* contains a perspective definitely different from O'Neill's. He tends toward a more long-range view, away from the immediate problems of Earth. And since the book is newer, there is some material covered that did not appear in *The High Frontier. Colonies in Space* also has color plates, whereas *The High Frontier* has only black and white illustrations.

The book starts out speculating on the existence of life in outer space, tells of our findings so far in the solar system (still very cloudy), and continues to discuss O'Neill's colonies, with power satellites and moon mining. But then Heppenheimer turns on the long-range vision with chapters entitled "The Next Million Years" and "Colonizing the Stars." He examines what the future holds for us in the neighborhood of the sun, and how we might leave it for greener pastures around other stars.

A thought-provoking book.

Colonies in Space and *The High Frontier* are general interest books and do not hold much hard, technical information. But for those of you who like punching caculators, a book entitled *Space Settlements: A Design Study,* is available from the U.S. Government Printing Office. Even if you shiver at the sight of integrals, the book may still interest you. It is mostly a verbal description of how such colonies would be built, so you can close your eyes whenever an equation pops up.

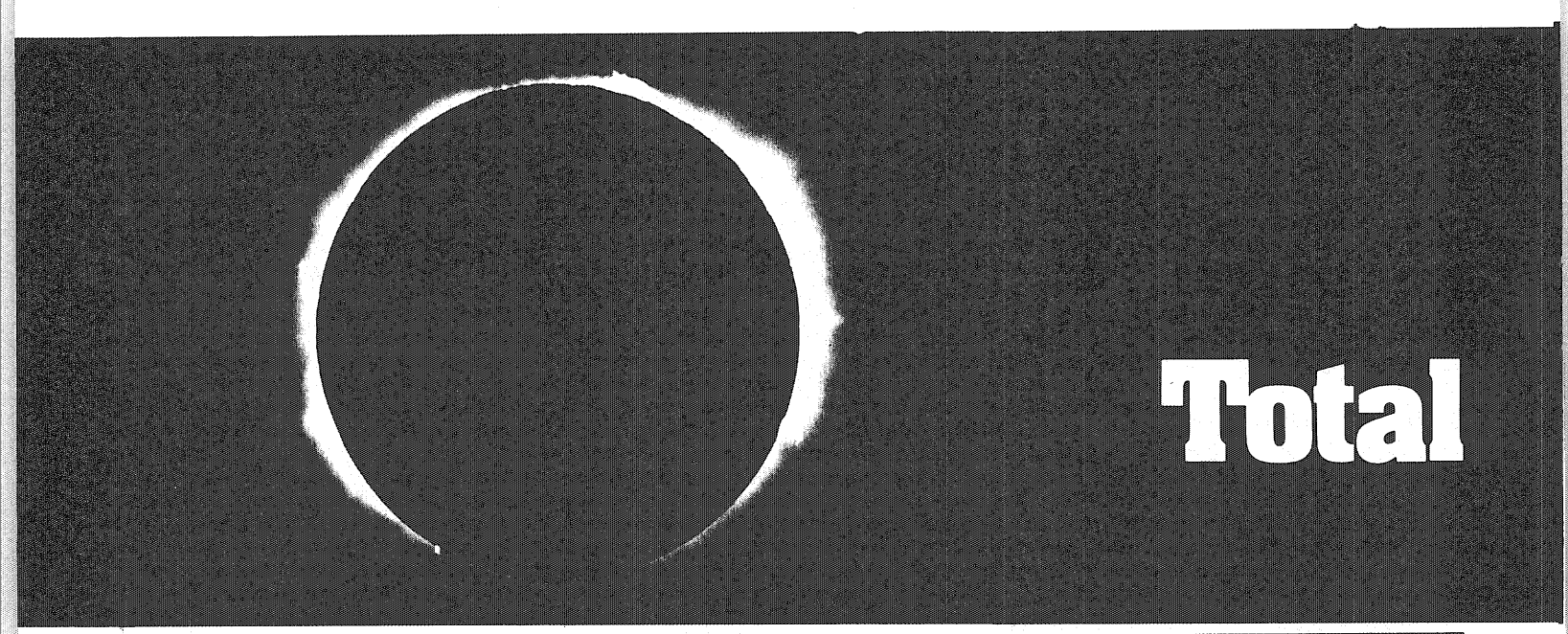
The book was produced by a summer study at Stanford University, sponsored by NASA. To get a copy, write the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. (Stock number 033-000-00669; catalog number NAS 1.21:413.)

For an even further out view of what life in space might be like, the *Handbook for Space Pioneers,* by L. Stephen Wolfe and Roy L. Wysack, provides fictional answers to most questions. Similar to pamphlets that local chambers of commerce issue, this book is a catalog of eight habitable planets, their life forms, resources, climates and histories.

Of course, the book is nothing but science fiction, unlike the O'Neill and Heppenheimer books. The planets described here are figments of the authors' imaginations and are sometimes quite weird: one of the planets has a few hundred moons, another is a member of the twin planetary system, yet another is mostly water. But they are not beyond the realm of believability...most of the time. A few things in the *Handbook* that some scientists have said, however, are flat wrong. But then, scientists aren't always right.

The *Handbook* gives orbital data for all the planets, maps of their surfaces, diagrams of the ships that will get you there, personal accounts of settlers and more. It is a curious brand of science fiction, and I can't say how such a book will fare: it's on the misty border between fact and fiction. Also, its price—a hefty $7.50—is a little forbidding.

The *Handbook* aside, these books take a serious view of a very possible prospect: the colonization of space. As we gain more experience with Earth-bound industries and energy sources (Three Mile Island foremost in mind), O'Neill's pie-in-the-sky ideas are looking more down-to-earth every day.



Total

By John Bartelt

"It's getting darker! It's getting darker!" In a moment, we were all saying it, there along the shore of frozen Lake Winnipeg. As totality approached, the surrounds took on an eerie hue, like dusk, and yet different. This is what my five companions and I had traveled more than 400 miles to see: an event that depended on the amazing coincidence of the sizes and distances of the sun and the moon.

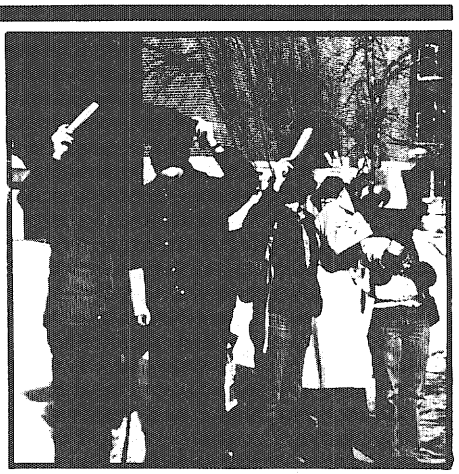
We had set out Saturday morning, Feb. 24, in a Scout and a Mustang. Several others had already decided to stay behind because of the weather forecasts. Nevertheless, the six of us went, spending most of Saturday on the road. We arrived in Winnipeg Saturday night. Sunday we relaxed, swam in the hotel's pool and watched the weather reports. The hotel was full of people there to see the eclipse. We went to bed Sunday to predictions of cloudly skies; partly cloudy was predicted for farther west; and clear up Hudson's Bay was predicted. Get an early start and head west toward Brandon, we decided.

Monday morning, at the ungodly hour of 5:30 a.m., we got up. Sleepily, I turned on the TV, to the station with continuous weather reports. Within a minute the special eclipse forecast was on. It had completely turned around! They were predicting clear skies for all of southern Manitoba. The only place that would be cloudy would be up near Hudson's Bay! Now we were wide awake and very excited.

"We wasted a day driving up there, another day driving back. We spent a lot of money for gas and rooms, and stood out in the freezing cold—all for two minutes of totality...It was worth it."

We decided to go north from Winnipeg. This would get us closer to the center line of the eclipse, giving us a little more totality. The Moon's shadow would be sweeping across the Earth's surface at well over 1,000 miles per hour, and we wanted to be in it as long as possible. We also wanted to get out of the city, because when totality came, all the street lights would come on; we wanted to see just how dark it would get.

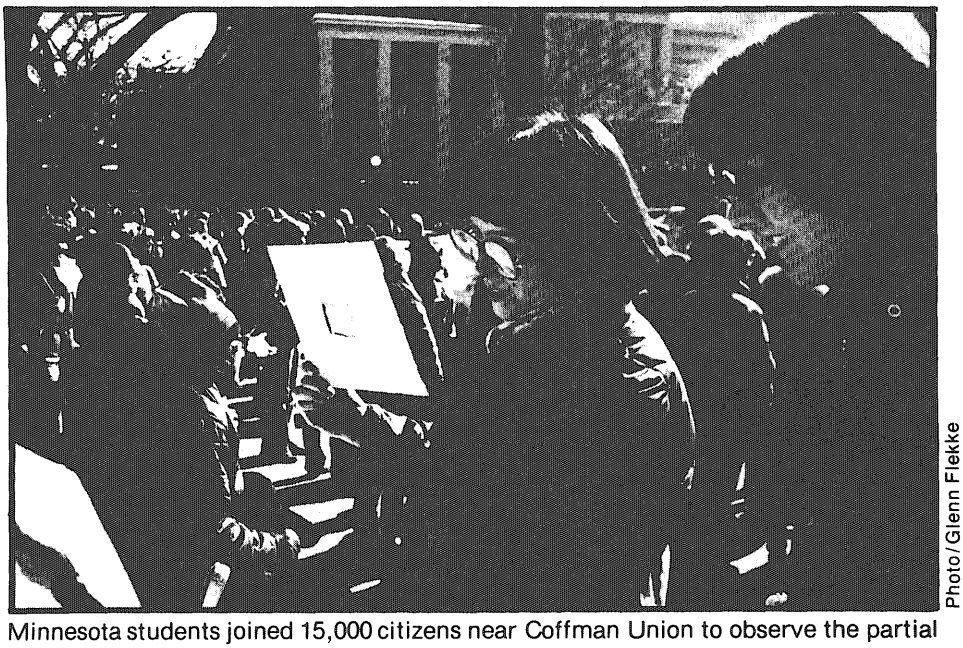
At sunrise the skies were very clear. But soon some thin cirrus—feathery clouds of ice crystals—appeared and would remain throughout the day. After breakfast, we set off north, originally toward Gimli. But we found a park and beach area in the town of Winnipeg Beach where a number of observers had already set up their cameras and telescopes on the frozen lake. We decided this would be an excellent spot and set up ourselves. By this time the partial eclipse was well underway. We had been



Photo/Glenn Flekke

While only approximately a 92 percent eclipse could be viewed from the University and southern Minnesota, these students stopped to get as much of an observation as possible, safely seen through exposed pieces of negative film.

Eclipse: the last word



Photo/Glenn Flekke

Minnesota students joined 15,000 citizens near Coffman Union to observe the partial eclipse using the traditional pin-hole camera effect.

observing it en route through darkened photographic negatives.

With less than half an hour remaining before totality, we set up our small telescope to project its image on a piece of cardboard. Then quickly—suprisingly quickly—totality was upon us. It had been immediately preceded by the diamond ring effect, seeing just a spot of sun before it finally disappears.

Once the sun was all covered only the corona, the thin outer atmosphere of the sun, was visible. Also visible to the naked eye were several prominences—huge eruptions on the sun's surface—looking very much like red tongues of flame. Cameras were clicking. We each took a look through the telescope (perfectly safe during totality) and got an even better view of the spectacle. There was a pink glow all around the horizon. Then someone said, "I think it's ending." It seemed like 30 seconds, not two and a half minutes. But he was right: another diamond ring and it was over. The moon would continue sliding to one side, mirroring the earlier partial phases, but that was anticlimatic. Some of us danced a gleeful little gig and started wondering when we could see our next eclipse.

The thin cirrus had obscured the outermost portions of the corona during the event. Out in Bow Bells, N.D., the same type of clouds were plaguing Dr. Edward Ney, from the University's Department of Astronomy. He was trying to measure the infrared emission from the corona, particularly that from the interplanetary dust in it. At some certain distance from the sun, the heat should vaporize the dust. This interior region is known as the "burn-out zone." Thus, by measuring the emission at various points near the sun, Dr. Ney hoped to find at what distance this burn-out occurs. This would tell us more about the dust, which in turn would help scientists understand more about the structure of the solar system.

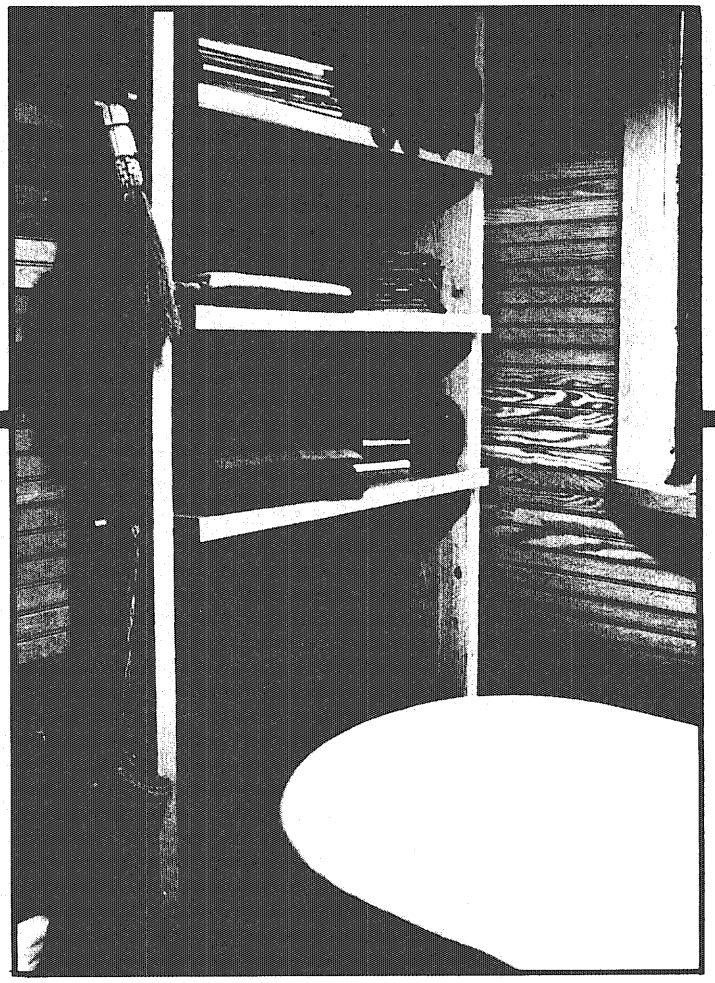
Looking at his data, Dr. Ney found a drop-off, as might be expected at the burn-out distance. But he couldn't be sure because the cirrus clouds, which are very good at absorbing infrared radiation, could produce the same effect.

"If we had had two widely separated sites, we could have been sure," Ney said. But he had been unable to obtain funding for his plans.

Still, the total eclipse was a spectacular sight. One of my traveling companions summed up my feelings: "We wasted a day driving up there, another day driving back. We spent a lot of money for gas and rooms, and stood out in the freezing cold—all for two minutes of totality. It was worth it."

The next total solar eclipse will be Feb. 16, 1980, visible from parts of Africa, India and Asia. On July 11, 1991, a total eclipse will cross Hawaii, Mexico and other areas of Central and South America. The next total eclipse visible from the 48 states will occur on Aug. 21, 2017. It will sweep through from the Pacific Northwest to the South Atlantic coast. Another one will cut across Mexico, Texas and on up through New England on April 8, 2024.

After Graduation



Photos / Dave Bissonnette

Bathroom: common materials made beautiful.

"When you are in school it seems you are constantly in pursuit of that education that is out in front of you. Then all of a sudden you are through school, but the pursuit continues. If you are to be interesting in Architecture you do not ever stop."

Daryl Hansen, Class of 1970
University of Minnesota School of Architecture

By Dave Bissonnette

Daryl Hansen, a 33 year old junior partner with The Leonard Parker Associates, a Minneapolis architecture firm, graduated from the University's School of Architecture in 1970. Since then he has been continuing his education by exposing himself to other schools of thought about architecture and life in general. Last year he won a nationwide competition for solar home design. Recently he finished renovating his home near Lake Calhoun.

Hanson feels that when you go through school, that is just the background you have to have to build on. It is that way all through life—you keep building.

Because architects work on a social level, dealing with people and behavior, Hansen said in a recent interview, "an architect has to develop a philosophy about life, about things, about where he is, about where society is." And in order to add to the field of architecture, at one point, Hansen believes, an architect has to develop some kind of philosophy which is truly a personal one.

Although Hansen has been reading several philosophers' work lately, he claims not to be a devoted follower of anyone in particular; rather, he has learned something from all of them—different ways of looking at everyday reality.

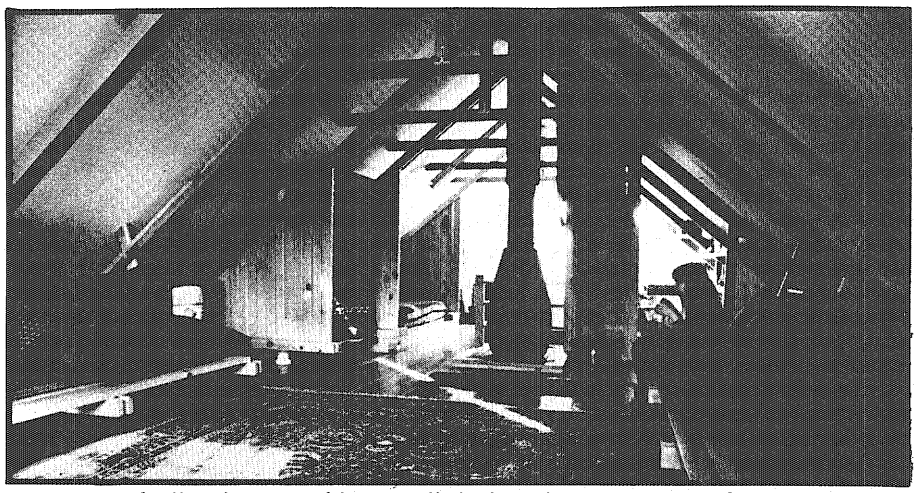
Hansen said his first year of architecture at the University was overwhelming because of all the information and work. Later, as he was exposed to other ideas and he had time to reflect, he began to develop his own philosophy.

Part of that philosophy deals with the economy of materials which is reflected in his home, lifestyle and award-winning solar home. His house, for example, is economical as well as functional, attractive and fitting to his space needs. He spent approximately $2,000 for materials on the renovation and did the labor himself.

"Why pay for expensive materials when you can use a common material in an eloquent way to serve the same purpose? It is something I really believe in."

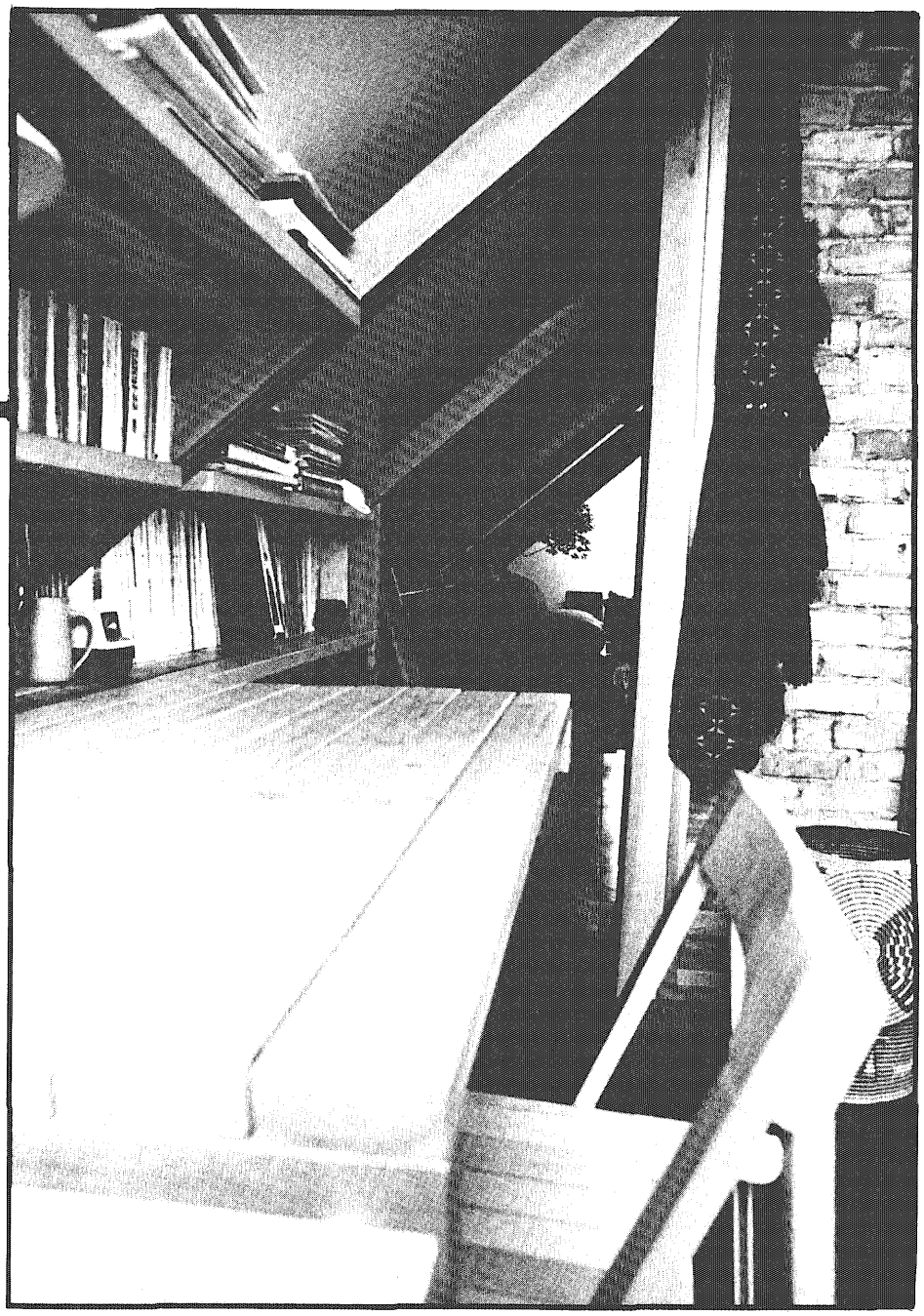
This same attitude can also be seen in his dress, musical interests and attitude toward people. It is a complete concept with him.

"People who have been additive at some point," he continued, "have done something different, something that is nonconforming. But you do not get rid of the basic old structure and architecture that easily. The way I have detailed my



A spacious feeling is created by a well-designed arrangement of two by fours in Hansen's renovated attic. Contains family, sleeping and work areas.

Darryl Hansen, Class of 1970



Desk and shelves "happen"—in tune with Hansen's philosophy—within framework of the upstairs attic.

upstairs—it has a lot of the old. In the upstairs I blended the old and the new by leaving the skeleton of the old which relates to the new framework, creating a cohesiveness between the old and new structures."

When Hansen remodeled his own house, his philosophy was applied to several aspects: "Because this is a small house, I wanted to extend the feeling of space as much as I could. The house was so compartmentalized it forced your activities to be also. When I went upstairs and saw the large, open space I liked the feeling. So considering the various uses we thought appropriate to the space and our needs, rather than close it off and partition it like the downstairs, we decided on one space. I created incidents where things could occur within it...A framework with two by fours which allow things to happen. Different things happen: seating happens, the bed happens, my desk happens, a shelf happens, partitions can float—all fitting within the framework.

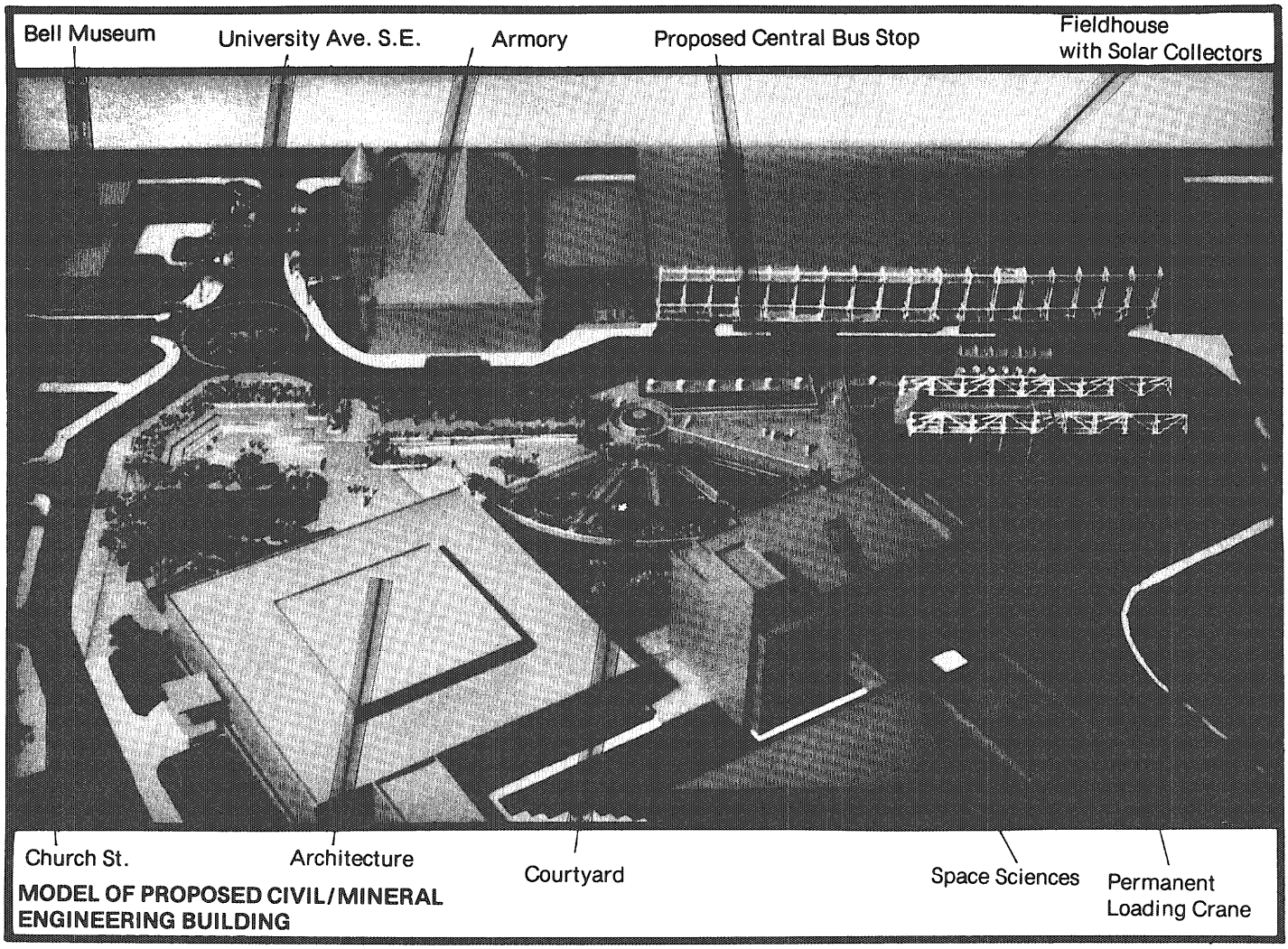
"I visually expanded the feeling of space upstairs by extending the slope of the roof all the way to the floor. Opening the floor of the upstairs to the first floor, on the south side, visually opens that area up and allows for conversion to solar heat someday. When I redid the kitchen I replaced the wall dividing the kitchen and dining room with an island and shelves, again visually expanding the feeling of space."

Hansen likes to build his own designs because he gets pleasure doing it himself. He enjoys seeing the results, working with the materials and getting to understand another process, a step beyond the architectural drawing.

Before settling into work in Minneapolis, Hansen also spent a year at the University of California—Berkeley. There he received his Masters degree in Architecture, working on a research project with Richard Bender, now Dean of the College of Environmental Design.

"Bender really influenced me," Hansen claims. In reference to Hansen's project, Bender told him to "pursue something that interests you. It doesn't matter what you do but do it well, to your own satisfaction."

And Hansen has taken the advice well, holding an influential position with a Minneapolis architecture firm, designing an award-winning solar home, renovating his own innovative home—after graduation.



MODEL OF PROPOSED CIVIL/MINERAL ENGINEERING BUILDING

Building an Education in Minnesota's Land Down Under....

By Mary Jo Hannasch

The blueprints of the future for the Civil and Mineral Engineering Department show that things are certainly looking down for the department—roughly 105 feet down. With full funding recently recommended for approval by Gov. Quie, the Civil and Mineral Engineering Department probably expect final approval and construction to begin on an innovative and exciting underground building, designed to house the faculty, classrooms, labs and department offices.

According to the building committee chairman, Lawrence E. Goodman, professor of Civil and Mineral Engineering, the building is to occupy the area just east of Architecture and north of Space Science.

The funds to plan the building and prepare contract documents—$680,000—were appropriated by the 1978 Legislature. The architecture firm of Myers and Bennett/B.R.W., of Minneapolis, was chosen by the State Designer Selection Board, the same architects who designed Williamson Hall.

When the Legislature allocated the planning funds, they simultaneously put a ceiling cost of 17.2 million dollars for the total project, which includes any costs for site preparations, tests, architects fees any other extraneous fees.

Because full funding was recommended last month, nearly a year ahead of the anticipated time, a half million dollar savings could be realized; construction may begin six months early, beating inflation to the punch for materials and labor costs.

The building will have almost 90,000 net assignable square feet, and a gross amount of 140,000 square feet. The difference between the two is accounted for by corridors, walls and elevators—all of which take space. In terms of percentages, 64 percent of the gross space will be net assignable space. This a better ratio than can be claimed of the more recently built structures at the University. An interesting comparision of space can be made with Williamson Hall which contains 83,000 gross square feet. The proposed Civil and Mineral Engineering Building will be just a little smaller than twice the size of Williamson Hall.

Part of the reason for going underground with another University building has to do with local geology. In this part of Minnesota, the first 50 feet below grade level is glacial till. Below that is

a layer of limestone spanning 30 feet. The solid limestone is the same limestone commonly used to form the foundations of most large buildings. Below this, beginning at 80 feet below grade is a layer of St. Peter sandstone. There have been earlier suggestions to exploit the deep mine space under the limestone for such things as parking garages and archives.

As part of the building, plans call for a shaft to be put through the limestone into the deep mine space below. The shaft will be the main access through the building, containing an elevator, stairs, and an open space. There will be several levels of laboratories in the deep mine space.

"We have an underground test room that was built as a part of a National Science Foundation project under Northrop Field," assured Goodman. "I was down in this deep mine space last January when the above ground temperature was -20 degrees Fahrenheit and the temperature in the room was 55. Once you get well below the surface, you do not have these large temperature changes."

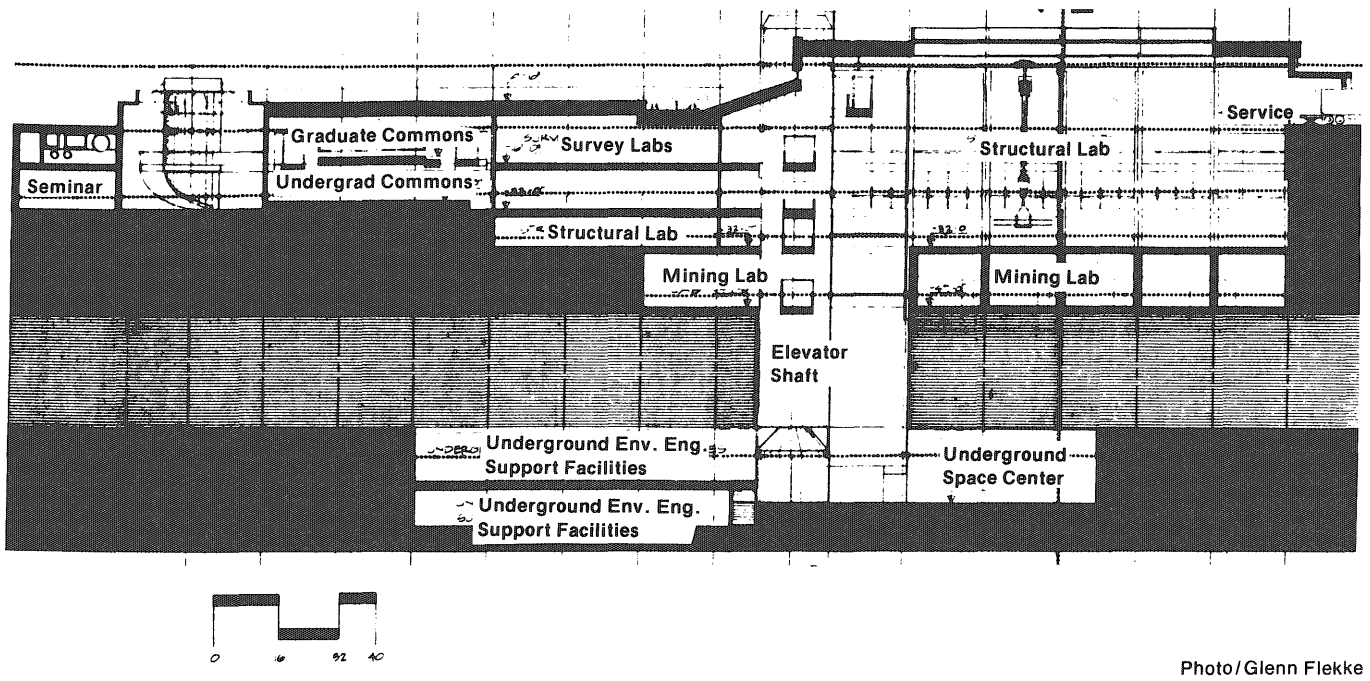
To the left of the shaft, there are three levels of classrooms. The first level, at 16 feet below grade level, will likely have connections to Architecture, Space Science, and Cooke Hall. Entrance to this level is via a circular staircase or ramp. The second level is at 22 feet below grade level, with the third level starting at 32 feet below grade level. These floors will not only hold classrooms, but they will hold facilities for the students to work on their designs, to study and to mingle with one another socially.

"We would like to restore the spirit of fellowship to the extent that it is possible," said Goodman. "It is quite important that this be an illustration of the human side of technology. We want to provide the amenities that students have at other universities, and that should be a part of a university experience."

Starting at 80 feet below grade level, there will be two levels of laboratories in the deep mine space to the left of the shaft. This area will accomodate the Underground Environmental Support Facilities. For numerous geological and cost reasons, the limestone layer of stone will not be excavated, which accounts for the large gap between the classroom levels and the two levels of laboratories. In fact the elevator will be the primary access to the lower level to bring in construction materials.

To the right of the shaft, there will be

SCHEMATIC DESIGN/CROSS SECTION



Photo/Glenn Flekke

two levels of laboratories, the first of which will be the structural lab. One of the more creative and unusual aspects of the building will be here. Sitting directly above the structural laboratory, on ground level, will be a crane. The open space in the adjoining shaft will allow the crane to lift bulky materials off trucks and down the shaft to accessible laboratories. This will allow for easier materials testing as a part of the department's teaching and research program by increasing and improving the mobility within the building system.

Beneath the structural lab will be the mining lab, down to 50 feet below grade level. Here agin, there will be a gap of 30 feet in order to bypass the limestone. The next level, which starts at 80 feet below grade level, will house the Underground Space Center.

Goodman said of the unusual layout of levels in this building: "With an underground building you are not limited to where you go or to what levels you establish. What limits you at the lower level is the Mississippi River, which sets the permanent water table. The lowest level, 105 feet below grade level, I must admit, is not very far from the water table."

Some of the precedents of construction at depth are the University heating tunnels which are as deep and reportedly they experience no trouble. To ward off water problems, associated with most underground buildings, a pump will be installed in conjunction with a connection to the storm sewer system. This would, planners hope, assure the absence of any water leakage into the building.

Brightly confident, Goodman smiled broadly when he stated, "Water as a structural problem is a little overrated."

Minnesota, being an energy dependent state, presents problems in the heating and cooling systems of any building. According to Goodman, however, an underground building, by the very nature of the design, will require about half of the heating and cooling energy of a conventional above ground building.

"With an underground building you are not limited to where you to or to what levels you establish. What limits you at the lower level is the Mississippi River, which sets the permanent water table. The lowest level, 105 feet below grade level, I must admit, is not very far from the water table."

"We currently have a request into the Department of Energy. If that funding does not materialize, the building will have a conventional heating and cooling system except that it will need only 50 percent of the energy used in an above ground building," explained Goodman. "It would work off the University heating system. We will have a trombe wall, and optical systems which will bring some natural light into the subsurface areas."

A trombe wall contains a great deal of mass that is exposed to the sunlight, and that mass can be either water or concrete. The wall is used as a means of controlling passive solar gain. The trombe wall is exposed to the sun, but because of the excessive mass, it takes so much energy to heat it up a few degrees that not much heat is received during the daytime. This trapped energy, however, is just enough to help keep the temperature during the colder periods of the night.

Professor Ray Sterling, who is an assistant professor in the Civil and Mineral Engineering Department and director of the Underground Space Center, described the wall as "a means of converting alot of heat into a small temperature rise. The size of such a wall and whether the building will actually have one is dependent on calculations which will tell the amount of solar radiation we will get during the day in relation to the total size of the building and the amount of heat that the building can take. Physically, it would be an almost vertical wall facing southward with the mass behind it."

If funding from the Department of Energy does come through, the building will be totally energy independent. This would be achieved by a unique and combination of three elements: (1) high temperature solar collectors, (2) an organic Rankin cycle turbo generator, and (3) an ice tank cooling system which is the brain child of the University's former Professor Thomas Bligh, now of Massachusetts Institute of Technology.

"The solar collectors, which would be mounted on the Field House, are the most expensive of the Rankin solar heating system," said Sterling. "We would like to use them as much as possible. For space heating in a large building like this, you must remember that the building generates a lot of heat within itself, so you only need the collectors two or three months of the year; and if you did nothing else with them they would just sit idle. By using an ice air conditioning tank—which is Professor Bligh's idea and is basically a large tank of water in which you make ice by using Minnesota's natural climate—to cool the build-

ing in the summertime we have effectively freed the solar collectors from cooling use.

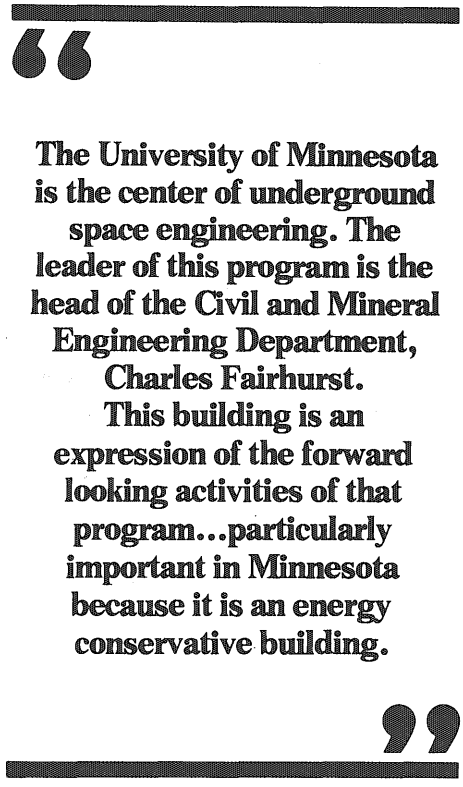
"Then we add the third component of the system, which is an organic Rankin cycle turbo generator. You put heat in, and you get electricity out by a process of compression and expansion. It is a thermodynamic cycle which is the reverse of a refridgerator cycle. This generator will be powered by the heat from the collectors when they are not space heating."

The Rankin cycle generator is now in limited use in a few places around the country. Honeywell of Minneapolis is using a slightly different system, a Rankin assisted air conditioning system.

Steve Scarborough, a project engineer whose responsibilities include work with the General Offices of Honeywell commented on the system: "We are very pleased with the sample tests we have performed. But the real question of how efficient the design is, or how the system actually functions under real life circumstances can't be answered until the cooling season starts sometime this summer.

Other complications in planning arose when the problems of an already crowded campus caused the University transit planners to consider moving the bus terminal in front of Jones Hall to just north of Architecture. This would fit into the Civil and Mineral Engineering department's plan to move Union Street north to run alongside the Armory and Field House. The broomball field, currently located on the proposed building site would be relocated.

According to many of the Civil and Mineral Engineering Department, the need for a larger building became apparent years ago. The major problem is the limited number of laboratories and their small size. They are designed to hold 12 to 15 students. In 1965, the graduating class was about 45 students.



The University of Minnesota is the center of underground space engineering. The leader of this program is the head of the Civil and Mineral Engineering Department, Charles Fairhurst. This building is an expression of the forward looking activities of that program...particularly important in Minnesota because it is an energy conservative building.

Now the graduating class is about 145 students. Meanwhile, a graduate program in Civil Engineering has been instigated, with well over 100 students in the program. This has all combined to make the space pressure on the laboratories even greater.

Graduate laboratory instruction, in soil mechanics for instance, has to be virtually set aside because of the time pressure the undergraduate courses place on the laboratories. It also eliminates any time in between scheduled labs which is ordinarily needed to set up the lab for the incoming section.

George Weaton, a research associate in the Department, not only teaches but also schedules the classes and rooms. Weaton claims that "the largest need we have is for all of our career courses to be taught in one unified building. We are currently scattered from one end of the campus to the other."

I.T. Dean Staehle, very pleased with this project, expressed his optimism about the plans: "The University of Minnesota is the center of underground space engineering. The leader of this program is the head of the Civil and Mineral Engineering Department, Charles Fairhurst. This building is an expression of the forward looking activities of that program. The building is particularly important in Minnesota because it is an energy conservative building. This furnishes a prototype not only for University buildings but also for industry as well."

Others affected by the new building share Staehle's enthusiasm. For Professor Weaton, who has worked in mining research since 1932, the idea of an underground building is most welcome. Weaton admitted that he was "just tickled about going underground again."

When asked about his thoughts on the new building Professor Michael Semmens flashed a smile and said, "Well, an underground building would certainly be a lot quieter."

Others such as Professor Walter Maier have mixed emotions about the building. "My main interest in the new building is in obtaining undergraduate laboratory space. I am not necessarily favorably inclined towards an underground building because I love the outdoors, but I'm very willing to accept the underground building in return for the needed lab space."

While certainly the students and faculty will soon be able to sun themselves (underground of course) in the glory of all kinds of new working space, every University citizen should benefit from the proposed improvements in the neighboring bus stop, added tunnel access to other buildings and a nearly park-like walkway between Minnesota's most architecturally innovative underground structures.

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SCIENCE/SCOPE

For the first time in the history of space technology, a single electronics system will perform both radar and communications functions aboard NASA's Space Shuttle Orbiter. Meshing the "eyes, ears and voice" functions into a 260-pound hardware package, results in a significant reduction in weight and space. Major components such as the transmitter, receiver, antenna and servo mechanisms perform dual roles.

As a radar, the unit searches for, acquires, tracks and delivers spatial data needed for Orbiter to effect a quick, efficient rendezvous with other space vehicles. As a communications system, it provides high-quality transmission and reception with ground stations via two relay satellites. The Ku-band subsystem will be built by Hughes for prime Space Shuttle contractor Rockwell International.

Plant engineers now can see an instant picture of energy losses during plant operations. Using a handheld infrared viewing device, they can pinpoint a wide range of energy-wasting situations—among them: steam leaks, product-flow problems, electrical overloads, components failures, machinery hotspots, cable shorts, heating/airconditioning system losses, insulation defects, chemical/thermal pollution.

The device is an industrial version of the Probeye® Infrared Viewer, originally developed and marketed by Hughes for use in law enforcement, fire detection and search-and-rescue. It senses infrared rays radiated by objects within its viewing field and converts the radiation to a red image viewable through its eyepiece. Temperature differences as small as 0.1 C. are detected and portrayed by the 7.2 lb. self-contained unit.

Hughes has free reprints available of technical papers describing important contributions in areas of research, engineering, and science. Included are the following: "Horn Structures for Integrated Optics," "High Power On-Off Switching with Crossed Field Tubes," "Aircraft Identification by Moment Invariants," and "Gravity Gradient Mapping from the Luncar Polar Orbiter—A Simulating Study." For copies or information, write to Hughes Aircraft Company, Building 100 M/S C-666, P.O. Box 90515, Los Angeles, CA 90009.

A bright, high-resolution, large screen liquid crystal projection system that can display dynamic tactical military situations in real time has been delivered to the U.S. Navy for evaluation. It can project virtually anything that can be displayed on a cathode ray tube either in raster scan or random scan mode. Typical applications include symbols, alphanumerics, geographical maps, and text. Its bright, clear display reduces requirements for specially controlled lighting during briefing sessions or command conferences.

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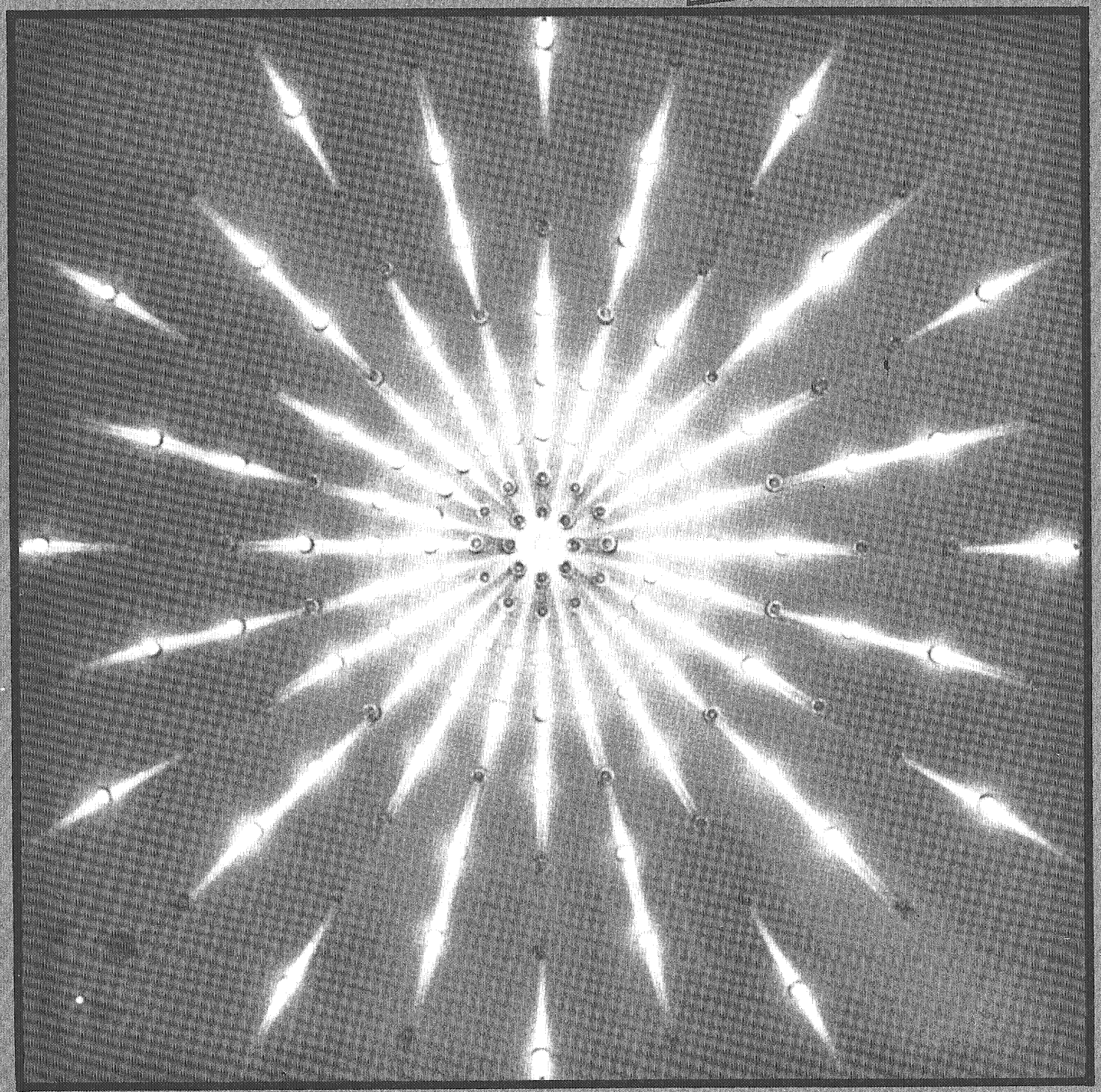
TECHNOLOG

Spring II, 1979



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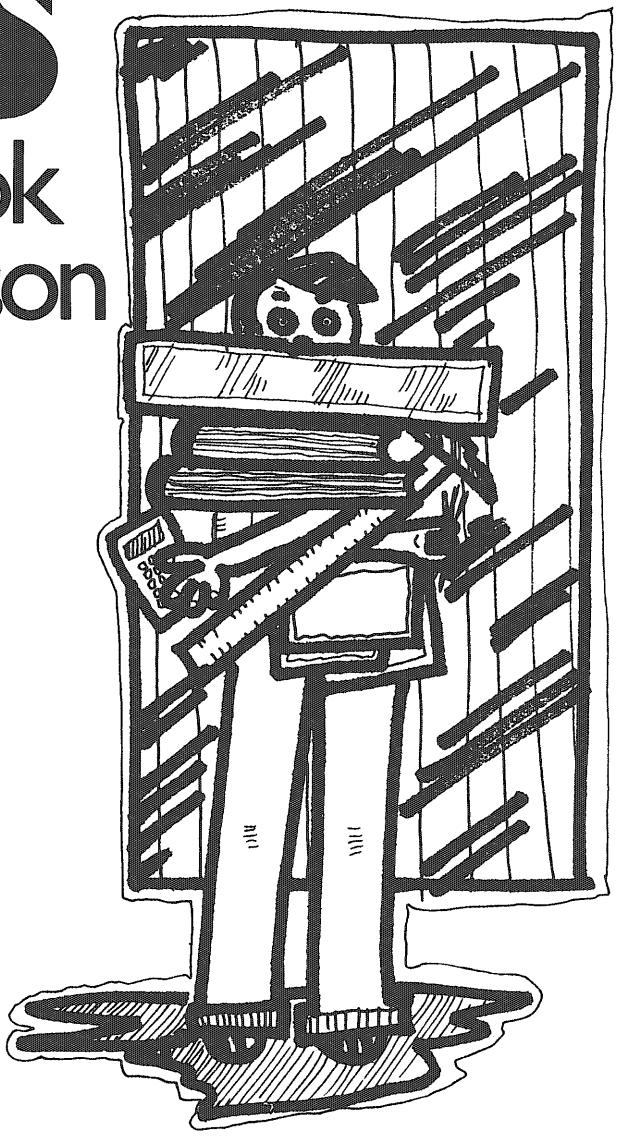

Editor's Log

At last it's SPRING.! And time to put the finishing touches on another year of publication. For many around I.T. this is a time of not only finishing touches but of change, of beginning, celebrating, of resting after a long, busy academic year.

For Dean Paul Cartwright, for instance, the end of Spring Quarter means retirement after a brilliant, productive 37 years of service to the University and I.T.. Hap Atwood summarizes Cartwrights accomplishments and aspirations for engineers and I.T. this issue.

Those close to Prof. Keith Champlin, Electrical Engineering Department, are celebrating this spring. Champlin was named I.T. Professor of the Year by students in the annual award sponsored by the I.T. Student Board. Mary Jo Hannasch spent some time with Champlin recently and tells what makes him a likely choice for the honor.

Spring in the radio industry means fierce competition as the Arbitron ratings war occurs for four weeks, April 15-May 15, to capture the largest share of the radio listening audience. Don Leeper reports this issue on some of the tactics station engineers employ to manipulate broadcast sound, to make it, they hope, more attractive to listeners, creating virtual "Loudness Wars" at times.

Graduating engineers and scientists may be faced with several problems with patents once they get involved with research, design and development of products in professional life. This issue, Bruce Kvam reports on the state of government and industrial patents and patent law and what is being done to ensure, among other things, the protection of scientific discovery and development from copying.

E-Week is no doubt a high-light of spring life around I.T. It came and went with the usual enthusiasm and flair of races, parties and a break before finals. To wrap up spring this issue, we present a photo followup of the festivities and "the way it was" with several events.

After the dust settles on the blue books this week, take time to visit the Minneapolis Institute of Arts, where until Oct. 19, 1979, a special introductory gallery showing entitled "Technology", will be maintained. The show explores the relationship of art and technology through more than one hundred years of creative work.

And for those of you who have been wondering where in the world the Bionic T.A. emanates from, don't miss Steve Smith's special "Origin of the Bionic T.A." on page 26.

Finally, this issue's Editor's Log is being written with reluctance as it is not only the last message for the school year, but also the last in this editor's career with **Technolog** after three years on staff. Beginning with the fall, 1979 issues, enthusiastic, capable Denny Sullivan will team up with editorial wizard Steven Deyo to lead next year's staff through what appears to be a year full of exciting new ideas and quality all year long.

Thanks to all who contributed ideas, time, talent and advice all year long. Special thanks to a group of individuals who rarely are recognized for their continuing support and direction through the year: Prof. John C. Clausen, adviser, and the Minnesota Technolog Board of Publications, including Wayne Asp; Stan Brooks, president; Robert Day; Nancy Gesvain; John Gutenkauf, secretary; Scott Haugdahl, treasurer; Karl Jorgenson, vice president; and Patti Peterson.

Editor

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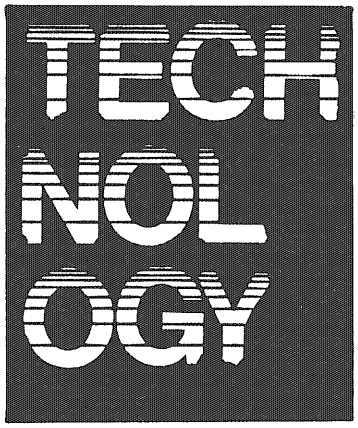

Cover photo by **Glenn Flekke**

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Log Ledger

Summer Jobs: Never to late...

Even though it may seem a little late in the year, there's still time to find a career-related job for this summer.

"I really think a technical summer job is one of the best benefits a student can have," said Lee Ponto, I.T. placement director in a recent interview about summer employment prospects. "Students can see what the industry is really like."

Ponto said the placement office hosts company recruiters each winter quarter who interview students for summer and long-term employment. The placement office also posts summer job listings all year. "We're still getting job postings. Now is the time to pay attention to them, get a resume together, and write to companies," he said.

Other references students can use are catalogs available in the placement office such as the Minnesota Directory of Manufacturers, and the College Placement Annual. Another good reference is the yellow pages under engineering. "There are a lot of engineering firms around," said Ponto. "A little bit of initiative and imagination pays off."

Ponto said a student should first develop a resume, then get together a list of about 15 or 20 companies to send it to. Each resume should be sent with a separate cover letter. In about three weeks the student should follow up his or her requests with a letter or phone call. "In this area, students have to be aggressive," he said. "If they do enough work, their odds are 50-50 in finding a job. The odds are in doing it in numbers —write to enough companies and make enough contacts."

One I.T. student, Colleen Willhite, worked as an engineering technician at 3M in Hutchinson the past two summers. "I was specifically looking for work outside the Twin Cities area," she said. "The idea was that I could live at home and work at 3M."

She explained that she wrote to the company, explained her situation, her position in terms of school completed, and what she was looking for. "Don't automatically rule out someplace. You never can tell," she added.

Willhite will begin working permanently this summer at the Hutchinson plant. "One reason companies give summer jobs is so they can get a look at students. I would say that is one of the prime motivators for companies," said Ponto.

Alison Cody, manager of employment and staffing at Pillsbury's research and development division, agreed it is a long-term goal. "We definitely do not do it to get production out. It's a learning experience. We're looking for long-term employees."

Cody said the basic qualifications they look for in a student include whether the student is in his or her junior or senior year, majoring in the field, has good academic achievement, and involvement in extra-curricular activities. She hires six to ten students for the summer in her division.

She also said they do give priority to students looking for long-term jobs who have worked for them during the summer. "They get to know a particular company, and get exposed to the industry. They become a more vaulable employee to us full-time."

Cody added that it is highly recommended by professors to get experience. "I interview very few engineers that don't have experience," she said.

—**Susan Sherry**

"A good time to be in engineering"

As of Aug. 1, 1978, 98 percent of I.T. graduates seeking jobs found one. Without a doubt, it's a good time to be in engineering.

"The demand is high. This year and last year have been the best in 20 years," said Lee Ponto, I.T. placement director. "One wonders if the demand can stay as high for a long time."

"This has also been the largest year ever for recruiting," Ponto said. "Normally we get 220 companies. This year we had 320. We already have bookings from companies for next year."

He said the placement office is presently surveying the June class. Of the 750 total graduating students (both graduates and undergraduates), 80 percent come throug the placement office to find jobs. 15-20 percent will go to graduate school, about five percent will go into the military or travel, and about 75 percent will go out with a job, Ponto said.

Because of the large amount of state industry, about 60 percent of the graduates stay in Minnesota. "I don't know if other states retain that high a number of students," Ponto said.

Students to produce first all-I.T. yearbook

By this time next year, students in I.T. will have in their hands the first edition of what Dean Roger Staehle hopes will be the beginning of a long tradition in I.T.—an all I.T. yearbook.

The idea came about as Staehle assumed the dean's office in February of this year. In speeches to students, faculty and industry prior to coming to Minnesota, Staehle stressed his commitment to improving and developing new lines of communications, especially amongst students and staff. An I.T. yearbook, it is hoped, would give students in this specialized school a better idea of activities and people who make up each special year in I.T.

The new yearbook will be largely under the direction of Lee Ponto, I.T. placement director, although it will be produced entirely by students and printed commercially. The annual will appear late spring of the 1979-80 school year.

Having a second student publication, in addition to the Technolog, would not only improve communications around I.T. but open up new creative and work opportunities for many more students than can now be accommodated by the Technolog and other university publications. Staff members of all persuasions and talents are needed, including writers, photographers, organizers, publicity people, artists, layout designers, business and advertising staff. There will be many leadership positions open as well for key editorial and graphic departments within the yearbook structure.

Ponto is also searching for an editor-in-chief to serve as the first editor and get the publication off the ground. The editor's position will be a salaried one. An I.T. student is preferred and the candidate should be able to begin work yet during the summer.

The yearbook will be partially funded from general I.T. sources. Advertising will be solicited to help meet expenses. A price for the book, which will be available separate from student services fees, is yet to be determined.

Prospective editors and students interested in working on the staff in any capacity should contact Lee Ponto at the I.T. Placement Office in 15 Experimental Engineering or call 373-2922 as soon as possible.

EDITOR'S NOTE: All of us at the Technolog are excited and enthused about the publication of an I.T. yearbook. From our own experiences in magazine production, we recognize the great opportunity for students to become involved on the ground floor of an important and creative publishing venture. The rewards are many for this type of work: publications experience, new friendships, contacts for future employment and a sense of accomplishment and input to student affairs within this specialized school. Interested students are eligible to work on both publications if they wish. We wish Lee Ponto and the new I.T. yearbook staff much success in this first step toward a new publishing tradition.

But he added that the job market is even better if a student is willing to relocate. "If a student only wants Minneapolis, the job competition is keen and it can be tough for them," he said.

Ponto feels that the placement office offers an opportunity that will never happen again—many companies in one place at the same time. Although this service is open to alumni, very rarely do they come back to interview again in the fall.

"Every year there is always a small percent that isn't placed," Ponto said. "We find that if they stay at it, the odds that they will be placed are very high. Keep looking—the jobs are there."

—**Susan Sherry**

Board names Sullivan, Deyo to lead Technolog

The Minnesota Technolog Board of Publications has named two I.T. transfer students for the top editorial and management positions of Technolog for the 1979-80 academic year.

Denny Sullivan, hired under a new management structure developed by the current editor and business manager, will serve as managing editor and assume ultimate responsibility for the day-to-day functions of the magazine. Sullivan will be completing a bachelor's degree in journalism/advertising fall quarter, when he will transfer to I.T. in the Chemical Engineering Department as a sophomore for an additional degree. Sullivan has strong business, writing, promotion, media planning and organizational background; he hopes to expand

the size of the Technolog and improve its financial status.

Steven Deyo will transfer to the Computer Science Department from the College of St. Thomas where he has earned a degree in Spanish and Theology. As assistant editor of Technolog, Deyo will be primarily responsible for developing editorial material and working with the writing staff for issues of Technolog. He has extensive writing and some teaching background; he is well-read and well-studied in many areas of science and technology.

Denny Sullivan, upon hearing of his appointment to his position, said "I'm really excited. I think this arrangement will be great...to split responsibilities of business, management and editorial work."

Because of the size and complexity of Technolog production and growing time constraints on any student editor, the proposed two-person management structure was initiated. The new plan should allow more time to be devoted to specific programs of promotion, advertising, staff organization, special projects, fundraising as well as free up the managing editor from the complete responsibilities of editorial work. The assistant editor, then, will be able to concentrate soley on working with articles, photos and staff on writing assignments, etc.

Tim Schultheis, senior in Physiology, will continue as business manager after reappointment by the Board of Publications. The Board annually selects the business manager and editor for the magazine; other staff are interviewed and hired by the managing editor and business manager.

Anyone interested in being a part of the Technolog for the 1979-80 school year should contact Denny Sullivan, Rm. 2 Mechanical Engineering, University of Minnesota, Minneapolis, MN 55455, or call 373-3298.

Get in on the ground floor.

Beginning this fall, with the 1979-80 academic year, I.T. students will publish an all-I.T. **YEARBOOK** FOR for i.t. students and staff. The production will be complete with photos, senior pictures, features, articles on activities and organizations found in and around the I.T. community—everything you want to remember—good and bad—about your 1979-80 special year in I.T.

To produce this first in a long line of I.T. yearbooks, a full staff of interested I.T. students is needed: **Writers, photographers, artists, layout designers, ad sales people, proofreaders, organizers, business and accounting people, department editors, promotion and distribution staff, clerical assistants, production aids.**

And...**WANTED:** AN EDITOR—IN—CHIEF to get the yearbook off and rolling. Prospective editor should be an I.T. student interested in working with students and staff, and be able to organize for all facets of yearbook production, beginning this summer. This is a salaried position carrying through until spring of 19780.

If you are interested in being editor or want to work on the staff of the new I.T. yearbook, contact:

Lee Ponto, placement director
Rm. 15 Experimental Engineering
University of Minnesota
Minneapolis, MN 55414

Or call 373-2922.

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To 1978-79 Issues of Technolog

LOUDNESS WARS

By Don Leeper

"It's all electronic mind control. The name of the game is to try and see how many square waves you can transmit and not sound terrible."

—Frank Martin, chief engineer
WEFM, Top-40 Chicago FM radio

"We're trying to maintain a specific acoustic environment."

—Engineer, Minnesota Public Radio

These two quotations represent the extreme philosophies in the treatment of audio in FM broadcasting. The management of the Top-40 station has spent a lot of money on electronic gadgetry that processes the audio signal drastically. At Minnesota Public Radio, a lot of money and effort has gone into making sure the signal is **not** altered in bringing it from turntable or concert hall to the listener. Most stations lie between these extremes, and process their signal to some degree.

Audio processing is essentially a commercial phenomenon. The income of a commercial radio station depends upon the number of people listening to it and what demographic group they belong to. These figures are measured by ratings surveys, and ad rates set accordingly.

If a listener has a choice between two stations which play the same music in similar formats, one station having an average signal and the other having one that "sticks out" on the dial as the listener tunes past it, the listener will tune in more often, and stay tuned in longer, to the louder signal.

Minneapolis FM broadcasters say that they do not find it necessary to go to extreme lengths to "stick out" on the band. There are reports, however, that during the recent rating period the personnel at one local FM rocker were fiddling almost daily with their signal in an attempt to garner more ratings points.

In cities where there are more stations in head to head competition, "loudness wars" may erupt. Such wars are old hat in AM broadcasting. In Houston, in 1976 and '77, FM Top-40 stations borrowed tactics from their AM cousins and, goosing their signals to the limit, waged an all-out battle for ratings.

Since the Federal Communications Commission allows only 100 percent modulation and no more, being loud in FM means compressing as much RMS energy as possible into the channel. This is done with automatic gain controls which bring the level up or down to keep it constantly loud, limiters that keep fast rise time events from causing overmodulation, and usually a protection clipper that clips off any possible overmodulation-causing events before transmission.

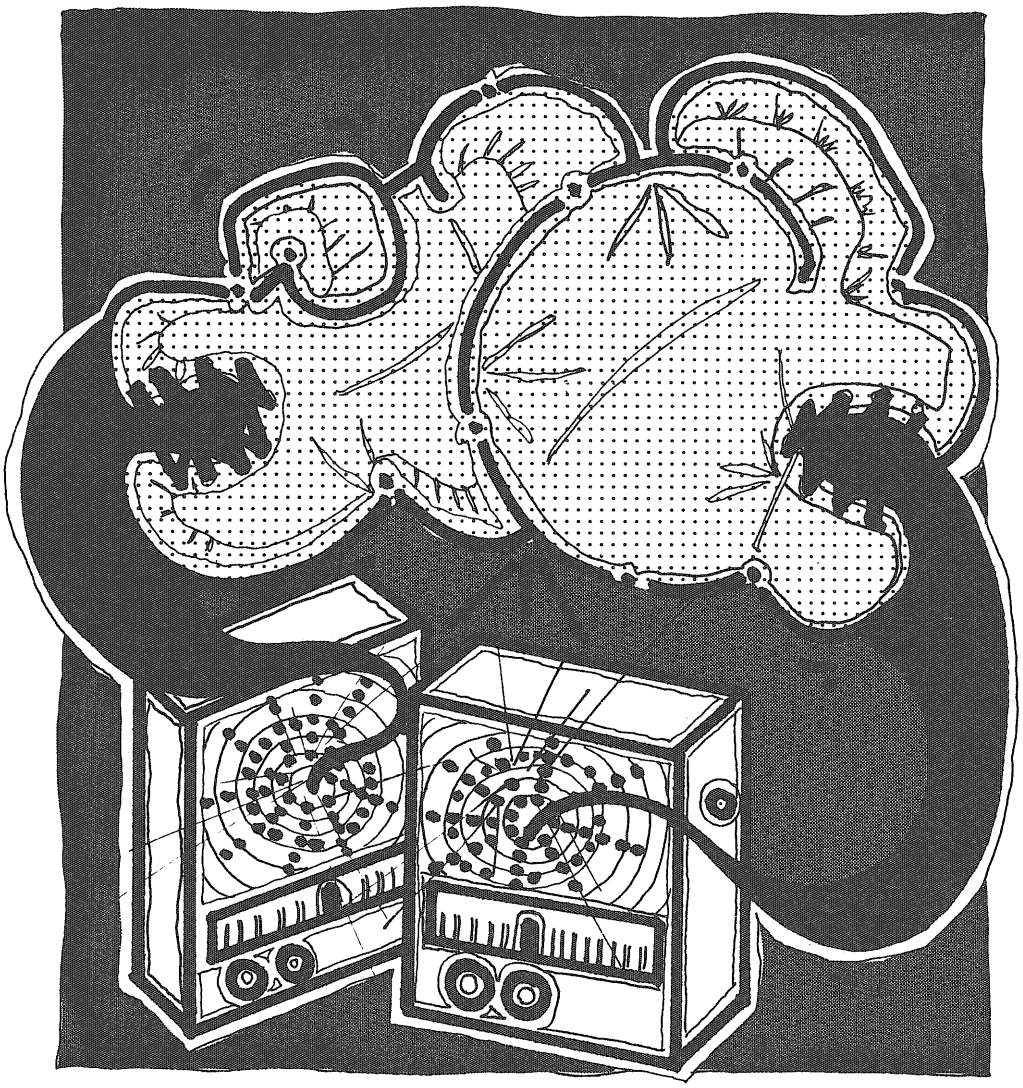
The price for all of this is distortion. According to one engineer, this may reach 15 percent at some frequencies. Eventually the distortion induced by processing may begin to work against the broadcaster. People working in the "beautiful music" format found that people would tune out heavily processed stations after a short period of time. The distortion was literally causing fatigue in the listener. The music became more like noise than music, more an irritant than a pleasure.

In keeping the level constant, audio processing reduces the difference between the loud and soft parts of a recording. Maintaining this difference, the dynamic range, is essential to high fidelity reproduction. With classical music, where the dynamic range can be great, such compression is disastrous. Popular music, which usually has a far less dynamic range, suffers less.

Every piece of equipment colors the sound in its own distinctive way. Often evaluation of this coloration is a matter of personal taste. There is general agreement, however, about the effect of some kinds of equipment. It is generally conceded that broadcast cartridge tape machines are inferior in fidelity to turntables. "Cart" machines are used universally for short pieces of material like commercials and station identifications, and by many stations for music. The frequency response of these machines extends to about 13KHz on the high end, whereas the response of a turntable easily exceeds the limitations of the FM system, which rolls off around 15KHz. Carts also produce tape hiss, which is audible on at least one local station during quiet moments in the program.

The 15 KHz rolloff in FM is actually an artificial limit. FM could, technically speaking, broadcast material to the limits of human hearing up to 20 KHz. When FM was fir conceived, however, the people who devised the standards had no idea that home stereo equipment would develop to the sophisticated degree that it has.

When FM stereo broadcasting was introduced, it was designed so that it would not make obsolete all the mono receivers already in use. Part of the resulting design is a 19KHz stereo pilot signal, which allows the combined left and right channels in the transmitted signal to be separated by the receiver. This pilot has to be protected from stray program material. To do this the stereo



generator, which is the device that combines the stereo channels before transmission, is equipped with filters that pass only material below around 15KHz. Thus the only material being broadcast above that frequency within the audible range is the 19KHz pilot.

Another aspect of the original FM standards which causes problems is pre-emphasis, where circuits jack up the high frequency parts of the signal before transmission. Complementary de-emphasis circuits in receivers jack them back down. The purpose is to reduce noise. These circuits have no problems dealing with sine waves. However, program material is made up of all kinds of waves, including square and triangle. Square waves present a special problem. Each normally consists of an infinite sum of sinusoids of increasing frequency and decreasing amplitude. Pre-emphasis distorts the correct amplitude ratios by accentuating the higher-frequency components. The result is a spike on the square wave. These spikes can peak at a level up to 35 percent over the average level of the signal. In order to prevent overmodulation caused by the spike, the overall level must be reduced. This reduction may be to as little as 60 percent of modulation.

A few years ago a company called Orban developed a circuit using a series of digitally derived filters, each of which gave pre-emphasis to a bit of the signal. This circuit took care of the spiking problem. Modulation could now come closer to the 100 percent limit, with a resulting increase in loudness. Installed in a combination compressor, limiter and stereo generator called the Optimod, it created a revolution in FM audio processing.

As of 1977 half the FM stations in Houston were using Optimods. Right now KQRS-FM and all its sister stations in the Hudson chain use Optimods. KSTP-FM and the rest of the Hubbard FM stations also use Optimods. KSJN even tried one out for awhile for news broadcasts.

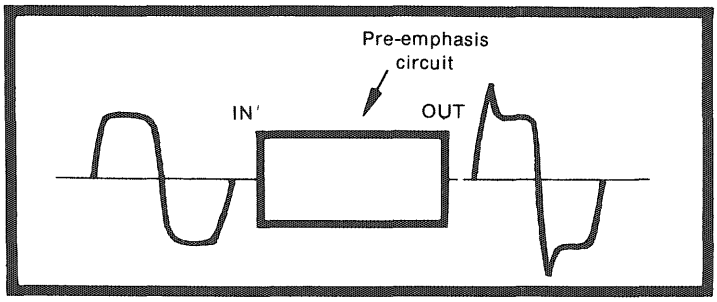
Since the introduction of the Optimod competitors have brought out gear that performs similarly. According to both George Werl, chief engineer at KQRS, and Neil Swanson, chief at KSTP, nothing they've tried has improved on the Optimod.

Not everybody in commercial radio thinks Optimods are the ideal processor. Frank Martin, the chief engineer from Chicago's WEFM, quoted at the beginning of the story, says that newer developments have improved upon the Optimod's performance.

Martin was brought from the hotly competitive Houston market a year and a half ago to convert an aged commercial classical station to Top-40. For the first year he used a device called a Dorrough Discriminate Audio Processor. Recently he's installed a new type of processor, made by Circuit Research Labs of Phoenix, which makes assymmetrical audio signals symmetrical. By making them easier to process this allows a three to five dB gain. His installation is one of four in the country using this device.

Martin also uses a "composite clipper." This clipper makes the FM signal look like square waves.

Besides making the signal stick out, he has another competitive trick up his sleeve. He refers to it as "psycho-acoustical programming." It's a piece of hardware called an Aphex. The Aphex is said to do amazing things with vocals. In



Pre-emphasis circuit reads fast-time event (square wave) as high frequency material, causing spikes.

their ads the Aphex people claim that Linda Ronstadt, Jackson Browne and James Taylor will neither record nor perform without an Aphex.

Apparently it does two things: One, to split the band and shift the two halves slightly out of phase. The other is to eliminate the odd harmonics of the main fundamental frequencies. This has an effect because odd harmonics aren't pleasing to the human ear, while even ones are.

Minnesota Public Radio is the best local example of a station that takes the opposite tack on processing. Their compressor-limiter, made by Rupert Neve of England, is set at minimum compression to maintain the maximum dynamic range. They make concert recordings generally without added equalization. Occasionally an adverse acoustic situation will require some equalization or a touch of artificial reverberation.

Minnesota Public Radio uses the Dolby noise reduction system in both its forms. Dolby A is used in relaying of programs from remote locations such as Orchestra Hall to the studio. Dolby B is used in all regular broadcasts.

The reasons for the different ways stations treat audio can be found in their differing listenership and programming. MPR's classical music demands a more conservative approach than Top-40 material. Top-40's biggest audience listens to the radio in their cars, where low passages tend to get buried in the ambient noise of the road unless they're boosted.

Minnesota Public Radio listeners, on the other hand, generally listen on home stereo systems. They are also often audiophiles. Tim Metzger, KSJN chief engineer, says he gets three to four inquiries a week from listeners on technical matters. An audience like this is demanding, but it is also willing to give direct support to a station that provides the kind of programming and audio that MPR provides.

Photo/Mike Dorn

E-Week '79

By Hap Atwood

Time was getting short. After weeks of planning, designing, testing and redesigning, the time had come for them to unveil their inventions before the judges and the public.

Wed., May 2, 1:00 p.m. The competitors huddled around the judges in the middle of the testing grounds to make sure they rules were understood by all.

"Contestants will get two throws," said Ron Ricci, a Plum Bob member and coordinator of the event. "The first throw will be for duration, the other throw for accuracy."

The competitors trudged slowly up the steps to the "flight deck." The bravest of them stepped forward to the railing, the judges stood motionless with their stop watches poised. The brave one lifted his invention delicately and released it! The Paper Airplane Contest for E-Week '79 was underway!

The airplane designs were, as in past years, many and varied. Of the 15 or so participants, there were as many different designs. The conventional "swept-wing" type was well represented as were those of the short, stubby variety.

Sizes ranged from a five-inch mini glider to a three foot by four foot wood and cardboard monster tossed by a bystander. The rules stated that each entry had to be made with standard 8½ by 11 piece of paper which could be glued or stapled into any shape.

One by one the contestants tried their luck, with varying success. One small plane, once launched, did lazy spirals until it came to rest in a trash can. Others curved left and curved right, while still others went straight down.

Launch techniques varied also. Some,

going for duration, gently let go of their plane with hardly a push at all. Others, trying for the longest distance, threw their planes like baseball pitchers.

Two Aerospace Engineering students, fittingly, walked away with the top honors. Nick Hein, a junior, won the duration contest with a time aloft of 11 seconds. Hein used a design that resembled real gliders, a long wingspan and a pencil thin body. Jim Nelson won first prize in the distance category with a throw from one end of the Architecture Court to the other. Nelson opted for the "swept-wing" style of plane presumably to cut down on wind resistance.

For the other contestants, however, it was "back to the ol' drawing board" until next year.

By Jon Kavanaugh

For the thousands who lined the streets to watch E-Day races or for those who participated in E-Week events, the annual celebration was more than a last hurrah before finals and papers would be due. The winter of '79, which never seemed to let go its grasp with temperature or precipitation, made E-Week a time to celebrate green leaves as well as a green shamrock hidden somewhere on the I.T. campus; a time to celebrate sunshine—even worship it—not just honor St. Patrick, the patron saint of engineers; a time to throw barbs at old man winter, not just at those "damned foresters" who sometimes get in the way of E-Week celebrations.

Annual events pulled off nearly without a hitch, except for some confusion about date and time for the Airplane race. Sponsored by Plumb Bob members, the week-long festivities included bed races, tricycle races (Golden Gopher even took a turn), wheelbarrel races, and sports competition.

While E-Day, Fri., May 4, didn't bring the best weather to ring in spring, the crowds were out on Church St. at least until the traditional E-Day picnic, when threatening skies forced it to be moved to Architecture Court where mass quantities of junk food was consumed and awards were presented. Prof. Keith Champlin was on hand to receive applause and a special award as I.T. Professor of the Year, presented by the I.T. Student Board.

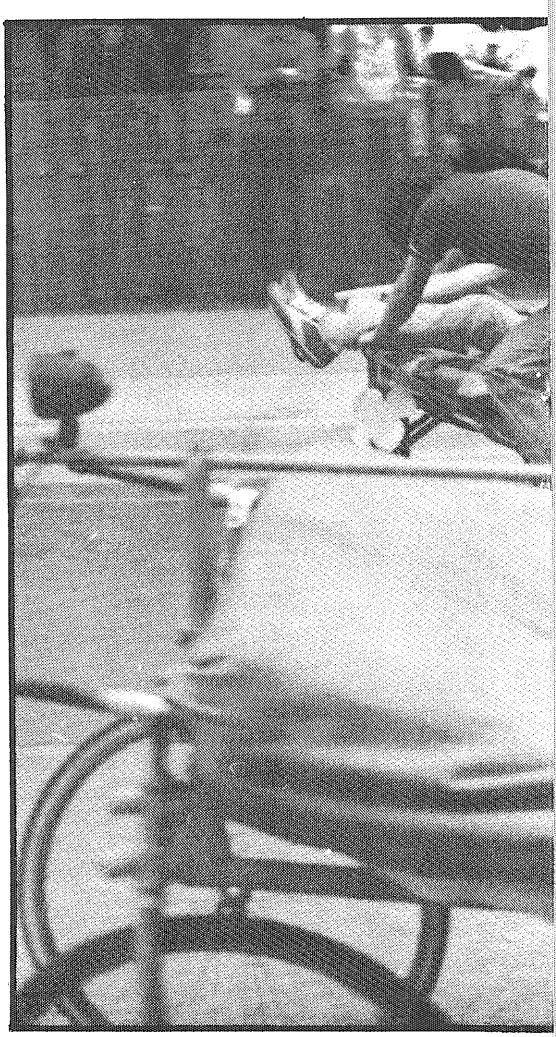
Photo/Mike Dorn

Golden Gopher appeared to try the tricycle race and give an E-Week thumbs up salute to students lined up to watch races on Church St.

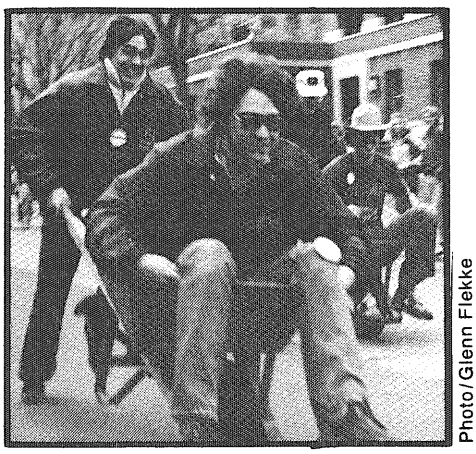
Throughout E-Week, students were kept informed about events by this years **Blarney's Castle.** Through new cooperation between Plumb Bob organization and **Technolog,** the publication received a facelift to the tune of professional typesetting and improved graphics for the five-day publishing schedule.

And if anyone was worried about the invasion of foresters from the St. Paul campus, who usually appear to mess up E-Day and harrass **Technolog** cartoonists, Captain Carrot (A.K.A. Stan Brooks), was on hand with forester detector and laser gun to protect the masses from eternal chipboard disease and other ailments.

On top of it all you could even profess allegiance to being an engineer by purchasing a tee shirt which said something like "Do I.T. With An Engineer." Bionic T.A. fans got a chance to wear



Avoiding spills and collisions in the fiercely competitive bed

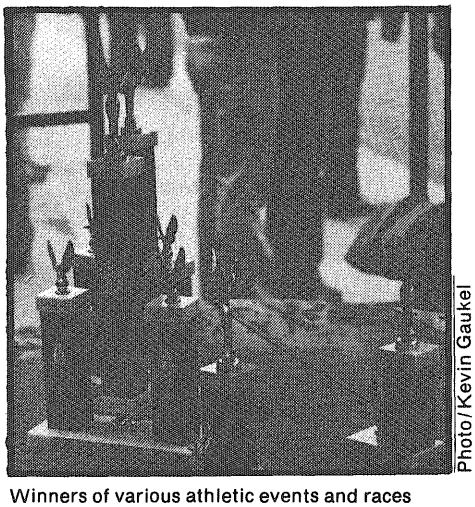


Photo/Glenn Flekke

Two I.T. students bear down toward victory in the wheelbarrel race.

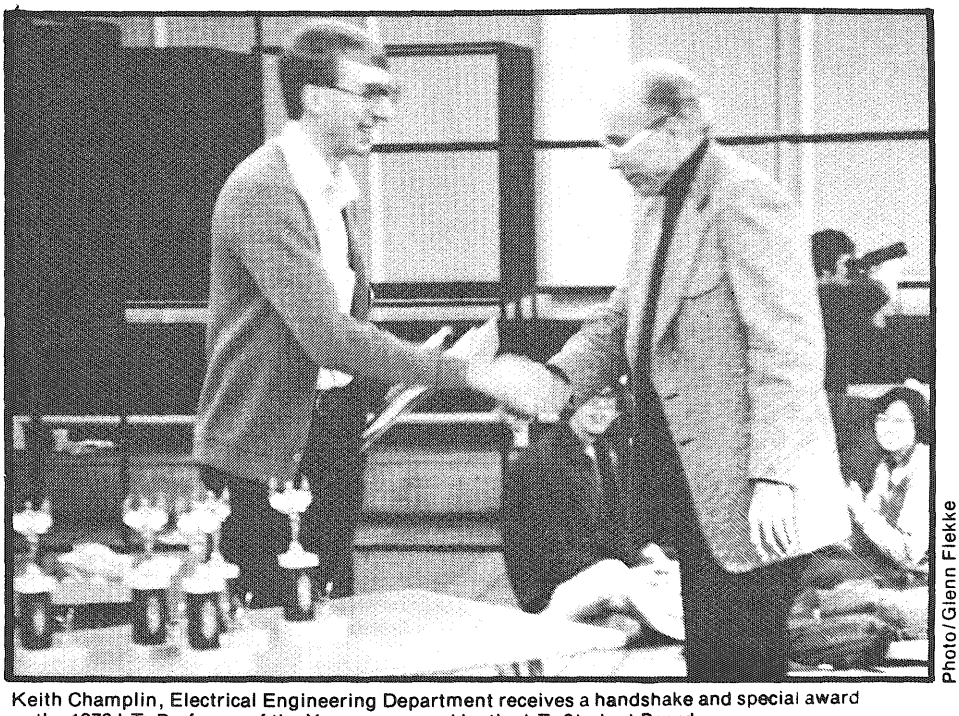
Photo/Mike Dorn

race highlights this perrennial challenge heading North on Church St.



Photo/Kevin Gaukel

Winners of various athletic events and races received trophies for their efforts, presented by Plumb Bob members.



Photo/Glenn Flekke

Keith Champlin, Electrical Engineering Department receives a handshake and special award as the 1979 I.T. Professor of the Year, sponsored by the I.T. Student Board.

their allegiance to the crazy truth seeker, too.

When it was all over, hog dogs had disappeared, many felt a reality attack after missing canceled classes for three quarters of a day; then it was back to work, books, or to cap off a more relaxing week than usual with a beer or two, or three, or.....

Whatever Happened to Good Old

By Bruce Kvam

With a history filled with such names as Edison, Ford and Bell, it seems strange that America should worry about its lead in the technological arena. Americans have **always** been at the forefront of innovation. But in recent years technology watchers have grown more and more anxious about the on America in fields like electronics, steel production and automobile manufacturing, and in some cases have surpassed the industrial giant.

What has caused this technological inferiority complex? There are no pat answers, just a few indications.

Fact: From 1961 to 1976 the proportion of U.S. patents granted to foreigners climbed from 17 percent to 35.3 percent.

Fact: America's Gross National Product (GNP) rose 120 percent from 1965 to 1976, but research and development (R&D) went up only 75 percent over the same period.

Do these numbers represent an adequate gauge of that unmeasurable quantity known as creativity? No one can truthfully say. But it is obvious that foreigners are encroaching on sacred American ground.

The reasons for this decline—though it's more of a lack of progress than a decline—are not at all clear. The reasons most people point to—lack of investment capital, timid corporate leaders, high taxes, the threat of recession and depression—have more to do with economics than creativity. On that stage, the two most popular villains are, of course, big business and big government.

G. Willard Fornell, patent administrator for the University attorney's office, outlines the problem in terms of risk.

New companies usually start out small. They have a new idea for a new product, a small backbone of enthusiastic engineers and management that is behind the venture 100 percent. A small company can be more flexible, more competitive; it can grow faster, it thrives on innovation. It is a high-risk venture.

Big corporations, however, are dependent on their current marketing base rather than innovation. Based on past experience, a company will estimate that a new product in a new market has a one in twenty chance of success, while an old product in an old market (say a 'new' toaster) has an almost one in one chance of selling well. From a large corporate point of view, therefore, the money is in the old standards; new products are far riskier. Even though the potential profit is far higher, the guaranteed profit isn't there. A large corporation must show its stock holders a good profit margin; it can't afford to take chances, while a small company is born amidst risk.

If a large corporation does decide to get into a new field, more often than not it will buy up a small company already engaged in research, rather than start their own. Targets are set for the new subsidiary and the same marketing techniques are used. Again, the emphasis shifts away from creativity to market expertise.

Corporations are quick to shift the blame for all of this to the government. They complain of high taxes, overly strict regulations and antitrust laws that forbid them to pool their resources with other companies on expensive projects. Corporations feel that the government is treating them as adversaries, playing them off against the people of the United States.

But this is not the case in other countries. For example, ties between Japanese government and industry are so close that the term "Japan, Incorporated" has been coined to describe the intimate cooperation present there. In fact, the Japanese government has committed 72 billion yen ($380 million) to a VLSI (very large scale integration) program that would give Japanese industry a tremendous advantage over American industry. Under the agreement five companies have received tax-free loans as well as a centralized directing organization.

Thus U.S. firms have lodged complaints of unfair competition against Japan on several counts: government subsidies, higher Japanese import tariffs and one-way flow of information from the U.S. to Japan.

The close cooperation seems to stem from the realization that Japan must export to survive, because it has so few resources to begin with. This acknowledged, Japan will keep on with these policies, much to the dismay of Americans who watch the dollar plummet and the yen soar.

Other factors hamper U.S. innovation as well, Fornell points out. The rights to any patents resulting from research done under government funding automatically revert to the government. Unfortunately much of this research is never used (thus never benefitting the economy), because the government just sits on the patents.

Or worse. Frequently the government grants non-exclusive patent licenses. This gives a company the right to use the patent, but since it is non-exclusive another company may be able to obtain such rights. If the first company goes ahead and tries to market a product using the patent, the product must be subjected to months or years of development and testing to ensure safety and reliability. Often this development cost runs into the millions of dollars, and after the investment has been made, the second company can just copy the first company's design. Since the patent is non-exclusive, there isn't much the injured company can do. Government

American Know-How?

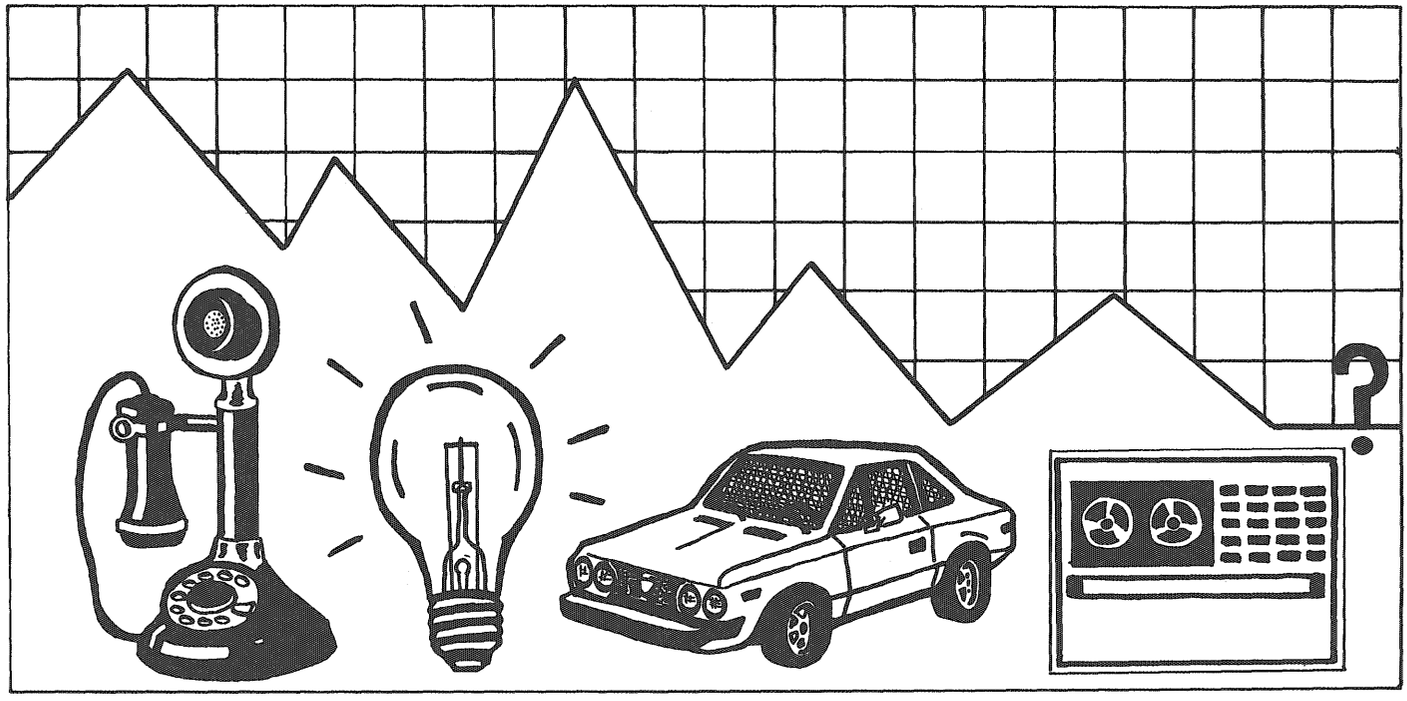


Illustration / Bruce Hannum

patents, as a result, aren't very lucrative prospects.

Not everything on the technological horizon is black. In an article in **Science**, writer Deborah Shapley tells of a trend in the electronics industry to abandon the patent process. The rationale behind the move is quite simple: If a company applies for a patent, the competition gets a chance to see what the company is doing. In the fast-moving field of electronics an idea can be completely outmoded in the time it takes to obtain a patent.

Patents themselves aren't all that expensive to procure, but proving in court that they have been infringed upon is expensive and often quite difficult. Also, the industry feels that the patent process provides inadequate protection of 'industrial know-how.'

To protect their secrets some companies have begun to encase their circuits in epoxy resin, or sand the serial numbers off components to deter the competition from divining their inner workings. It seems a pity that such tactics must be resorted to, but the patent process just doesn't meet the needs of the electronics industry.

One very simple explanation for the apparent increase in foreign innovation may be that foreigners want the protection an American patent affords them when they export their products here. Judging by the trade deficit the U.S. has been experiencing the past few years, this could be a very significant factor.

But, alas, there is no explanation for the very real decline in R&D expenditure in America. As of late there has been some increase, what with the oil shortage/ non-shortage/ rip-off/ crisis/ boondoggle, but these are half-hearted efforts with little emphasis on truly new sources of energy such as solar power and nuclear fusion. Most of the dollars pumped into energy research are being funneled into coal and oil research, which are old-hat and doomed in the long run anyhow.

Two things would strengthen a sagging Yanke industry: a more stable economy which encourages long-term investment rather than sure-fire same-old-thing quick-buck schemes; a stronger basic R&D foundation. If our fund of basic knowledge runs dry, there will be no place for new inventions to develop.

Two bills before Congress may help the situation somewhat. The Uniform Patent Procedure (S414 and HR2414) would allow individuals and universities exclusive rights to patents developed by them under government-sponsored research. In the Senate it enjoys bipartisan sponsorship, its supporters including such diverse men as Birch Bayh and Robert Dole. Its chances of passing appear good. But as long as government and industry sit around exchanging accusations, Americans are going to keep on buying German cars and Japanese stereos.

Technology As Art

There seems to be little doubt among creative, thinking people that technology has come a long way in the last 150 years. But the relationship technology has had on the world of fine and commercial arts and photography is a little less obvious. Nonetheless, the tools and materials artists use have been developed and refined by engineers and scientists, using appropriate technology and need as a base to work from. As the tools of the artist developed, so have artists and photographers, to create new forms and institute new approaches to solve design problems.

To help illustrate the magnitude of this relationship, the **Technology** exhibition in the Introductory Gallery at the Minneapolis Institute of Arts has been assembled from loan and permanent collection pieces of photography, painting, sculpture, artifacts and printmaking. The exhibition will continue through Oct. 21, 1979.

Technology as related to art showed its earliest influences in the medium of photography. Since 1826 when Joseph Nicephore Niece successfully recorded the first permanent image on a light-sensitive surface, photography equipment and techniques have been created, modified and evolved into the most sophisticated medium from early portraiture and documentary photography to the medium it is today. High quality images are captured through sophisticated lenses, lighting and illusive techniques. They are then made visually more appealing through use of papers and processing and enlarging equipment.

Painting has developed along similar lines althoug not as quickly nor as exotically. The exhibition's painting, **Frank,** by Chuck Close, illustrates the illusion of depth and focus beyond the limits of human sight as he transfers a photographic image onto canvas via a grid system. Because the original photograph only focuses on a small part of the image, Close has recreated the out-of-focus effect by applying black ink with an air brush. Highlights and white areas are achieved by removing some of the black with razor blades, hand drills and erasers.

Like Chuck Close, Jerry Ott works from black and white photographs, preferring to transfer the image by using advanced air brush equipment. He achieves remarkable color likenesses.

Science and technology has also affected contemporary printmaking in a big way. An important aspect of the medium is the addition, as with sculpture, of skilled craftsmen to manufacture a portion of what the artist may not hae the technical expertise to accomplish. The lithography process of printmaking dates back to 1798, using simple flat stones and the concept that water repells oil in preparing and transfering images from greased stone to fine paper. Today, nearly ever magazine is printed by offset lithography method using high-speed presses and employing virtually the same water/oil (ink) principle. For fine artists, however, prints, posters and graphics as means of expression have been accelerated with the help of the 1960s pop movement, making lithography a process used heavily by contemporary artists for mass appeal images.

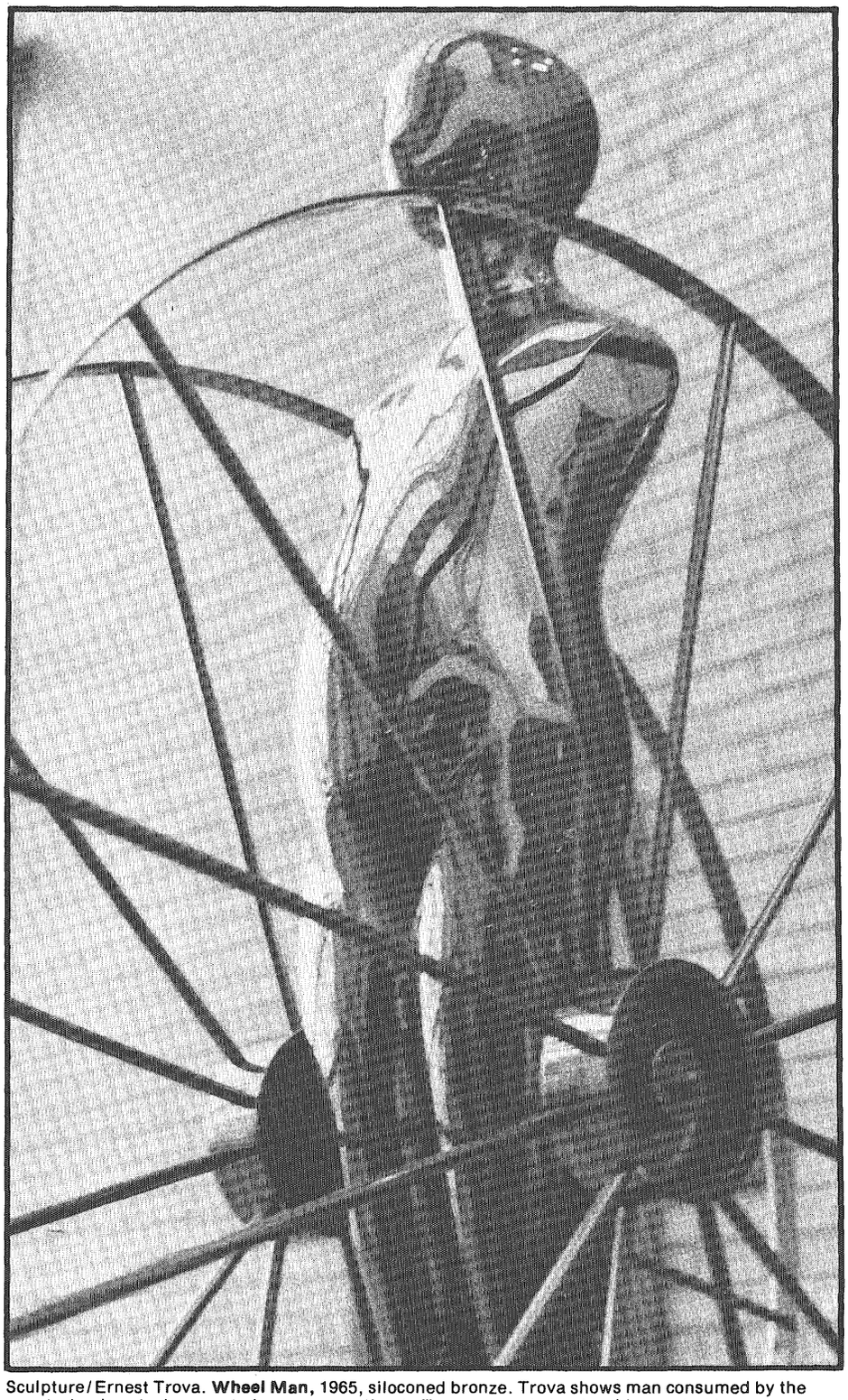
Serigraphy, another printmaking process, essentially uses a sophistocated stencil technique where pigment is forced onto paper through a silk screen stretched over a wooden frame. All areas except those to be printed have been masked with stencil material. The ink simply leaks through to the paper for reproduction. Photography has been combined as well to accomplish dramatic color images through photographic stenciling. The new technology of serigraphy also employs new foils, plastics and fluids, allowing for more creative control by the artist.

Photo/Glenn Flekke

Painting/Chuck Close. **Frank,** 1969. Acrylic on canvas. Close work from an 8 x 10 black and white photograph proportionally transferred to the canvas using a grid pattern. But a camera only focuses on a specific area, so Close repoduces the out-of-focus effect to show the viewer something the human eye cannot physically accomplish. The image was created using only black ink for positive imagery; Close scrapes away part of the ink to achieve highlights, using razor blades, erasers and an electric drill.

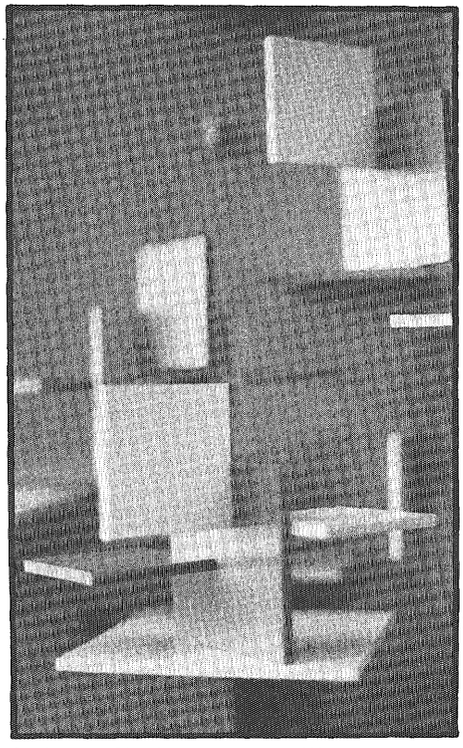
For contemporary sculptors, technology opens doors every day to new materials, electronics and factory-produced art pieces which require skilled craftsmen to render the finished pieces for the artist. Charles Biederman's **Work #27, Red Wing,** utilizes painted aluminum rectangles, pre-cut and painted according to the artist's specifications. Biederman then returns to add glossy color and mount the rectangles to the permanent backboard.

In his innovative sculpture, **Ice Bag,** Claes Oldenburg uses factory engineering and workmanship to render his design. Seemingly sensitive to approaching onlookers the bag inflates automatic-



Photo/Jon Kavanaugh

Sculpture/Ernest Trova. **Wheel Man,** 1965, siloconed bronze. Trova shows man consumed by the very technology he has created; man, according to Trova, cannot stand on his own but becomes a slave after awhile to machines and other products of advanced technology.



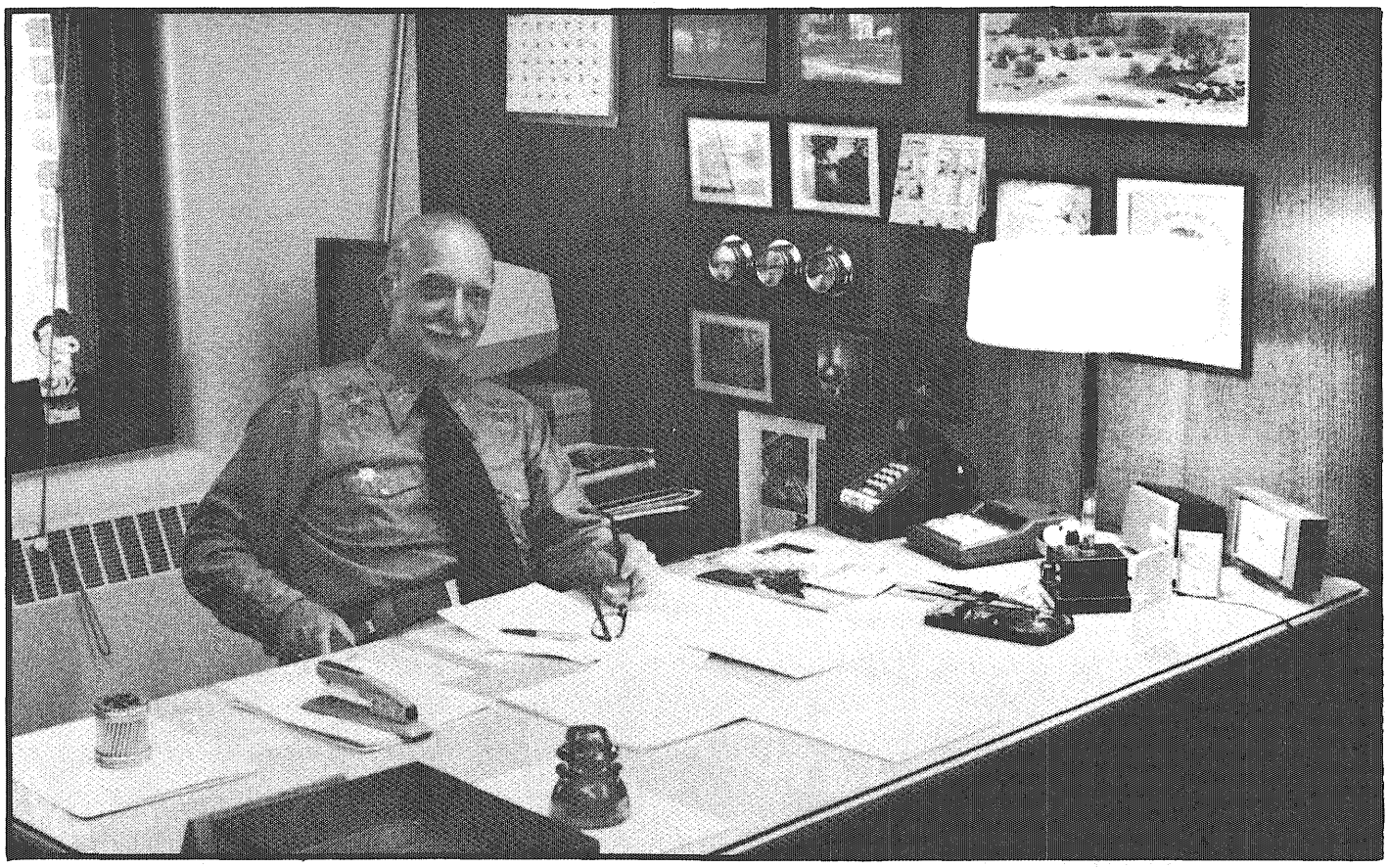
Photo/Jon Kavanaugh

Sculpture/Charles Biederman. **Work #27, Red Wing,** 1968-9, polychromed aluminum. In this work, Biederman uses high tech materials to reflect the underlying structure of nature, rather than simply duplicating nature in another form. Biederman works from a painted wood model. A technician cuts aluminum rectangles 1/8-inch thick. The artist then sprays each rectangle with oil colors for the finishing lustre and tonal quality.

ally, rotates and contorts itself for a few minutes and slowly settles back to rest. Oldenburg designed the piece but technicians worked out the mechanical details and produced the finished product under Oldenburg's guidance.

Skylight Two, shown on the cover, by Howard Jones, points out that the medium ins't necessarily the message. In fact, Howard utilizes technology not to make a statement about technology but to suggest, through a sporadic pattern of blinking lights, elements of time and decay.

Another piece, utilizing metalwork techniques, depicts the one central idea of the **Technology** exhibition. Ernest Trova's **Falling Man** is a clean brilliant bronze sculpture of a humanoid form seemingly trapped between two bronze wheels. Has man created and developed technology beyond his control or does man utilize technology as a tool for his own creative process?



Photo/Mike Dorn

Paul Cartwright: 37 Years of Pride, Progress

By Hap Atwood

"I've enjoyed my career. I've had the chance to influence some people's lives. I'll miss the contact with the young people here. Working with them is the best way to stay young yourself."

Paul A. Cartwright, assistant dean for student affairs, is leaving I.T. at the end of this year, yet he'll be leaving behind several beneficial programs for I.T. as well as countless grateful students and alumni whom he has helped over the years.

As Assistant Dean for Student Affairs Cartwright has had a hand in admissions and records of students, placement services, minority programs, orientation, registration, generation of the Dean's list, an "active, aggressive" program to keep in touch with colleges around the state, and obtaining money from industry to help fund various programs as well as the Merit Scholarships which are unique to I.T.

Cartwright has been responsible for creating the tutorial program in 1965 and adding other programs thoughout the years that have raised the number of Freshmen staying in I.T. after their first year from 44.2 percent in 1965 to 80 percent in 1976. The programs instrumental in this increase are the I.T. Dorm Houses (certain areas in Frontier and Territorial Halls set aside exclusively for I.T. students), in 1968, Suburban Tutoring (convenient tutoring service for those who live in the suburbs) in 1969 and the organization of the Central Advising Office in 1970.

"My case worked out well," said Cartwright. "I had a chance to start, innovate and create programs to benefit students."

Cartwright is in the middle of yet

another program, a survey that explores high school seniors' extra-curricular activities and interests. Cartwright hopes that some of these activities can get started here so that more students will get involved in I.T.

"These kids are interested in everything from backgammon to basketball. It's not true that I.T. students are bookworms."

At 64, Cartwright has been associated with I.T., one way or another, practically all his life. He received a Bachelor's degree in Electrical Engineering from I.T. in 1937. He worked for Northern States Power for four years, then returned to the University and the U.S. Naval Training School where he was Assistant Director from 1942-45. Cartwright has been teaching in the Electrical Engineering Department since 1946. He became Assistant Dean in 1964.

When talking with Cartwright's colleagues and former students one thing always is mentioned: Cartwright's interest in students.

"Paul Cartwright has a creative and sincere interest in students," said Prof. John Clausen, director of lower division programs. "He'll be greatly missed. A national search is being conducted for his replacement and they hope to find someone by next September."

Prof. Vernon Albertson was a student of Cartwright's and is now his teaching partner for a class called Electrical Machinery and Power Distribution. Albertson reminisced about the years he's spent working with Cartwright:

"I was a T.A. and taught labs for him," said Albertson. "I always did my best to be prepared for his labs. I learned a lot from him. He takes pride in being an electrical engineer and his concern for students really stands out."

Charles Purcell graduated from I.T. in 1947 and is now working for Control Data Corp. but he hasn't forgotton Cartwright.

"My case worked out well. I had the chance to start, innovate and create programs to benefit students.

These kids are interested in everything from backgammon to basketball. It's not true that I.T. students are bookworms."

"Cartwright stands out in my mind as one of the better teachers I had while I was in I.T.," said Purcell. "I believe I had him for a class in electric engines which was kind of a mundane subject. But Cartwright made the class interesting and illuminated the subject for me."

Evidently Cartwright's ability to get students interested in the subjects he teaches has carried over through the years. Daniel Wirth, an I.T. senior, thought Cartwright was a pretty good teacher.

"Some teachers care about what they're teaching and some don't," Wirth said. "Cartwright cared. That's why I thought he was a good teacher."

Throughout his 37 years of service Cartwright has seen many changes take place in I.T.

"The Institute of Technology has grown in size and complexity since I started teaching," he said. "Our enrollment is increasing and it's difficult to keep up the quality of education. I also feel though that more interest and effort are going into good teaching than when I first started teaching here."

Cartwright offered some thoughts on I.T. today as well as job prospects for engineers and some comments about I.T. Dean Roger Staehle.

"I think the outlook of students today is pretty good," Cartwright said. "But I'm not pleased with the salaries the faculty are receiving. They could get double their present salary if they went out to work in industry. I think it says we have many dedicated people teaching here.

"There is a tremendous business climate for engineers today. They can make 18,19, $20,000 a year. Graduates today are **starting** with the same salary as those who graduated two years ago are just getting today!

"Dean Staehle has something that's definitely needed around here: a sense of humor. He has lots of ideas and shows a concern for the students. These are exciting times with the new dean. The best way to judge his performance would be to come back in three years and see what he's accomplished."

Cartwright also talked about another new I.T. project: "The new Civil and Mineral Engineering building is a great idea. It will serve as a model for others, plus we can use it to study heat loss, consumption and gain. It will also provide more study space for students which is something I'd like to see more of around here."

Cartwright has definite ideas for technology and engineering in the future, including getting engineers into the political arena.

"I think technology's job in the future is to preserve our resources. There are a lot of challenges for engineers: energy, pollution, nuclear waste disposal. And I'd like to see more engineers in government. Lots of politicians today just worry about getting reelected, not about doing

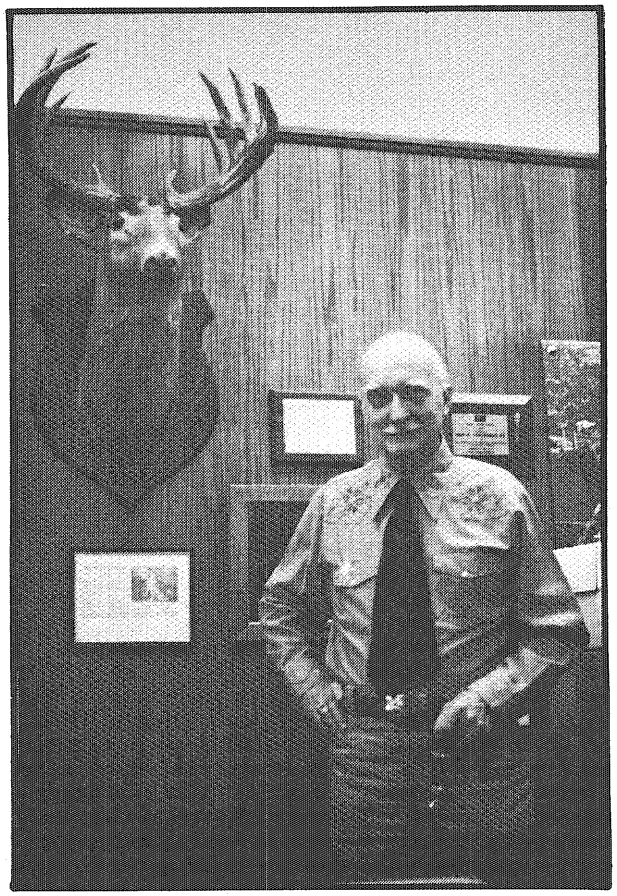
what's right. I think engineers would inject a sense of dedication into the political arena."

Cartwright will be retiring to Sun City Ariz. with his wife June 21 of this year. There, he said he would like to join the Sierra Club. "I think an engineering would give them a little more balance."

At the end of the conversation, Cartwright gazed out his office window, contemplating his career.

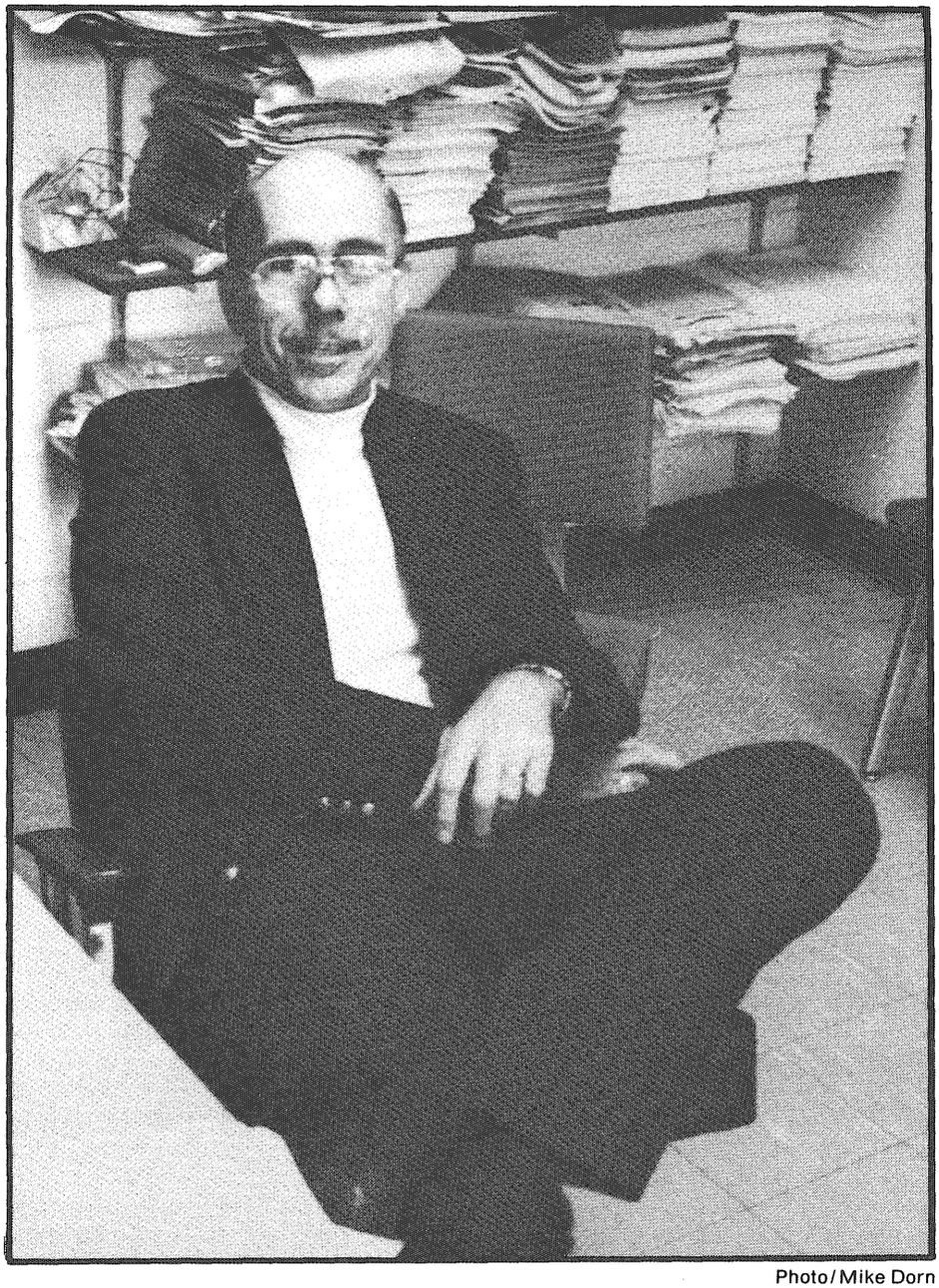
"Working with bright students upgrades your own interests and develops your own mind," he said. "I'd do the same damn thing over again if I had the chance. You make mistakes, but it turned out so well I'd do it again."

> **"I'd do the same damn thing over again if I had the chance."**



Photo/Mike Dorn

I.T. Professor of the Year: Keith Champlin



Photo/ Mike Dorn

By Mary Jo Hannasch

There is a Mother of the Year. There is a Playmate of the Year. There is a Man of the Year. And there is even a Worst Irish Tenor of the Year. But for I.T. students, there is only one "year" award that counts. It is the I.T. Teacher of the Year Award.

This prestigious local honor is awarded by the I.T. Student Board. Their choice for his year is Dr. Keith S. Champlin, professor of Electrical engineering, who describes himself as "a home grown product."

"I like being a professor; I enjoy the work and I enjoy the subject," explained Champlin with a note of enthusiasm. "I am really still turned on by electrical engineering, probably more than I ever was."

For Champlin, the strong interest in electrical engineering has been life long, and there were never any doubts in his mind that electrical engineering was the field that he wanted to become deeply involved with.

"I always thought that I was going to be an electrical engineer. I was the radio nut in the family, and by the age of eight or nine I was reparing and taking apart radios. People were always saying, 'That kid should be an electrical engineer', even though at that time I really didn't know what an electrical engineer did."

Champlin has lived in the Twin City area all of his life, and received his degrees in electrical engineering from the University. According to Champlin, "the University just seemed the natural place to go."

As a student, he had distinctive likes

and dislikes. "I always liked professors who clearly outlined their subject," recalled Champlin. "In fact, two of the best professors I ever had, Profs. Nier and Nye, are still in the Physics Department. At any level they taught, they were able to organize the material and thoroughly outline it for the students. What I disliked were professors who were unorganized and simply did not have a good handle on the material. Unconciously, I probably try to emulate the methods of those professors I liked.

"I am a plodder, and it takes me a while to learn something. I continually go over the material in my mind, and I do this even if I'm teaching the material. Then because I have worked so hard on the material, I am usually able to fit it together in large chunks and see how it relates to other areas.

"As a student, I found difficult the same courses that students today find difficult. For example, I found some of the math and physics courses hard. However, if I really worked on them, I could learn them."

While Champlin's life ambition was clearly to be an electrical engineer, he was never certain that he wanted to be a professor until after he received his Ph.D.

"I just fell in to teaching. I had never wanted to be a teacher. While I was working on my Ph.D., I taught a few undergraduate courses and started to get some feedback that I was doing a good job. Then when I received my Ph.D., there was an opportunity to stay as an assistant professor. Since this opportunity was not readily available, I was advised by others to accept the position. At the same time, I had offers from industry. I realized that if I went into industry I'd probably never come back to teaching, but if I took the teaching position, I could try it for a year and if I didn't like it, I could still go into industry. And like anyone else, over the years I have wondered whether I did the right thing, but I enjoy being a professor."

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All through school, Champlin worked at various jobs frequently involving his earlier interest in radios. A main hobby during this time was ham radios, and he became a ham radio amateur for a number of years, but eventually stopped because of the demands it made on his time.

"While in school, I had a number of jobs, mainly in technical areas. I repaired radios, and I worked in a few radio stations as an engineer.

In 1950, Champlin was pulled out of college during the Korean War. He was in the army for two years as a high speed radio operator, and later was in charge of a radio school with the rank of master sergeant.

"In the summer of 1954 after I received my bachelor's degree, I worked for Univac. At that time, they were just assembling the 1103 computer. This computer was filled with vacuum tubes and took up a room you wouldn't believe. That was a fantastic machine for that day, but today I have a more powerful computer in my basement."

While technology plays a large part in Champlin's life, he also has a very active personal and family life. He is married and has two children—a boy, 15, and a girl, 11.

"My son is a computer freak," described Champlin. "He and I have built a microprocessor-based computer, which started as a small box and has grown to a large unit, which includes floppy discs, two printouts, a voice synthesizer and a 32 K random access memory. He is very turned on by all of this, and this is good for him....My daughter is the artist in the family. She loves to paint, write, and play the flute and organ. She's basically interested in everything."

Champlin and his wife, Marion, enjoy traveling together. In 1963, they went to Paris for three months while he was an exchange professor at the University of Paris. In order to save money for traveling, they camped in the Bois de Boulogne, a woods and camp area on the west side of Paris.

"In the lab the other professors would ask where we were staying, and when I said that we were living in a tent in the Bois de Boulogne, they just laughed in disbelief. We then bought a Volkswagon so that on the weekends we could pack up the tent and drive around Europe."

Since that time, Champlin and his family have returned twice to Europe, once while he was lecturing there at various universities, and later while he was doing some consulting over there.

The range of interests exhibited in Champlin's professional career rivals his broad range of personal interests. Even though the field has "changed a great deal in a short time", Champlin has kept pace by involvement in a wide spectrum of projects. During this period

he has done research at the University, taught a variety of classes and done consulting in many innovating and open areas.

"Through the years, I have become involved in many areas of electrical engineering. For instance, I have a patent on a battery tester, which tests storage batteries. This is being marketed by Motorola. I also worked on research for microwaves and semi-conductors.

Champlin revealed great faith in the future engineers and their ability to find solutions to mounting problems.

"Two of the biggest problems of today are energy shortages and pollution. The solutions to these problems are going to be engineering solutions. This will be achieved by using some of the tools of today and some of the tools of the future. New tools are appearing all the time."

This positive outlook and interest sparks a close rapport between Champlin and his students.

"I don't have a specific teaching philosophy. I just try to do the best I can. And it is easy when you are interested in the subject.

"Being an engineer, I think like other engineers, so I find it easy to get to know them. One reason I get along so well with the engineering students is because we are so much alike. There may be years between us, but that doesn't make any difference because we are interested in the same things."

The comments made by students in his classes reflect the atmosphere of mutual respect. They described the classes as "challenging," and said his lectures were "carefully prepared" and are so interesting that "the students are not in any hurray to get out of the classroom." One student summarized the feeling by saying that "—both as a teacher and a researcher, he's outstanding."

With a broad smile, Champlin concluded. "I can't think of anything I'd rather get than an award from the students. They are the ultimate consumers, and if I please them, I'm happy. In 1963 I won another teaching award, the Distinguished Teaching Award from the Regents. I'm very glad that after 16 years I haven't lost the ability to do whatever it is I do."


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)
WHEEE!
..HOWEVER, WE DON'T HAVE ANY TEACHING ASSISTANT* JOBS OPEN. BUT YOU COULD SUB FOR ONE OF OUR T.A.'S WHO'S SICK TODAY.
P. FLUNKEM
JA, DAT SOUND'SA GOOD!!
*T.A.
BRIEFLY...
KEEP OFF
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 ?!!
Grrrr!!
Arrr!
SPLAT! WHACK! KRUNCH! CRASH! CHOP!
STOP JEEVES!
YES, SIR!
HAR! HAR!
SPLINK!
CARTER MONDALE in '76
Skreeeeee
VOOSH!
The Blood and Gore in this scene have been deleted.
WHAT IS IT?
IT IS...ER.. WAS A..(ICK!). STUDENT!
ERGH!
HE'S ALIVE! I'LL CALL AN AMBULANCE!
CHAUFFEUR
PETE EXEMPT
MOMENTS LATER...
MAYO MEMORIAL AUDITORIUM
BRRRRRR
MAYO GA... AND EMERGEN... ENTRAN...
"FFR" 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!
SSSSSSSS
IN THE BASEMENT OF ELECTRICAL ENG....
WAIT! WE CAN USE THAT!
TORNG!
SCRAP
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!
BURBLE!
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 SUMMER OKAY?
GZ ZIEMANS

As They Say In The Publishing Business...

This magazine is really **COOKING!**

Well, actually the line is borrowed from a crazy maitre d' at a Chicago sidewalk cafe on Rush St. But nonetheless, we're ready to make the same claim. I.T.'s **Technolog** is nationally-recognized as a leader among college engineering magazines. We'll be back this fall with more great issues, but some of our graduating staff members will not. To make your next year in I.T. a complete one, plan to participate in the production of 1979-80 issues of **Technolog.**

Technolog is looking for many dedicated staffers of all abilities. Denny Sullivan will wear the chief chef's hat as managing editor. And there'll be plenty of openings for writers, photographers, ad sales people, proofreaders, circulation help, office assistants, production artists, illustrators, cartoonists...whatever your time or talent allows, the **Technolog** wants your involvement. All staff members are paid for their efforts. And who knows when your experience at the **Technolog** may pay off during the job search or toward a promotion to technical publications work at your future employer's.

If you are interested in being an ingredient in next year's publications, contact Denny Sullivan at the **Technolog, 373-3298,** stop by Rm. 2 Mech. Eng., or write: Denny Sullivan, managing editor, Minnesota Technolog, Rm. 2 Mechanical Engineering, University of Minnesota, Minneapolis, MN 55455.

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minnesota
TECHNOLOG

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

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