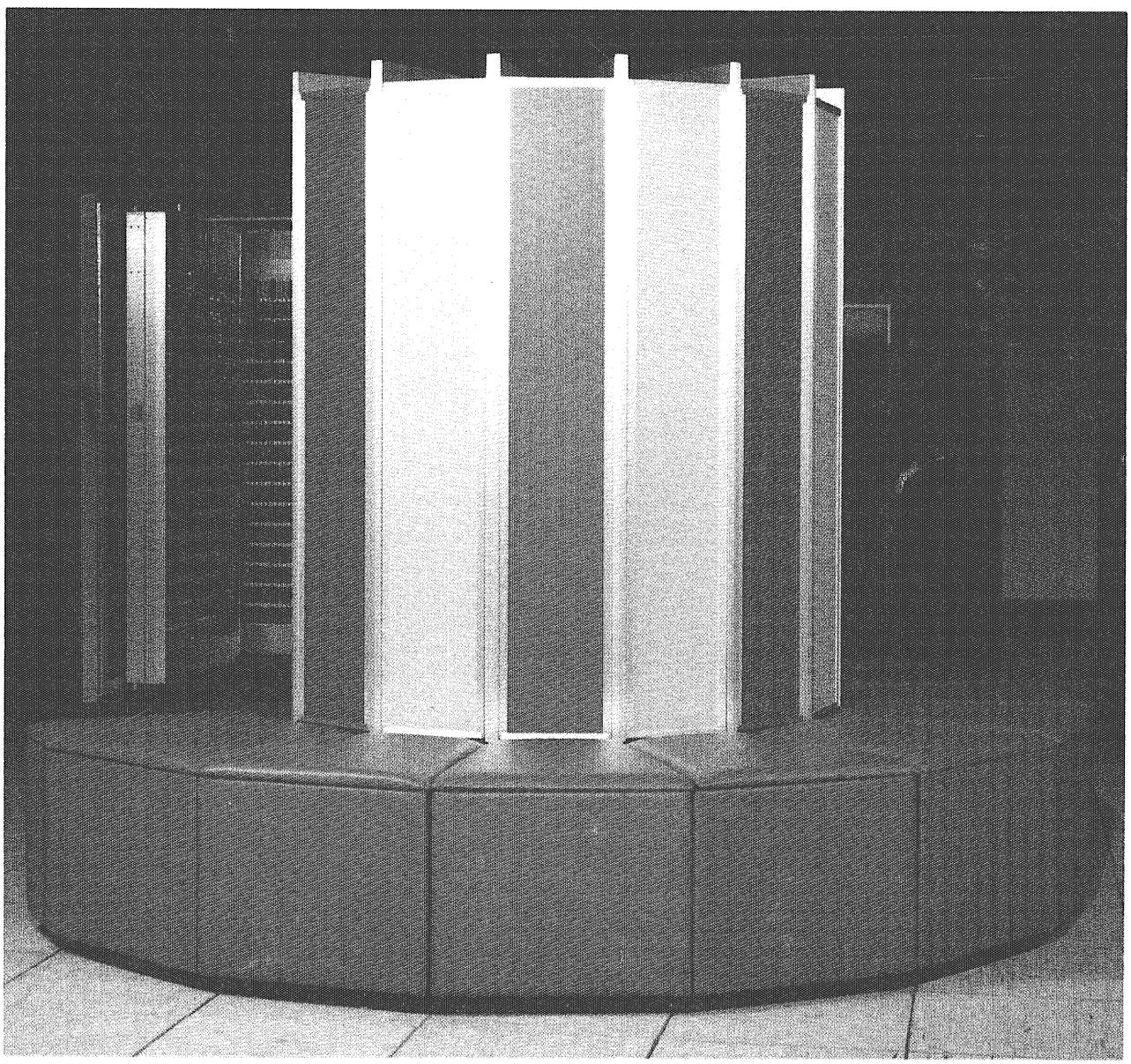
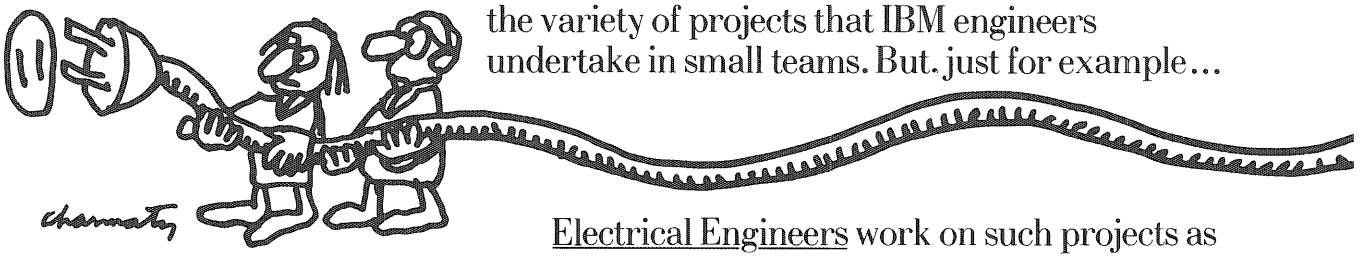
minnesota
TECHNOLOG

Fall I, 1981 $\sum_{n=1}^{\infty} a_n$



Super-Computer hits U of M

What do engineers do at IBM?



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Editor's Log

There's that nip of autumn in the air, the cold reminder that summer fun is over. It's time to hit the books again, and whether you are returning once again, or hitting the banks of the Mississippi for the first time, welcome to the Institute of Technology.

This is *Minnesota Technolog*, better than ever! *Technolog* is the official undergraduate publication of the Institute of Technology. It's your magazine, so enjoy it. Pick it up twice every quarter. You'll find it scattered all over I.T. *Technolog* takes you on tours through several research activities here on campus, as well as keeping you abreast of breakthroughs and news in the entire technological world. But that's not all. You'll find humor and brain teasers (you could be a winner) in every issue, along with an annual science fiction writing contest after Christmas.

As you know, Minnesota is one of the top engineering schools in the country. But with the prestige comes a grueling curricula. Face it, it has to be tough to be good. It's not going to be easy in the "real world" either. Since you have chosen to pursue a technical career, many doors and opportunities will be opened to you when you finish. In fact, studies show that jobs for electronic, computer and mechanical technicians, programmers, engineers, business machine repairers and secretaries with word processing experience, to name a few, will be at a premium into the 21st century.

So there's jobs all over the place and nothing but big bucks at the end of the road! Sit back and cruise! Wrong. With a degree you'll take on a big responsibility. The big bucks at the end of the road is really the start of a tougher, longer road. Now more than ever the country and the world need people to come up with answers for unanswered questions. You are those people.

But don't lose sight of the forest through the trees. You have the rest of your life to solve the world's problems. Don't come down on yourself too hard, yet. By all means, hit the books hard, but keep some time for yourself, and in that time take a look at the *Technolog*. I think you'll enjoy it, and maybe even learn something from it by accident.

Starting with the November issue, *Technolog* will feature a 'Letters to the Editor' section. Please write in and let I.T. know what's on your mind. You can drop off your letters in the office in Room 2, Mechanical Engineering, or stick it in the mailbox. The address is:

Minnesota Technolog
Room 2, Mechanical Engineering Bldg.
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Minneapolis, MN 55455

Please try to keep your letters to 300 words or less, and you must sign it to have it printed. (Also, Technolog reserved the right to edit your letters.)

Go ahead now.....open the magazine.....take a look.....enjoy it. *Minnesota Technolog.* "We do I.T. for You!"

Pete Marsnik is a senior in chemical engineering. His ambition is to have the magazine off the ground enough by December to make a down payment on the Technolog Lear jet right after the New Year.

Peter G. Marsnik

Peter G. Marsnik
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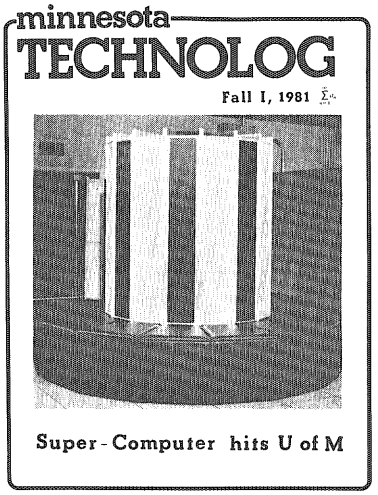

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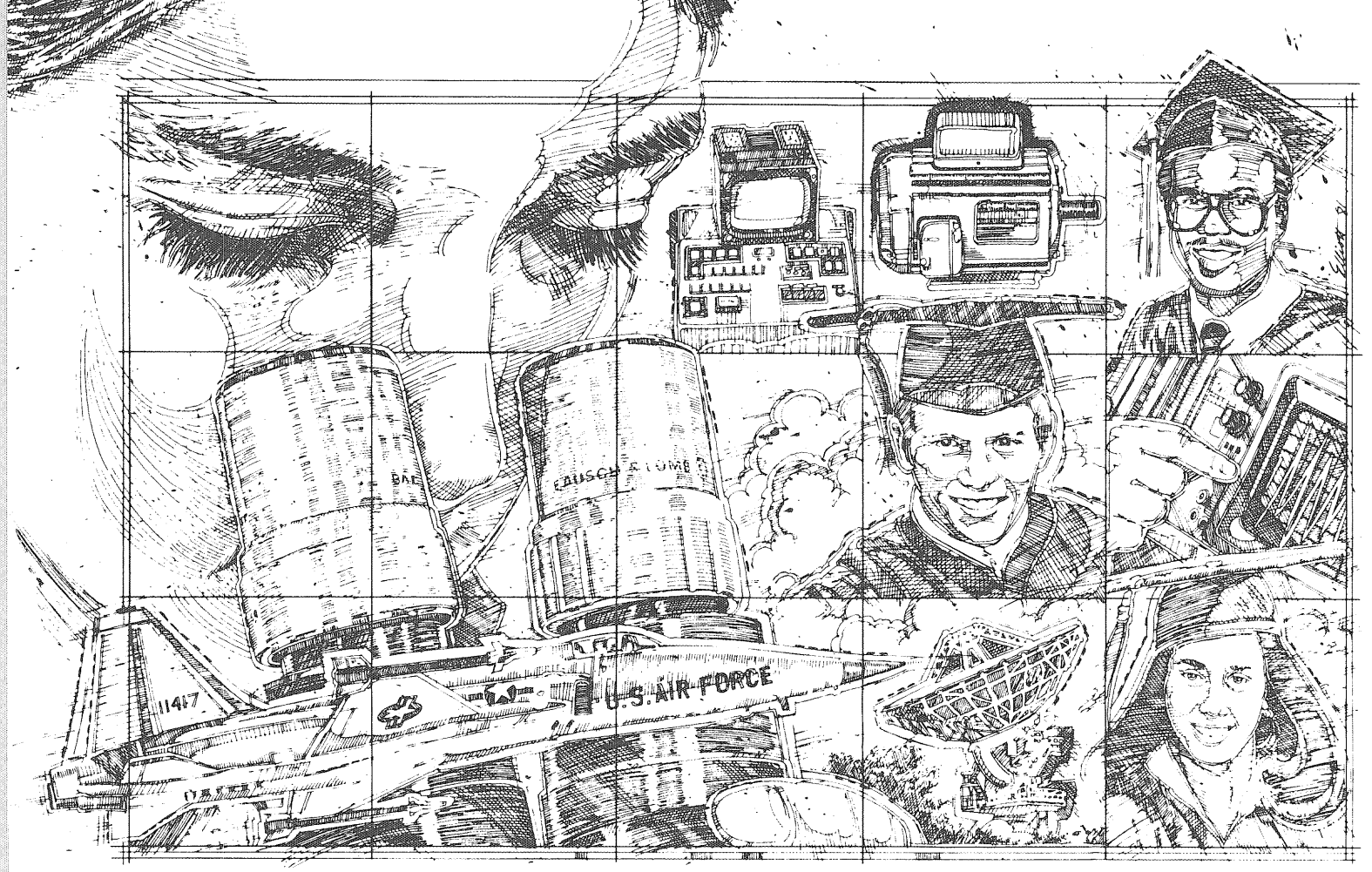

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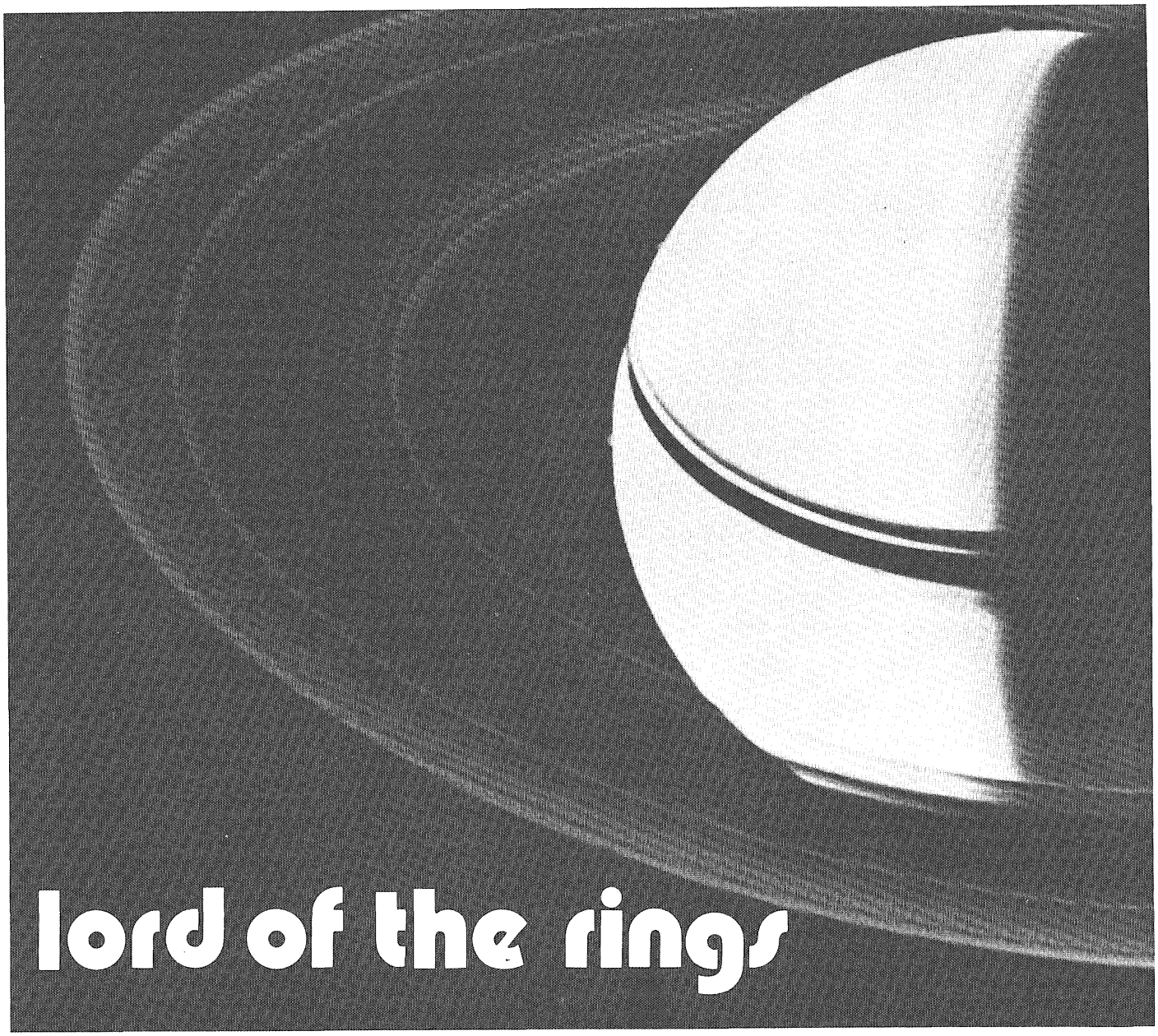


lord of the rings

By Steve Deyo and Nancy Hurd

No, not J.R.R. Tolkien's Sauron. This Lord of the Rings is JPL's Saturn. He also holds sway over fifteen or sixteen moons and has cast confusion (and renewed curiosity) clear out to Pasadena's Jet Propulsion Laboratory—thanks to Voyagers 1 and 2.

The Lord

Butterscotch-pastel Saturn is blander in color than Jupiter because its bands lie beneath an 80-km-thick haze layer that diffusely scatters back half the sunlight that hits it. (Saturn itself receives one percent of the sunlight which hits Earth.) Cloudtop temperatures vary between 86° K and 92° K, with coolest temperatures found near the center of the equatorial zone. Clouds form at about a 140-km altitude, where rising gas reaches the 140° K level, into reddish and dark ovals with stretched ends and anticyclonic circulation, small eddies, and long "wave" features. One jovian-like orange oval 6,000 km long was found at the 55° latitude and observed for four months.

Saturn's winds blow eastward, in the direction of planetary rotation, at 480 m/sec near the equator, dropping to near *nill* around 40° N and 40° S with a weak jet near 75° N *(see Figure 1)*. Saturn's wind strength, then, generally quadruples Jupiter's. Theories have justified this discrepancy by positing that Jupiter's winds are caused by the planet's internal heat radiation—1.7 times more than it receives from the Sun—due to ongoing post-formation cooling. Saturn, however, smaller and expected to generate less heat (and wind strength) turns out to radiate 2.8 times the heat it receives from the Sun. Therefore the theory was proposed that Saturn's heat source was the separation of helium from hydrogen during its cooling 2.5 billion years ago. Problem: the Saturn He/H ratio is the same as Jupiter's, about 0.10. If the theory were correct, the ratio should have been lower. So: either theoretical models of He/H behavior under high temperature and pressure need revision, or Pioneer 11's measurements were in error.

Most of Saturn's atmosphere is hydrogen. Helium accounts for 11 percent of the atmospheric mass above the clouds. Also detected were methane, ammonia, ethane, acetylene, and phosphine—though gaseous ammonia was less than expected due to low atmospheric temperatures.

Ultraviolet auroras were detected in a polar band near 80° S, and aurora-like emissions from molecular hydrogen were found as well near Saturn's sunlit edges at very low latitudes; but other aurora or lightening detection was hampered by night-side illumination from the rings.

The Rings

At a mass of no more than 1 x 10^{-7} that of Saturn, the ethereal rings appear reddish, sorrel and golden-tan. Their color is thought to come from damage to the lattice structure of their characteristic bands of ice (which would normally appear white) due to radiation and ionic bombardment. Each ring particle, ranging in size from microscopic to larger than a house, has its own particular orbit. Size and shape affect sunlight scattering and reflection. Most scientists adhere to the theory that the rings date back to the formation of the solar system, and that they were formed by the destruction of one or more moons. If this is true, then particles larger than a good-sized snowball have probably been stable over the estimated 4.6-billion-year age of the solar system, due to extremely cold intra-ring temperatures (70-75° K in the "B" ring).

Voyager 2 not only turned out to have a better camera than Voyager 1 with which to view the lord Saturn and his rings—no two vidicons are exactly the same—but whereas Voyager 1 reached Saturn near its equinox and at a 1° inclination, Voyager 2 arrived at a more pronounced and advantageous 7° inclination.

Voyagers 1 and 2 discovered hundreds of narrow ringlets and ringlets-within-ringlets right down to the camera's limit of resolution—a few kilometers. The rings are thought to be controlled mainly by gravity, with electrostatic and magnetic forces affecting the smaller ring particles. Full solutions to such questions are extremely complex. Small outer satellites are believed to play a significant role in "shepherding" the particles within particular rings and ringlets. This "guardian" theory of ring control intensified scientists' interest in determining the size of ring particles through radio occultation of the scattering of sunlight.

Figure 1. From *Astronomy* magazine

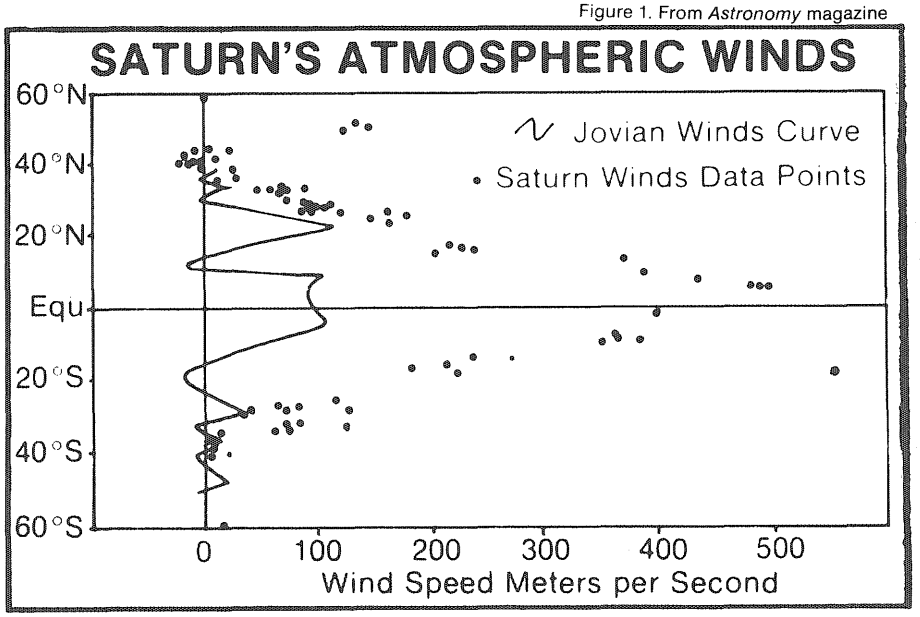
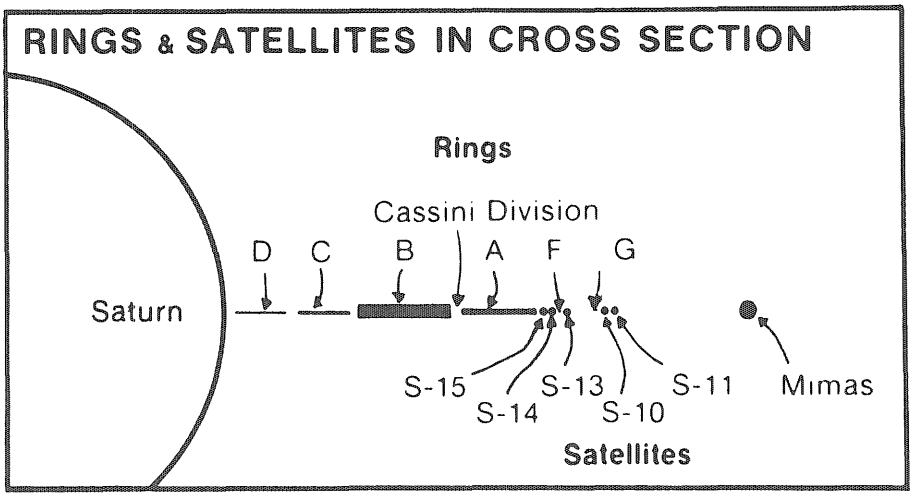


Figure 2. From *Astronomy* magazine



Voyager cameras viewed the rings from a wide range of angles relative to the Sun: from the front, from behind, and through. Large chunks appear brightest from the front (same-side as sunlight) and dark from behind, casting shadows. Very small particles, on the other hand, appear brighter when viewed from behind because they scatter sunlight forward rather than reflect it back towards the Sun. A 50-km-diameter satellite—large enough to "shepherd" ring particles—could be detected in this way, even though it might be indistinguishable from other ring material if observed from different angles.

Still, Voyager 2's camera—twice as good as Voyager 1's and with a resolution of 1 kilometer—found hundreds of thousands of ringlets and one braided ring without any of the nearby moons which are supposedly necessary to "shepherd" such phenomena. Imaging Sciences team leader Bradford A. Smith of the University of Arizona—said, "We find ourselves at a point where we had hoped not to be"—without a plausible theory.

The innermost ("D") ring, extending from Saturn's atmosphere—maybe even surface—to the inner edge of the "C" ring, was discovered only by long-exposure Voyager photographs of its forward-scattering properties (though it had long been suspected to exist). Its material may be of fine particles leaking past the "C"-ring-boundary hypothetical satelite to spiral down into Saturn's atmosphere due to drag forces.

Radio transmissions through the "C" ring indicate it contains ice particles about two meters in diameter and 20 meters apart, as well as a number of narrow, dense ringlets whose eccentric orbits seem unrelated to orbital resonances of larger satellites. The "C" ring is dim when seen from above, and brighter than the "A" or "B" rings when seen from below.

Next comes the "B" ring, the broadest and brightest when seen from above (sunside). A broad gap separates it from the "C" ring; the Cassini Division sunders it from the "A" ring at its outer edge. The "B" ring may contain many hundreds of fine, bright and dark ringlets of no apparent large-scale order. This region also displayed sporadic radial patterns or "spokes," along the eastern ansa which followed the ring in the direction of rotation. They appeared 5 to 10 percent darker than the rest of the ring, and appeared to cross both bright and dark ringlets. They weren't visible from the far side of Saturn. For these reasons, and since a custom-written analysis program showed the "spokes" rotate with Saturn's magnetic field and not with the ring particles, scientists believe electrostatic charging "levitates" small particles out of

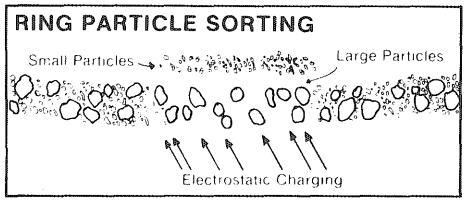


Figure 3. From *Astronomy* magazine

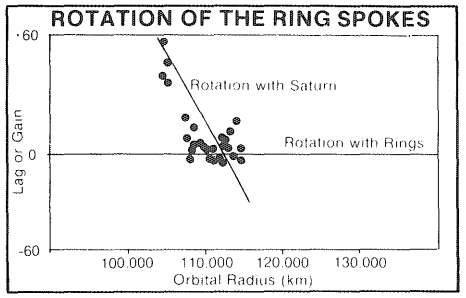


Figure 4. From *Astronomy* magazine

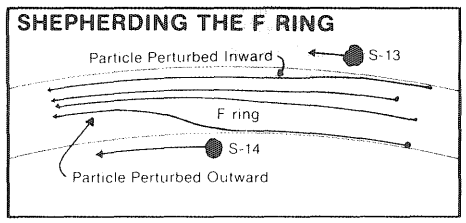


Figure 5. From *Astronomy* magazine

the rings to form the "spokes" *(see Figure 3)*. Besides, intra-ring electrostatic discharges were found to be loosely correlated with Saturn's rotation *(see Figure 4)*.

The Cassini Division contains five broad rings separated by narrow gaps and many small features. Radio occultation indicated particles of about 8 meters in diameter. Its inner edge is in resonance with Mimas, its outer with Iapetus. Its width is about 4,000 km.

The "A" ring best fits expectations of what a ring should be: broad and free of many ringlets—though it has several due to gravitational resonances—as well as a wide resonance gap called the Encke Division in which Voyager 2 found braided rings. The "A" ring is 800 km wide and bounded on the outer edge by satellite S-15. Its outer edge is bright in backlighting, suggesting fine particles. An atmosphere of neutral hydrogens extends 60,000 km above and below the main rings and slightly beyond the "A" ring outer edge. The hydrogen cloud, estimated at 600 atoms/cc , may have been formed from water ice within the rings.

Beyond the "A" ring and between "shepherd" satellites S-13 and S-14 lies the puzzling "F" ring. The "F" ring was seen to be resolving into three narrow "braid" strands with kinks and twists. S-13 and S-14 are thought to "shepherd" "F"-ring particles by alternate gravitational deceleration and acceleration into lower and higher orbits, respectively *(see Figure 5)*. This may cause the "braiding" effect. Backlit, the "F" ring is bright—so it probably contains fine particles—and its "braids" are possibly subjects of the same electrostatic charges as in the "B" region. (The "F" ring in fact absorbs half the charged particles d i ffusing back towards Saturn from the magnetosphere.)

Another faint ring, the "G" ring, is located less than 1,000 km inside the orbits of S-10 and S-11. It's not visible from above or below, but was discovered when its shadow fell across S-11 and through forward-scattering studies as Voyager 1 left Saturn.

The farthest ring is the "E" ring, 5 Saturn-radii out and about 100 km thick. It is brightest at the orbit of Enceladus. This ring was first seen from Earth during our 1978-80 passage through the ring plane.

Final data from Voyager 2 seem to indicate that the rings may not have concentric orbits at all. Rather, a few seem to "spiral," much as do phonograph record groves, outward to the moons that drive them in "spiral density waves" as in Saturn's "A" ring. Others experience simple gravitational perturbations and deform in portions of their orbits.

This complete image shows two views of the outer edge of Saturn's B-ring (left) and the inner part of the Cassini Division (right) in the rings. The images were taken on opposite sides of the planet. The dramatic result of this comparison is that the thin eccentric ringlet in the inner gap of the Cassini Division is shown not to match from side to side; moreover, the edge of the B-ring differs by about 50 km. as well. Scientists believe that the distorted shape of the B-ring is due to the gravitational influence of the Saturnian satellite Mimas. It is noted, too, that much of the fine B-ring structure also mismatches from side to side, possibly indicating that they are wave phenomena.

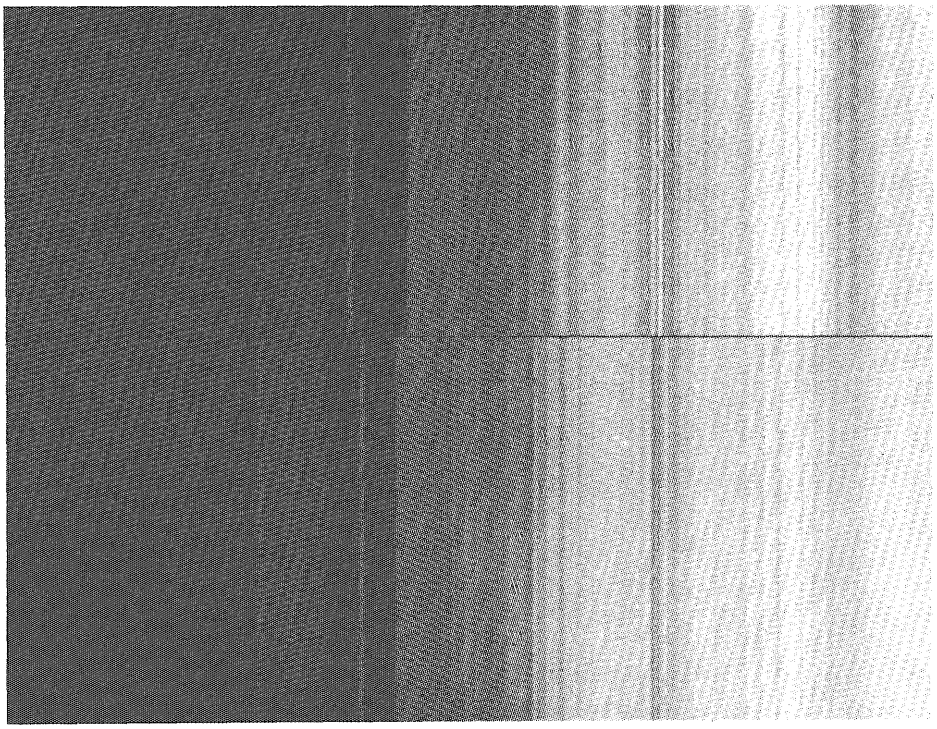
"Noise" and the Magnetosphere

Voyager detected short, intense bursts of radio power resembling terrestrial lightening as it passed Saturn. Since Saturn's ionosphere should, at the wavelengths concerned, cut off radio emissions, Saturn's clouds were unlikely the lightening source. Rather the rings' electric fields seem to produce the lightening bursts—*sans* light, since the atmosphere is too sparse—at voltages estimated to be at least 1 x 10^4 more powerful than terrestrial lightening!

While Voyager was measuring Saturn's rotation period to precisely 10 hours, 39 minutes, and 24 seconds through timed radio emissions, it also recorded separate and variable radio emissions of up to 20 billion watts. Supposedly these radio bursts' origin was Saturn, though the planet's magnetic field is relatively mild (only 5 percent of Jupiter's) and aligned to better than 1° of tilt. Emitted near the 90° longitude and high northern latitudes, the signals probably originate by irregularities in the flow of conducting material (in Saturn, liquid metallic hydrogen) deep within the core.

The satellite Dione's location seems to control Saturn's radio energy, possibly by "outgassing" materials that could generate radio waves. (Magnetospheric particles peak at Dione's orbit.) The process, though not understood, may be similar to Jupiter's moon Io's control of jovian radio emissions.

Voyager's ultraviolet spectrometer found a 9,000-km auroral zone centered on Saturn's poles which closely resembles Earth's own auroral phenomena. Voyager also detected evidence of light-



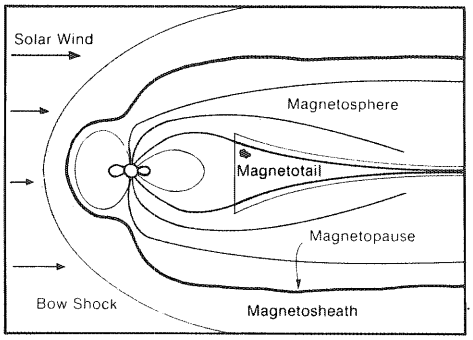


Figure 6. From *Astronomy* magazine

ening in Saturn's clouds.

Like a vast invisible comet's tail, Saturn's magnetosphere envelopes the planet and trails far behind in the ionic gusts of the solar wind, (Voyager's measurements hint that Dione interacts strongly with the magnetosphere.)

A disk of plasma extends out practically to Titan's orbit. The plasma is in near-total co-rotation with Saturn's magnetosphere, with a velocity of about 150 km/sec at a distance of 17 Saturn radii from the planet. (Titan is at 20 radii.)

Saturn's magnetic tail has a diameter of about 80 Saturn-radii and is relatively void of plasma in the higher latitudes. Low-energy electron flux abounds, though higher-rigidity particles (i.e., protons with energies in excess of 2 MeV) are not stably trapped in the magnetosphere's outward bounds.

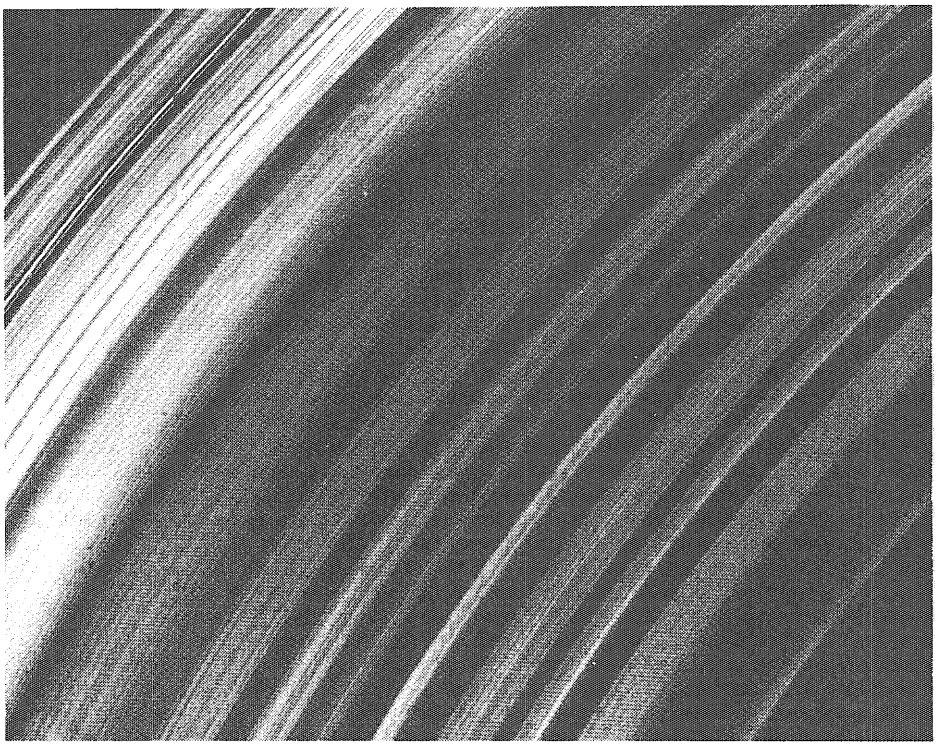
Titan itself has an induced magnetic field and dipolar magnetic tail. Ionized hydrogen and nitrogen may have been stripped from its upper atmosphere as well. Titan is thought to have some effect on Saturn's magnetosphere beyond 10 Saturn-radii, and outer-edge magnetosphere particles—quantities of helium and energetic molecular hydrogen—presumably came from the atmospheres of Saturn or Titan.

The Moons

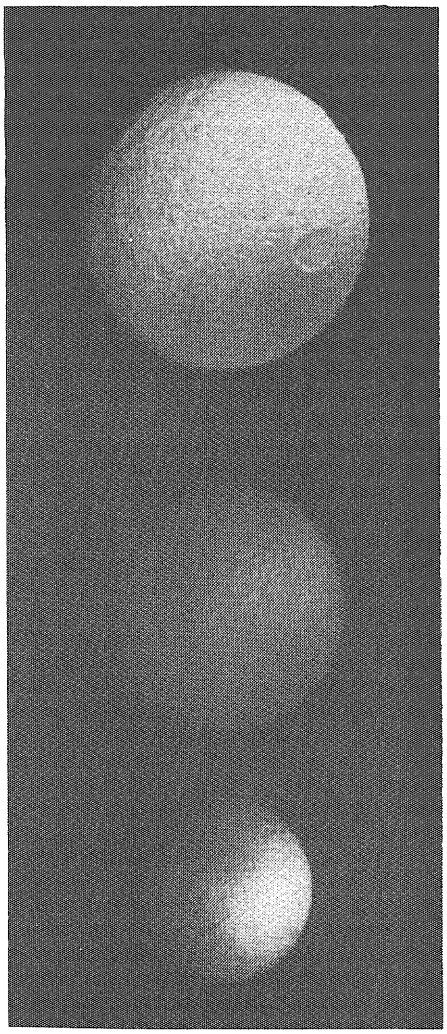
At 5,140 km in diameter, Titan is more a planet than a moon. It has its own atmosphere: mostly nitrogen, less than 10 percent methane at the surface (one percent in the upper reaches), acetylene, ethylene, ethane and hydrogen cyanide. The latter compounds form from broken-down methane under ultraviolet light. The atmosphere's opaque reddish tinge may be due to the presence of polyacetylene and polycyanide. Surface temperature is near the triple point of methane (93° K), ensuring the presence of either solid, liquid or gaseous methane, and some puddles of liquid nitrogen, depending on season and latitude. (Titan, with Saturn, entered a 7.5-year-long autumn early in 1980.) Temperature decreases to a minimum around 70° K at 40 km in altitude, and increases to 160° K at higher altitudes. Titan's mass is about 1.95g/cc , indicating about a 50/50 mixture of silicates and ice. Surface pressure is 1.6 times Earth's. Titan has virtually no magnetic field of its own and thus no liquid, conductive core. Its atmosphere probably provides the atoms which for a gas torus extending 300,000 km beyond Titan and inward to the orbit of Rhea.

The smaller moons include Dione B (S-12) which oscillates slowly around Dione's L-4 lagrangian point, leading Dione by about 70°. S-13 and S-14 shepherd the "F" ring while orbiting 2,500 km apart. Every few months the inner satellite passes the outer one. S-10 and S-11 orbit only 50 km apart and may be the halves of a split satellite. S-10, the smaller, runs a slightly tighter and faster orbit than S-11, and in January of 1982 will overtake it.

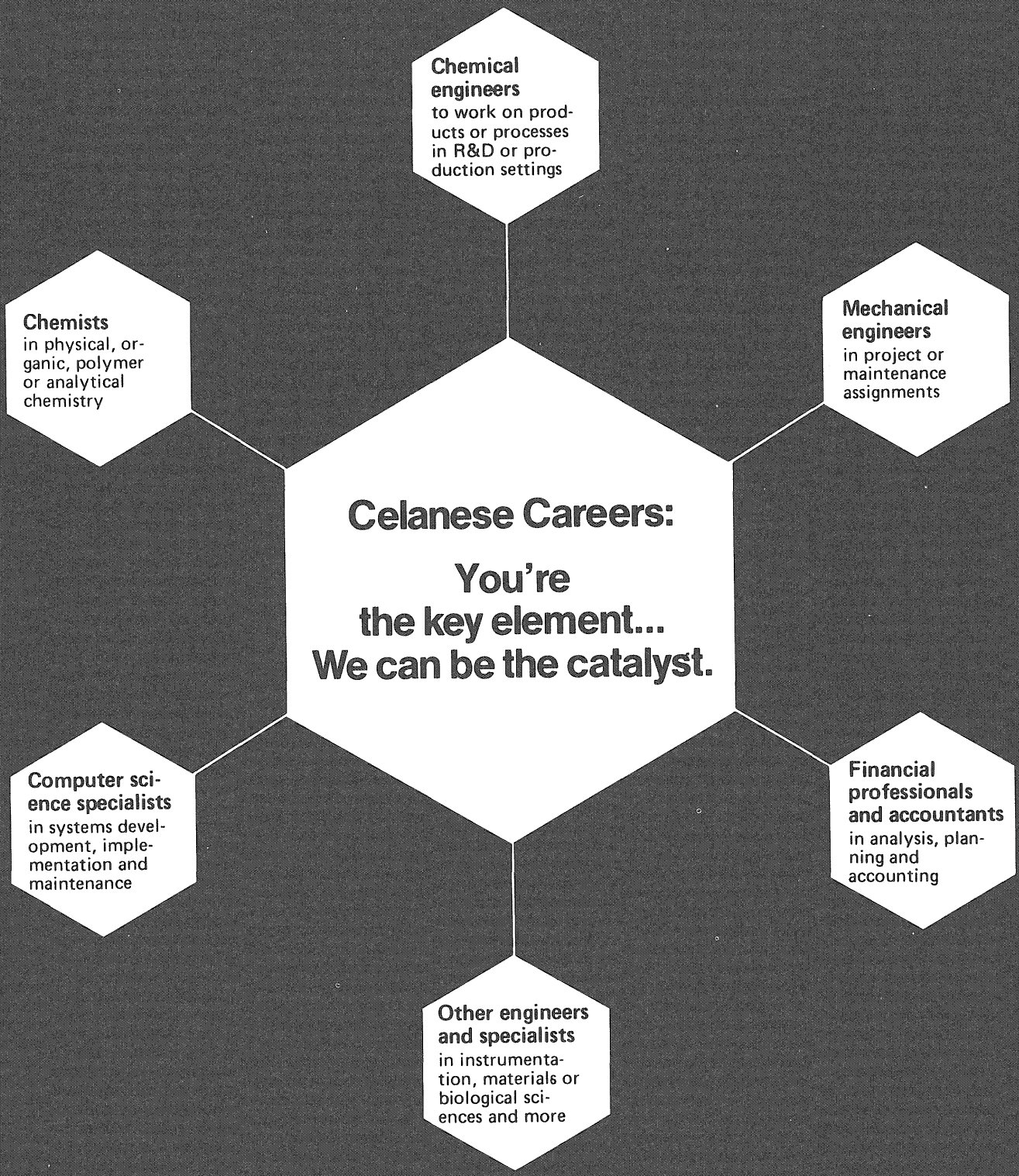
Rhea's wispy bright and dark regions show dense cratering to the point of saturation, though the dark regions display fewer craters; also linear grooves, though and evidence of resurfacing. Its temperature was measured by Voyager 1 at 98° K



This photograph of Saturn's B-ring was obtained from 743,000 km. It covers a range of about 6,000 km, and it shows the ring structure broken up into about ten times more ringlets than previously suspected. Variations in brightness are due to a combination of differences in ring particle number density and light scattering properties.



This series of Voyager 2 pictures of Tethys shows its distincitive large crater, 400 km in diameter, as it rotates toward the termination and limb of this satellite of Saturn. These images were obtained at four-hour intervals. The crater, the remnant of a large impace, has a central peak and several concentric rings. Some grooves radiating from the center may be formed of material thrown from the crater during the impact. The bottom frame, with the crater in profile, reveals that its floor has risen back to the spherical shape of the satellite, unlike the large crater seen on Tethys, sister moon, Mimas.



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in sunlight, 75° K in Saturn's shadow.

Tethys has a long branching trench at least one kilometer deep and several hundred long. From its density, 1.0, Tethys looks to be about 15 percent rock and 85 percent ice. Also Tethys, on a side photographed by Voyager 2, revealed a vast crater 400 km wide—big enough to swallow Mimas with its 100-km-wide crater covering nearly a third of one hemisphere. That is about as big a crater Mimas could sustain without turning into ring material.

Mimas also bears heavy cratering on its other side, and a series of huge trenches. Its density is higher than Tethys', 1.2.

This Voyager 2 image of Titan was taken Aug. 23 through the violet filter from a range of 2.3 million kilometers (1.4 million miles), showing considerable detail in the clouds. The southern hemisphere is distinctly different in contrast. In addition, a well-defined boundary with the dark northern latitudes is seen near Titan's equator, and a dark polar collar appears at about 60° north latitude. All these features are associated with the circulation of Titan's atmosphere. A distinct layer of tiny, submicron-size haze particles extends beyond the limb of the main clouds.

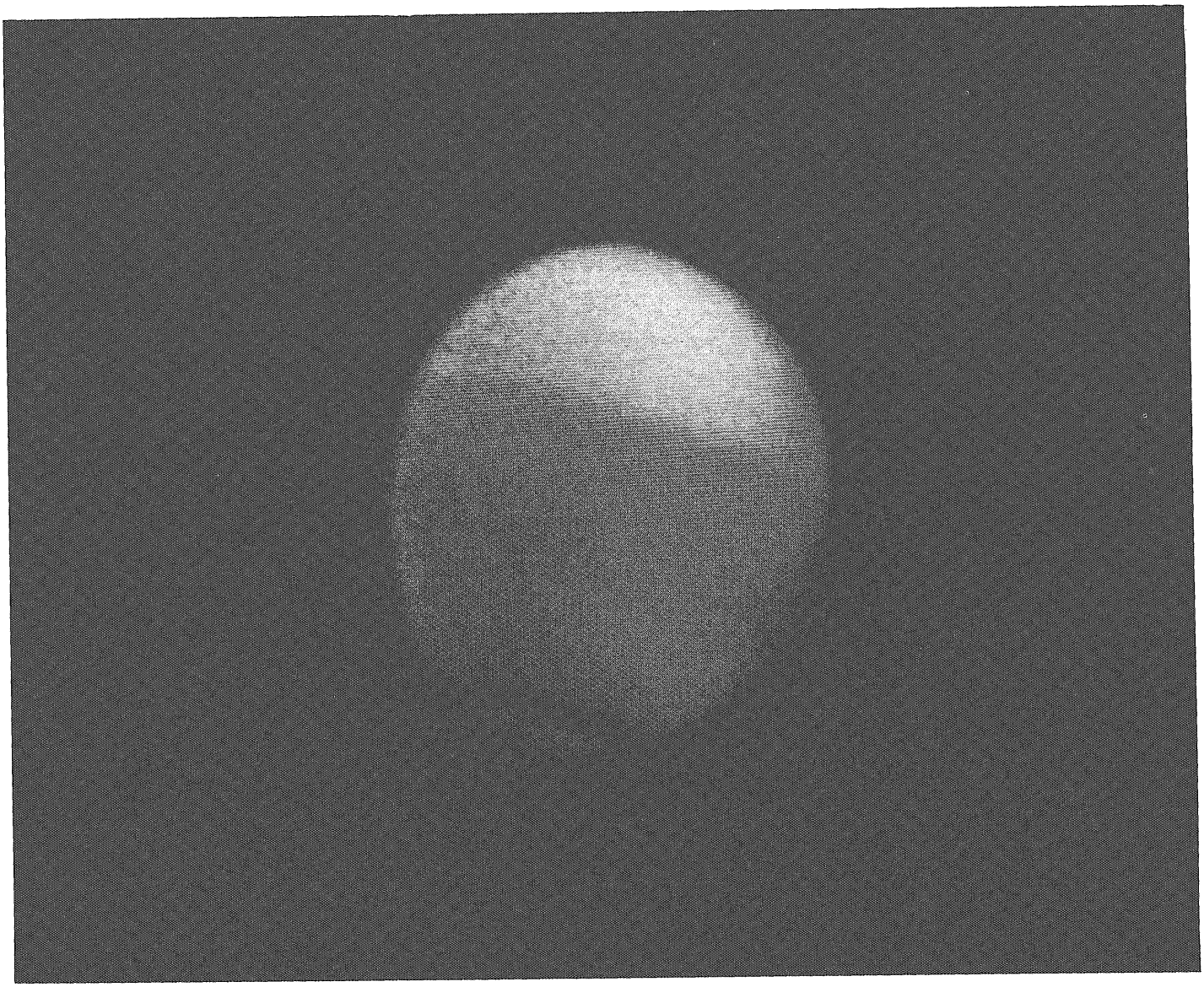
Voyager 2's cameras show Hyperion is shaped like a can of tuna: roughly 200 by 300 km and 100 km thick. Odder still, Hyperion's rotation axis passes through it at an angle—an unstable postion less preferable than rotation along the short axis with the long axis oriented towards Saturn. At this writing, nothing in print has explained whether the off-axis rotation is an improbable but stable equilibrium or caused by recent impact.

Iapetus has a bright leading side and a dark trailing side. The bright side's albedo is 50 percent—apparently ice—but the dark side's is 3 percent. Too dark for silicates. The dark side's albedo is now thought to be due to a covering of carbonaceous chondrites which has welled up overwhelming Iapetus's surface ice. (For more on carbonaceous chondrites, see Nancy Hurd's "Meteorites and Life," *Minnesota Technolog*, Fall II 1980, pp. 8-12, 14.)

Dione is practically Tethys' twin in size, but density indicates at 60/40 mixture of ice and rock. Like Rhea, Dione has extensive white, wispy areas which are evidently large fractures in the ice crust where water has escaped and formed frost. Some areas show resurfacing.

Enceladus, viewed in detail by Voyager 2, shows fissured, canyons corrugated "ropey" terrain and a wide, smooth area wiped clear of craters. Was this area formed due to tidal pumping as on the jovian moon Io? Pulls from Dione and Tethys may produce enough deformation in Saturn's gravitational field to raise Enceladus' internal temperature. A second theory suggests the surface ice contains ammonia and methane besides water. Melting and resurfacing could then occur at a temperature 100° C lower than that required by tidal pumping.

Phoebe, Saturn's furthest moon at 10.6 million km away, is thought to be a captured asteriod because of its highly inclined retrograde orbit. Voyager 2 was allowed unrestricted use of its recuperated scan platform September 4 during its



closest approach to Phoebe. What jammed the platform and held Voyager 2's eye uselessly pointing to the stars for several days will never be known, but deputy Voyager program manager Richard P. Laeser said that the attitudinal gears seemed to be stuck with something in them which eventually worked its work out.

Aftermath

Voyager 2 topped its predecessor with a (providentially) better camera and a working photopolarimeter. (Voyager 1's failed inexplicably during its Jupiter encounter.) Even its camera platform, if it had to be jammed, jammed at the least inconvenient time.

Voyager scientists now have 17,000 photos and other data to study in years to come. For in-depth preliminary findings of Voyager 1, see the 12-article series in *Science* magazine. Further Voyager 2 reports should be found soon in *Astronomy* and in recent issues of *Science*.

"We've completed most, if not all, of our major objectives," said Edward C. Stone, a chief Voyager scientist from California's Institute of Technology. NASA estimates Voyager 2 to have no better than a 2-in-3 chance of reaching Uranus in a functioning state in January of 1986, and a 1-in-3 chance of transmitting data from Neptune in 1989.

Voyager is travelling out of our solar system,sending back non-image information. It may determine the exact location of the heliopause, the outer edge of the solar wind, around 1990. If it survives, Voyager 1 will then watch for low-energy cosmic rays penetrating the outer reaches of our solar system from nearby supernova remnants. Voyager 1 also contains an aluminum-encased copper phonograph recording containing Earth sounds, music, languages, and digitally recorded images—with instructions on how to play the record—for the information on any alien people who may stumble upon Voyager for however long it drifts.

Besides the Space Shuttle program, all that is on the books for further space exploration so far is the Galileo probe of Jupiter in 1985 and the Venus Orbiting and Image Radar (VOIR) project in 1988. (JPL has also begun conceptual planning for a series of Mariner Mark II missions.) The Halley's comet probe plans—in fact, the entire future of the space program—otherwise may never "get off the ground."

minnesota TECHNOLOG

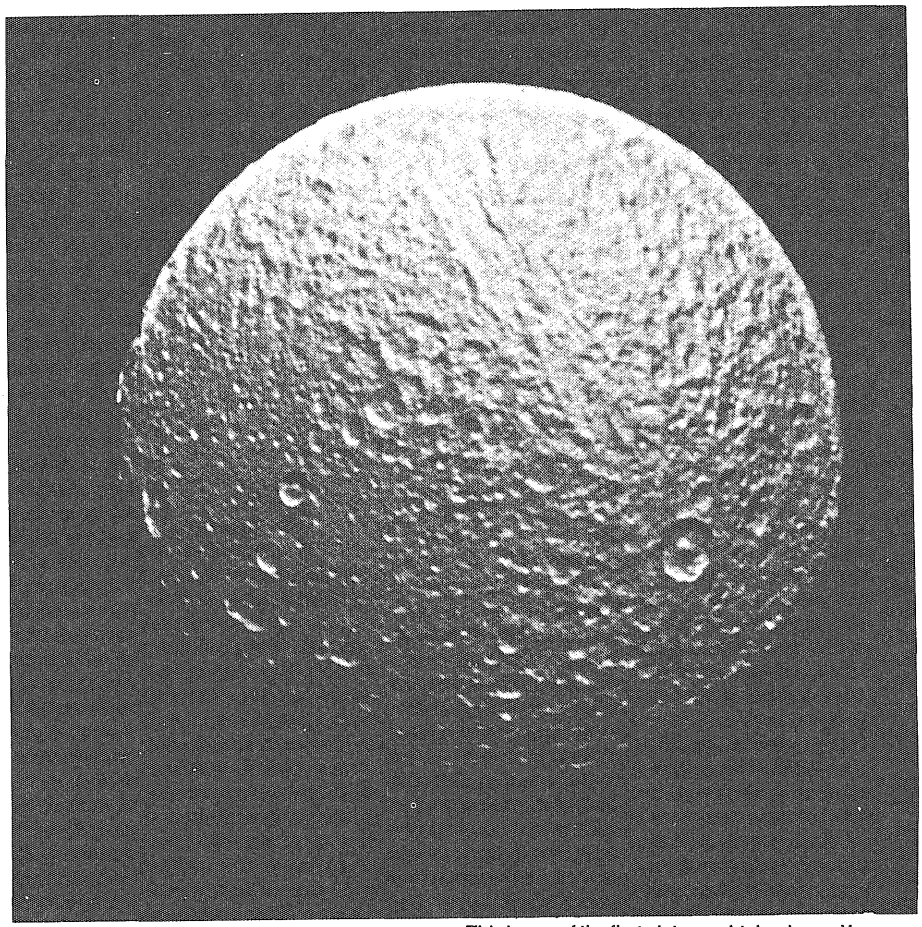
Table 1. Saturn ring data.

Feature	Distance (km)	Distance (R=60,330 km)	Period (hours)	Comments
Cloud Tops*	60,330	1.000	10.57	near 100-mbar level
D ring inner edge	67,000	1.11	4.91	Extremely small optical depth
C ring inner edge	73,200	1.21	5.61	
B ring inner edge	92,200	1.95	7.93	
B ring outer edge	177,500	1.53	11.41	Inner edge of Cassini division
A ring inner edge	121,000	2.01	11.93	Outer edge of Cassini division
Encke division	133,500	2.21	13.82	About 200 km wide
A ring outer edge	136,200	2.26	14.24	
F ring	140,600	2.33	14.94	Three narrow components, braiding noted
G ring	170,000	2.8	19.9	Seen only in forward-scattered light
E ring inner edge	210,000	3.5	27.3	
E ring maximum	230,000	3.8	31.3	Near orbit of Enceladus
E ring outer edge	300,000	5.0	46.6	

*distance at equator from Saturn's center: the period is the rotation rate of the planet.

Table 2. Saturn Satellite data.

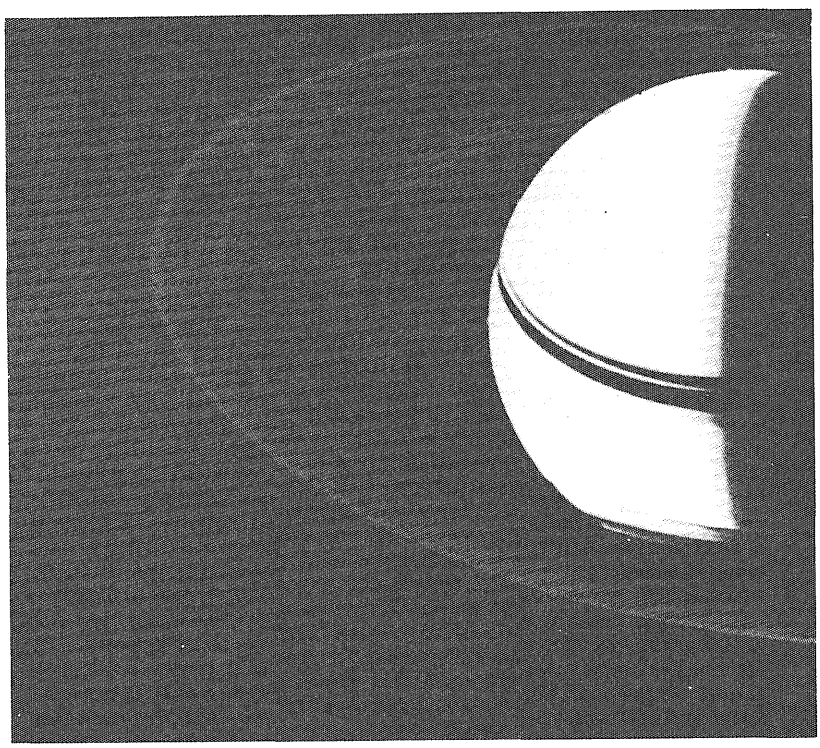
Satellite	Diameter (km)	Distance (km)	Distance (R = 69,330 km)	Period (hours)	Albedo	Closest approach (km) Voyager 1	Voyager 2
S-15	30	137.300	2.276	14.446	-	219,000	287,000
S-14	220	139.400	2.310	14.712	-	300,000	247,000
S-13	200	141.700	2.349	15.085	-	270,000	107,000
S-10	90×40	151,422	2.510	16.664	40%	121,000	147,000
S-11	100×90	151,472	2.511	16.672	40%	297,000	223,000
Mimas	390	188,224	3.120	23.139	60%	88,440	309,990
Enceladus	500	240,192	3.981	33.356	100%	202,040	87,140
Tethys	1,050	296,563	4.916	45.762	80%	415,670	93,000
S-12	160	378,600	6.275	65.738	-	230,000	270,000
Dione	1,120	379,074	6.283	66.133	60%	161,520	502,250
Rhea	1,530	527,828	8.749	18.660	60%	73,980	645,280
Titan	5,140	1,221,432	20.246	382.504	19%	6,490	665,960
Hyperion	290×100	1,502,275	24.901	521.743	30%	880,440	470,840
Iapetus	1,440	3,559,400	58.999	1901.820	3/50%	2,470,000	909,070
Phoebe	160	10,583,200	175.422	9755.679	-	13,537,000	1,473,000



This Voyager 2 photograph of Tethys shows objects about 5 km in size and is one of the best images of the Saturnian satellite returned by the spacecraft. Voyager 2 obtained this picture August 26 from a range of 282,000 km. It has been specially processed by computer to bring out fine detail on the surface. A boundary between heavily cratered regions (top right) and more lightly cratered areas (bottom right) is very similar to the boundaries on the moons Dione and Rhea, indicating a period of internal activity early in Tethys' history that partially resurfaced the older terrain.

Photos Courtesy of NASA

This is one of the first pictures obtained once Voyager 2 resumed returning images August 29 after its scan platform was commanded to view Saturn. This view shows some detail and differences in the complex system of rings. The "reddening" of the B-ring on the unlit side was also seen in Voyager 1 images. Voyager 2 obtained this picture from a range of 3.4 million km. (2.1 million miles) through the clear, green and violet filters.



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Journalism graduate student Steve Deyo has compiled updated Voyager findings with portions of research done last spring by Nancy Hurd, a recently graduated biology major.

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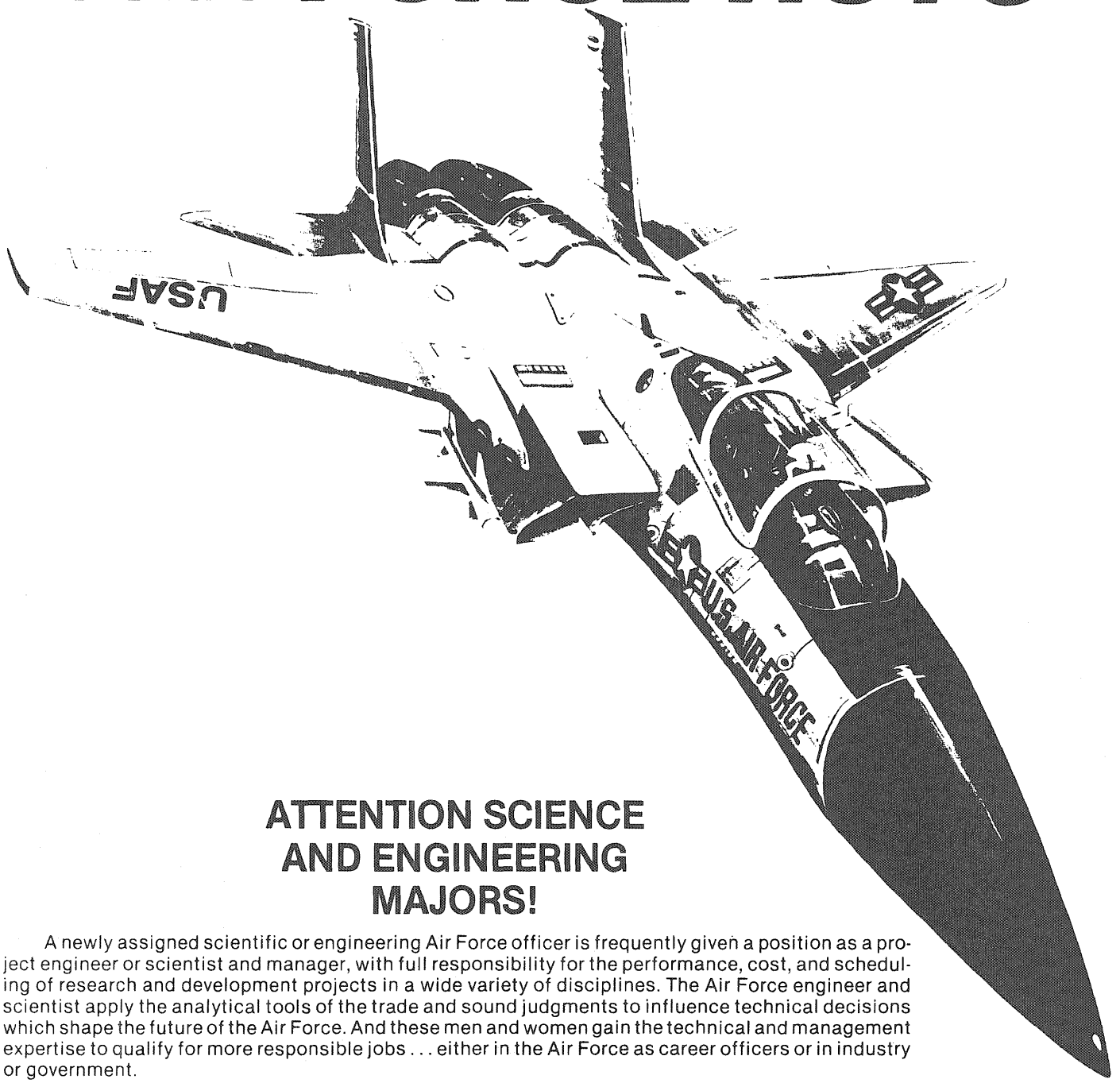

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ICBMs: Are We Safe?

by Jeanne Hanson
University News Service

Intercontinental ballistic missiles are so inaccurate at finding their targets that a first strike by the Soviet Union might knock out only about half of the U.S. Minuteman missiles, according to a University of Minnesota expert on missile guidance systems.

This lack of accuracy would allow the United States ample time to retaliate, a fact that make the $108 billion MX system unnecessary. So says **J. Edward Anderson**, a professor of mechanical engineering at the University of Minnesota Institute of Technology. A former missile expert form Honeywell, Anderson invented some of the guidance systems now used by the U.S. Air Force.

Anderson's calculations and arguments are presented in articles recently submitted to *Science* and *Foreign Affairs*. Support for Anderson's views has already come from IBM research consultant Richard Garwin and an August 1980 issue of *Defense Week*.

The vision of a sleek, silver missile, guided unerringly toward its target by computerized controls and exploding in white heat upon successful impact, is a mental picture commonly held by most people.

But, Anderson says, intercontinental ballistic missiles are not all that accurate. In fact, anywhere from 0 to 900 of 1,000 U.S. missiles could survive a first strike, he said. The high "miss probabilities" would allow time for retaliation. "I don't think the Soviets are crazy enough to strike against such odds," he said.

Missile accuracy is affected by five factors, Anderson said. The first is bias error. Created mostly by the combined gravity of the earth and the moon, this tug on airborne missiles can create a target error of up to several miles, throwing a "systematic and devastating uncertainty" into any Soviet plans to destroy individual Minuteman silos, Anderson said.

Figuring the effect of gravity into a guidance system is too complicated because several unknown factors are involved, Anderson said. The effects of the moon's pull on different parts of our land and water surface, although generally known, change every day as the moon moves. The earth is a mosaic of its own "gravity anomalies," patches of stronger and weaker gravity created by the earth's rotation and motion within the earth's core.

The Soviets are well aware of the patterns in their own missile test areas, but they have naturally not tested their missiles over U.S. territory. Thus the Soviets have no idea of what U.S. gravitational patterns would do to the paths of their missiles. Nor have they launched the dozens of navigational satellites that would be necessary to learn these patterns and to correct them ahead of time. Even if such Soviet satellites were launched, they could be "jammed" electronically and rendered ineffective.

In figuring gravity's effects, an error of even four parts per million can throw missile accuracy off by 300 feet, Anderson said. Once an ICBM has begun its descent, its path cannot be changed. Traveling at 16,000 mph, it becomes wrapped in an ionized shock layer that makes its computer guidance systems unreachable. The Pentagon is now beginning to concede the existance of bias error, Anderson said.

Circle of error probability (CEP) also affects missile accuracy. Created by random errors in missile alignment, velocity formulas, gyroscope guidance, rocket timing, computer instructions, and simple "glitches" in parts from ignition switches to bomb fuses, this type of inaccuracy can be considerable. A system that is initially fairly correct can quickly be thrown off substantially by vibrations and changes in temperature and humidity. Although the Soviets probably check their missiles frequently, during an attack there can be no dress rehearsal, Anderson said. A CEP of 300 feet is often claimed for ICBMs, but 600 to 900 feet is more likely, he said.

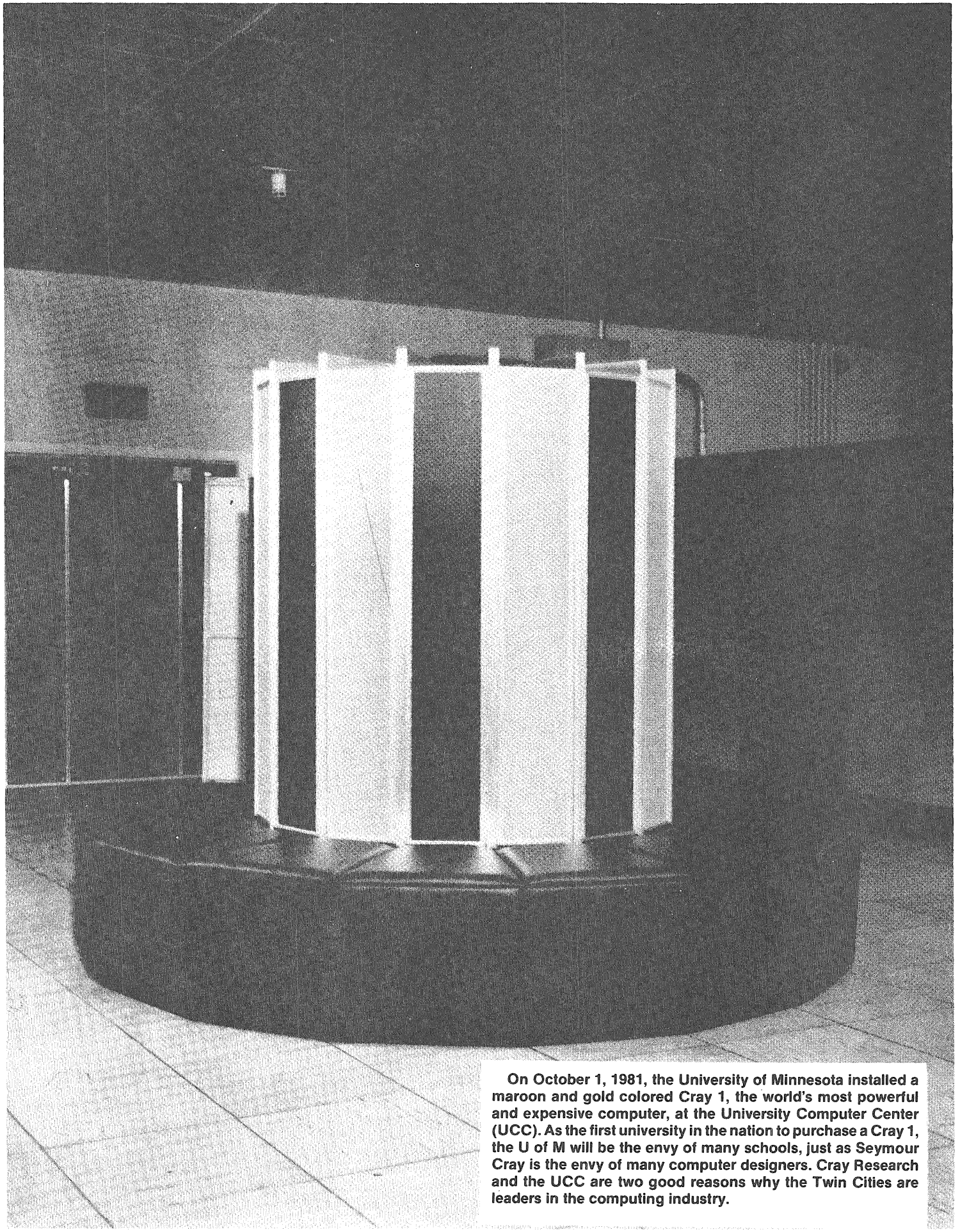
Bomb size can also throw off accuracy. Large bombs contribute to better accuracy, Anderson said, but even with warheads larger than those the Soviets currently use small bias errors and small CEPs can lead to a significant number of misses. Doubling the two types of error increases the miss probability by a factor of 6.

A fourth problem is what is called fratricide. A follow-up missile cannot be sent directly behind its "brother" to cover for glitches and mis-aims because the missles tend to destroy each other. If one explodes, even in mid-air or off target, the massive electromagnetic radiation and shock wave would vaporize the other. They must be several minutes apart, which gives the attacked country time to strike back.

Finally, human factors play a role in target accuracy. Any defense system that requires thousands of operations people is vulnerable to morale problems, common drunkenness, labor shortages, and problems caused by poor training. Soviet military brass is well enough acquainted with these problems alone to make them unlikely to authorize a first strike, Anderson said.

Soviet leaders are also aware of other factors likely to discourage them, he said. The risk of retaliation from the United States or its European allies during the 30 minutes it would take for an ICBM to hit is significant. The effect of the subsequently released radioactivity on the earth's ozone layer is an additional deterrent. Likewise, dust from the explosions would have a disasterous effect on worldwide agriculture, a fact the Soviets are unlikely to ignore.

U.S. vulnerability to a first strike attack by the Soviets is a myth that has been perpetrated for too long, Anderson said. Money that would go toward building the MX missile, which he feels is unnecessary, should be spent in much more mundane projects, such as boosting military wages, improving NATO forces in Europe, rebuilding the U.S. Navy, and upgrading the present Minuteman system. Recognizing that the United States is not truly vulnerable should shape our entire strategic policy, he said.



On October 1, 1981, the University of Minnesota installed a maroon and gold colored Cray 1, the world's most powerful and expensive computer, at the University Computer Center (UCC). As the first university in the nation to purchase a Cray 1, the U of M will be the envy of many schools, just as Seymour Cray is the envy of many computer designers. Cray Research and the UCC are two good reasons why the Twin Cities are leaders in the computing industry.

THE ADVENTURES OF SUPERCOMPUTER: CRAY-1

Kent S. Christensen & Barbara E. Gross

Faster than our editor's hands with a freshman coed... More powerful than your professor's glare as you sneak out of class early... Able to multiply tall columns in a single computation...

It's an overgrown telephone booth!! No, it's a new seating area for the Architecture Court!!! No, it's "SUPER COMPUTER"!!!

Since its delivery, the Cray 1 has been the center of attention at the University Computer Center's Lauderdale headquarters. It's a 6½ foot high hollow semi cylinder, surrounded by upholstered benches, which provides an aesthetic appearance for a computer.

Behind those maroon and gold panels is hidden a dense circuitry composing the world's most powerful computer which performs at the incredible speed of over 140 million calculations per second, approximately 20 times faster than the existing Cybers at UCC.

What Makes It So Fast?

The reason, says John Rollwagon, president and chief executive officer of Cray Research, is that, "We chose from the very beginning to build a machine which would be the fastest in the world."

From a physical standpoint, Cray 1 has challenged the fundamental limitation of high speed computer design, the speed of light. Since electricity travels at the speed of light, it takes approximately one nano-second to go one foot. The longest pathlength in the Cray 1 stands at just four feet! Since the circuits are switching in less than a nano-second, the net effect is a computer which spends half the time computing and half the time waiting.

The electronic modules of the Cray 1's Central Processing Unit (CPU) are on the outside of its cylinder, thus enabling the shortest pathlengths possible on the inside. The semi-conductor mainframe houses over 200,000 integrated circuits, 3,400 printed circuit boards, and 60 miles of wire in less than 70 square feet of floor space.

This dense circuitry presents a major complication—an intense buildup of heat. Cray attacked this problem by designing a clever under floor freon cooling system which maintains internal temperatures of approximately 68°F. The heat created by the circuits is transmittted to the copper plates they are mounted on. The copper plates are clamped into a chassis made out of aluminum in a way making conductivity as high as possible. To complete the cooling process, these plates are connected to pipes containing boiling freon.

The UCC expects the Cray to dissapate approximately 600,000 Btu/hr of heat, almost doubling the combined heat dissipated from its machines.

Another problem in dealing with high speed computers is getting information in and out of them fast enough to allow their circuitry to work up to potential. The Cray 1's memory design has solved this. The Cray 1 has a very large and very fast memory. The ECL integrated circuits are each approximately 1/3 the size of a postage stamp and each circuit holds 1,000 bits of information. Their compact size allows the Cray computer to contain up to 4 million worlds of internal storage.

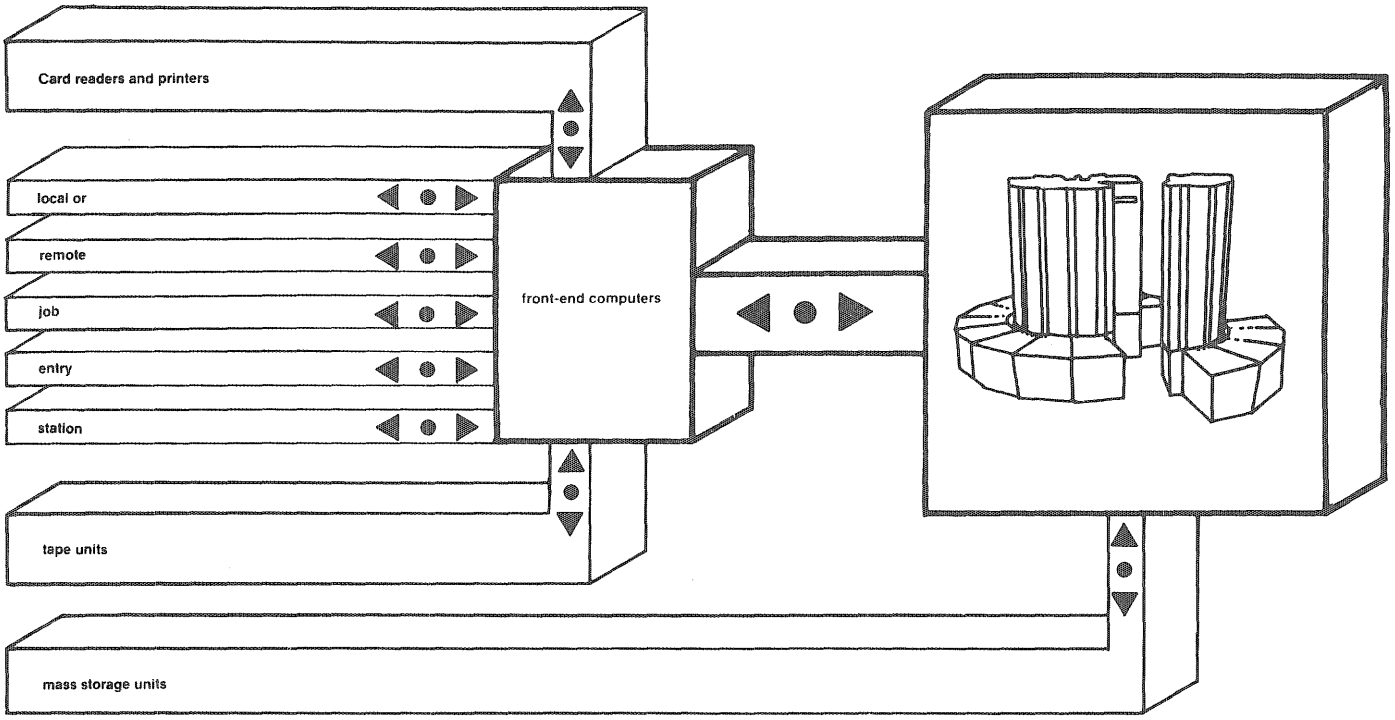
Hidden beneath the upholstered benches surrounding the Central Processing Units are Cray 1's power supplies.

PLEASED CRAY CUSTOMERS

A computer clocked at speeds of up to 140 million floating point operations per second obviously stands not as a typical data-sorting computer, such as those turned out by IBM. Quite the contrary, the Cray 1 was designed specifically to be the world's most powerful problem solving machine. For example, within the Cray 1 an automobile designer can build a car, crash it against the wall, and predict the results.

One word consists of 8 bytes of information, and one byte consists of 8 bits of information; thus the largest memory available holds 32 million bytes and 256,000 bits of information.

Combine this immense storage capacity with the lightning speed accessibility of one word every 12.5 nano-seconds and the computer's potential appears to be realized. However, with a computer performing calculations at an average of 50 to 100 million per second, even 4 million words will not provide enough data for very long. This is the reason that the Cray is a back end processing unit, which means it must be interfaced (connected) to a front end processing unit such as the Cyber computers residing at UCC. These front end computer systems, along with other mass storage units, link directly to input and output channels of the Cray 1, satisfying its massive data requirements.



Lawrence Livermore Laboratory in California finds the Cray 1 especially useful in its development of nuclear fusion as an energy source. The Laboratory's goal is to contain the energy of a hydrogen bomb within a reactor. "One vital area of this research is to simulate the action of indredibly hot hydrogen gas, or plasma, within the fusion reactor. So complicated has this become that it has exhausted the capacity of the Laboratory's other computers," says John Killeen, director of Livermore's Fusion Computer Center.

Also contributing to its usefulness is the Cray 1's ability to take a matrice (or vector) calculation and handle it as a single operation. Through the Cray 1 this Laboratory can simulate the behavior of plasma in three dimensions. "Cray 1 is going to shorten the time we need to reach our nuclear fusion goals," said Killeen.

The aircraft industry can also take full advantage of Cray 1's vector capabilities and mathematically calculate the shape of an airplane and fly it through the atmosphere, predicting its performance before the aircraft is actually built.

Evolution of the Cray 1

The Cray 1 did not evolve because a large corporation systematically and bureaucratically produced computers that became the fastest in the world. Rather, the determination of one University of Minnesota graduate, Seymour R. Cray, who concentrated specifically on the design of very high speed problem solving computers, built the Cray 1.

Seymour Cray carries very impressive credentials. After graduating from the University of Minnesota in 1952, he went to work for Enginerring Research Associated, which eventually became Sperry Rand Corporation's Univac division, where he worked until 1957.

The company had become very large and Seymour decided it was too bureaucratic and boring for his tastes. He then, with a group of Sperry Rand employees, set out to form Control Data Corporation (CDC).

At Control Data, Cray led the development of the model 1604 and early transistor computers and then the 6600, the first commercially successful 'super-computer.'

CDC, impressed by Seymour Cray's ability, built an advanced design laboratory in Chippewa Falls, Wisconsin, a short walk from Cray's home. It was in this laboratory that Cray designed the 7600 super computer that was introduced in 1969. Three years later, in 1972, Cray, then a senior vice president and top designer at Control Data, decided that CDC was becoming too commercialized, bureaucratic, and dull for his tastes and moved on to start Cray Research, Inc.

With visions of designing a computer 20 times faster than those he designed at Control Data, Seymour Cray put up $500,000 and started collecting money to build the Cray 1. Wisely, Control Data was among the investors that quickly came up with seed money so Cray could shrug off future customers who might offer to buy the design as it evolved.

During the creation of the new computer, Cray Research employed only 24 or 25 people. "Seymour's best work seems to be done with small groups of people," says John Rollwagen, a Minnesota native himself with degrees from MIT and Harvard School of Business.

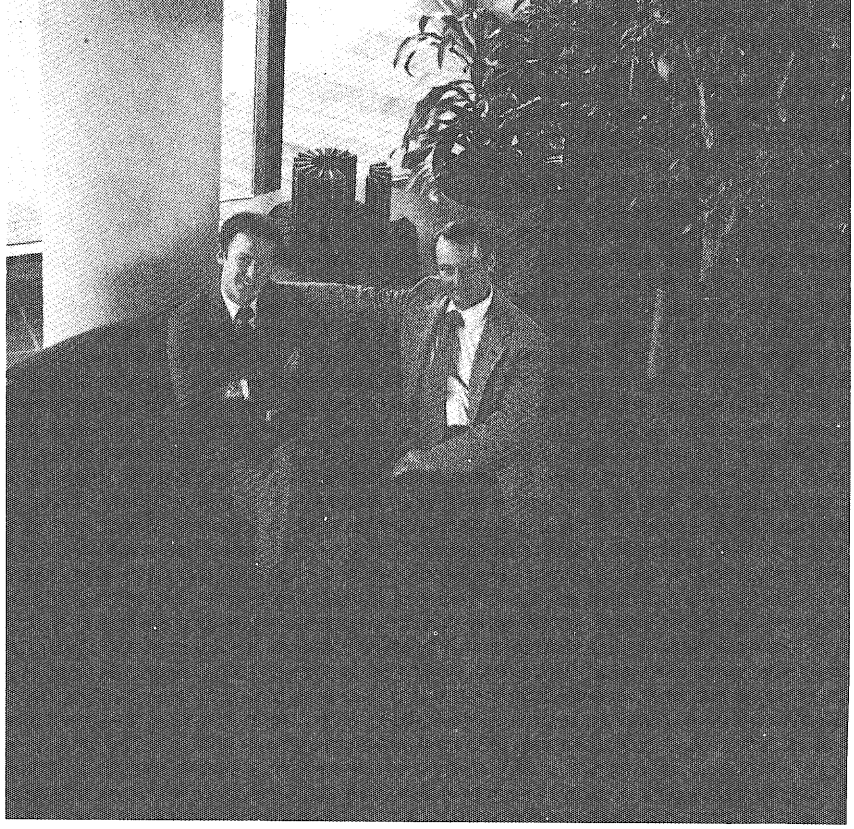
Between its start and March 1976 Cray Research spent a total of $8.5 million and produced one full Cray 1 and half of another. "So you see all of the original operations money came back on the first sale in 1976." said Rollwagen, who, at the time, was vice president of marketing. "I'd been in contact wiht the company for some time before actually going to work for them in 1975," he added.

In 1977, Rollwagen became the president of Cray Research and the company operated its first full business year. In 1980, Rollwagen became president and chief executive officer.

Cray Research now employs over 1,000 people and has 32 Cray computers installed and running in the United States, Europe and Japan.

What do a thousand people do at Cray? "Beats me," says Rollwagen. "Our design groups are still small and close knit," But a thousand employees is not too large according to John Sell at UCC. "I've been very impressed by Cray,. from sight planning right on through. They've been a very high caliber group and very enjoyable to work with," he noted. And even Seymour Cray is starting to enjoy the things he used to dislike so much such as administrative work.

But Cray still keeps his hands into design. He likes to perform each operation in the construction of a Cray 1 at least



Seymour Cray with John Rollwagon

A NEW HOME FOR THE GOPHER: UCC

The University Computer Center provides research and instructional computing to the industry, processing over 2,000,000 jobs a year. The volume of research procured at the center makes the purchase of the Cray 1B only natural. The ultimate goal for UCC remains as continually reducing cost to the user, says John Sell, the Business Developer for the center. The attractive price/performance ratio of the 4.5 million dollar Cray 1B helps the UCC to progress towards this goal. One may wonder how a University department could budget this fantastic cost. Through future revenues of the Cray 1 over a five year span, the computer will essentially pay for itself. The gold connectors within the Cray 1, composing a large fraction of the super computer's price, prove worthwhile with a conductivity superior to any other metal.

The UCC takes pride in the fact that they're the leaders in purchasing "state of the art" computers. One may view the center as a special museum, ranging from the oldest hardstrung, core memory still operating in the world to the Cray 1, a class 6 computer, and to a 1.3 billion word capacity CDC 885 disk storage unit. Filling the gap are the transistorized Cyber 74 (actually a refabricated version of the CDC 6600), two generations of integrated circuit computers, and 10 gigabites of disk storage. The services offered through the UCC are very appealing to the other University departments. For example, the Computer Science Department purchases time-sharing and batch. Other Institute of Technology departments purchase time for things such as research and development projects, and all departments enjoy the organizational help provided with computing time.

With the Cray 1B, the UCC adds a new dimension to the services it can provide. A sample of research work planned for the Cray includes, "theoretical studies on molecular orbital calculations in quantum chemistry and experimental and theoretical studies in high-energy physics," said Frank Verbrugge, director of the University's computer services. In the future, the UCC hopes to assist users in developing applications for the new super computer. The Cray 1B version at the center uses 8 columns, which may be expanded to 12 columns. In doing so, the internal storage increases from ½ million words to 1 million, doubling its capacity.

To prepare for the new arrival, the UCC must be ready to meet the Cray's extensive power, cooling, and upkeep requirements. The center has been powering up to the computer for the past year. The staggering amount of current this machine requires will be filtered through large generators to steady the current. It will then be channeled into the Cray 1B's monitering center, where it is separated into the eight columns of the machine. Because this super computer requires 140 gallons per hour of water to cool it, a special cooling tower with a 50 ton condensing unit, and a 4,000 gallon reservoir tank is being built by UCC. The cooling done in a convection manner is completed with a closed top process. This water recycling system will save the UCC an enormous amount on water bills. To house the upkeep equipment, UCC constructed a special building situated behind the center. As with other computer hardware, the Cray 1B reqruies a relatively dust free, low humidity environment, maintained at 68°F.

Seeing the Bell Labs place its hand-carved telephone atop of its Cray 1, the UCC will soon place the Gopher mascot atop the Cray 1B. With the prospering of UCC, perhaps the Gopher will smile atop the Cray 2 someday!

once, Rollwagen said. Last spring, working on his porch overlooking Lake Misota, Cray used a card table, binocular microscope, circuit board parts, tweezers, and a soldering iron to put together super computer parts. For him, it was like building a heathkit that he had designed.

Need for Even Faster Computers

Seymour Cray now works on one of two designs for a Cray 2 which may be five to ten times faster than the Cray 1. Sometimes it is hard to understand why a computer of such intense speed is needed. An example clarified its need.

The European Cneter for Medium Range Weather Forecasts (ECMEW) organized just as Cray 1 was developed. ECMEW would produce six to ten day forecasts which would be economically valuable to such industries as agriculture, transportation, construction, shipping, and energy. However, ECMEW needed a Cray 1 or similar computer in order to function.

To predict the weather a week in advance in any one area, you must be able to predict the weather in the entire world. ECMEW does this by collecting data from 100 kilometer cubed grids all over the world and using the Cray 1 to create the atmosphere and thus predict what will happen. The operation takes approximately 12 hours with a Cray 1. It would take 60 hours on other computers.

Still, 100 kilometers occupies a lot of space and much can happen within that space. To become more accurate ECMEW must shrink the cubes from 100 kilometers to 10 kilometers, creating 1,000 more cubed grids and calculating at least 500 times faster.

What Is Cray Doing To Meet These Needs?

Cray Research is presently working on three projects: two versions of the Cray 2 and an improved version of the Cray 1.

The group designing the Cray 1 works in Chippewa Falls and utilizes a more revolutionary instrumental approach.

One design unit working on a version of the Cray 2 is in Boulder, Colorado. They are using very sophisticated semi-conductor technology and may produce a 30 inch by 30 inch cylinder that could be ten times faster than the Cray 1.

Seymour Cray presently works with a group on a less ambitious semi-conductor, but more ambitious packaging and cooling technology. His version will have the CPU completely submerged in the liquid coolant.

All three of these computers have been designed and are starting to be built to be on the market within three years—so start saving your money!

How fast will these Cray-designed computers go?

That questions intrigues scientists. Says Sidney Fernbach, a scientific administrator at Livermore, "There's no machine Seymour Cray can conceive that would be too fast for us."

minnesota TECHNOLOG

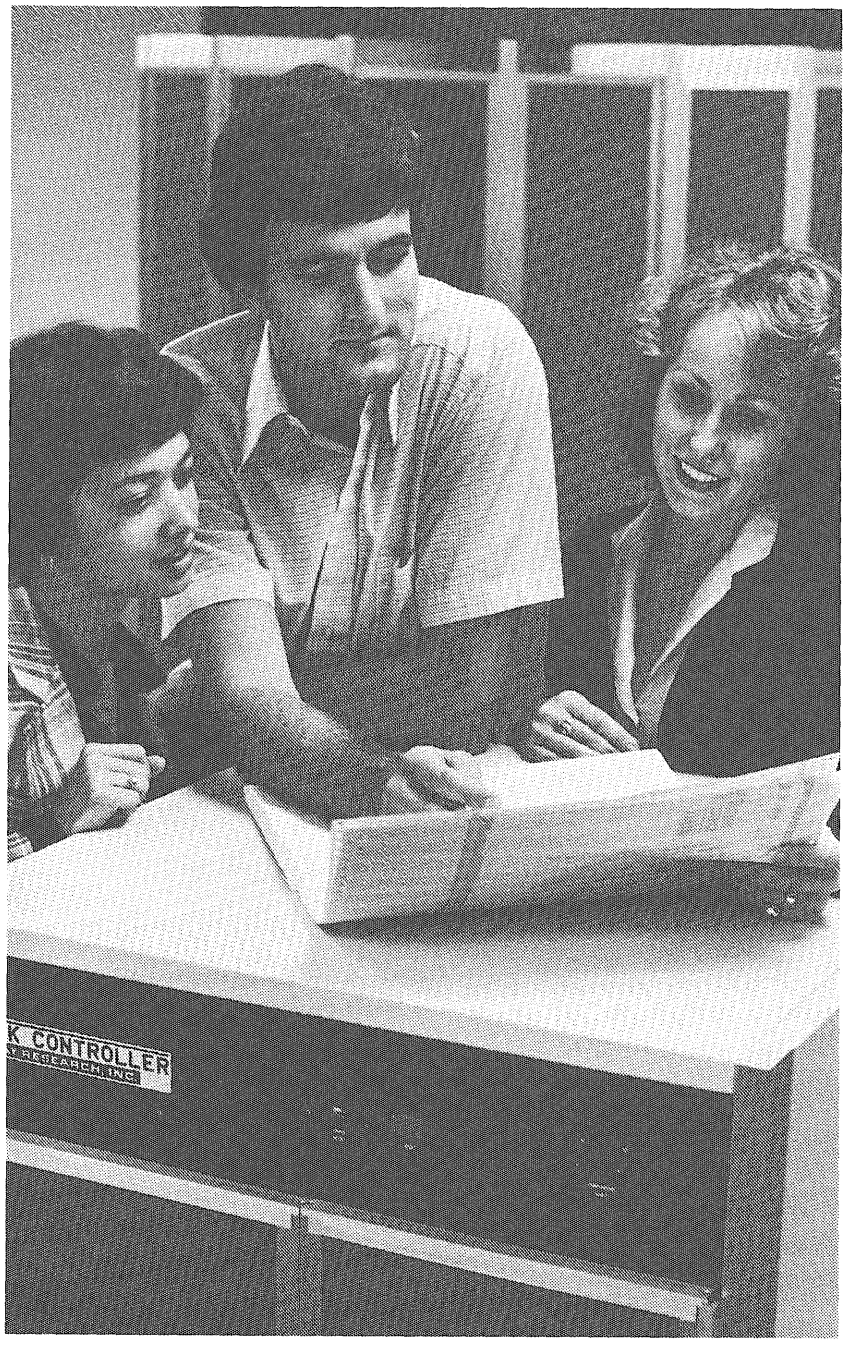
Kent Christensen and Barb Gross pulled double duties at Technolog this issue. In addition to working with the business and advertising, they found time to write this article. Kent, second year business manager, is a junior in Computer Science. He's also a member of the Delta Kappa Epsilon fraternity. Barb is a senior majoring in mechanical engineering and French. She works in advertising at Technolog, and is president of the Kappa Alpha Theta sorority.

ACHIEVERS.

At Cray Research, the efforts of our technical staff are the essence of this company's success.

And successful we are; in just a few short years, Cray Research has climbed to the number one spot in the industry for development of large-scale, scientific computers.

The CRAY-1 supercomputer, our most visible contribution to date, is regarded as the fastest machine in the world. This computer has earned the distinction of being the industry's technological benchmark — the standard of excellence by which all others are compared. Throughout the world, the CRAY-1's immense processing capabilities are being utilized to solve complex problems in weather forecasting, seismic analysis and other leading-edge research.



Our ability to offer reliable, cost-effective equipment has increased the demand for Cray technology. And, to help meet these needs, we're building on the people resources of our company.

As a new member of the Cray Research professional team, you'll enjoy immediate hands-on opportunities for contributing new ideas. Further, you'll be offered on-going support to continue achieving your very best. And, the youthful, energetic flavor at Cray helps promote excellence and innovative thinking.

If your background involves FORTRAN or assembly language programming, compiler development, software engineering or field engineering, we invite you to consider a career committed to progressive achievement. Send a resume for immediate attention to: **John Borchers (MT), Cray Research, Inc., Human Resources Dept., 1440 Northland Drive, Mendota Heights, MN 55120.**

Our Technical Recruiters will be interviewing on campus November 3rd and 4th.

CRAY RESEARCH, INC.

An Equal Opportunity Employer M/F

Math Institute opens doors at U of M

The University of Minnesota has received approval for a $5 million, five year renewable grant from the National Science Foundation to launch one of two institutes for mathematics and its applications. The Minnesota research institute is scheduled to open in the fall of 1982, and will bring mathematicians from around the world to work with scientists and engineers in solving high-level scientific research problems.

The University of Minnesota and the University of California at Berkeley were chosen to house the two mathematics institutes, although neither will have a permanent core faculty. A dozen other major universities competed for the award.

Minnesota's institute will focus on the applications of mathematics research, while Berkeley institute will focus on pure mathematics.

Willard Miller, head of the School of Mathematics, the University's largest department, said "Minnesota was chosen because of its great strength in applied mathematics and its history of collaboration between mathematicians and other researchers."

Each year, a different scientific area will be chosen for research at the institute. In the first year, the researchers will analyze the behavior of matter in abrupt change (i.e. a gas evaporating or a liquid freezing), an area ripe for mathematical development, Miller said. In subsequent years, researchers will cooperate on problems across the biological, social, and physical sciences and engineering.

About 30 researchers will be working at the institute at any one time. Some will be supported through the NSF grant, while others will be funded by a consortium f eight midwestern universities, which have contributed $10,000 each to the institute.

Through the initiative and funds supplied by eight companies—seven of which are members of the American Society for Engineering Education ASEE)—the Society will hire a Staff Executive to work on solving the country's gorwing engineering faculty shortage.

A conservative estimate puts the faculty shortage at 2000 nationwide. Industry's demand for engineers at both graduate and undergraduate levels has placed tremendous strains on the country's engineering schools and their increasigly overextended faculties.

Log Ledger

The University of Minnesota's chemistry professor Dr. **Bryce Crawford** has received the American Chemical Society's most prestigious and coveted award, the **Priestley Medal**. He will be presented with the award next spring at the ACS national meeting in Las Vegas.

Crawford did his schooling at Stanford University, where he received his A.B. in 1934, his A.M. in 1935 and his Ph. D. in chemistry in 1937. After receiving his Ph. D., Dr. Crawford spent two years at Harvard as a National Research fellow, then he was appointed an instructor in chemistry at Yale.

In 1940, Crawford came to the University of Minnesota as an assistant professor of physical chemistry, he became a full professor in 1946. Crawford chaired the Minnesota chemistry department from 1950 to 1972. After that, the returned to the classroom and laboratory for full time teaching and research.

Crawford's many accomplishments and contributions to chemistry have been good enough for one colleague to say in *Chemical and Engineering News* (July 13, 1981), "As a scientist, he is extremely highly regarded. As a statesman for chemistry he is renowned."

Science faculty and students can take "Scientific Russian" again during fall and winter quarters. Taught by Professor **Keith Armes**, Department of Slavic Languages, the two-quarter course familiarizes students with basic Russian grammar and syntax, and provides a basic vocabulary, with emphasis on scientific terminology. Students get the background necessary to read Russian material in the area of specialization with the aid of a dictionary.

An adjunct professor of geology and geophysics who returns to the University of Minnesota campus once or twice each year is equally at home on the Trinity College Campus in Dublin, Ireland, where he is provost. **William A. Watts** was elected provost by the Trinity faculty of Dublin's major university.

His association with IT began when he did postdoctoral work under H.E. Wright in the Limnological Research Center. He later became a visiting professor, helping Wright with some joint projects and working with graduate students. Now, as an adjunct professor, he returns two weeks in the spring and during the summer months.

Watts, a paleoecologist, studies the vegetation history of the southeastern United States, complementing the research he does in Ireland.

Physics Professor **Paul J. Ellis** was honored as IT's Outstanding Teacher for last school year, 1980-81. Mechanical Engineering Professor **Katsuhiko Ogata** is IT's Outstanding Advisor, and Chemistry's **David A. Keyes** is IT's Outstanding Teaching Assistant. All three received a special citation and a gift certificate for dinner at the Charthassen. Congratulations!

Professor Emeritus of Chemistry **Izaak M. Kolthoff** will receive the Olin-Palladium Medal at the October meeting of the Electrochemical Society.

The V. M. Slipher Fund committee of the National Academy of Sciences awarded $2,000 to the Astronomy Department's **Minnesota Starwatch** to enhance public astronomy education.

Dr. Raymond L. Sterling, director of the Underground Space Center at the University of Minnesota, will present one of 22 technical papers during the National Technical Conference on Earth Sheltered Performance and Evaluation, set for Oct. 16-17 at the Williams Plaza Hotel in Tulsa, Okla.

Sterling will present "Review of Underground Heat Transfer Research," which is about strategies for analysis of heat flow in earth contact systems. The paper will also include the status and future program of heat transfer research at the Underground Space Center. **George Meixel**, also of the University of Minnesota, is co-author of this paper.

The conference is sponsored by Oklahoma State University's Architectural Extension in cooperations with the American Underground Space Association and Earth Shelter Digest Magazine. More than 300 architects, interior designers, engineers, contractors and researchers are expected to attend the two-day meeting, which will feature earth sheltered housing experts from various parts of the United States and other countries.

Experimental "hybrid" vehicle being developed by General Electric for delivery to the U.S. Department of Energy will have both a 40-horsepower electric motor and an 80-horsepower gasoline engine under its hood. The electric motor will primarily be used for speeds from zero to 30 mph and the gasoline engine for higher speeds, particularly in highway driving. In situations where both the electric motor and the gasoline engine are needed, such as in passing, the load will automatically be shared. The $8 million, 30-month contract under which GE is developing the test vehicle is being administered for DOE by the Jet Propulsion Laboratory, Pasadena, Calif. Major subcontractors include the Research Division of Volkswagen AG, Wolfsburg, West Germany; Globe-Union Inc., Milwaukee, Wis.; and Triad Services, Inc., Madison Heights, Mich.

"Neither snow, nor rain, nor heat nor gloom of night stays these carriers from the swift completion of their appointed rounds."

To this age-old credo may soon be added, "nor lack of gasoline," as the U.S. Postal Service adds the first 14 of 375 electric mail delivery vans to its fleet of gasoline powered delivery vehicles. The electric delivery van operates for just pennies a day, can be re-charged overnight or between deliveries and is also quiet and pollution-free. The electric mail delivery program is expected to go nationwide in an effort by the Postal Service to reduce costs. The current gasoline powered delivery vans burn on the average five gallons of gasoline a day.

The Department of Energy's (DOE) Solar Energy Research Institute (SERI) has announced that it is now road testing a 1980 Chevrolet Citation that was modified to run on a hydrogen/carbon monoxide mixture produced from methanol.

In May of this year, SERI announced the conclusions of a year-long project, declaring that the engine and fuel system is on the average 50% more efficient than a conventional gasoline engine. During that time, thermal efficiency improvements of a 35-40% at heavy load (accelerating uphill) were obtained, as well as 80-100% improvements at light loads (level road at constant speed).

SERI's Systems Development Branch, which is responsible for the project, said the group expects to road test the vehicle for a year and will focus on its performance, driveability, response under varying driving conditions, and miles-per-gallon.

SERI scientists and engineers are hopeful that additional refinements can boost the efficiency even further. The project is a DOE Alcohol Fuels Office proof-of-concept experiment for utilizing unique characteristics of alcohol fuels in very efficient engines. The work has been closely followed by auto manufacturers in Brazil, Germany and Japan.

The engineers believe there is a potential for doubling the efficiency, which would result in an equivalent miles-per-gallon to gasoline since methanol has about one-half the energy per gallon as gasoline. Current methanol prices are approximately 76¢/gallon and may be reduced by mass production from biomass and coal. This concept therefore has the potential for much lower per-mile fuel costs than gasoline.

They occupy the lower niches of organizations, usually work for long hours, often paid minimal salaries, forego summer vacations, and--with few exceptions--are the happiest and most enthusiastic of workers.

They are interns. College students in search of hands-on experience. In a survey of these summer workers the *Wall Street Journal* reported that interns feel they learn valuable lessons from their summer work. Lessons, they say, that can't be taught in the classroom.

A summer internship is like a three-month interview. It can step up the intern for "real" job searching. It's also an excellent way for the employer to survey the crop of potential employees. And considering the determination and stick-to-it-ness that goes into engineering and technology degrees, it's an excellent way to find the job that's right for you.

First, the internship is the job experience that can turn a padded resume into a real gem. Second, if the internship is planned right, it produces showcase material for a job interview, an example of what the individual can do. Finally, the internship creates a sense of direction and self worth. It's scary to leave the familiar surroundings of the university and suddenly be in the business world full-time. The internship makes the transition less of a shock. When it comes time for the job interview, the intern will have worked in a company's offices, had lunch with people on the job, and probably met professionals of the same rank as the interviewer. Nerves will be calmer to say the least.

Take Eugene Volokh, a junior majoring in mathematics and computer science at the University of California. He's only 13 years old, but because of his 206 IQ, he's earning $966 every two weeks on his summer internship with Hewlett Packard, a pay rate "basically competitive" with the earnings of other interns, according to a company spokesman.

Not all internships offer such high rewards for the priviledge to get hands-on experience. However, they can make the difference when experience shows up as confidence and knowing where you're headed. This could result in more companies making better offers.

Critical Fluid Systems, Inc., a subsidiary of Arthur D. Little, Inc., has developed a process for removing oil from potato chips and similar snack foods without affecting their flavor and texture.

The proprietary process involves an extraction method that uses carbon dioxide near its critical state as an extractive solvent. Critical state carbon dioxide exhibits solvent properties which can enhance the selective removal of fattening oils from snack foods. Tests carried out show that potato chip flavor and texture can be retained after much of the oil is removed.

Critical Fuel Systems has applied for patents on the process and is seeking industrial partners in the snack food industry to help introduce the technology commercially to the diet-conscious segment of the snack food industry.

The United States now has a stockpile of uranium fuel for potential use in breeder reactors equivalent in energy to four times the estimated oil reserves of the Middle East.

This is one of the key points stressed by Wallace B. Behnke, Jr., Chairman of Project Management Corporation (PMC), in an assessment of the need for breeder reactors in the current issue of *Public Power Magazine*. PMC manages the utility interests in the Clinch River Breeder Reactor Plant Project in Oak Ridge, Tennessee.

"Current estimates show that U.S. reserves of reasonably priced uranium provide little margin for further expansion," Behnke states. "Thus it is imperative that the nation go ahead with the breeder. The breeder will use nuclear fuel 30 to 50 times more efficiently than the present generation of commercial nuclear power reactors. In fact, there is enough uranium already mined and stored as tailings from the government's enrichment plants to provide an energy potential equivalent of 1.4 trillion barrels of oil when used in breeder reactors. This is about four times the estimated oil reserves of the Middle East."

The Clinch River Project is the nation's first large-scale demonstration breeder reactor and is a joint effort of government and private industry. A breeder reactor is a nuclear power plant that produces more fuel than it consumes as it generates electricity.

The project is the largest industry commitment ever made to a single research and development effort. It is supported by 753 utilities from across the nation who have pledged $257 million to build and operate the plant.

Breeder development is necessary now to assure an adequate supply of electricity in the future, Behnke says. He contends that the Clinch River Project is the most cost-effective way to achieve eventual development of commercial breeder reactors because it will cost less, achieve critical project objectives sooner, and entail less technical risk than any alternative.

The utility executive says the Clinch River Project is the necessary next step in the U.S. breeder development program which includes construction and test operation of a breeder power plant. More than $1 billion has been invested, and the plant could be started up as early as 1989 with timely government approval this year to go ahead toward completion.

There is a broad consensus among those responsible for energy supply that the United States will need the breeder within the next 20 to 40 years. The nation cannot afford to slow or abandon development of the breeder.

According to Behnke, the worldwide consensus of energy experts supports breeder reactors. The International Nuclear Fuel Cycle Evaluation, a two-year study of alternative fuel cycles initiated by former President Carter and endorsed by 66 national and five international organizations, concluded that early deployment of fast breeder reactors would be required to provide assured nuclear electricity supply.

"The facts are that the Clinch River design is technically advanced, it has been continually updated. The project will keep the United States at the forefront of worldwide breeder technology. Further delay will increase costs when inflationary pressures call for restraint in federal spending. At current inflation rates each year of delay will add more than $150 million to the project cost.

The General Accounting Office has repeatedly recommended to Congress that the Clinch River Project proceed without delay, Behnke concluded. "The United States is now at the crossroads of deciding on nuclear power's future. A decision to go ahead will be a long overdue signal to the world that the United States is once again serious about addressing the supply side of its energy problems."

I.T. Recruiting Schedule

MONDAY, OCTOBER 12
Abbott Laboratories (2)
Chicago and North Western Transp. Co. (1)
BF Goodrich Company (The) (1)
3M Company (1)
Monsanto Company (2)
Raychem Corporation (1)
Texaco Incorporated (1)
Trane Company (The) (1)
United States Steel Corporation (3)

TUESDAY, OCTOBER 13
E.I. Du Pont (2)
Exxon Corporation & U.S.A. Affiliates (5)
Interstate Power Company (1)
3M Company (2nd day) (1)
Monsanto Company (2nd day) (2)
Motorola Incorporated (4)
Texaco Incorporated (2nd day) (1)
Trane Company (The) (2nd day) (1)

WEDNESDAY, OCTOBER 14
E.I. Du Pont (2nd day) (2)
Exxon Corporation & U.S.A. Affiliates (2nd day) (5)
3M Company (3rd day) (2)
Mobile Oil Corporation (4)
Monsanto Company (3rd day) (2)
Stone & Webster Engineering Corporation (2)
Trane Company (The) (3rd day) (1)

THURSDAY, OCTOBER 15
Cities Service Company (1)
E.I. Du Pont (3rd day) (2)
Exxon Corporation & U.S.A. Affiliates (3rd day) (5)
Factory Mutual Engineering (1)
General Electric Company (PhD) (3)
Halliburton Services (1)
IBM Corporation (15) (Coffman Memorial Union)
3M Company (4th day) (2)
Trane Company (The) (4th day) (1)
Monsanto Company (3nd day) (1)

FRIDAY, OCTOBER 16
American Hoist & Derrick Company (1)
FMC Corporation (3)
Maytag Company (The) (2)
3M Company (5th day) (2)
Sperry Flight Systems (1)
Trane Company (The) (5th day) (1)
Union Oil Company of California (2)

MONDAY, OCTOBER 19
Amoco Chemicals (Chicago) (1)
Amoco Oil (Whiting) (1)
Boeing Military Airplane Company (2)
Ethyl Corporation/Edwin Cooper Div. (1)
General Mills Incorporated (1)
Koch Refining Company (3)
Medtronic Incorporated (2)
Radio Corporation of America (RCA) (1)
Seismograph Service Corporation (1)
Square D Company (2)
Cargill Incorporated/Processing Group (1)

TUESDAY, OCTOBER 20
Allen-Bradley Company (1)
Amoco Oil, RTE (1)
Amoco Research Center (ChemE) (2)
Eaton Corporation (1)
Hughes Aircraft Company (3)
Honeywell Incorporated (6)
Phillips Petroleum Company (2)
Wisconsin Public Service Corporation (1)

WEDNESDAY, OCTOBER 21
Amoco Oil, RTE (2nd day) (1)
Amoco Research Center (ChemE) (2nd day) (2)
Detroit Edison Company (1)
Eaton Corporation (2nd day) (1)
Honeywell Incorporated (2nd day) (6)
Phillips Petroleum Company (2nd day) (2)
Pillsbury Company (The) (2)
Rohm and Hass Company (1)
THURSDAY, OCTOBER 22
American Cyanamid Company (1)
Bell Labs (CompSci) (1)
Bell Labs (ElecE) (2)
Boeing Company (The) (4)
Diamond Shamrock Corporation (3)
Procter & Gamble Company (The) (3)

FRIDAY, OCTOBER 23
American Cyanamid Company (2nd day) (1)
Bell Labs (CompSci) (2nd day) (1)
Bell Labs (ElecE) (2nd day) (2)
Boeing Company (The) (2nd day) (4)
Harris-Stewart Companies Incorporated (1)
Northern States Power Company (Minnesota) (1)
Occidental Research Corporation (1)
Procter & Gamble Company (The) (2nd day) (3)
Western Gear Corporation (1)
Northrop Corporation (Aircraft Division) (1)

MONDAY, OCTOBER 26
Air Products & Chemicals, Inc. (1)
Cargill Incorporated/Salt Division (1)
Chicago and North Western Transp. Co. (1) (Room only)
S.C. Johnson & Son (1)
Naval Weapons Center (1)
Northrop Corporation (Defense Sys. Div.)(1)
Shell Companies (1)
Sperry Univac/Semiconductor Div. (1)
Teradyne (1)
Warner Elecric Brake & Clutch Company (2)
Westinghouse Electric Corporation (3)

TUESDAY, OCTOBER 27
Amoco Production Company (Houston) (2)
Conoco Incorporated (4)
Consolidation Coal Company (1)
Gulf Research & Development Company (1)
Minnesota Valley Engineering (1)
National Steel Corporation (1)
Nelson Industries Incorported (1)
Shell Companies (2nd day) (1)
Sperry Univac/Semiconductor Div. (2nd day) (1)

WEDNESDAY, OCTOBER 28
ADC Magnetic Controls Company (1)
Caterpillar Tractor Company (2)
Kimberly-Clark Company (2)
Oscar Mayer & Company (1)
Rosemount Incorporated (3)
St. Regis Paper Company (2)
Shell Companies (3rd day) (1)
Sperry Univac/Semiconductor Div. (3rd day) (1)
Standard Oil Company (The) (Ohio) (2)

THURSDAY, OCTOBER 29
Chevron Companies (5)
Control Data Corporation (3)
Shell Companies (4th day) (1)
Shell Development Co. (PhD-ElecE, Phys) (1)
Std. Oil Co. Div. (The) (Ohio) (2nd day) (2)
UOP Process Division (3)
Deere & Company (1)

FRIDAY, OCTOBER 30
Bechtel Power Corporation (MI) (6)
Chevron Companies (2nd day) (4)
Upjohn Company (The) (3)
Conoco Incorporated (2nd day) (1)

MONDAY, NOVEMBER 2
Archer Daniels Midland (2)
Boise Cascade Corporation/Paper Group (2)
DARCOM (1)
General Electric Company (6)
Gulf Oil Corporation (Geology) (1)
National Security Agency (1)
Sperry Univac (Roseville) (2)
Westvaco Corporation (1)

TUESDAY, NOVEMBER 3
Bemis Company Incorporated (2)
Cray Research (2)
Data General Corporation (2)
McDonnell Douglas Corporation (3)
Shell Development Company (2)
Sperry Univac (Roseville) (2nd day) (2)
Texas Instruments Incorporated (1)
Gulf Oil Corporation (Summer) (1) (2nd day)

WEDNESDAY, NOVEMBER 4
Advance Micro Devices, Inc. (1)
Burlington Northern Incorporated (2)
Cray Research (2nd day) (2)
Eastman Kodak Company (PhD-ChemE) (1)
McDonnell Douglas Corporation (2nd day) (3)
Nekoosa Papers Incorporated (1)
Procter & Gamble Co. (The) (Mgmt. Sys.) (1)
Rexnord Incorporated (1)
Siemens-Allis Incorporated (1)

THURSDAY, NOVEMBER 5
Commonwealth Edison Company (2)
Fairchild Test Systems Group (1)
Hewlett-Packard Company (8)
Intel Corporation (2)
Texas Instruments Incorporated (4)

FRIDAY, NOVEMBER 6
Fairchild Test Systems Group (2nd day) (1)
Hewlett-Packard Company (2nd day) (8)
Intel Corporation (2nd day) (2)
Texas Instruments Incorporated (2nd day) (4)

MONDAY, NOVEMBER 9
Amoco Production Research (1)
Beloit Corporation (1)
Bucyrus-Erie Company (1)
CPT Corporation (1)
Gould Incorporated (1)
GTE Corporation (1)
E.F. Johnson Company (2)
Missouri Pacific Railroad (1)
Sandia Labs (1)
Stanley Consultants Incorporated (1)
United Telephone Company of Minnesota (1)

TUESDAY, NOVEMBER 10
Celanese Corporation (2)
General Motors Corporation (6)
National Semiconductor Corporation (1)
Sandia Labs (2nd day) (1)
Schlumberger Well Services (2)
Wang Laboratories Incorporated (2)

WEDNESDAY, NOVEMBER 11
Burroughs Corporation (2)
General Dynamics Corporation (4)
General Motors Corporation (2nd day) (6)
Pillsbury Company (The) (3)
Schlumberger Well Services (2nd day) (2)

THURSDAY, NOVEMBER 12
General Dynamics Corporation (2nd day) (4)
General Motors Corporation (call-back) (6)

FRIDAY, NOVEMBER 13
W.H. Brady Company (1)
E.I. Du Pont (CompSci)(1)
Emerson Electric Company (1)
Harris Corporation (1)
International Harvester Company (1)
Lawrence Livermore National Laboratory (2)
Marquip Incorporated (1)
Northern States Power Co. (MN) (2nd visit) (1)
Sundstrand Corporation (1)
Whirlpool Corporation (2)
Menasha Corporation (1)
Tektronix Incorporated (1)

MONDAY, NOVEMBER 16
Allis-Chalmers Corporation (1)
Dow Chemical U.S.A. (3)
Johnson Controls Incorporated (1)
Eastman Kodak Company (3)
NBI Incorporated (1)
Nortronics Company Incorporated (1)
Pacific Gas & Electric Company (4)
Sperry Univac Defense Systems (1)

TUESDAY, NOVEMBER 17
Allis-Chalmers Corporation (2nd day) (1)
Ampex Corporation (2)
Dow Chemical U.S.A. (2nd day) (3)
Eastman Kodak Company (2nd day) (3)
Mead Corporation (1)
Pacific Gas & Electric Company (2nd day) (4)
Scientific-Atlanta Incorporated (1)
Sperry Univac Defense Systems (2nd day) (1)

WEDNESDAY, NOVEMBER 18
American Electric Power Service Corp. (2)
Atlantic Richfield Company (5)
Black & Veatch Consulting Engineers (3)
Fluor Engineers and Constructors, Inc. (3)
Scientific-Atlanta Incorporated (2nd day) (1)
Sperry Univac Defense Systems (3rd day) (1)

THURSDAY, NOVEMBER 19
Atlantic Richfield Company (2nd day) (5)
Chrysler Corporation (1)
Corning Glass Works (P.M.) (2)
Hooker Chemical Company (1)
M.I.T. Lincoln Laboratory (1)
Union Carbide Corporation (6)
Union Carbide Corporation (PhD-ChemE)-(1)

FRIDAY, NOVEMBER 20
Corning Glass Works (A.M.) (2nd day) (2)
Inland Steel Company (2)
Long Beach Naval Shipyard (1)
Northern States Power Co. (MN) (3rd visit) (1)
Schlumberger International (2)
Union Carbide Corporation (2nd day) (7)

MONDAY, NOVEMBER 23
Brown Boveri Tumbomachinery Incorporated (1)
Fairchild Semiconductor Products (2)
Fisher Controls Company (1)
Al Johnson Construction Company (1)
Minnesota Mutual Life Ins. Co. (The) (1)
Peace Corps, Vistas (1)
Rockwell International (2)
Square D. Company (2nd visit) (1)
Texas Instruments Incorporated (1)
United States Air Force (1)
Vought Corporation (1)
Western Geophysical Company (1)
Wisconsin Natural Gas Company (1)

TUESDAY, NOVEMBER 24
Champion International (2)
Fairchild Semiconductor Products (2)
Fisher Controls Company (2nd day) (1)
General Mills Research (1)
NASA/Lewis Research Center (1)
Owens-Corning Fiberglas Technical Center (1)
Pickands Mather & Company (2)
Rockwell International (2nd day) (2)
Western Geophysical Company (2nd day) (1)
Doboy Packaging and Machinery (2)

WEDNESDAY, NOVEMBER 25
No Interviews

THURSDAY, NOVEMBER 26
Thanksgiving Holiday

FRIDAY, NOVEMBER 27
Thanksgiving Holiday

MONDAY NOVEMBER 30
Cargill Incorporated/Grain Handling Res. Lab. (1)
Digicon Incorporated (1)
Kaiser Aluminium and Chemical Corporation (3)
Kato Engineering (1)
Litton Microwave Cooking Products (1)
PPG Industries (1)
Reserve Mining Company (1)
Travenol Laboratories Incorporated (1)

TUESDAY, DECEMBER 1
Cargill Incorporated/Research Department (1)
Corps of Engineers/St. Paul District (1)
Gearhart Industries Incorporated (1)
Kennecott Minerals Company (2)
Micro Control Company (1)
Engineering NCR Comten
PPG Industries (2nd day) (1)
National Computer Systems (1)
Western Electric Company (1)
York Division/Borg-Warner Corporation (1)

WEDNESDAY, DECEMBER 2
Corps of Engineers/St. Paul District (2nd day) (1)
Falk Corporation (The) (1)
Firestone Tire & Rubber Company (1)
Gearhart Industries Incorporated (2nd day) (1)
Signetics Corporation (2)
United States Air Force (2nd visit) (1)
Xerox Corporation (PhD-ChemE) (1)
Cargill Incorporated/Chemical Product Div. (1)
Ford Motor Company (1)
Central Intelligence Agency (1)

THURSDAY, DECEMBER 3
Albany International (2)
Fruin-Colnon Corporation (1)
Central Intelligence Agency (2nd day) (1)

FRIDAY, DECEMBER 4
Fruin-Colnon Corporation (2nd day) (1)

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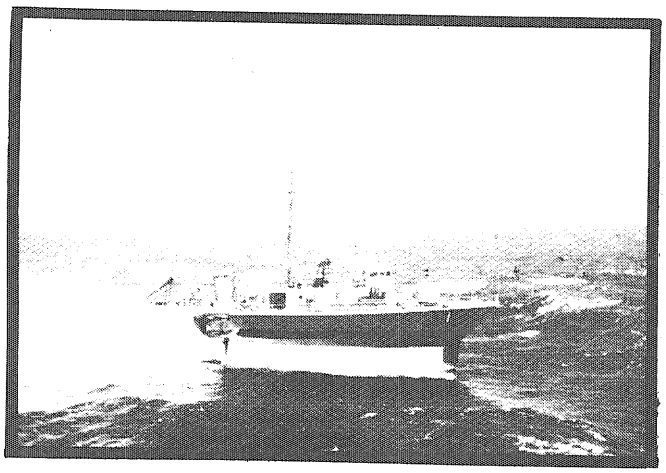

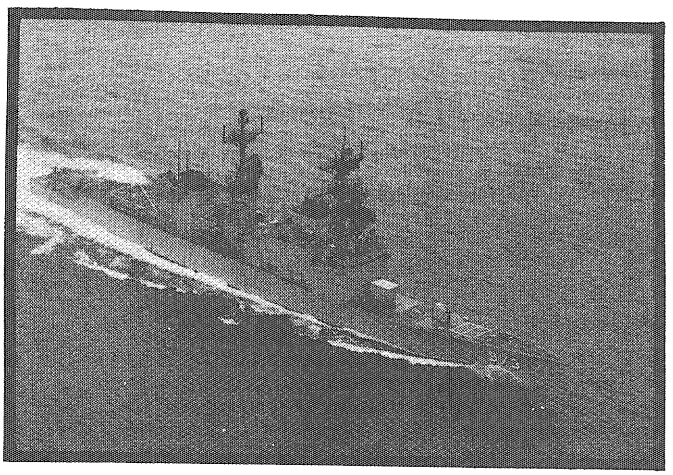

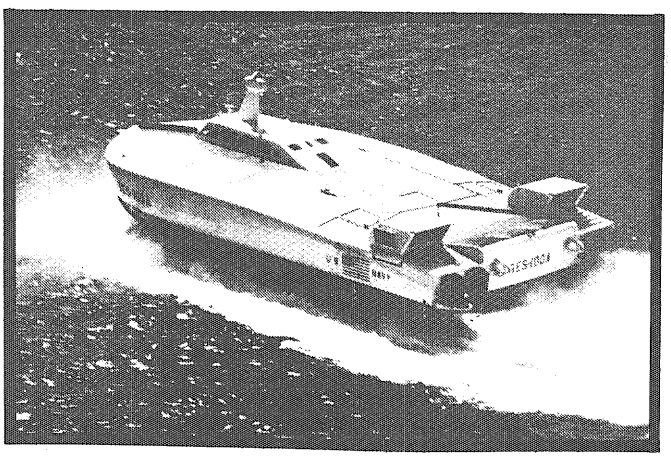

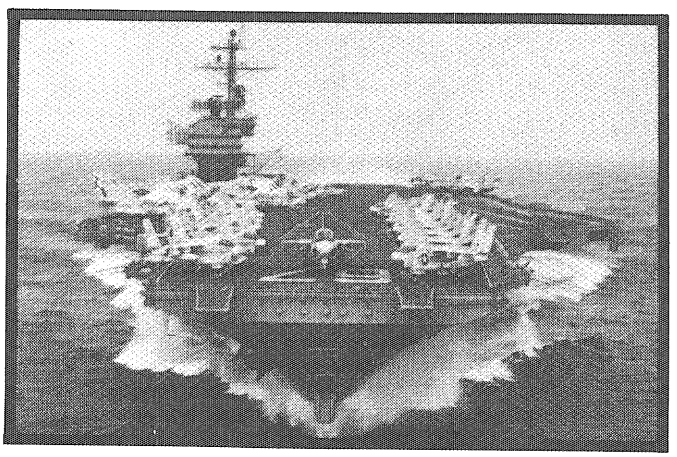

Naval ROTC pays off in a number of ways. First, of course, it leads to a commission as an Ensign in the Navy.

It can also help pay your way through college. After two years in the Naval ROTC College Program, every student receives $100 a month living allowance for ten months each year, during his junior and senior years. In addition, he has the opportunity to qualify for a full scholarship—tuition, fees, books, plus expenses—up to a total of $10,000.

For more information, speak to the Professor of Naval Science on campus.

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THE NAVY

Faculty shortage in engineering

Once again a popular degree, engineering is also a highly marketable degree. According to a College Placement Council survey of first job offers, the 1980 crop of engineers with B.S. degrees lead the pack in starting salaries and job offers. Petroleum engineers commanded starting salaries of $26,244. Salary offers at the Ph.D. level are very attractive too, which is where the faculty problem really begins.

Universities simply cannot compete with industry's offers to Ph.D.s Industrial offers of twice the amount professors earn in academe are common.

"Practically the first thing you hear from a dean when you walk in the door is, 'You ... you're stealing our faculty'," says one corporate representative who has visiting more than 80 campuses across the country.

"While retaining faculty is a grave problem, what we find even more disturbing," says ASEE's executive director, W. Edward Lear, "is the drastic decline in the number of students going on to graduate study." Industrial salary offers have made the added years of toil in the university economically unattractive. Fewer and fewer American students are going to graduate school. According to the Engineering Manpower Commission's yearly survey of engineering colleges, in 1980, 2751 doctoral degrees were granted in the U.S. In 1979, the figure was 2815, continuing a downward trend since the peak year of 1972 when 3774 doctoral degrees were granted.

Hidden within the 1980 figure of 2751 Ph.D.'s is the fact that nearly one-thirds are foreign national, only half of whom will probably remain in the U.S. Industry hires approximately two-thirds of the Ph.D.'s, says Lear. Obviously, this situation leaves only a trickle to come back to the faculty pipeline.

AT&T, DuPont, Exxon, General Electric, General Motors, GTE, IBM and Union Carbide have become increasingly concerned during the past year about the shortage of engineering faculty member. They have agreed to provide money for the new position of a Staff Executive, who will work out of ASEE headquarters in Washington, D.C. during the next two years.

The person in this position will have four major responsibilities:

To bring together relevant data on the problem, ensuring the accurate and adequate data base;

To develop, with industry, a viable plan of action to solve the faculty problem;

To coordinate the activities of other industrial and association efforts on this problem.

The grant for the new position and accompanying activities—funded at approximately $100,000 each year—will actually come to ASEE through the American Association of Engineering Societies (AAES) which represents nearly one million engineers. This route will be taken, says Lear, "to insure that the effort has the support of the entire profession," rather than just that of engineering education.

The faculty shortage has long been an issue of deep concern to ASEE, and not surprisingly, some means of attacking the problem have already been formed. "We have a variety of inititatives under consideration by industry to aid the engineering colleges with recruitment and retention of faculty," says Lear. "Among the possibilites are fellowships bearing stipends in an amount that wil make graduate study more attractive, more use by more universities of engineers on loan from industry for short-term teaching assignments, and engineering faculty salary supplements to make them more competitive with industrial salaries. "I'm sure that additional approaches will result from the growing awareness in industry, government and the universities themselves that the shortage poses a serious threat to the future supply of the engineering manpower needs of the nation. But we very much need to organize all the efforts under consideration to insure that we have a planned, nationwide attack on the problem—and that will be the job of the person we are attempting to recruit."

Lear has begun active recruiting for someone to fill this slot and hopes to have that person working on the faculty problem by August.

EDITOR'S NOTE: Founded in 1893, the American Society of Engineering Education is a professional society dedicated to the improvement of engineering and engineering technology education. The Society is composed of approximately 11,000 individual members and 550 instititional members. Included in the latter category are engineering colleges; technical, community and junior colleges; industrial firms; and professional societies.

minnesota TECHNOLOG

FOCAL

by David E. E. Carlson

In another instant the cloud had passed, releasing 920W/m² of spectacular splendor to bathe the earth below. At the same instant our focal point materializes with the gathered power of 1,000 suns, illuminating the quarter-inch steel plate we've placed there to mark its location and bear its effect. We lower our welding glasses to avoid blindness. Five seconds to orange, ten seconds to glowing red, then white-hot, eye-squinting intensity mark the metal's thermal passage at the back of the plate. The metal drips like candle wax and spills away from the growing hole. At the fifteen second mark the focus has melted entirely through the plate. The run is complete.

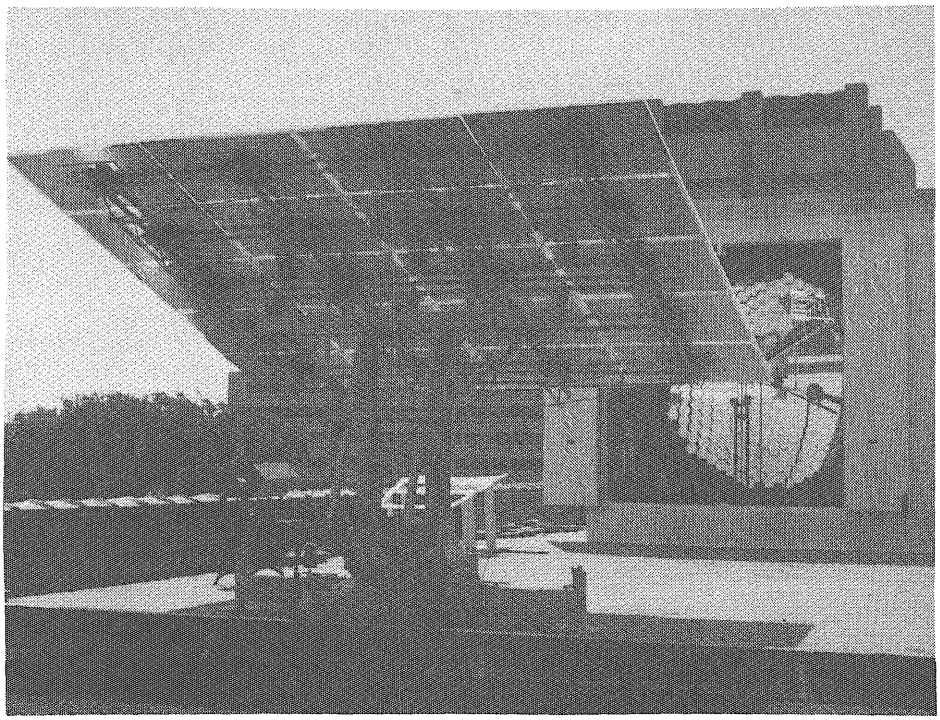
Is this some obscure, high-tech, big-money industry project, laid out in the middle of a western high plains desert. Nope. It's the brand-spanking-new solar reactor/furnace sitting atop Ackerman Hall at the University of Minnesota.

Described above was a typical early run to get a rough feel for what we've spent the last fifteen months building. Beyond saying simply "It works," we can actually boast of having the most up-to-date high-intensity solar research facility in the United States.

At a peak rated power of 8kW$_t$* our furnace isn't the largest facility in the country. The few other furnaces here in the U.S., Georgia Tech, (400kW$_t$), White Sands, N.M. (30kW$_t$), Sandia Labs, N.M. (5MW$_t$), and the Jet Propulsion Lab, in California (85kW$_t$), are all larger.

But for our experimental studies, total power is of minimum importance. Intensity is watt counts, and in that area we rank with the best. With approximately 500W/cm² at the very center of the focus, even firebrick melts to glass in seconds. Further testing is being conducted to better characterize the flux distribution at the focus.

Approximations are OK for early work, and drawing "0o"s and "Ah"s by melting perceptual immutables is certainly entertaining. But, save the military, research monies aren't given over for building big toys. Our furnace was funded and built on the basis of a need for sound fundamental research in corrosion and high-temperature thermochemistry. A solar furnace not only allows very high operating temperatures, it also permits selection of the chemical environment, an advantage not allowed using regular combustion furnaces. Main thermochemistry efforts concern effusional separation of hydrogen from a high-temperature equilibrium water mixture using zirconia membranes.



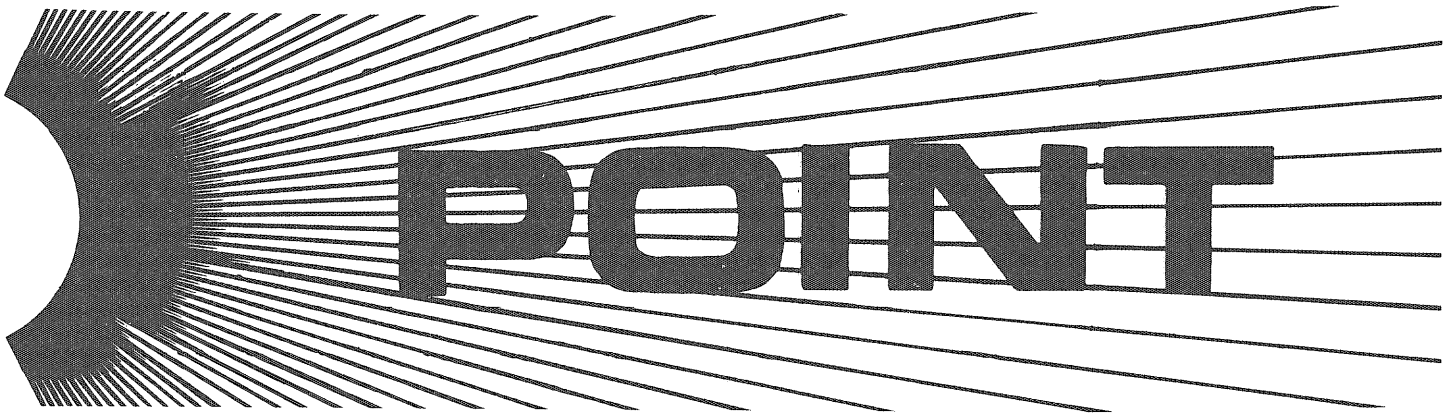
The heliostat and the mirrors sit silently atop Akerman Hall.

For those who have been familiar with the happenings on the 4th floor of M.E. for the last two years, the furnaces stands as a shining example of that wonderous and often untenable bridge between imagination and reality, between forms in mind and forms in matter. Seed thoughts may be credited to Dr. Edward A. Fletcher, head of graduate studies in M.E. A travel grant from the Office of International Programs permitted continued discourse between Dr. Fletcher and Dr. Claude Royere. Their exchange took place on Dr. Royere's home territory—at the French CNRS (Centre Nationale de Rechearche Scientifique) Solar Furnace in Odiello, France. A power rating of 1 MW$_t$ with a flux of 1600w/m² for the main furnace dwarfs facilities in the U.S. Tower Power configuration, with the Sanida's set up, may gather more power, but their intensity, at 240W/cm², doesn't even come close to Odiello's.

Scale is limited by building structure at the University. Smaller furnaces at the French site, rated from 1.5 to 6.5 kW$_t$, provided the real design models that Dr. Fletcher brought back with him.

Upon returning, Dr. Fletcher was soon joined by Richard B. Diver, B.S. in General Engineering from West Point. Early theoretical work in the fall of 1975 involved determining suitable materials and microstructures for the stringent hydrogen from water mix separation conditions. Really, now does anything readily come to you mind when you're asked to construct a surface with an extensive network of

*kW thermal; radiant energy delivered through the focus.



micronesque holes that can withstand a highly oxidizing atmosphere at 2500° K? The solution to this problem, and the design of the total reactor/separator system gave us one Dr. Richard B. Diver.

Paper proofs and problem sets are great fun, as any engineering student can attest. Guess again. Any engineering student can vouch for the inherent futility and hollow victory that goes with matching the four-digit product of two hour's labor to the answer at the back of the book. So big deal. I get nine out of ten on a problem set and then what? Then I get more problem sets.

Likewise, there was only so much satisfaction to be gained from pushing numbers around on paper, churning out equilibrium temperatures and product mixtures, corrosion rates, pressure differentials, and enrichment ratios. A solar reactor/furnace, the only known device which could meet our exacting energy and atmospheric requirements, had to be built.

Presentation of a grant proposal, along with the good faith of I.T. Dean Roger Staehle and Professor Richard Oriane, got us started with a grnt from the Corrosion Research Center on campus. A grant from the Solar Energy Research Insitute (SERI) for "Proof of Principle" for the hydrogen from water process soon followed. We were on our way.

In the fall of 1980, Dr. Diver and Jon Noring formed a senior design group to review the literature and come up with ideas to amend and adopt the Odiello-based design to our needs. Design parameters were established as follows:

1. 4 meter minimum diameter for the concentrator.
2. Year-round use.
3. Fixed point of focus.
4. Minimum obtainable black body temperature of 3500° K.
5. Survivability against wind, hail, temperature variations, etc.
6. Room for adequate laboratory space.

Study was broken into the areas Site and Optics, Structures, Tracking, with additional work on concentraion ratio, efficiency and dispersion, and parabolic approximation. All but item 4 were found to be feasible. Maximum theoretical temperature was limited to the low 3000°K range.

Spring quarter saw the formation of a similar design group. Actual hardware design and cost estimates were the main goals here. By this time, gross morphology had been decided on. A large, flat mirror called a heliostat would track the sun, continually directing its reflected rays parallel to a fixed horizontal axis into the concentrating mirror array. From the concentrator, hundreds of hexagonal interlocking mirrors (see diagram 1) direct the rays to the desired fixed focal point. Based on this design, the spring quarter group broke analysis into three areas: Concentrator, Heliostat, and Control /Tracking.

With the end of spring quarter and the coming of summer it was finally time to apply all that engineering. From stress analysis to computer modeling of heliostat reflection angles, it was all down on paper, three hundred some odd pages of detailed engineering. Blast the price estimates — Purchasing Department, here we come.

Paths from materials purchase to final form didn't always pass through detailed calculations. As with almost any engineering endeavor, the final design and method of construction must rest with conditions, materials, and knowledge available right as fabriction begins. The entire heliostat support and drive system design was superceded by the sudden avialability of an old Army mortar-tracking radar. Pro-

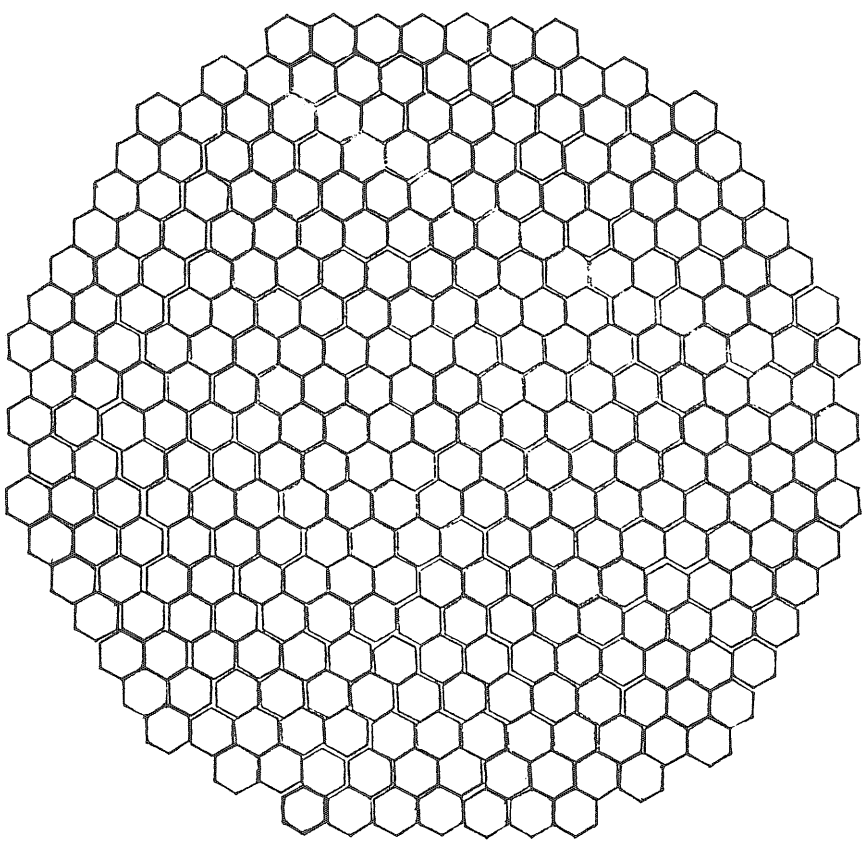


Diagram 1 DIVER PATTERN- 312 facets (center facets not included)

fessor Don Olson of the Physics Department at the U. of M. Duluth campus located it for us at the U. of M.-Morris. Given equivalent function, immediate availability, and the unbeatable price of $00.00, we replaced the exisiting design with an on-site adoption of the tracking base to the heliostat backing. Much time and money was saved by analogous, but less extreme modificaitons throughout the rest of the building process.

When necessary, we checked the suitability and safety of our modifications with various faculty. Professor Dick Springer, for example, provided extremely valuable consultation on matters concerning structural integrity. For the most part, though, remaining construction followed the design plan.

Stories surrounding construction abound. There was the day we rounded up 30 unsuspecting grad students by scouring halls and raiding rooms with open doors. We needed help lifting the heliostat mirror backing to its mount, Egyptian pyramid worker style. There was the day we scrambled among cold steel joists in the midst of winter, affixing mirrors to backing with metal brackets by bare hand. And there was the day the hornet flew into John McFeater's welding mask, causing the spontaneous explosion of mask, rods, gloves and John to all four corners of the solar deck. Ah, memories.

One of the most challenging aspects of construction was the alignment of 312 spherical concentrating mirrors to a precision of one milliradian. Using many small mirrors eliminate the tremendous expense of a special-order parabolic concentrator. At the same time it necessitates aligning by hand those hundreds of mirrors to mm accuracies. Solution to this delicate problem lay in inspection of the concentrator geometry. (See diagram 2).

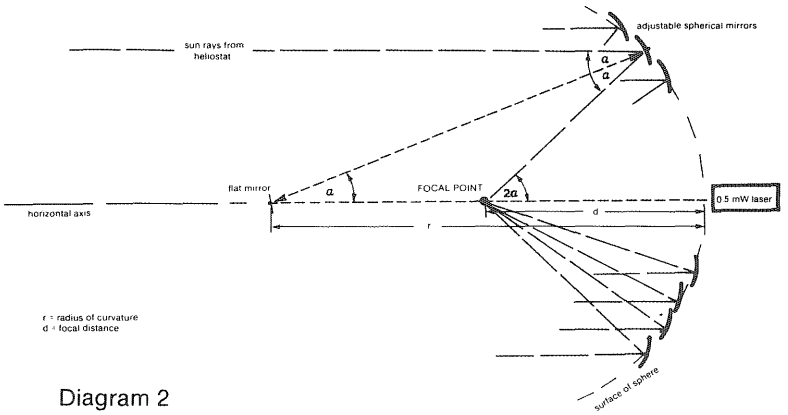


Diagram 2

Each mirror intercepts a ray and reflects it to a point on the central axis exactly 2.89 m from its surface. Analysis of a single mirror placement suffices because all mirrors are distanced on the surface of a sphere. Inspection of the diagram shows that the projection of the surface normal intercepts the central axis exactly two focal distances from the center of the array. Placement of a flat mirror at that point should reflect a ray back upon itself when the concentrating mirror is properly positioned. Based on this principle, we installed a 0.5 mW laser just behind the array on the right axis. Reflecting from the flat mirror, the laser light was centered on each mirror in turn, each was swiveled in its ball and socket until it reflected the light back on itself. You could just see us singing "One O two pieces of mirror on the wall, one O two pieces of mirror, you tack one up and spin it around, one O three pieces of mirror on the wall..."

One month after we began we finished, and only two mirrors were broken along the way. Now, if anyone so much as sneezes near the mirrors, they are bodily removed and forever banished. Remember that when you come to visit.

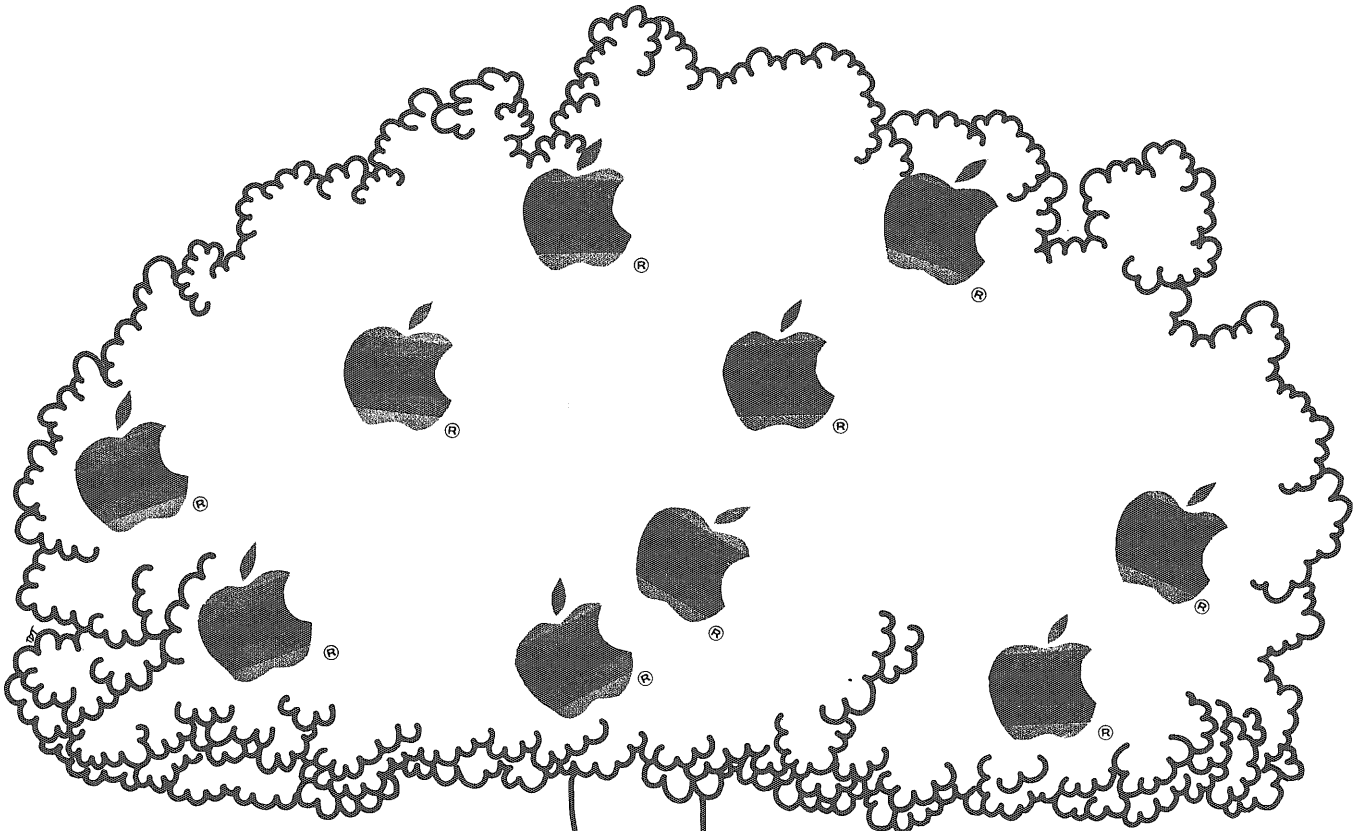
Final dimensions are worth noting. In its final form the furnace has 32.5m^2 heliostat, composed of 20 individually adjustable flat plate mirrors on plastic and aluminum cellular backing. 13.52 m^2 of concentrating array focus approximately 70% of available solar insolation to a circular focus of approximately 10cm diameter. Until we put a plate or reactor at the focus to reflect its light, it is invisible to the eye. Further work involves characterizing flux distribution at the focus, as previously mentioned, temperature measurements using black-body receivers, some minor work on the tracking system, and fine tuning the optics.

Since its inception, the availability of an intense solar flux has inspired several other projects. Todd Kappauff, for example, is breaking new ground in the high temperature corrosion of platinum group metals. Oxidation and evaporation coordinate surface attack in a way which is currently only vaguely understood. At lower temperatures, oxidation dominates, but as more energy becomes available with increasing temperature, evaporation dominates. Complicating this volitalization of newly formed oxides and permeability of oxides to evaporation. Irridium is

STILL WAITING FOR THE APPLE TO FALL?

DISCOVER THE

LAW OF AVAILABILITY.



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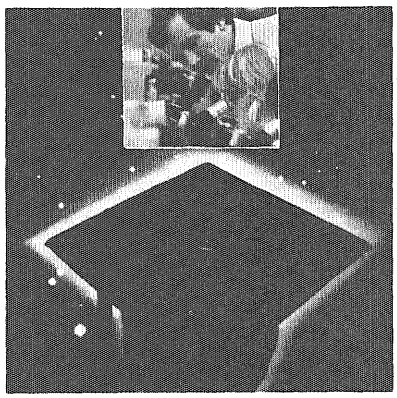
- The designer and producer of the most complex MOS chip.
- The inventor of single-chip solid-state voice synthesis.
- The largest producer of microelectronic memory products.
- The world leader in Very Large Scale Integration.
- The primary supplier of airborne radars to the U.S. defense program.
- The leading developer and producer of infrared and laser systems.
- The world's foremost geophysical survey company.



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Campus Interviews

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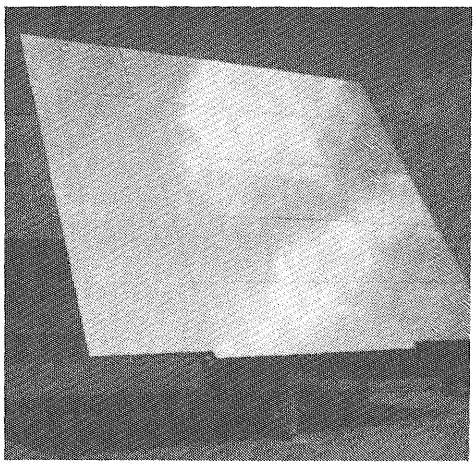


The heliostat

the metal with which Todd is working. With luck, the work wil tie in to more advanced hydrogen separation schemes planned for later.

Irridium oxides don't excite you? There's always Frank MacDonald, who is computer modeling equilibrium conditions and mass flow rates for the separation of hydrogen bromide. In a manner similar to the separation of water, HBr dissociates into five molecular species whose relative concentration depend on temperature and pressure conditions (Hello thermo 3303). Molecular weight differences, combined with the similiar equipartition principle of energy, result in species with different rms speeds and mean free paths. By selecting a membrane with appropriately sized holes, one can effect a separation of hydrogen from the equilibrium mix which is proportional to the inverse square root of molecular weight. Hydrogen and bromine can then be recombined in a fuel cell to produce electicity. Got all that straight? Never mind, Frank says it works. By the time he escapes here with his doctorate, he'll have constructed a working system to prove it, using the furnace to create the high temperatures required.

Another grad student, yours truly, is attempting to determine low pressure, high radiant intensity effects on volatile product yields in biomass pyrolysis. It is well known that zapping cellulose with high energy fluxes yields a chemically valuable mix of hydrogen, carbon oxides, methane, ethane, ethylene, acetylene, and countless other minor products. Maximizing valuable products like ethylene means payola, since ethylene can be considered the most valuable single chemical of the petrochemical industry.[1]

1. Kniel, Winter, and Stork, "Ethylene-Keystone to the Petrochemical Industry," Marcel Dekker, Inc., N.Y. 1980.

To be more precise, a substantial product yield of olefins like ethylene might, for example, give 22 kg of gasoline for every kg of dry biomass.[2] You can chew on the economics of that yourself; but the usefulness is pretty well apparent, even without your calculator.

Future experimentation with the furnace is limited only by the imaginations of those who use it. Ponder, for instance, potetial Carnot efficiencies with engines working in the 3000° K range. Remember the Stirling engine?. How do ceramics fit into this all?

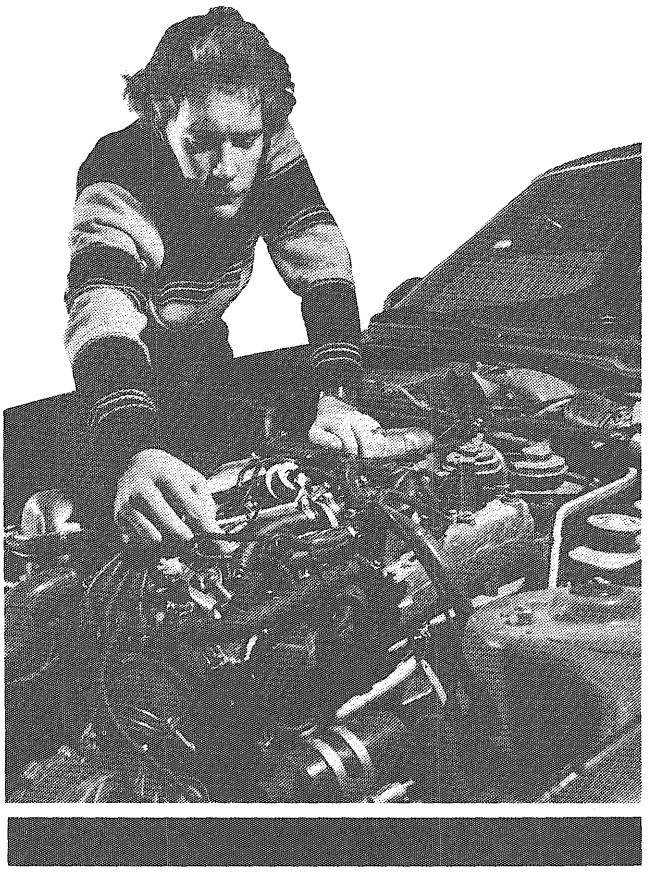
It's a whole new field with the sun as the limit. And the sun is yours. Come on up and see us sometime!

Minnesota TECHNOLOG

2. Diebold, J.P. Benham, C.B., Smith, G.D., "Conversion of Organic Wastes to Unleaded, High Octane Gasoline", Naval Weapons Center, China Lake, California, September, 1979.

Dave Carlson is a graduate student in Mechanical Engineering. Here Dave is shown pondering the solar furnace. Dave's major area of study is pyrolysis.

Frontrunner.



Our Technical Recruiters will be interviewing on campus November 16th, 17th and 18th.

Meet Tom Erickson, Associate Electrical Engineer at Sperry Univac Defense Systems Division. Tom works hard but he enjoys his free time too.

Away from the job, you'll often find him changing plugs or adjusting the pick-up module of his 280-Z. It's a clean machine and he takes personal pride in the car's appearance and maintenance.

Just a few months ago, Tom was mostly concerned with maintaining his grade point, as he completed his EE degree at the U of Minnesota. Working as a Research Assistant, he helped design an ultra-high vacuum system used to precalibrate satellite instruments.

Today, Tom is applying this knowledge and skill in a design group at Sperry Univac DSD. His most recent accomplishment was helping develop an automatic tester which verifies signal transfers from land cruise missiles.

What's in store for the future?

"From day-1, they've made me feel part of the team. I've been able to do the types of things I like because they take the time to listen to my ideas and goals. Somehow, there always seems to be a project available that fits both my needs and theirs."

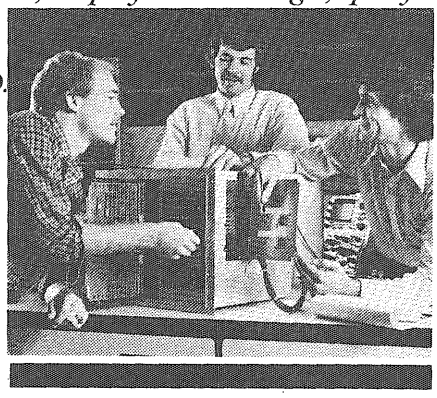
Tom and his associates are proud of their efforts. And so are we. That's why we're recruiting for more people like them – in design and other related positions.

One such area is Maintainability, where EE's are needed to work with vendors, government customers and our own design teams to help develop cost-effective, easy-to-maintain computer parts and systems.

Reliability is another. Here, EE's use the most advanced systems and tools available to evaluate the performance and durability of parts selected for new designs. Working with both internal design teams and the customer, subcontractors and vendors, they help ensure good field performance for systems/equipment.

And, within our Component Engineering area, EE's with semiconductor backgrounds are needed to work with in-house designers and outside vendors to help determine specifications for new IC and medium, large and very large scale components.

For details on what your future may hold, contact *Midge Rothrock, Employment Manager, Sperry Univac Defense Systems Division, U1E20, (MT), P.O. Box 3525, St. Paul, MN 55165.* Upon interviewing, you'll have a chance to talk with technical personnel representatives and the front-running members of our engineering team.



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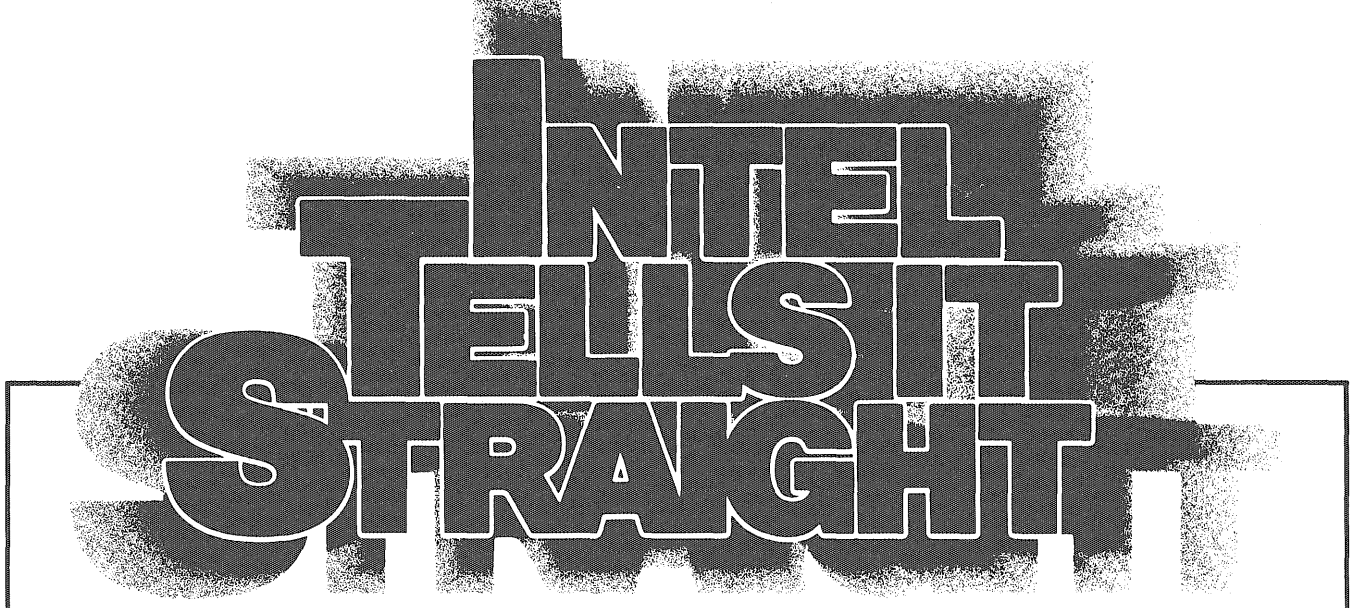

Straight talk...a rare commodity. But then, we're a rare company. The straight talkers at Intel first shook up the world of microelectronics with the first semiconductor memory. Next came the news of a computer on a chip. Today, we're developing software on a chip too.

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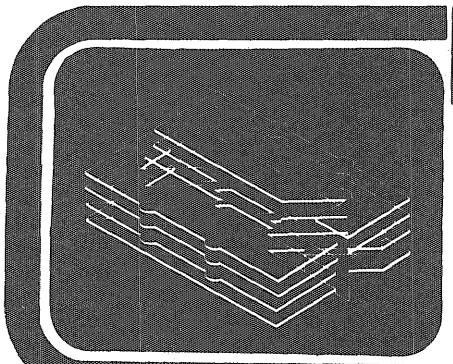


Brain Teasers and Belly Laughs

The first Adam-splitting gave us Eve, a force which man in all the ages since has never got under control.

A young lady, with a touch of hay fever, took with her to a party two hankerchiefs, one of which she stuck in her bosom for a spare. As the party progressed, she began to rummage to right and left in her bosom for the fresh hankerchief. Engrossed in her search, she suddenly realized that all conversation had ceased and people were watching her, fascinated. In the confusion, she murmured, "I know I had two of them when I came."

Two engineering students were taking calculus for the first time. While they were waiting for the instructor to arrive, they took a quick perusal through the book. One of them came across some formulas in the back of the book.

"Tell me," he asked his friend, "can you read this?"

"No, but if I had my flute with me, I could play it."

Couple applying for an extension of son's college loan: "We had the tuition and board figured out all right, but we didn't figure on the bail.

It tooks tens of thousands of years for a monkey to evolve into a man. Strange that a woman can reverse that process in seconds.

ALIBI-OGRAPHY FOR STUDENTS:
What to say—
When you're given an objective test:
"It doesn't let you express yourself."
When you're given an essay test:
"It's so vague. You don't know what's expected."
When you're given many minor tests:
"Why not have a few big ones. This keeps you on the edge all the time."
When you're given a few major tests:
"Too much depends on each one."
When you're given no tests:
"It's not fair. How can he possibly judge what we know."
When every part of the subject is taken up:
"Oh, he just follows the book."
When you're asked to study a part of the subject yourself:
"Well, we never discussed it."
When the course is in lecture form:
"We never get a chance to say anything."
When the course consists of informal lecture and discussion:
"He just sits there. Who wants to hear the students? They don't know how to teach the course."
When detailed material is presented:
"What's the use. You forget it all after the exam anyway."
When general principles are presented:
"What did we learn? We knew all that before we took the course."

—Robert Tyson, *Curriculum Bulletin*
University of Oregon, September, 1969

"I shot a pass into the air,
It fell to earth I know not where.
And that is why I sit and dream,
Here on the bench with the second team."
-------Tim Sail'em, Minnesota Goofers

laws...

Murphy's Second Law of Thermodynamics—"Everything gets worse under pressure."

Fourth Law of Thermodynamics—"If the probability of success is not almost one, then it is damn near zero."

ERR'S LAW—Err is basically a synonym for Murphy, but those who quote him over the better known prophet insist he is as real as Murphy. The basis for their argument: (1) his spirit, like Murphy's is everywhere, and (2) Err is human.

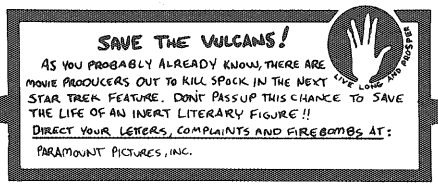
Splinters off old Logs.....

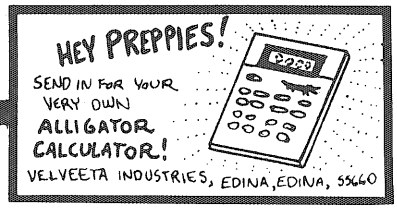
One strawberry to another: "If we hadn't been in the same bed together, we wouldn't be in this jam right now."

Then there was the M.E. who thought steel wool was the fleece from an hydraulic ram.

The latest thing they've discovered in freshman biology is that you can't tell the sex of a chromosome unless you take off the genes and look.

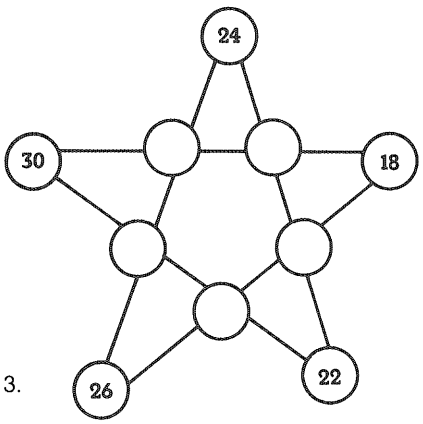
Then there was the C.E. who walked through the screen door. He strained himself.





In each issue of the Minnesota Technolog, there will be a collection of brain teasers and puzzlers. If you're the kind who thrives on these puzzles and games, you can make yourself a winner! Be the first person to solve all the problems, and win youself a Technolog "Do I.T. with an Engineer" T-shirt. Submit your solutions to the Technolog office, Room 2, Mechanical Engineering. The answers will be printed in the next issue. Good Luck!

1. What number base, other than base ten, has the numeral 121 as a perfect square?
2. Suppose you want to boil an egg for fifteen minutes. All you have for timing are two hourglasses, one eleven-minute and one seven-minute. What is the simplest (though not necessarily the quickest) way to time the boiling.



3. Look at your watch before starting this puzzle. The game is golf...see how well you can do in getting in the right holes, with the lowest possible score. In the five blank circles shown in the star, put the numbers 2, 4, 6, 8 and 10. They are to go in such a way that the total of four numbers along any of the straight lines in the star add up to 60.
4. A ship is at anchor. Over its sides hangs a ladder with rungs one foot apart. The tide rises at the rate of 8 inches per hour. At the end of four hours, how much of the rope ladder will be above water, assuming that seven feet were above the water to begin with, when the tide began to rise.
5. Nine men play the positions on a baseball team. Their names are Brown, White, Adams, Miller, Green, Hunter, Knight, Smith and Jones. Determine from the following information the position played by each man:
   a. Brown and Smith each won $10 playing poker with the pitcher.
   b. Hunter is taller than Knight and shorter than White, but each weighs more than the first baseman.
   c. The third baseman lives across the corridor from Jones in the same apartment house.
   d. Miller and the outfielders play bridge in their spare time.
   e. White, Miller, Brown, the rightfielder, and the centerfielder are bachelors, and the rest are married.
   f. Of Adams and Knight, one plays an outfield position.
   g. The rightfielder is shorter than the centerfielder.
   h. The third baseman is a brother of the pitcher's wife.
   i. Green is taller than the infielders and the batter, except for Jones and Smith and Adams.
   j. The second baseman beat Jones, Brown, Hunter, and the catcher at cards.
   k. The third baseman, the shortstop, and Hunter made $500 each speculating on Exxon stock.
   l. The second baseman is engaged to Miller's sister.
   m. Adams lives in the same house as his own sister but dislikes the catcher.
   n. Adams. Brown, and the shortstop lost $200 each speculating in grain.
   o. The catcher has three daughters, the third baseman has two sons, but Green is being sued for divorce.

   —excerpt from "Problems for the Good Student," by Floyd D. Strow, Toledo, Ohio.

minnesota TECHNOLOG

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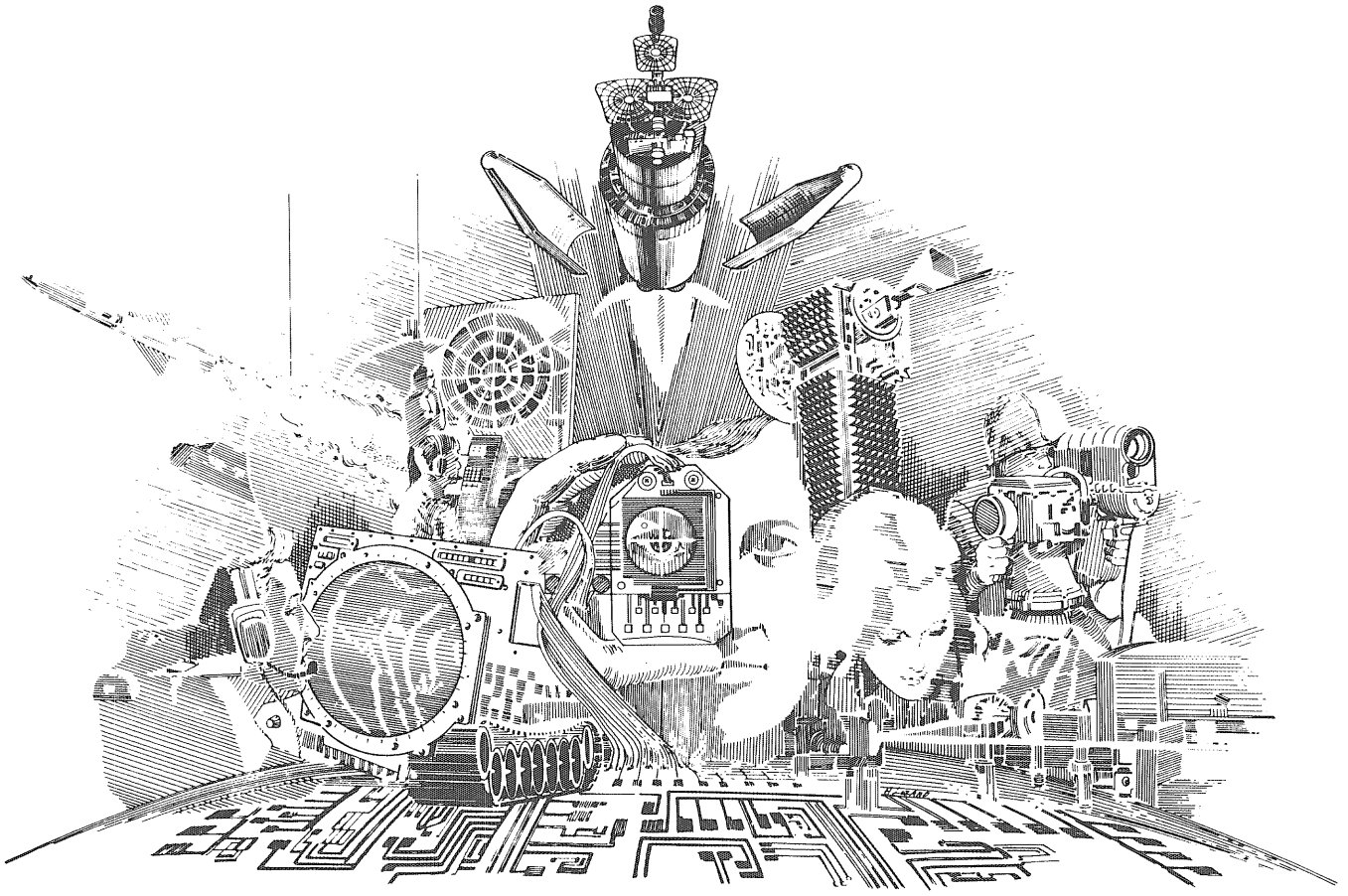

Hughes College Relations Office, P.O. Box 90515, 100/445, Dept. LB, Los Angeles, CA 90009

Luis Castellanos mines copper with software.

Most copper is found deep underground. But the Bell System's 100 million miles of copper cable have tons of it above and below ground. That copper provides vital circuit paths to transmit customer voice, data and video signals for today's Information Age needs.

And Luis Castellanos, seven years out of undergraduate school, supervises one of the groups that helps Bell System companies "mine" all that copper. He works with one of the largest computer hardware and software systems in the world—the Trunks Integrated Record Keeping System (TIRKS). Every day it "mines" the vast Bell network for available circuits and equipment. As a result of efficient use of network facilities, the Bell System saves millions by eliminating the need for certain capital expenditures.

Plus, there's more to TIRKS than "mining copper." It also configures circuits and assigns components needed for each circuit path. That allows Bell companies to respond faster to customer requests for complex services like video and data transmission. Employees are more productive too, because TIRKS helps them set up circuits and forecast facility needs.

Before TIRKS was available, keeping track of communications circuits and facilities required enormous amounts of paperwork and manual calculation. Every day, the average Bell System company handles orders involving 1500 circuits and up to 7500 individual components associated with them. Each detail has to be specified and accounted for.

Now, thanks to people like Luis, TIRKS keeps track of all that information instantaneously using computers. Information is up-to-date. It's instantly available. And it's more accurate.

According to computer scientists like Luis, the benefits from TIRKS are just beginning. He believes that, as more computer hardware and software systems like TIRKS interact, new benefits for customers may be possible, as well as additional productivity increases for employees.

Luis joined Bell Labs with a B.S. in computer science from Pratt Institute. Under a company-sponsored graduate study program, he attended Stevens Institute of Technology for his M.S. in computer science. At the same time, he worked part-time assuming responsibility for a large piece of TIRKS software. Working with design teams, he gained valuable insight from experienced members. Now, his technical performance has earned him a promotion to supervisor.

If you're interested in similar challenging employment opportunities at Bell Labs, write:

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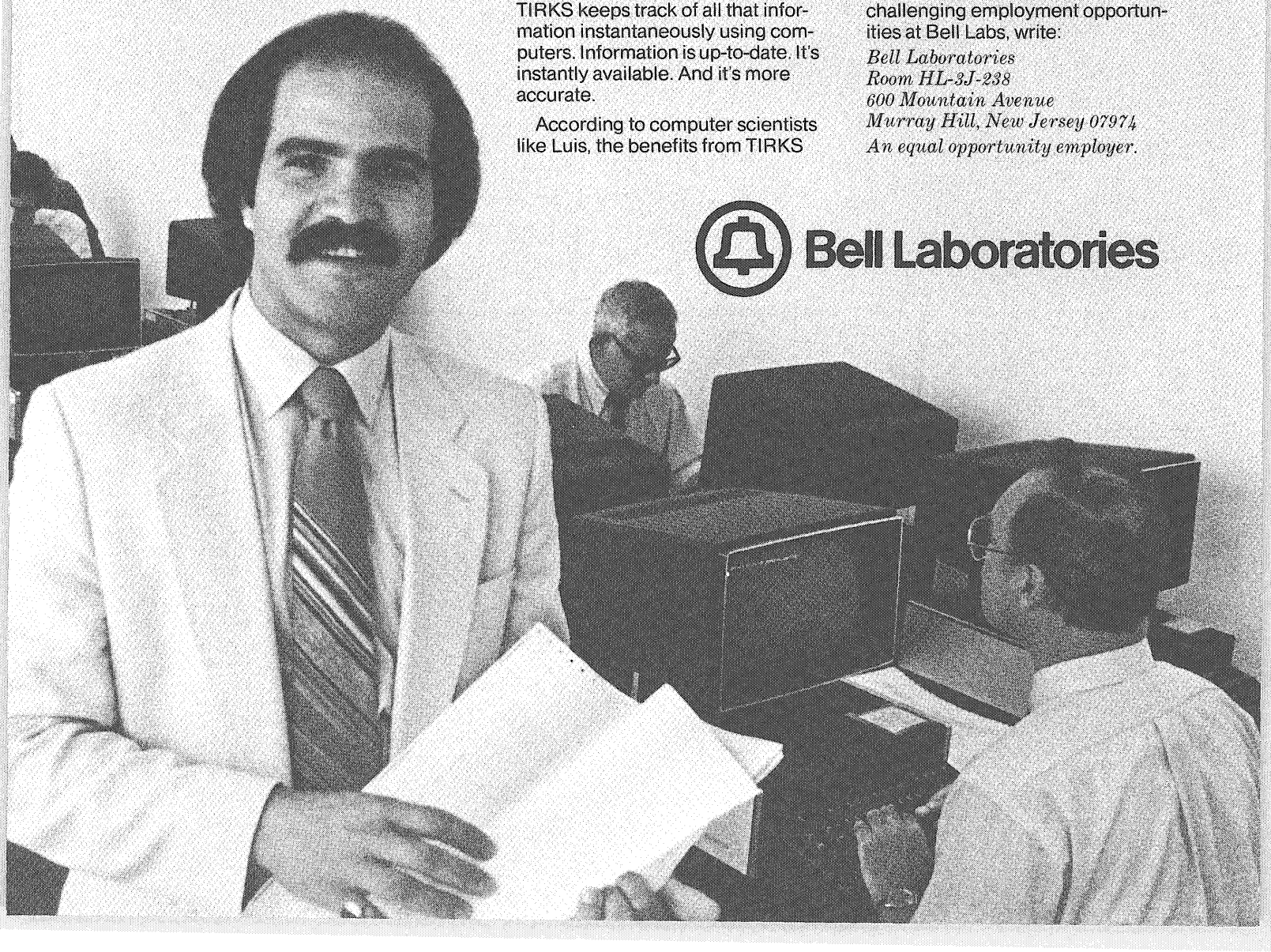

Bell Laboratories

Commencement Address 1981

J.J. Renier
Graduation Exercise
Institute of Technology
University of Minnesota
May 27, 1981

It is customary, in a commencement address, to generate glowing visions of a glorious future. The speaker, through the magic of his oratory, takes his audience to the top of the mountain and reveals the terrain the graduates will journey in the course of their career. He points out the dangers and the challenges they will face and the difficulties they will meet. And then he gestures broadly toward the distant future and points to the rewards, satisfactions and inner gratification that await them when they finally arrive at their goal. It usually sounds like a trip to Florida during the spring break—in a '61 Chevy.

Well, I am not going to give you the "onward and upward" speech. For one thing, with engineering graduates now getting starting offers close to $25,000 a year, it sounds to people of my generation like you have already arrived at "on" and "up." (However, I would be disappointed if you had much sympathy for that perspective.)

The reason for those tempting offers, of course, is that tehchnologists are now in great demand. Last fall, 100,000 freshman entered engineering schools—and industry would feel more comfortable if it had been twice that number. It is reminiscent of the bull-market for technology when I got my Bachelor's 30 years ago, almost to the day. There was tremendous demand for scientists and engineers, and great faith in the promise of technology. But then something happened. By the late 1950s, industry management looked around and asked, "where are all these great things we were expecting out of R & D?" Somehow, we had fallen short of our promise. The technical professions lost credibility in industry and the marketing people and finance people stepped into the vacuum. The nation's anti-technology mood of the '60s offered little to encourage the technical professions. In fact, Russia did more than anyone else for American technology. Ironically, Sputnik, and concerns of the U.S. Defense Department helped keep our technology alive during a long dry spell. And then, in the 70s, when industrial technology was ready to again take off, the recession of 1974 and '75 turned business thoughts in other directions—mostly of survival. Now government, labor and industry once again look to technology for leadership.

Computers are taking us into The Information Age. The Space Shuttle advanced our progress in The Space Age. And integrated circuits for everything from factory robots to coin-operated games are hastening The Age of Electronics. The world is waiting to see what Age you will lead us into next. For example, it is mind-boggling to realize that by the time your children enter the Institute of Technology around the turn of the century, you are expected to have the energy crisis under control. If you do not have, it will be The Dark & Cold Age.

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As a businessman, I can only say: What a time to be given the mantle of leadership! A look around shows the magnitude of the job to be done. At the beginning of the 1970s, America had the highest standard of living in the world. Today, we are fifth in Gross National Product per capita. During the last decade, our share of the world markets dropped by 23 percent. And American manufacturers lost more of their domestic market to foreign imports than ever before.

Since 1973, productivity in Japan has grown at a rate of 4.1 percent per year—in West Germany, 5 percent per year—in France, almost 5 percent per year— and in this country, just 1.6 percent per year. In 1979, our productivity actually decreased 2.1 percent. It was the first time in history that the American economy experienced an increase in total production along with a decrease in output per man-hour. And perhaps linked to that statistic is another American first. 1979 was the first year in which our rate of inflation was higher than the average of all industrial countries.

An editorial in *Science* magazine pointed out that we are becoming a colony of the rest of the industrial world, supplying food and raw materials, and moving toward increasing toward economic peril. And, of course, now even our former wealth of raw materials is runnig low. You and I are used to thinking of this country as the strongest industrial power in the world. It is shocking to think that we may fall back in the pack and become one of the "also rans." But tht possibility is very real. It was not until 1900 that we gained the highest Gross National Product per capita. And, it is now clear that we do not hold our high standard of living by divine right. We have to earn it every day.

So what do we do? It seems to me that it comes down to this: We have two powerful resources to work with, technology and people. We have to do as much as we can with both of them.

Our technology has always been a source of pride to us. Along with the energy we found on this continent and the other raw material, it made us a self-reliant nation. But, today, other countries are gaining our technology, too.

In the 10 years ending in 1978, the number of scientists and engineers working in R & D in Russia increased 55 percent; in West Germany, they were up 59 percent; in Japan, up 62 percent. And, in the U.S., there was a drop of 13 percent. The number of patents issued in the U.S. has held steady at just over 100,000 per year. But a growing portion of those patents are held by foreign nationals. Last year, of the 100 companies receiving the most patents, 26 were foreign owned. Of the top 10 companies, half were foreign.

But the burden of preparing for a career

really rests with the graduates. And I am afraid that all we expect from technology will be an empty promise if students look upon graduation as the end of education and the start of a job. Graduation marks the beginning of, and an important part of, the education that will prepare you for a profession.

I ask you to recognize that a technical education—no matter how complete and sophisticated it may be—has certain limitations. No one comes out of school with total preparation for the career he or she is about to undertake. There is not a technical job in the world that can be done more successfully with just the use of technical skills; something more is always needed. The choices and decisions that must be made on the job range beyond technology. School years just are not long enough for students to learn everything they need to know. And, in our colleges of science and engineering, that means that concerns with technical problems simply crowd out of the curriculum the courses that deal with people problems. People problems—that is the difficult set of fuzzy, frustrating, hard-to-handle questions, which unfortunately, are left almost completely to the school of On-the-Job-Training.

Meanwhile, other countries are surpassing our training of engineers, for example. We lag behind Japan, West Germany, and Russia in number of engineering graduates per capita. In Japan, 20 percent of all Bachelor's Degrees are awarded to engineers—for the U.S., it is five percent. About five times as many Russian students as American students go into engineering.

Of course, simply increasing our fund of new knowledge is not the total answer. We will also have to make the investments in plant and equipment that will put that knowledge to work for us—and that is another problem we have to solve. But technology is where it all starts.

It seems clear that we are going to have to find new ways to encourage high school students to build toward a technical career. We will have to make technology more attractive to our brightest young people. We will have to make sure that the rewards for those who succeed in technical careers are commensurate with the effort and are equal to the rewards in other pursuits. Technical schools must have all the resources needed to equip their graduates with the best possible training.

To show you how limiting an education in technology can be, let me give you an example of extreme obtuseness of human understanding. I know the case intimately, because it was "me." I took my Ph. D. in Physical Chemistry as a Research Fellow with the Atomic Energy Commission, did a short engineering hitch with ESSO Standard Oil Co., and joined Honeywell as a senior scientist at the Honeywell Research Center. A few years afterward, two of my colleagues and I were asked to design an award program to honor outstanding scientists and engineers. To show you how little we knew of human motives and needs, we thought that, as an award trip, the winners would rather come to a professional seminar in Minneapolis in February than go with their spouses to a resort in Florida. Now that is obtuse!

Because of my educational background and experience in management, I think I know something of the strengths of graduates in the technical professions. Have you ever asked yourself why a company would hire you? If you received an offer from Honeywell, I hope it was because you are strong in analytical thinking and problem solving, and you are creative. You have a good self-image as professionals. You are able to work independently, and you like to be good at what you do. You are high contributors, and the fact that you are graduating in a tough school shows you are obviously a very good learner.

But I must admit to you that we make the offer very much aware of—and very much concerned about—a significant gap in your technical education. Unfortunately, the concentration on solid, quantifiable things seems to close the door on the fuzzy, human things. The hard sciences demand so much time, aptitude, and interest that there does not seem to be much left for what the hard scientists call the soft sciences. For good or ill, however, the soft sciences determine much of what happens in industry and in the world. Engineers or scientists who feel insecure in them—for example, in dealing with people—tend to draw the protective cloak of technical specialization about themselves. You do not improve your self-esteem by shutting out the rest of the world. Human relations is the area in which conflicts are resolved, goals are set, and direcitons established. If technologists withdraw from the arena, marketing, finance and other disciplines will again take it over. And—rightly or wrongly—the technologists often project the image that they can't be bothered with the fuzzy issues.

I even know scientists who use technical cliches to analyze everything from good looks to a sales pitch. But is there really a two-dimensional approximation of sex appeal or a friendly pat on the back?

Let me show you a scenario that I have observed, not once but several times: A young engineer or scientist comes out of school into his first job with stars in his eyes and fire in his belly. He has been told he is good, he knows he is good, and he has a mission. Six months on the job, he begins to recognize that things are not quite what he had expected, After a year, he knows something is wrong. He finds he is involved in a lot of stuff that is not really enigneering or science—he is given job assignments he does not really understand. Something he calls "politics" is apparently a big force in decision making. And the guys in marketing, who do not know a diode from a differential equation, seem to be calling all the shots. After another six months, he is convinced a technical profession is not what he thought it was. He is disappointed and disaffected, his morale is low, and his self-esteem is nonexistant. And he is feeling very insecure about the world of business. Over a period of time, this insecurity may change to a strong drive of professionalism to an interest in collective protection.

Something went wrong. And the tragedy is that the experience may have lasting effects, because there is ample indication that the first job experience colors the perception of the entire career. He may go through his working life feeling insecure and defensive about his profession and himself.

What went wrong is this: He took a job without a very clear understanding of where engineering or science fits into company objectives. Moreover, he was not equipped with the understanding of human motivation and relationships that would enable him to deal effectively with others. He thought he knew the technical profession—but he did not know its "practice" in the real world. He did not know that in the real world you can't separate technology from human instincts, prejudices and foibles. And these are much harder to grapple with than anything encountered in his technical training. They are even more difficult when they occur in the massive doses we call bureacracy.

An the irony of the situation is that his boss, who may have graduated from the same technical school 10 years earlier, was not equipped to understand him, nor to help him, and is now lost in the same bureacracy himself.

I use engineering or science in my example-but this kind of problem goes across all of the technical specialities. I do not wish to be discouraging to you, just as you are starting out, by drawing a dark and forboding picture of your working life. But I do want to warn you that if you aspire to a successful and satisfying career, as I hope you do, your education is just beginning. From your first day in industry or government, or whatever arena you enter, you will have to start expanding on what education you already have. The only question is whether you set about learning systematically or just let it happen.

So...he gets promoted. And immediately he becomes a victim of the Peter Principle—he is elevated to the level of his incompetence. He is a good technician, but a poor supervisor. He is a technologist—but not a professional.

Let me be more specific about the kind of broader vision I have in mind. Recently, *Chemical & Engineering News* published a list of elective courses recommended by senior technical managers in industry. The list included the study of statistics, computer sciences, writing, public speaking, physics, economics, market research, psychology, foreign languages, environmental studies, history, and art appreciation. (The latter, incidentally, was recommended by a manager who said art appreciation helped him design a new chem lab.). The list is far too long to be realistic. If I had taken all of

them, I would still be working on my doctoral research. But it does show that senior technical management recognizes the need for understanding that lies far beyond one's technical major.

I am not asking for that kind of breadth—nor am I suggesting that you go back to school for another degree in the humanities. but I would recommend that both on the job and in after-hours courses you develop an alertness and an appreciation for some of the soft sciences. Specifically, I would propose that you develop special awareness in seven different areas:

Psychology—Observing the needs and motivations of individuals to help create an understanding of what makes people tick, what drives them.

Team Dynamics—How to work with others effectively, how to use what others know, and how to make contributions to group objectives.

Communications—How to listen, what to listen for, how to hear what people are really saying, and how to winnow the wheat from the chaff.

A Foreign Language—To be able to deal with people of other nations, who are exerting tremendous influences on American business, and to have some understanding of their cultures.

Economics—To understand the business context in which we operate.

Business Management—To appreciate the factors that go into business decisions.

Marketing—To help the technical specialist weigh the considerations that are important to his marketing colleagues, and to understand the language they use.

Let me give you a very real illustration of why "outside" skills are necessary. As you all know, business today demands more teamwork than ever. And the teams are not just technical teams, but inter-departmental teams. Matrix operations are becoming common. When a design engineer, for example, is assigned to a project, he may find himself working with the specialists in human factors, test engineering, production engineering, factory management, marketing and accounting in addition to his departmental boss and the project boss.

The design engineer, or the scientist, will feel comfortable and secure in such a diverse group only if he knows what his teammates are talking about, and if he has some facility in communication and intra-group relations. He has to contribute to setting group objectives; he has to understand individual objectives—and recognize hidden agendas.

If he feels inadequate to this process, he can only develop frustration and disappointment. His ideas will not sell. You can imagine the effect this has. He will not feel the confidence and self-esteem that enable him to contribute importantly to the company and help him realize a rewarding career.

He will not be well equipped to advance into management. This is not to say he will not advance anyway; it is my observation that when an opening occurs, it gets filled—regardless. If he is a good problem solver, a good technician who measures carefully and calculates accurately, he may well get promoted. But he may not have the skills to enable him to supervise well. In fact, his concentration on technology may cause him to overlook the human side and the business side of the job.

So... he gets promoted. And immediately he becomes a victim of the Peter Principle—he is elevated to the level of his incompetence. He is a good technician, but a poor supervisor. He is a technologist—but not a professional. I have seen it many times.

This is sad enough for the victim—but it is tragic for the young people who report to him. They enter the business fully-charged and aspiring to meaningful careers. But, after a few months, they are turned off because they have a boss who does not understand what they need, and is not even equipped to talk with them about it.

Universities are not unmindful of the problems of the technologist and his manager. More than 70 schools have established curricula in technical management, which include business-related courses. But few of them recognize the need for group skills, communication, and the "softer" aspects of management. A survey reported in *Engineering Education* magazine (January, 1980) said, "Most of the programs appear to employ solid work in engineeering, based on the standard foundations of the discipline." However, the same article reported that, for people who have been through these programs, "The human side of management was by far the first choice of valuable subject...this response included specific mention of the behavioral sciences, personnel management, psychology and human relations."

Some companies are acutely aware of the need for the development of engineering management talent, and step in themselves to fill the need. Among them are General Motors, General Electric, Bendix and Dana. Each of them offer programs leading to undergraduate degrees. Hewlett-Packard and Motorola have smaller programs designed with special-subject focus.

I can assure you that my own company, Honeywell, is taking action, too. We are somewhat later than the companies I mentioned. And our program, at the moment is smaller. But it is far-reaching. It will cover every technical employee within my area of responsibility, and it will focus on what we consider to be the greatest areas of need—human relations.

With the emphasis I have placed on the people aspects of the profession, it may be appropriate to say a few words about human relations to this group, which represents the future leadership of our society. Along with our technology and our dwindling natural resources, people are the most valuable resource we have to work with in the competition for the world's markets. It behooves us to make the most of the potential of our human resources.

Unfortunately, this is one resource that American industry has traditionally taken for granted. As long as there were enough people to man the machines, sell the products, and do the technical chores, we never thought about them too much. If problems developed, we believed they could be solved with the carrot on the stick.

But that was never the way to make the best use of people. And, today, when we will depend more than ever on our human resources, we had better find the methods to make them as productive as they can become, It is time we start to acknowledge that people need something more if they are to make their maximum contribution.

The process begins with the recognition of a few principles. The first one is that people in industry want to do a good job. Our jobs are a major portion of our lives—most of us want that portion to count for something. Second, people want to be recognized as intelligent, interested employees. And they want to participate in decisions that affect their work. They want to take their place as contributing members of the team. Third, people want information so they can better understand the goals and problems of the organization and make informed decisions. They need the facts that affect their working lives. Fourth, they are looking for a sense of self-fulfillment on the job—and by that I mean the realization that they are making a real difference, that their best talents are being used, and that they can leave work at the end of the day with a good feeling that they accomplished something worthwhile. And, fifth, people need the feeling of self-esteem that these things provide. Self-esteem is simply feeling good about ourselves and what we do, and it is something that almost every one of us will do anything to get. It is the greatest motivator there is.

I believe that, if we are going to be successful in preserving the standards that we have all come to accept as part of America's birth-right, we are all going to have to develop a new appreciation for these human principles and make the understanding a part of the way we conduct our organizational and professional lives. If we continue to ignore the need for self-esteem and self-realization that is part of everyone's personality, then we ignore the most important ingredient in the development of human resources, and the attainment of top productivity.

For an enterprise to succeed, individuals in the enterprise must achieve their personal objectives, too. That is true in a company, a government agency, a graduate school, or whatever kind of organization you go into. For science and engineering to grow to the leadership we need, you are going to have to solve more of the technical questions. You will have to solve the people equations, as well. My whole thesis is that you help yourself and the organization by helping others achieve their human goals.

You are only a practitioner if you have come this far just for the sake of technology, corporate financial objectives, intellectual superiority, scholarly reputation, published papers or a corner office with your own water carafe. You're on the road to being a professional if all your hard work helps others achieve their human goals. If this all sounds to preachy and idealistic, just remember that all the evidence says it also leads to the down-to-earth goal of high productivity. (I have said I would not give you the "onward and upward" lecture—and I am trying to stick to my script.)

It comes down to this: An understanding of the human side of the organization is perhaps the most important agenda item in your continuing education whether it is on-the-job or in more formal courses.

People and technology are the two best answers we have to the challenge of world competition. When you look at what this nation needs to pull even with the world leaders, the bottom line is productivity. Productivity to increase our Gross National Product. Productivity to get inflation in hand. Productivity to make our goods more competitive in the world markets and to enable American industry to regain its own domestic markets.

Productivity requires many solutions—and perhaps a key is a vital and growing professional technical establishment. The National

Science Foundation showed the importance of technology and some conclusive statistics. In comparing high-technology industries with low-technology industries, they found that high technology provides twice the productivity growth rate, triple the real growth rate, and nine times more growth in employment, with only one-sixth as many price increases. Even a fraction of those figures applied to our whole national economy, would solve all our problems.

So it is time for you to assert your leadership. People in the technical professions must be confident, positive, and aggressive—sure of themselves, their professions, and their place in the industrial scheme. Attitudes or limitations which lead to insecurity in working with other business disciplines, are negative and restricting, and result in low technical productivity.

There is one characteristic of technical professionals and students that can give us all confidence—they are superior learners. They can assimilate any knowledge that will prepare them for a more productive and satisfying work life. With proper training and incentive, they can solve people problems, as well as problems in circuit design. Their desire to excel can be directed at personal relations, as well as calculus.

But one thing is required: You must appreciate that an understanding of business and human behavior is necessary when you begin to practice your profession in the push-and-shove of industry, government, or education. Decisions in the real world are not handed down on tablets of stone. They are made on the factory floors, in the research labs, and the administrative offices—by people like you and me, who work to form a consensus out of a thousand different ideas and interests. The process often involves disagreement, sometimes heated disagreement. But usually the process works. And it works best for those who are prepared for the rough-and-tumble and the subtle science that we call interpersonal relations.

The better you prepare yourself for this process, the more effective will be the technology we can bring to bear on our problems. Those who are ready for the arena will be more creative. Their jobs will be more fulfilling. And they will realize a greater measure of self-esteem and job satisfaction during the course of their working lives.

And, perhaps even more important, I guarantee that they will have more fun, more excitement, and make a more important contribution all through their professional careers.

What will it be—a technical job or a professional career? The potential is there—it is up to you. And it is the full realization of that potential that I wish for this graduating class.

Thank you.

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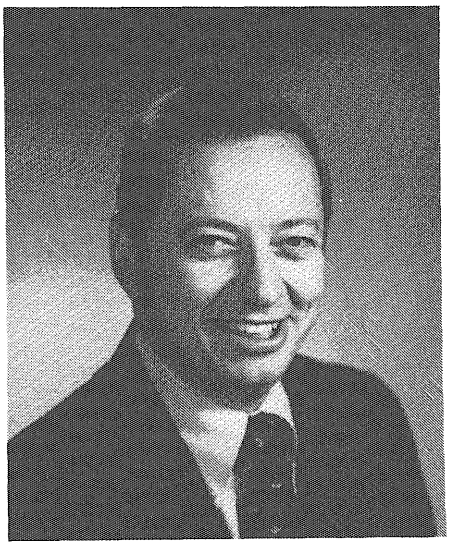
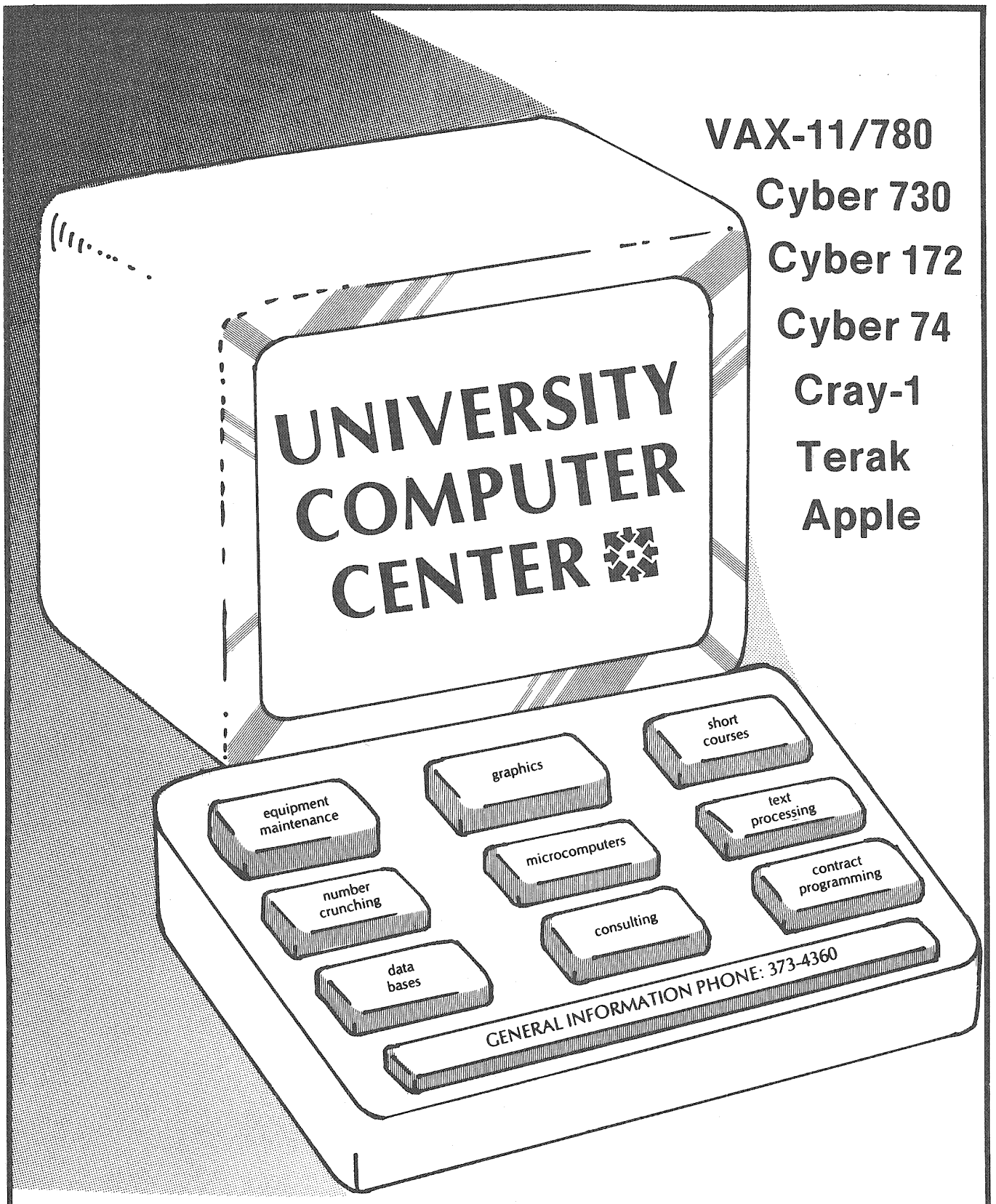


Dr. James J. Renier is the president of control systems for Honeywell, Inc. He is responsible for the worldwide operations of Honeywell's control systems business, which includes commercial, residential, industrial, and aerospace and defense products and systems. He received his bachelor's degree in chemistry from the College of St. Thomas in St. Paul, Minnesota in 1951, and his Ph. D. in Physical Chemistry form Iowa State University in 1955.



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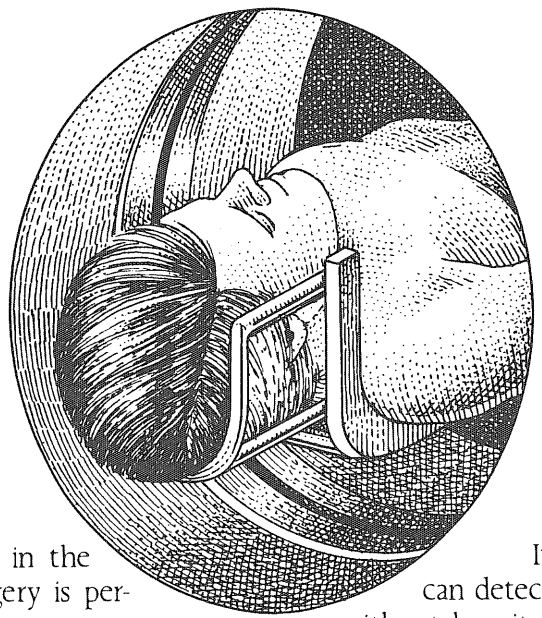
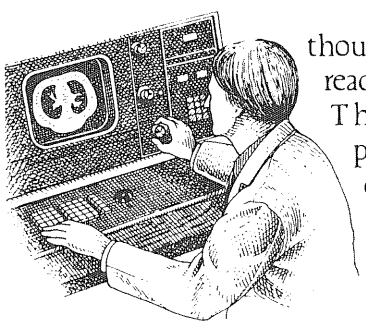


His doctors suspect a mass in the right lung. Exploratory surgery is performed—but without the surgery.

This is made possible because of a major advance in radiology called the CT Scan (short for computed tomography).



The CT Scan provides thousands of digitized X-ray readings of a patient's body. Then, using a computer, it synthesizes the data into a series of cross-sectional or tomographic images—all within seconds.

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Fall 11,1981 $\sum_{n=2}^{\infty} a_n$

NASA Makes History
Laser Fantasy
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more

Editor's Log

I woke up one morning not long ago to the music on the radio, which then blended into an advertisement. My mind drifted in and out of consciousness, desperately reaching for one final moment of slumber. The brain slowly engaged into first gear, to hear Bill Cosby's familiar voice say, ". . . so what goes 'Clomp, clomp, clomp, thank you, clomp, clomp, clomp, thank you . . ." It's the captain of the football team receiving his college diploma, thanks to the wonders of the Texas Instruments TI-35.

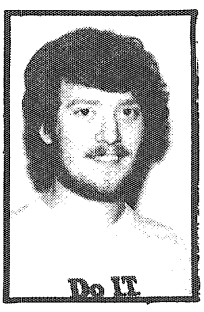
Look around. Some of them are riding around on their master's belts, others lie hidden in the depths of a backpack. They come in all shapes and sizes. Some can even sing a song. Whatever they do, their is nary an engineering student who would believe that life could exist without his pocket calculator.

Is there life beyond a slide rule? Or should I say, was there life before the hand-held phenom, the pocket calculator? What, you ask, is a slide rule? Oh yes, remember that day in high school, when they showed you the obsolete method engineers used for their calculations, Sorry, slide rule, you just don't cut the mustard anymore. Move over, the new kid in town is a whiz. Depending on how much you want to spend, you can buy a little box filled with several memories, programming capabilities, and maybe even the ability to solve some of those tricky integrals that always tripped you up.

So the slide rule is dead. But it went out with dignity, and still upholds a nostalgic self-esteem. Rest assured, Mr. Engineer, as you watch six students commit suicide in a Physics final exam in lieu of a power pack gone dry, the great Slide Rule in the Sky will hold its head up high.

Peter G. Marsnik

Peter G. Marsnik
Editor



Pete Marsnik is still a senior in Chemical Engineering. In his spare time he tries magazine engineering for *Technolog*.

Staff

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COVER BY SCOTT HOU

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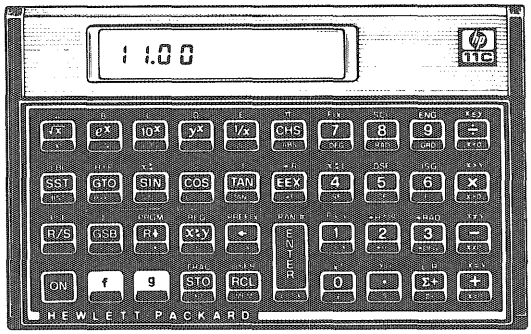

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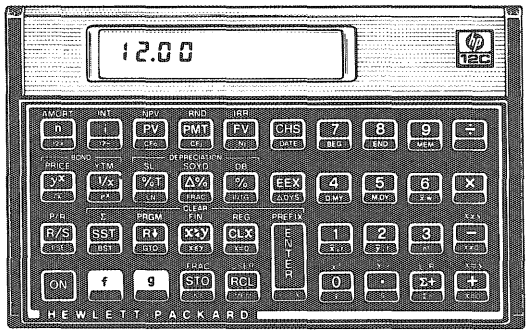

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CRAWFORD WINS 1982 PRIESTLY MEDAL

THE 1982 PRIESTLY MEDAL, BY FAR THE MOST PRESTIGIOUS AND COVETED AWARD GIVEN BY THE AMERICAN CHEMICAL SOCIETY, PRESENTED TO THE UNIVERSITY OF MINNESOTA'S DR. BRYCE CRAWFORD.

by Deb Wagner

Dr. Bryce Crawford has made contributions in a number of areas of science and technology including his research on rocket propellants which has led to the modern theory of combusion of propellants and to the development of solid propellants for much larger rockets. Through his study of molecular spectroscopy, he has furthered the concept of intramolecular force constants. Crawford is an active member of the American Chemical Society and the National Academy of Sciences. He has served as Chairman of the Chemistry Department and Dean of the Graduate School.

Dr. Crawford's many contributions to chemistry have earned him the 1982 Priestly Medal, the most prestigious award given by the American Chemical Society. The ACS will present the medal at its national meeting next Spring.

Bryce Crawford, Jr., was born in New Orleans, Louisiana, and grew up mostly in the San Francisco Bay region and in southwestern Texas. He attended Stanford University where he received his A.B. in 1934, A.M. in 1935, and his Ph.D. in chemistry in 1937. He then spent two years at Harvard University as a National Research Fellow. Following this he spent a year at Yale University as an instructor in chemistry. In 1940 he joined the Chemistry Department at the University of Minnesota. He spent some time at the California Institute of Technology in 1950-51 as a Guggenheim Fellow and at Oxford University as a Fulbright Professor. He served as a Fulbright Professor again in 1966 at the University of Tokyo.

From 1960 to 1972, Dr. Crawford was Dean of the Graduate School at Minnesota. During this time, he served as chairman of the Council of Graduate Schools in the United States, president of the Association of Graduate Schools in the Association of American Universities, a member of the Graduate Record Examinations Board and chairman of its Research Committee. On leaving the deanship in 1972, he spent a year's sabbatical as a Guggenheim Fellow, and in 1973 returned to full-time activity as Professor of Physical Chemistry at Minnesota.

Dr. Crawford is a member of numerous professional societies including: The American Chemical Society, the National Academy of Sciences, the American Philosophical Society, the Optical Society of America and the Coblentz Society. He was editor of *Journal of Physical*

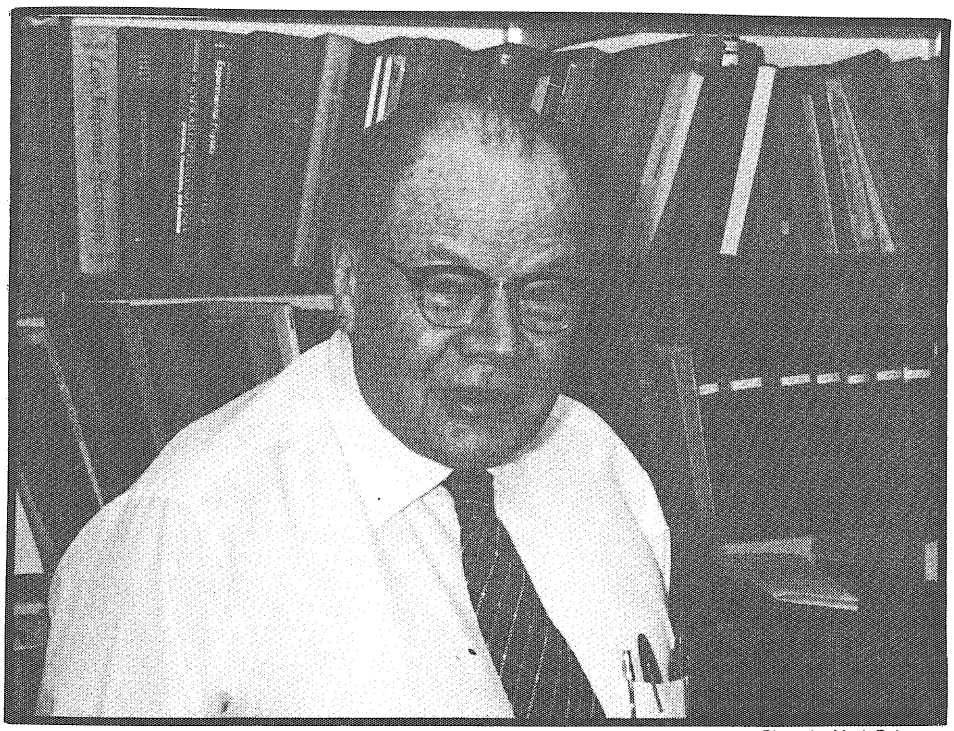

Photo by Mark Behrens

DR. BRYCE CRAWFORD

Chemistry from 1970-80 and a member and chairman of the President's Committee on the National Medal of Science. In 1977 he received the Pittsburgh Spectroscopy Award and in 1978, the Ellis Lippincott Medal.

As a member of the National Academy of Sciences (NAS), Crawford is involved in advising the federal government on questions having to do with science and technology. For example, the NAS recently advised NASA on its International Solar Polar mission. NASA and the European Space Agency agreed to launch two space probes which would travel side by side to Jupiter and then separate, going back toward earth and outside the plane of the ecliptic to cover the poles of the sun. The NAS gave a report comparing the scientific benefits against the cost. Remarks Crawford of the NAS, "There's no pay but there's the fun of working on something important..."

Crawford's major interest has always been molecular spectroscopy, particularly molecular vibrations. He observes, "The normal modes that caused the Lockheed Electra's wings to fall off are the same normal modes that you get in a molecule." He contributed to the development of the concept of intramolecular force constants and introduced methods of estimating their effectiveness. He worked to establish that force constants are a property of the chemical bond like bond distances or energies.

The intensity of infrared absorption is related to the dipole-moment change in a molecular vibration. In principle you can work back from the experimental infrared intensities to find out how electrons move around when you distort a molecule; that is, to find the derivative of the molecular dipole moment with respect to the internal-displacement coordinates. The relationship is of the form:

Intensity = (constants) × (dipole-moment derivative with respect to the vibrational coordinate)²

After taking the square root of Intensity, the sign of the dipole-moment derivative remains undetermined.

This sign dilemma has since been partially solved; Crawford says, "What's needed now to advance the field of vibrational intensities is a lot of good measurements on the building block molecules: ethene, normal propane, normal butane... The theory is pretty much in place."

In the last several years Crawford has pursued his interest in infrared intensities into studies of the condensed phases, developing and utilizing the new technique of attenuated total reflection. In this he has sought to clarify essential factors involved in molecular relaxation processes in liquids through the appropriate interpretation of spectroscopic observations.

Dr. Crawford is pleased with the Priestley Medal and notes that some of his "favorite heros" are on the list of recipients. He quips, "I don't think it will increase my salary though; I don't think anything is going to increase my salary." He's gotten a lot of letters from friends he hasn't seen for a long while. According to Crawford, "A university president wrote: 'We've never met, but I know you because I got my degree in chemistry as Bill King's[1] second graduate student. And since Bill King was your graduate student, that makes me your scientific grandchild. So, I thought it was nice you got the Priestley Medal.' "

As Crawford says, "It's just one of those nice things that happens to you every so often."

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[1]W.T. King, Professor of Chemistry at Brown University, 1957-81.

Deb Wagner is a senior in Aerospace Engineering. She is also the president of the I.T. Student Board.

Strikes, Strikes

A possible strike of chemists at the Loco Chemical Company was narrowly averted, thanks to the efforts of Prof. Jean-Jacques (Two-Top) Bleet, of Pharbelough Normal U., who volunteered his services as arbitrator. The main issues involved were: (1) providing a tastier brand of coffee in the laboratories; (2) shorter reaction times for molecules to become free radicals; and (3) a share in the cable revenues forthcoming from the reruns of the Sesame Bleet television series teaching thermodynamics to preschoolers. When asked about his success as an arbitrator, Prof. Two-Top responded: "It's because of my ability to see both sides of an issue, to demonstrate how to put your heads together to negotiate, and my firm resolve when hit on one cheek to turn the other." To which Sir J. Conrad Bleet, Loco Chemical's president replied, "That's easy for you to say!"

Not involved in the above dispute was J.C. Bleet, III, Sir Conrad's grandson, who spent the summer touring with a Country & Western band. JCIII says he really enjoyed traveling in a $75,000 van, equipped with $182,000 worth of hi-fi amplifiers, dressing in $275 shirts, $180 pants and $400 Stetson hats, and playing a $5000 electric guitar while singing songs extolling the simple rural life. Accepting the challenge of old-time baseball players about artificial playing surfaces ("If a cow can't eat it, I don't want to play on it") the Noah's Ark., agricultural research center has announced a program to develop a strain of ruminants that will graze on Astro-Turf.

From *The Chemical Bulletin,* October, 1981

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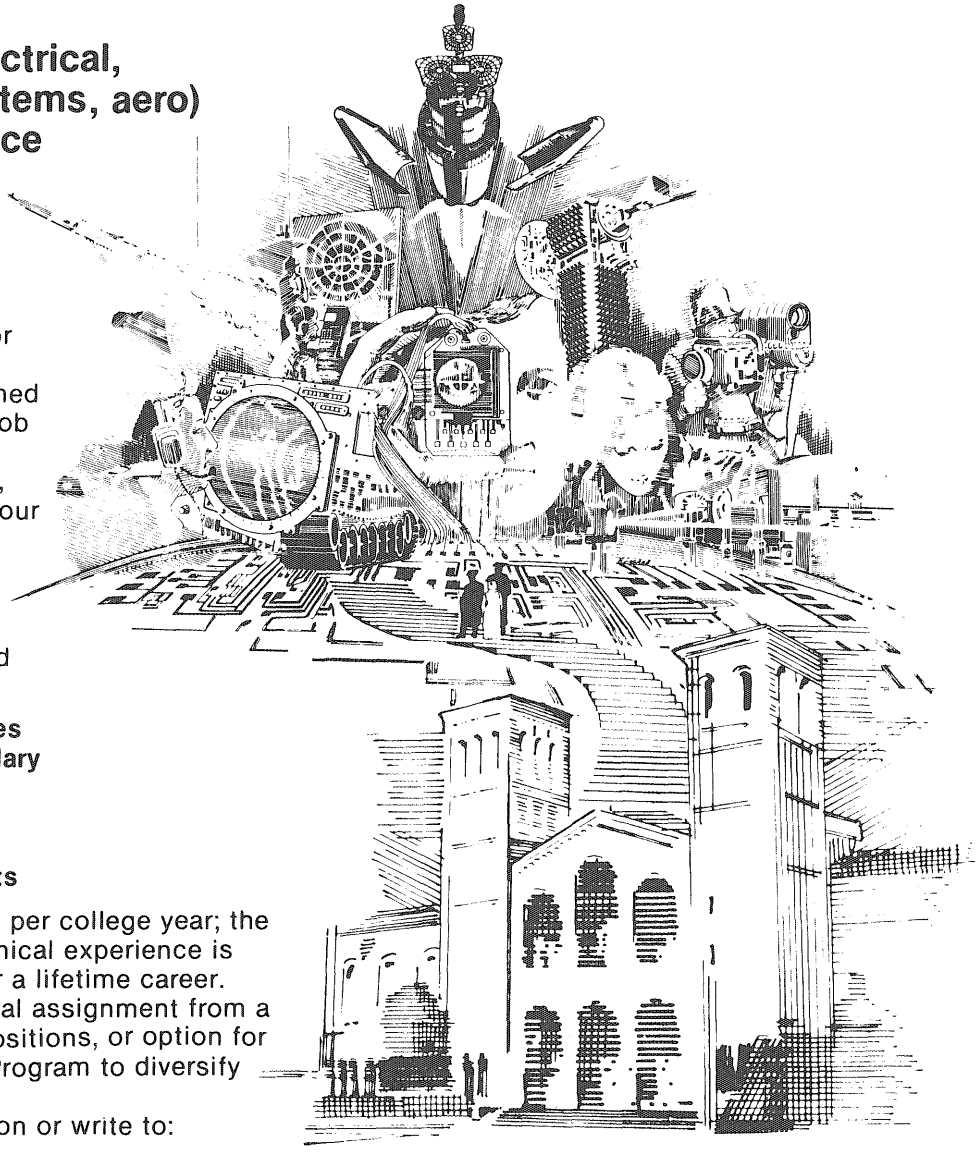

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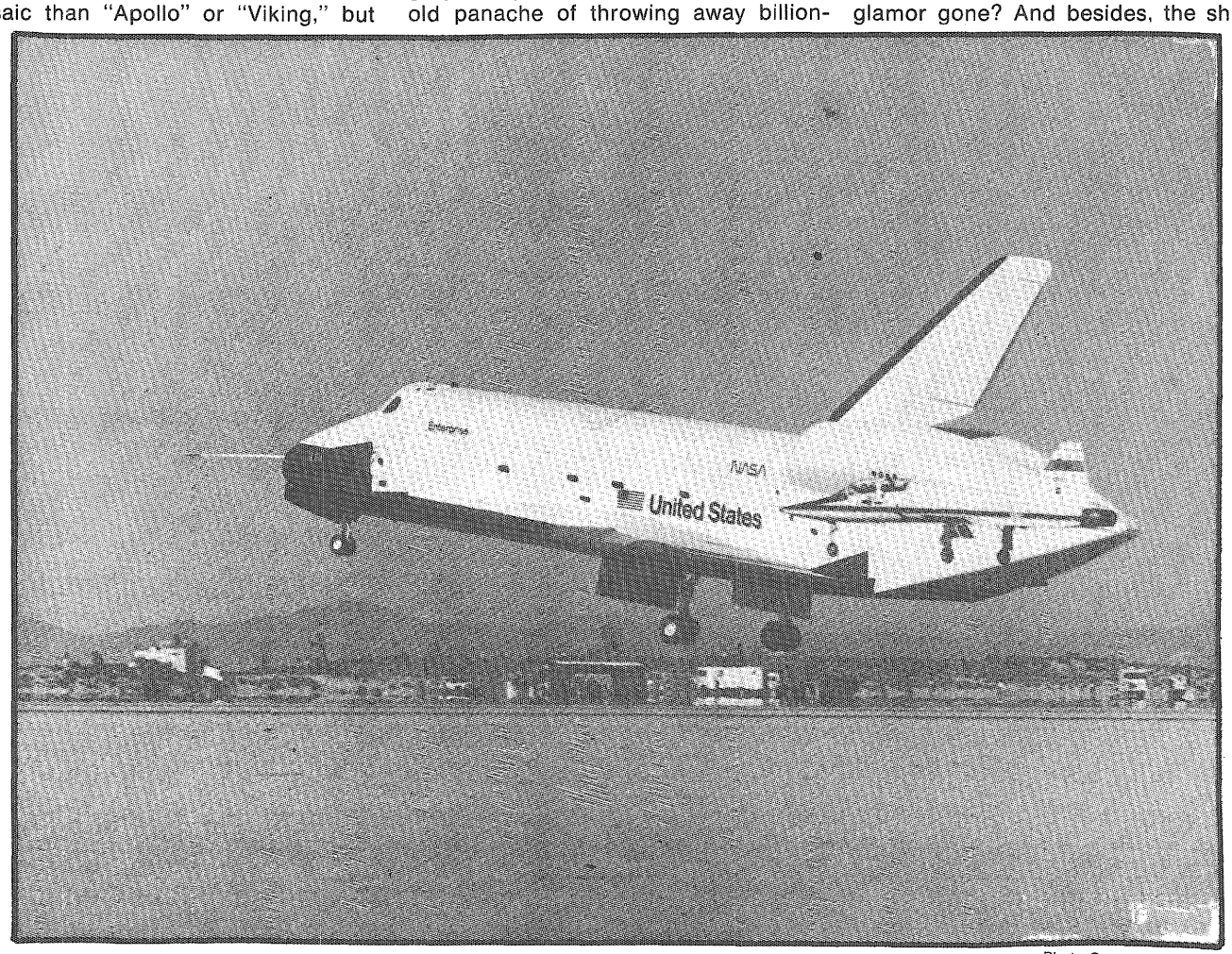
Space Shuttle

by Mat Hollinshead

NASA is making history again. This month's second Space Shuttle mission, or STS-2, as NASA calls it, marks the first time any space vehicle has been used for two consecutive launchings.

The "STS" stands for Space Transportation System, a term much more prosaic than "Apollo" or "Viking," but also fitting because it is a indicative of NASA's current practical goals. When the ignition command opens the fuel valves for this launch, and the main engine plus solid fuel boosters develop their 6.425 million pounds of total thrust, space travel and exploration will have been put into a new category, the category of regular transport. We're past the old panache of throwing away billion-dollar one-of-a-kinds for the sake of goals which now, in the light of the shuttle operation, look much more sexy than sustainable.

Big deal, you say? Nothing compared to the whole world watching Neil Armstrong plant his foot in the moon-dust? What's a space truck compared to a lunar rover, anyway? Where has all the glamor gone? And besides, the shuttle



TOUCHDOWN

Photo Courtesy of NASA

Rides Again

already did its thing once, last April. Do we have to get all hot about every launch?

Well, the glamour is all still there, even if it is in a more subtle form. Columbus may have discovered a new world, but it's all the people who followed him that did the heroic grunt work of bringing back the gold and building a society, and that's what we're into here. Deep down inside their poetic souls, NASA officials, along with space freaks everywhere, and many fairly ordinary people as well, feel that this second shuttle trip, the one that proves we can drive the same car twice, so to speak, is the real ticket to making something out of space. Instead of the cold and inscrutable source of myth and fiction that it's been even through the moon landings, space is about to become our own new back yard. What Joe Engle and Dick Truly are doing this month is something ultimately more important and epic than glamour. They're helping to add space to our habitat.

This month's launch is the second in a series of four test flights to qualify the shuttle for routine space operations. The flight will last for five days, four hours, and ten minutes, during which time several of what NASA calls "scientific and applications" tests will be carried out. In addition, orbiter systems will be put through attitude control, electrical power generation, and other performance tests, and the shuttle's Canadian-built, 50-foot-long manipulator arm will make its debut. This is the cargo boom that will deploy and stow the payloads on future flights when regular service is established in late 1982 or early 1983.

Launch preparations for STS-2 have gone relatively smoothly, but there has seldom been a NASA flight, or any space flight, without its share of surprises and delays, and this one was no exception. Lift-off was initially scheduled for the morning of Sept. 30, but had to be rescheduled to Nov. 4 due to an oxydizer spill. The nitrogen tetroxide which the shuttle uses in orbit for its attitude manipulation thrusters (the rockets which adjust its physical orientation) turned out to be contaminated with five parts per million iron nitrate, a level sufficient to cause a valve seal failure Sept. 22 as the oxydizer was being loaded into the nose of the orbiter. About two and a half gallons of it spilled onto the nose tiles and some of it made its way into the forward reaction control module, which contains the control system for the attitude thrusters. At first NASA feared the whole shuttle "stack" — orbiter, solid rocket boosters, and external tank — would have to be emptied of liquid fuel and moved back to the vehicle assembly building for removal of the control system module, but control bay damage proved less serious than that. The real problem turned out to involve something NASA technicians are all too familiar with — debonding of 379 thermal protection tiles vital to safe reentry of the orbiter after the mission is completed.

The silica fiber tiles have been the major source of trouble virtually throughout the shuttle development program, at one time causing enough delay to threaten a congressional investigation of NASA research and development procedures, so agency officials must have been concerned that the oxydizer spill not be allowed to rekindle old misgivings.

The nitrogen tetroxide probably followed one of two scenarios in the debonding, according to university sources here (detailed confirmation from NASA was not available at press time). Either it formed nitric acid upon contact with the moisture in the earth's atmosphere, and ate away the Koropon primer between the shuttle's aluminum skin and the adhesive which bonds its thermal protection tiles to the spacecraft; or, if the primer is a high polymer, the nitrogen tetroxide might have oxydized the polymer directly, breaking up its chemical chains and leading, also, to debonding.

In addition to the tile debonding the highly toxic oxydizer also contaminated several layers of insulation blanketing inside the reaction control module in the shuttle's nose, and these blankets were replaced by new ones. The rebonding of the tiles at first went very slowly, so that NASA projected the rebonding rate at an agonizingly slow one-tile-per-day, but methods were soon developed to jump that rate ahead severalfold and eventually nearly all the tiles were firmly reattached by the second week last month. Engineers decided to opt for decontaminating the nitrogen tetroxide, rather than replacing it, which meant putting the fuel through a rather laborious heat-chill/filtering cycle twice around, to get contaminate levels down to a requisite 2.5 parts per million. This cost some time, but did not affect the new launch schedule overall.

This second shuttle mission is the first to carry a research payload, the 19,388-lb. "OSTA-1" pallet mounted in the cargo bay just aft of the flight crew cabin and working quarters. From this position five remote sensing experiments will "test their eyes." The results will not only determine the operating capability of the sensors themselves, but also the ability of the shuttle to act as a stable viewing platform for such operations in the future. The shuttle has to orbit upside down to give the sensors a clear view of the earth below, and STS-2 will be a demonstration of that capability.

"OSTA" stands for Office of Space and Terrestrial Applications, which coordinates procedures for certifying and often developing research experiments to be flown on future shuttle missions. The OSTA pallet in the cargo bay contains five experiments having to do with land resources, environmental quality, and ocean conditions. Two more OSTA experiments, a Heflex Bioengineering

Test and the Night/Day Optical Survey of Lightning, will stay inside the crew compartment.

The largest of the five OSTA "outboard" experiments is called the Shuttle Imaging Radar antenna, a boom-like structure thirty-one feet long, half a foot wide, and weighing about four hundred pounds. It will bounce microwaves off the earth below and create map-like images of the earth's surface. Previously orbited systems of similar design have revealed ancient Mayan canals and studied ocean ice flows and wave patterns. This time the microwaves will be evaluated for their effectiveness in identifying fault lines and other geological formations which might contain oil or other mineral deposits. Since the radar will not be dependent on solar energy to operate and is strong enough to penetrate cloud cover and vegitation, NASA expects it to be a major source of accurate surface information, even in areas covered by tropical rain forest. The mission schedule calls for an eight-hour operating time, during which the instrument will take data covering 10 million square km — about the area of the United States. Evaluation of collected data will involve comparing it with Landsat Photos of the same terrain sections.

A closely related experiment is the Shuttle Multispectral Infrared Radiometer (SMIRR). Its purpose is to determine the best spectral bands to use in remote sensing of the rock types which the radar scan will cover. It will evaluate 10 bands in the 0.5 to 2.5 μm range. This data will then be correlated with field spectrometer data from the ground to decide whether ground measurement is sufficient to determine the best spectral bands to be used for future spacecraft doing geological mapping.

The multispectral radiometer will operate during daytime passes over land areas with less than 30 percent cloud cover. Data recording capacity is six hours total, but will be interrupted whenever the shuttle dumps water or purges fuel cells, in order to ensure against contamination of the sensitive optics inside the instrument.

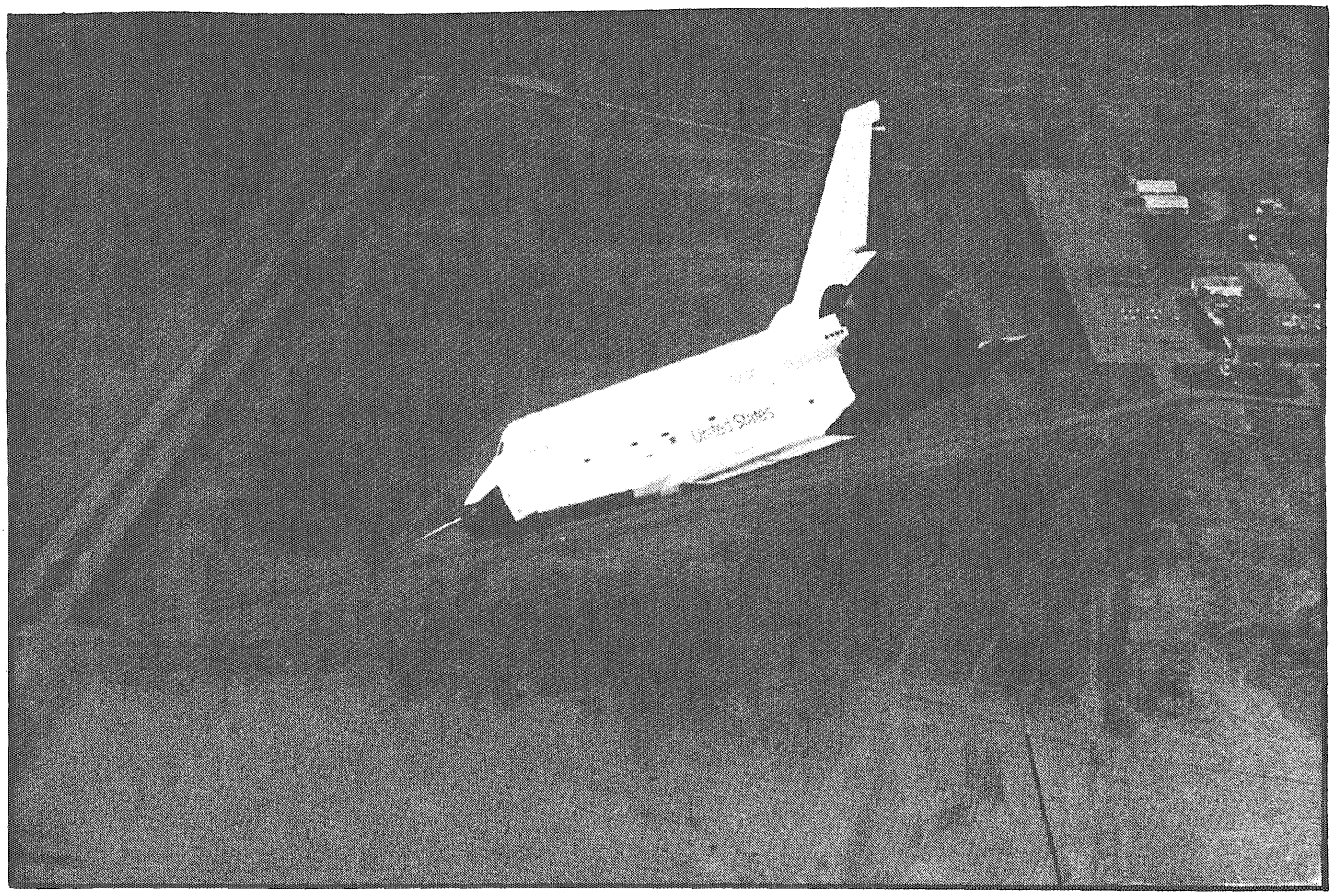
In the instrument itself, a filter wheel with 15 evenly spaced positions rotates at 100 revolutions per second. Every third opening is opaque to provide a zero base for the detector electronics. The other 10 positions contain filters to sample the chosen spectral bands. Two mercury-cadmium-telluride detectors convert photons to electrons which comprise the transmission signal. The detector assembly is mounted on a thermoelectric cooler to maintain a temperature of minus 81 degrees Celsius.

Two 16mm cameras, one black and white and the other color, will be triggered each 1.28 second cycle, half a cycle apart, in order to correlate the data being taken by the mercury-cadmium detectors with the ground view over which they are operating. The electronics assembly inside the experiment amplifies the detector signal, integrates it over the time an individual filter is in the optical path, and converts it from analog to digital form for recording on the payload recorder. Both the Shuttle Imaging Radar and the radiometer experiments have been developed and coordinated by NASA's Jet Propulsion Laboratory in Pasadena.

The third OSTA experiment is again related to the first two, in final application if not in direct function. The Feature Identification and Location Experiment (FILE) is intended to help develop equipment which will automate remote sensing units such as the radar and the radiometer, by activating them only when appropriate conditions exist for taking data.

Using the ratio between visual red reflectance and near infrared reflectance, this experiment will attempt to categorize scenes as either vegetation, water, snow, clouds, or bare ground. The long-term goal, extending over a number of Shuttle flights, is to make possible the development of tracking technology capable of distinguishing specific natural landmarks and certain types of generic surface features, such as coniferous or deciduous forest, for example. Two television cameras and a Hasselblad 70mm camera will serve as imaging equipment for this experiment.

The remaining OSTA cargo bay experiments, Measurement of Air Pollution (MAPS) and the Ocean Color Experiment, concern environmental conditions which NASA hopes can be accurately assessed on an ongoing basis from space during future operations. MAPS involves a complex process of using carbon monoxide in gas cells at two different pressures, plus a control detector. The two gas cells measure carbon monoxide levels in the atmosphere by sensing atmospheric thermal radiation and comparing different voltages pro-



SPACE SHUTTLE ORBITER

Photo Courtesy of NASA

duced by the radiation as it passes through the two gas cells and the direct detector. The difference in voltage readings between the dense gas cell and the control will determine carbon monoxide presence and levels in the lower troposphere (to an altitude of 7 to 8 km). The difference in voltage levels between the low density gas cell and the control will describe carbon monoxide presence in the upper troposphere and slightly beyond (8 to 12 km).

The Ocean Color experiment is designed to test equipment which will distinguish high concentrations of algae in the ocean from other obscuring reflections, such as high sediment concentration and the sea floor. The dominant pigment of chlorophyll is green, and by detecting it satellites could pinpoint schools of fish or detect pollution areas.

About 25 two- to 13 minute flyovers will be recorded on data tapes by the Ocean Color Experiment, all during sunlit passes over two main areas — the friction area between the Canary Islands Current and equatorial countercurrents and the upwelling area off the coast of Peru. The experiment also will take data along the eastern coast of the United States in the areas of Cape Cod and Georgia. Ships and low-flying aircraft in these areas will gather surface data for comparison.

The instrument used in the experiment is simply a modified version of the U-2 reconnaisance planes Ocean Color Scanner. The rotating mirror on the experiment instrument scans plus or minus 45 degrees across the direction of flight and reflects radiations through a telescope which images them onto a grating, which in turn defracts the radiation onto a bundle of 24 glass fibers. Scattering of ocean color bands will be measured indirectly by comparison of different radiation detector channels connected to the glass fibers.

While all of this automated data-gathering is going on just outside the flight deck, inside the crew cabin the Lightning Survey will depend on manual observations and photography. Many observers of thunderstorms, including astronauts in earth orbit, have commented on the unusual nature of some lightning phenomena. The crew will use a movie camera to film lightning flashes in nighttime thunderstorms. As in the Ocean Color Experiment, a defraction grating, this time attached to the camera lens, will provide lightning spectrographs which can be used to determine the temperature pressure, molecular species, electron density, and percent ionization in the lightning's path.

The Heflex Bioengineering Test consists of a suitcase full of 72 sealed plant modules, each module containing dwarf sunflower seeds. The object of the experiment will be to test the growth of these tiny seeds in the weightlessness of the cabin environment. The suitcase will be loaded into a crew compartment locker just before lift-off, and will stay

there the whole trip. Upon return it will be removed as soon as possible and opened for examination and evaluation.

Besides the OSTA research experiments, this second mission of the shuttle will continue the "orbiter experiments program" begun with the first shuttle mission. The objective is to gain a complete and accurate assessment of Shuttle performance beyond the initial measurements made on its maiden voyage.

The Aerodynamic Coefficient Identification Package (ACIP) which was used initially on the first flight will see duty again this time, collecting various aerodynamic data during launch, entry, and landing phases, as it did during STS-1 last April. This data is being used to create data bases for purposes of checking the accuracy of other data gathered on the ground and for application to other areas of technology, such as aerothermal and structural dynamics.

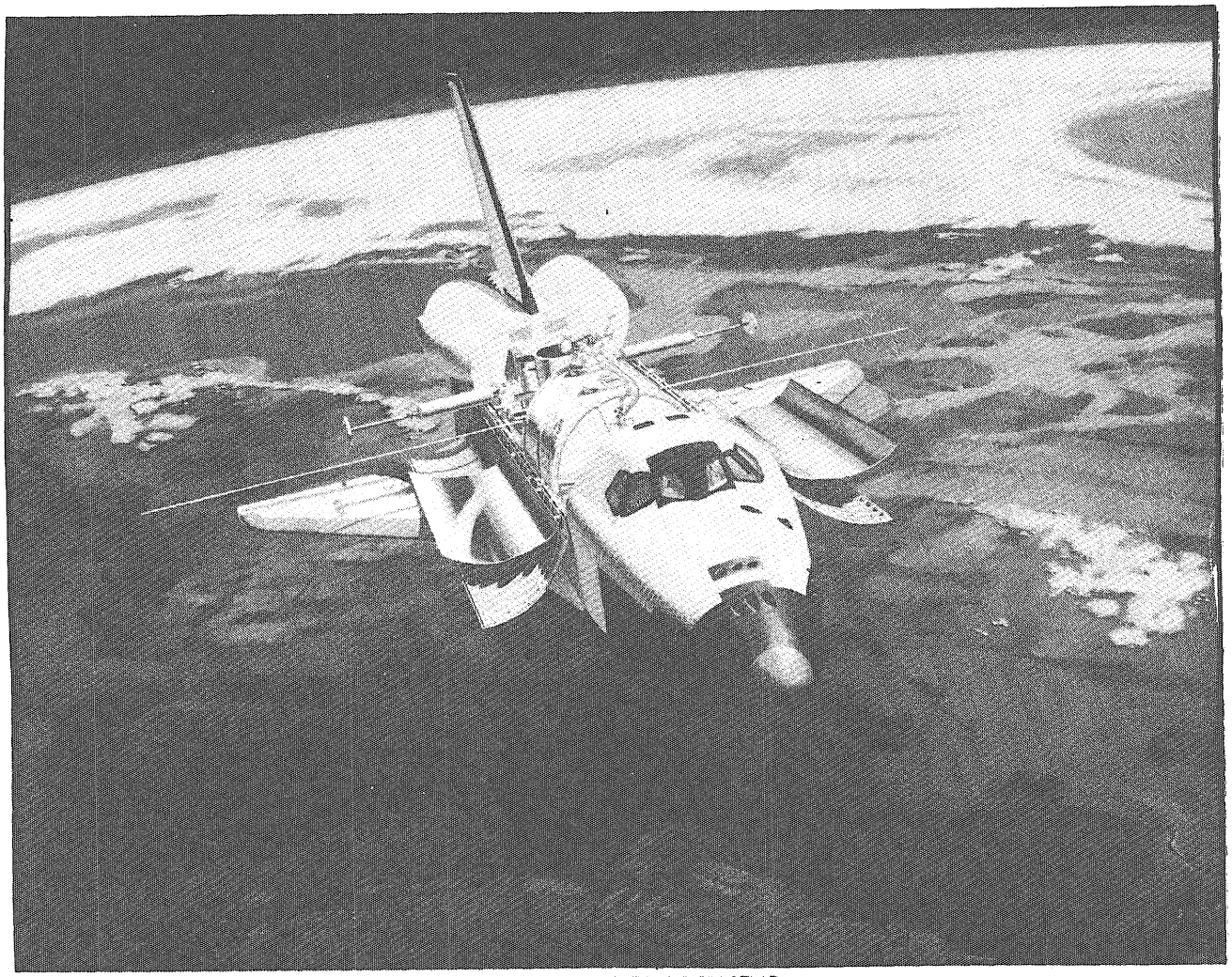
A Tile Gap Heating Effects Experiment went up with the first mission and will be performed again on this mission. NASA wants to know how it can refine the design of the gaps between the heat shield tiles to reduce the drag they create, thus reducing heating during reentry into the atmosphere.

Induced Environment Contamination Monitor is a new feature which will contain 10 instruments to measure the level of contaminants in and around the shuttle cargo bay during flight operation. Such knowledge is crucial to proper design and functioning of delicate optical and sensing instruments on future flights.

By the time you read this, if all has gone well, all of the hardware and the shuttle itself with Joe Engle and Dick Truly (what a great name for an astronaut) will be upsidedown in a 38° - inclination orbit 253.7 kilometers above the earth, probably just below our horizon line. But all of us will really be up there too, because the benefits of these flights will make changes we don't even imagine yet. So let yourself go. The great space movie that started with the first Mercury flights more than twenty years ago is still running. It may not be packing them in the way it used to, but it's still a terrific show.

minnesota TECHNOLOG

Mat Holinshead is a pre-graduate adult special in architecture. He likes to be verbal when he's not drawing. He freelances both his writing and photography, but can he play piano with his feet?



SHUTTLE ORBITER CARRYING SPACELAB

Photo Courtesy of NASA

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Steve Catrow BS, Electrical Engineering

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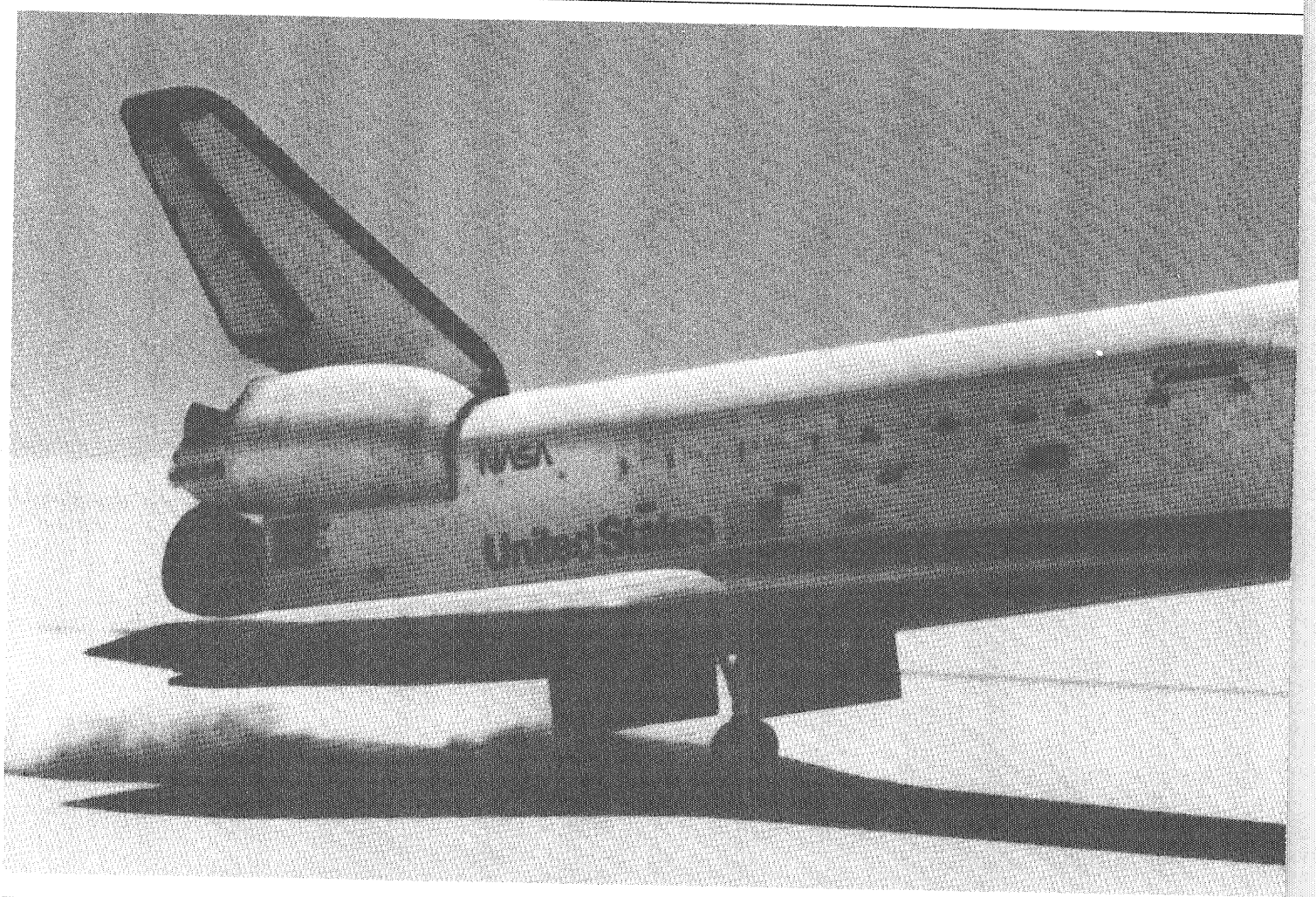

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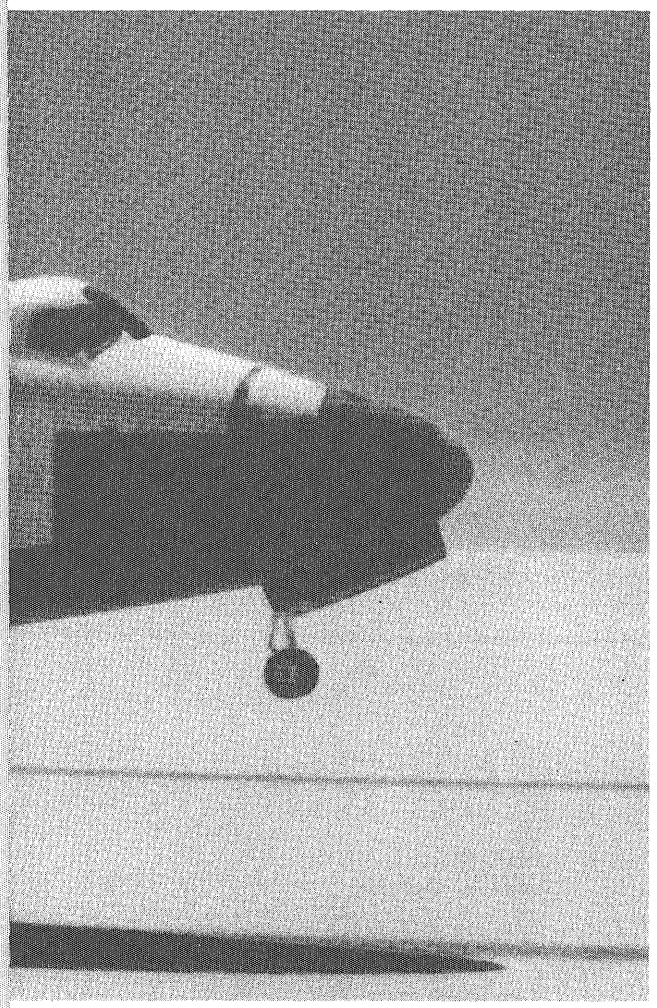

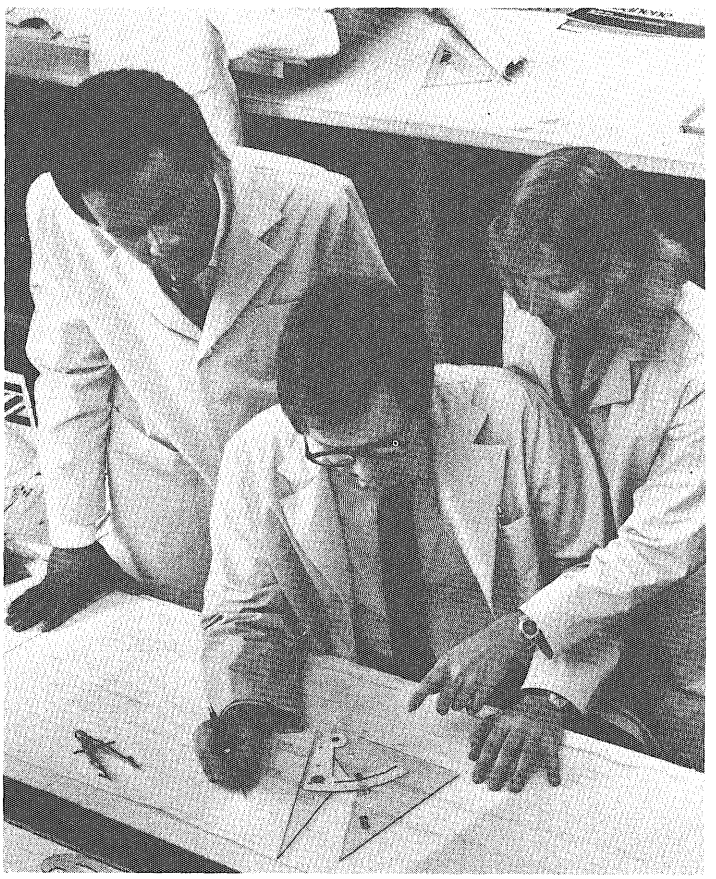

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The Graduates of I.T.: What Awaits Them?

by Scott Dacko

The average I.T. student spends 4.5 years in school in obtaining an engineering degree. This fall, about 175 I.T. students will have finished their average 4.5 years and are going to do something not all that uncommon: They're going to GRADUATE. What faces these graduates of I.T.? What faces the 925 more who will graduate throughout the year? For the answers, we turn to the man whose job it is to know them: Lee Ponto, Director of the I.T. Placement Office.

The I.T. Placement Office, located in 15 Experimental Engineering, takes in about 80% of all graduating engineering students. Of the remaining 20%, about 10% are going on to graduate school, and 10% either already have jobs lined up, or plan to do a little traveling before settling down into a lifetime career. Lee Ponto, the Placement Director, tells us about the 80%:

"A student typically has anywhere from 12-14 interviews, within a range of about 2-50 interviews. The average student also has about five plant trips which are arranged through the companies which are a direct result of the campus interviews. About 250 companies come to interview students each quarter."

Out of the students that graduate, about 60% stay in the state of Minnesota. Out of the companies that come to interview, about 70% come from out of state. When asked if that was good, Ponto explained, "Well, the state does provide a lot of opportunities, and it does like to keep its technical talent. Apparently the students like to stay here. The out of state companies are somewhat disappointed at that, that they can't get a lot of students to relocate."

How do these — and all technical companies for that matter — lure engineering students? There's a number of ways, but without question, due to the general demand of society and corporate competitiveness, the starting salary plays a predominant role.

"As of last June, EE's and ME's were starting at $23,000 a year on the average," Ponto explains. "Chemical engineers started at around $24,000, and the Computer Science and Civil Engineers began at around $21,000. The rest of the engineer's salaries fell somewhere in between. One thing is for sure, though. Those are the highest starting salaries of any bachelor degree at the University — no doubt about it."

As a direct result of these high starting salaries, fewer students are going on to graduate school, as mentioned before, only about 10%. Adds Ponto, "Graduate school would like to see that increase, and so would the departments. They'd like to see more qualified students; they're short of Teaching Assistants, and the companies are short of masters and PhD candidates to recruit. This has affected the demand for graduate students at both the department level and industry."

'. . . a student can't come into an interview and say, "Tell me what you have to offer and I'll tell you which one of those I'm interested in" . . .'

This doesn't mean, however, that engineers on the job are content with status quo. There are many programs within companies that encourage the technical personnel to continue their education. Most companies today have programs where they will pay 70-100% of the tuition costs of the students — but most expect the student to do that graduate work on an evening school basis. There aren't many companies who will send a student to school full-time or half-time while employed by the company, — but a few do exist.

"Bell Labs has a very excellent program, where a student goes for a masters degree full time and is expected to pick that up in a year. This is very unusual, and thus is very competitive; it's only very highly qualified applicants that they look at — the top-notch grade points. But almost all companies have the tuition policy for any person. There's a lot of encouragement to go on for either technical coursework or business administration-advanced coursework.

"The trend has been for coursework in business — and it has been for some time, mainly because the people find there are so many opportunities once they get out in industry that they need some business background, whether it be financial, accounting, etc. There are a lot of opportunities for technical people with those business interests. Also, our evening school technical advanced coursework enrollment has increased over the last couple of years. That's

come about because fewer are going on in graduate school in day-school."

How many jobs offers do the I.T. students get? For those using the Placement Office, on the average there are about three job offers per student. Some students have had as many as 18 offers, some maybe get one. Some don't get any. But on the average, they do quite well. Both large and small companies alike do the offering. If a large company were to be defined as one with over 500 employees, Lee Ponto estimates roughly 80% go to the large corporations.

"There are some small companies-and consulting firms-that don't interview on campus, and a lot of students approach them on their own by sending resumes, etc.," Ponto notes. "There are ways to get to both. It's a little more work, though, if the company doesn't come to campus."

Is the amount of job offers a student gets directly related to his/her Grade Point Average?

"I think it's broader than that," Ponto says, "The G.P.A. is certainly important. Technical experience, grades, student activities experiences, leadership positions held, communications skills, the way they interview — it's usually more of a total assessment, but certainly grades would be one of the half dozen most important factors.

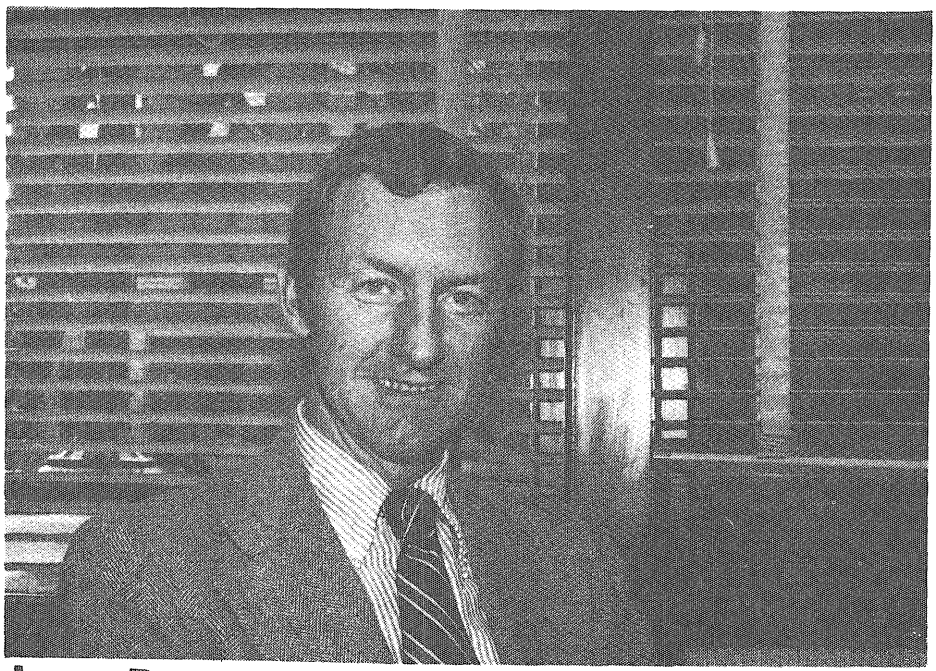
"As far as what's most important, it's hard to say. Companies come here looking for an overall assessment. If a person's grades are lower but some of their other skills are high, that would offset the grades, and higher grades would offset other things. So it's a balance of factors for students, which is good. Different companies look at students differently."

One thing for sure, communication skills should be developed as much as possible. If you talked to companies, that's probably the central theme that they bring up — *they want people with communication skills!* There aren't many jobs anymore where one doesn't interact very heavily with people, whether it be fellow workers, presenting projects to supervisors, the department, the company, or working with customers.

"Speech courses," Ponto notes, "or membership in clubs like Toastmasters where people get used to talking in front of groups, putting their thoughts together logically, or learning to write technical reports — it's all invaluable. There have been a lot of comments from companies that students in general don't have adequate communications skills; so the more they can do to increase their communication skills, the better they'll interview, and the better they'll do in their job. A lot of companies run programs on developing one's speech skills; but if a person had those somewhat developed already before going to a company, then they're just that much further ahead. All companies mention communication skills and all of them have that on their rating sheet of students — one of the top half dozen.

"Another thing companies want is that they expect students to be able to tell them what they're interested in doing. In other words, a student can't come into an interview and say, 'Tell me what you have to offer and I'll tell you which one of those

'How do these companies lure engineering students? There's a number of ways, but without question, the starting salary plays a predominant role.'



Lee Ponto

Photo by Debra Senske

I'm interested in.' Most companies will say, 'Tell me what you want to do and I'll tell you whether or not that exists within our company.' Students have to give thought prior to their senior year as to what they're interested in, whether it be design, development, sales, field engineering, etc. A lot of societies have company trips — students should be doing career planning and exploration long before the interviewing starts — before it's too late. And they're very inadequately prepared as far as what's in industry. Those students who have been in the intern programs have this advantage because they've seen some of these jobs in operation. Start to know what you want to do and what you don't want to do. Through company visits, seminars, etc. — the student should take advantage of whatever is offered. That's a very missing part for most students and for those who have it, they really have an advantage. Usually a student invests four years in the process of education and then does his/her career planning in about three months. That's not adequate."

At the present time, the demand for engineers look good. Is this a long term trend? Lee Ponto thinks so.

"Most people think unless there's something major that would happen such as a big economic downturn, or a recession that would affect a lot of these companies, that it will continue. The supply of engineers is certainly at an all time high. In some areas it hasn't caught yet except maybe in some construction areas, those that would normally depend on governmental hiring — that's down. They're having a more difficult time, but most of the industry still is doing pretty well, the steel and auto industry seems to be down but other areas are picking up, so it's predicted that the outlook for the next five years is to remain very good. Some of the electronics companies are growing at 18% per year (in profits), creating many jobs for people. There are some very healthy industries — computer, electronics, and petroleum are probably among the healthiest right now, so they're creating a lot of jobs. Even the aircraft companies are recruiting as heavily as they ever have, so they're doing quite well. Many of them pick up the slack that comes from other companies affected, and that's hopefully what will continue. The demand for engineers has remained very high and it looks like it will continue to be good."

So the graduates of I.T. don't have it too bad. Part of their success can be attributed to the Institute of Technology. In Lee Ponto's words, "The administration here is doing a lot to try and keep the status of I.T. very high and to draw funds, to draw faculty, and to continue to accept students when we can. So I think there's a lot of effort to get the word out of the importance of I.T. and its contributions within the U, within the state, within the country — a lot of work being done."

How very true! Sort of makes you proud to be an I.T. student. So just remember, when there's below-zero weather outside, you've just finished a physics quiz, and you've stopped to take a break and read the *IT Connection* before taking a math exam, think to yourself, "I.T. sure is a lot of work, but some day I'm going to be an engineer."

minnesota TECHNOLOG

When he's not editing the I.T. Connection, Scott Dacko amuses himself by pretending to be a sophomore in Mechanical Engineering.

A New Letter For GMC: S-Truck

"With our new S-truck plant, product quality is our top priority," says Robert W. Truxell, a General Motors vice president and general manager of GMC Truck & Coach Division.

GMC's S-truck plant in Pontiac, Michigan, is one of three GM plants building the first GM domestic compact pickup. Containing nearly 1.4 million square feet of work space, it includes a body shop, paint shop and final assembly line. The S-15 is built on two shifts here, employing about 1,700 workers.

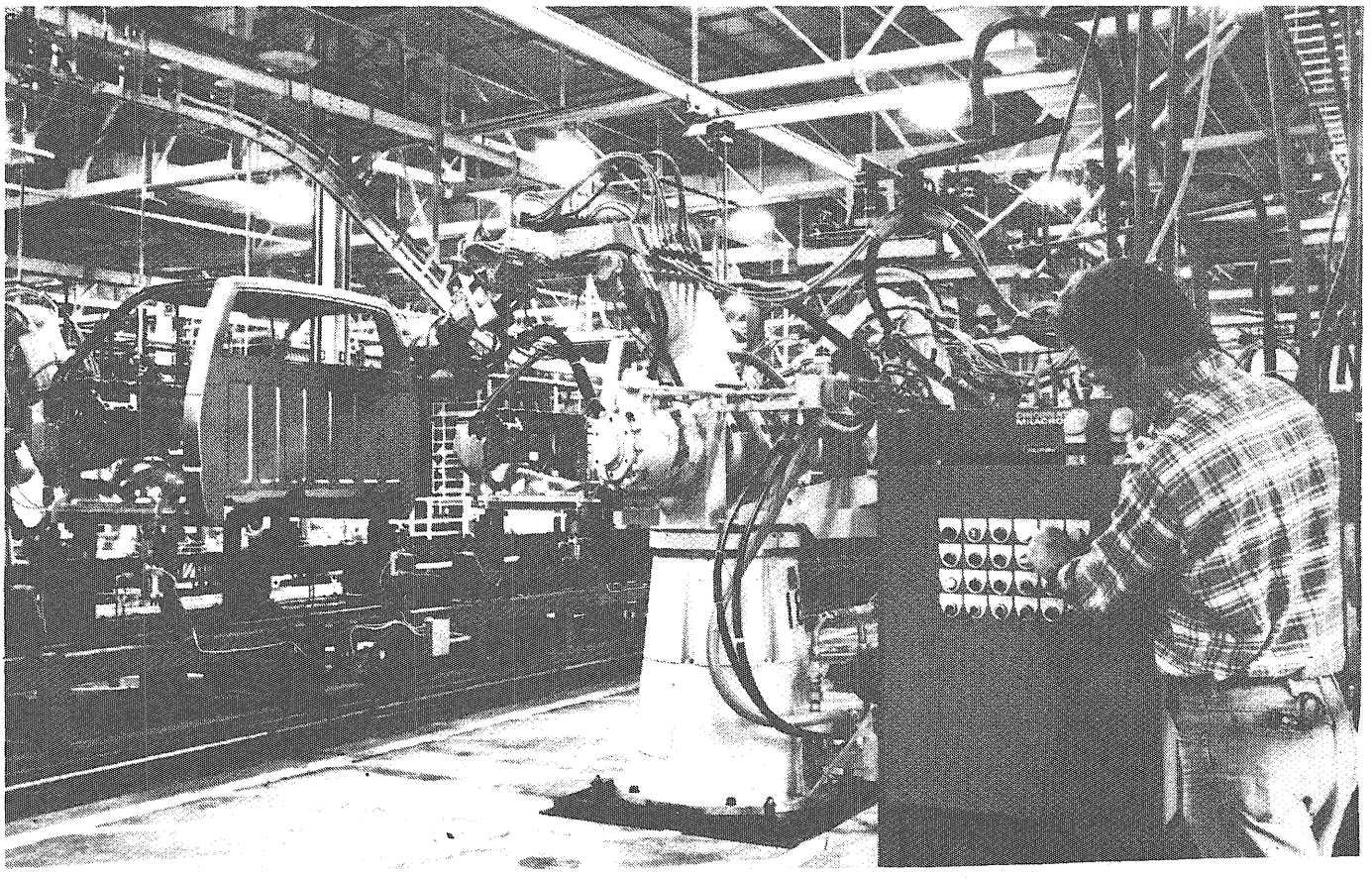
The new GMC S-truck plant is part of General Motors' $40 billion capital expenditure program for new products and facilities to help meet the needs of the marketplace and the foreign challenge.

The unique net design of the S-truck combined with a high degree of welding automation will help ensure the S-truck being a quality-built truck, according to Truxell.

"The net design concept allows parts to mate together the same way each time with no tolerance buildup," Truxell said. "Each part contains gauge holes that will line up accurately and consistently during the assembly process."

Common clamping points are designed right into the parts to mate exactly with the clamping fixtures used during assembly for joining sheet metal to ensure good fits in the final product.

In the body shop, 23 robots and 12 automated welders perform 87% of the total required welds to the pickup cab and box.



These are some of the 23 robots at the GMC S-truck plant body shop in Pontiac, Michigan which, along with 12 automated welders, perform 87% of the required welds to the all-new 1982 S-truck pickup cab and box. Each robot has its own programmable logic controller (PLC) for smooth product flow.

Tabs and slots are used for precision pre-assembly of the pick-up box and the box's welded construction is fully automated to help ensure quality new design.

All automated welding machines and robots have their own programmable logic controller (PLC) for smooth product flow and to help reduce machine downtime. The entire body shop will be monitored by computer to immediately alert maintenance personnel of machine problems.

A central equipment monitoring computer is being connected to each piece of equipment. The programs that run the robots and welding machines will be stored in each PLC control memory as well as the central computer. If the individual programmer control should "forget" what to do, the central computer can reprogram the welding machine or robot to refresh its memory, thus avoiding long line stoppage.

All cab and pickup box transfers during the assembly process are fully automatic to eliminate sheet metal damage.

GMC's S-truck paint process is designed to ensure a quality paint job on each truck.

The pickup passes through a phosphate system which prepares bare metal for coating processes. It's then dipped in a cathodic Elpo tank for a protective corrosion-resistant coating. The pickup is then seam-sealed and a chip-resistant spray is applied to the lower body side panels followed by a primer coating. The primed truck is baked in preparation for color application.

The S-truck cab, pickup box, front fenders and hood are color painted as a unit using high solid paints applied by electrostatically charged automatic spray guns. If the truck requires a two-tone paint combination, it is applied in a second color booth. After it's painted, decals are applied and also an aluminum wax to help prevent inner door corrosion.

The primary functions of final assembly are to build the frame, dress the engine, trim the cab, marriage of cab and box to frame and final vehicle prep.

"There are no less than eight innovative assembly processes in the GMC S-truck plant that result in improved product quality," Truxell said.

A clamshell-type carrier system is utilized to suspend cabs/boxes above work stations because the carrier height can be adjusted depending on the particular assembly operation to facilitate high quality.

Prior to assembly of cab to frame, the cab is subjected to an extensive four-minute test in chemically treated water that enables inspection under ultraviolet light to pinpoint the source of any leak. A body merge system is used rather than the traditional "body drop" method. The merge places the cab-box directly overhead of the frame and lowers the cab-box at the precise time it can be adjoined for the most trouble-free installation.

When seats are assembled, they are covered with a clear plastic material and put into an infrared oven. When the seat passes through the oven, the plastic material shrinks to conform with the seat and serves as protective coating to help keep the seat free from dirt or stain.

Currently unique to the industry, a robot is used to apply a urethane sealant to the S-truck windshield for a watertight seal before the assembler places it in the truck at the GMC plant. After an operator puts the windshield on a table, the robot applies the sealer and then places the windshield on a rack. The assembler takes it and installs it in the small pickup.

All electrical components such as instrument panel gauge cluster and radio are tested prior to sub-assembly as well as final assembly in the cab to ensure all are working properly.

The start-up of the truck occurs while it is still suspended so the unit can be completely inspected prior to the truck being driven.

There are areas along the assembly line to get problems corrected "on the spot" rather than waiting to do it at the end of the line.

minnesota TECHNOLOG

Log Ledger

The National Research Council plans to award approximately 35 Postdoctoral Fellowships for Minorities in a program designed to provide opportunities for continued education and experience in research to American Indians and Alaskan Natives (Eskimo or Aleut), Black Americans, Mexican Americans/ Chicanos, and Puerto Ricans. Fellowship recipients will be selected from among scientists, engineers, and scholars in the humanities who show greatest promise of future achievement in academic research and scholarship in higher education.

In this national competition sponsored by the Ford Foundation, citizens of the United States who are members of one of the designated minority groups, who are engaged in college or university teaching, and who hold doctoral degrees may apply for a fellowship award of one year's duration.

Awards will be made in the areas of behavioral and social sciences, humanities, EMP fields (engineering sciences, mathematics, physical sciences), life sciences, and for interdisciplinary programs of study. Awards will not be made in professions such as medicine, law, or social work, or in such areas as educational administration, curriculum supervision, or personnel and guidance. Tenure of fellowship provides postdoctoral research experience at an appropriate nonprofit institution of the Fellow's choice, such as a research university, government, laboratory, national laboratory, privately-sponsored nonprofit institute, or a center for advanced study.

The deadline date for the submission of applications is February 1, 1982. Further information and application materials may be obtained from the Fellowship Office, National Research Council, 2101 Constitution Avenue, Washington, D.C. 20418.

A maximum of eight graduate study Fellowships of $4,750 each will be awarded in 1982 by the American Institute of Steel Construction, the national organization representing the structural steel fabricating industry. The grants will be awarded to graduate civil or architectural engineering students proposing a course of study, toward an advanced degree, related to fabricated structural steel.

A.O. Wilson, Jr., President of A.O. Wilson Structural Company, Inc. and Chairman of the AISC Committee on Education, said that, "The purpose of the 1982 Fellowship Award Competition is to encourage expertise in the imaginative use of structural steel for bridges and buildings and to motivate students toward the pursuit of new ideas which will improve the technology of steel construction and benefit the nation through lower construction costs which will provide more funds for vital projects."

To be eligible for the Fellowship Awards applicants must be: senior or graduate civil or architectural engineering students, accepted by an ABET accredited college or university offering a graduate structural engineering degree program, and United States citizens.

Fellowships will be awarded on the basis of the candidate's proposed course of graduate study, scholastic achievement, and the recommendation by the engineering college faculty. Applications for fellowships are available at the colleges' civil or architectural engineering departments and from the AISC Education Foundation, 400 N. Michigan Ave., Chicago, Illinois 60611. The deadline for receiving applications is February 1, 1982. The names of the winners will be announced by February 15, 1982.

The National Research Council announces its 1982 Research Associateship Awards Programs for research in the sciences and engineering to be conducted in 18 federal research institutions, whose laboratories are located throughout the United States. The programs provide Ph.D scientists and engineers of unusual promise and ability with opportunities for research on problems largely of their own choosing yet compatible with the research interests of the supporting laboratory. Initiated in 1954, the Associateship Programs have contributed to the career development of over 3500 scientists ranging from recent Ph.D recipients to distinguished senior scientists.

Approximately 250 new full-time Associateships will be awarded on a competitive basis in 1982 for research in chemistry, engineering, and mathematics, and in the earth, environmental, physical, space, and life sciences. Most of the programs are open to both U.S. and non-U.S. nationals, and to both recent Ph.D holders and senior investigators.

Awards are made for a year with possible extensions through a second year; senior applicants may request shorter tenures. Stipends range from $22,400 a year for recent Ph.D.s to approximately $50,000 a year for Senior Associates. Allowances are made for relocation and for limited professional travel during tenure. The host federal laboratory provides the Associate programmatic support including facilities, support services, and nesessary equipment.

Applications to the Research Council must be postmarked no later than January 15, 1982. Awards will be announced in April.

Information on specific research opportunities and federal laboratories, as well as application materials, may be obtained from the Associateship Office, JH 610-D1, 2101 Constitution Avenue, N.W., Washington, D.C. 20418, (202) 389-6554.

The largest and most powerful superconducting dipole magnet ever built has been successfully tested at the Department of Energy's Argonne National Laboratory.

The high-technology device, embodying pioneering design principles, weighs almost 200 tons, is about 22 feet long, 13½ feet wide, and 16 feet high. When energized, it produces a magnetic field about 120,000 times stronger than that of the earth.

Successful testing of the huge superconducting magnet is a major milestone in magnet technology for magneto-hydrodynamic (MHD) power generation. The magnet is intended to be used for experimental investigations of MHD generators being carried out at DOE's Coal-Fired Flow Facility near Tullahoma, Tenn. The facility is operated by the University of Tennessee Space Institute.

Large electrical generators require high strength magnetic fields to operate efficiently. Conventional electro-magnets cannot provide these high magnetic fields without excessive use of electricity.

Superconducting magnets, on the other hand, are much smaller in size and are built of materials that lose all electrical resistance when cooled to near absolute zero (459 degrees below zero Fahrenheit). These magnets can provide higher and more compact magnetic fields with the use of very little electricity resulting in higher output for a power plant.

Argonni is recognized internationally for the design and construction of large superconducting magnets, including a 107-ton magnet now in use for high-energy physics research at Stanford University, and the world's highest field superconducting magnet for MHD research built four years ago.

In MHD generators, hot gases pass at high speed through a magnetic field inducing in the gases an electrical current for distribution. The gases replace the rotating armature found in conventional generators.

After passing through the MHD generator, the gases are still hot enough to generate additional electricity by conventional means.

The advanced technology developed by Argonne in the design and construction of superconducting magnets is available to industry to further the development of advanced energy sources for tomorrow.

It has been estimated that MHD electrical generation can raise efficiency of coal-fired power plants from a present average of about 35 percent to 50 percent or higher in the future, thus offering the potential of providing electricity to industry and the consumer more economically than conventional systems.

This magnet development was funded by the Department of Energy's Office of Fossil Energy. Argonne National Laboratory is operated for DOE by the University of Chicago under a contract among DOE, the university and the Argonne Universities Association.

"America has more engineers than any other industrialized nation, including Japan, and industry must maintain that worldwide engineering edge to surmount the challenge of global competition," says Warren J. Hayford, International Harvester president and chief operating officer.

In a commencement address to the engineering graduates of Northwestern University's Technological Institute on June 13, Hayford said the U.S. has the highest percentage of engineers in the free world, 60 per 10,000 of the labor force. In contrast, he noted that Japan has 50 engineers per 10,000.

"American industry must use its engineering edge," he said, "to accelerate the process of technological change especially in so-called mature industries. Since America is concerned about where its competitive advantages lie, the engineering field represents one of the major ways U.S. industry has of competing with the world."

The IH executive said that the outlook for engineers is bright, citing that surveys project engineering employment will increase 26.8% through 1990. He also said that the demand for engineers will not soon diminish because of the increased application of many engineering disciplines to a broad spectrum of industry segments and the need to quicken the pace of innovation in industries where the order of change has been slow.

"International Harvester recently introduced a new aerodynamically-design ed truck that is more fuel efficient by five to 10%," Hayford said. "On the other hand, an aircraft manufacturer announced a new model that is more fuel efficient by 25 to 50%. This demonstrates the performance difference between technologies. It also shows the large job that lies ahead in stimulating quantum growth in mature as well as high-technology industries."

Hayford also challenged industry, universities and government to work closer in the task of basic research, citing the drop since the 50s and 60s in the amount of basic research as a percentage of gross national product. "Universities should play a more significant role in performing more of the basic research, government should work smarter in targeting research objectives and industry should play a stronger role in bringing the results to the marketplace."

The executive addressed the subject of productivity and the increases that new engineering tools such as computer-aided-design are bringing to the work environment. He said that prod-

MAGNETIC PARTICLE TESTER REDUCES TESTING TIME AS MUCH AS 80%

Some of the standard features of the Multimag 2000 Series testers are the use of a digital-readout current meter; all solid-state plug-in modules; push-button demagnetization of the test piece; and thermistor overload protection for the tester, in the event of overheating or any critical area of the machine.

Optional features include a cable winch/counterbalance system and a removable dolly for repositioning the machine.

Because the Multimag 2000 Series systems are basically power packs, a separate wet test bench is required with facilities for mounting the test piece and applying magnetic material to it. A hand-held "energize" switch cabled to the power pack allows a single operator to use the machine while spraying a part, or examining it with a black light.

The input line voltage to the Multimag 2000 Series machines is 460 VAC, three phase. The full-wave rectified DC output ranges from 6,000 to 12,000 amperes, depending on model.

For full technical details and prices on Multimag 2000 Series magnetic particle testing systems, contact Uresco Ardrox, 10603 Midway Avenue, Cerritos, California 90701.

A new line of time-saving magnetic particle testing machines that magnetize a test piece of several directions has been announced by Uresco Ardrox, manufacturer of nondestructive testing equipment. By replacing localized magnetization with overall magnetization, testing time is reduced dramatically — as much as 80%.

Called the Multimag™ 2000 Series, the magnetic particle testers utilize the principle that magnetizing a test piece in different directions will reveal defects differently oriented in the part. The ability to magnetize in several directions is especially useful in testing large pieces which would be awkward or difficult to reorient on the test fixture.

Depending on the geometry of the part, the operator can elect to magnetize in one, two, or three directions. When this selection has been made, the tester automatically sequences the magnetization from one direction to the next, while the operator applies magnetic particle material and inspects for defects.

The switching time between magnetizing directions is 0.01 second, and the total current shot may be varied from 0.5 second to 5 seconds. The magnitude of the applied current in each direction may also be varied to accommodate the needs of the inspection situation. These levels are set by three potentiometers, which control the current supplied by three separate, proven solid-state power supplies directly to contacts on the part, or to magnetizing coils.

uctivity is not only important to industry, but necessary in the engineer's own activities in making the most of the individual's talents and capabilities. The end result is helping industry make quantum leaps in building high-quality products, using the best manufacturing processes.

"Engineering the future never ceases," said Hayford, "once you have achieved a goal or surmounted a challenge, another appears on the horizon. That is the challenge of engineering, that is the reward."

Chemical Abstracts Service will increase its grants to colleges and universities who subscribe to *Chemical Abstracts* from the present level of $500 to $1000 in 1982, continue a program of special grants to smaller U.S. colleges, and offer a reduced price of $5200 for purchase of *Chemical Abstracts* by all organizations in 30 least-developed countries.

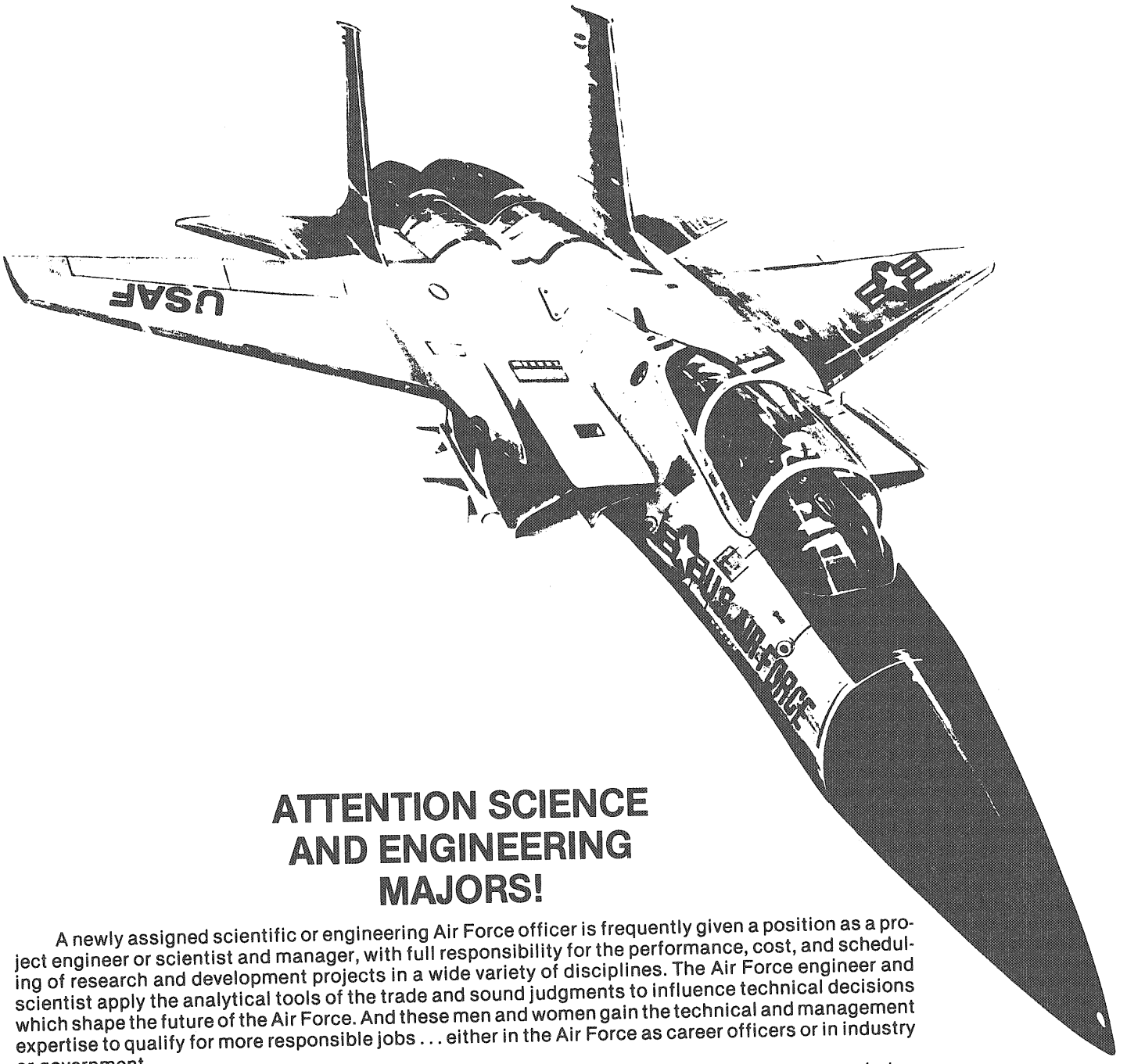
The base subscription price of *Chemical Abstracts* will increase from $5500 to $6200 in 1982. With the increased grants available from Chemical Abstracts Service and the American Chemical Society, the cost to all colleges and universities will be $5200 or less. Almost 2000 colleges and universities around the world will receive the grants. The $1000 academic grant also will apply to the *CA Chemweekly* service, which consists of weekly abstract issues on microfilm or microfiche and semiannual volume indexes in printed form.

U.S. colleges and universities that offer no degree higher than the bachelor's in chemistry or a related discipline and have fewer than 3000 students are eligible for additional special grants from the American Chemical Society toward the purchase of *Chemical Abstracts*. In 1982, the amount of the special grants will be increased so that the cost to these institutions does not rise. In addition, CAS will introduce a program of additional grants to U.S. colleges which offer no degree higher than the bachelor's in chemistry and have enrollments of 3000 to 4999. The size of the grant varies according to enrollment.

In announcing the new grants, CAS marketing director Ronald G. Dunn said, "CAS is acutely aware of and concerned about the financial problems that academic institutions face. We hope the expanded grants will make it easier for colleges and universities to acquire and retain subscriptions to *Chemical Abstracts*, a basic information tool in chemistry and many allied sciences."

CAS also will offer subscriptions to *Chemical Abstracts* (and *CA Chemweekly*) to organizations in 30 least developed nations for $1000 less than the normal subscription price beginning in 1982. "There currently is very little use of scientific and technical information in the least developed nations," Dunn said, "We hope that a special reduced price on *Chemical Abstracts* can help change that. If it proves successful, we will consider other special programs to encourage more information use in the future."

AIR FORCE ROTC



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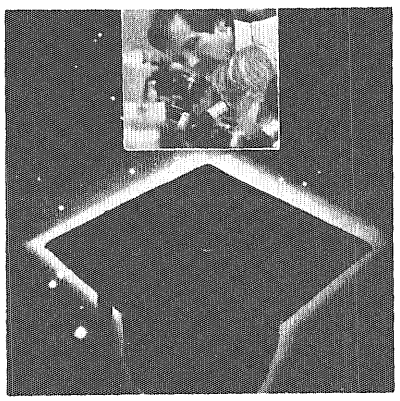
- The designer and producer of the most complex MOS chip.
- The inventor of single-chip solid-state voice synthesis.
- The largest producer of microelectronic memory products.
- The world leader in Very Large Scale Integration.
- The primary supplier of airborne radars to the U.S. defense program.
- The leading developer and producer of infrared and laser systems.
- The world's foremost geophysical survey company.



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LASER FLOYD

by Steven Deyo

What do John Philip Sousa, Pink Floyd and Van Halen have in common?

Their music provides the medium and the atmosphere for a sound-and-light fusion that captivates and entertains: Laser Fantasy, showing Tuesday through Sunday nights at the Norstar Theatre in downtown St. Paul.

Laser Fantasy opened in the Twin Cities in June of 1980 after a year-and-a-half stint in Chicago as "Laser Odyssey" during 1977 and 1978. Twenty-six-year-old Floyd Rollefstad, as president of Coherent Innovations, Inc., designed and built the Laser Fantasy projection equipment with $40,000 in backing from relatives — a laser alone costs $20,000 nowadays — and then he... Huh?

"What's a Laser Fantasy?"

You mean, you haven't been to one (or had one, as we *cognoscenti* put it)?

Laser Fantasy is projected on a 20-by-48-foot movie screen. Laser Fantasy pulses with, and at the command of, the accompanying music which actually generates some of the images. Laser Fantasy is a live, "cosmic" performance rendered at the hand of an artist-technician, called a "laserist," and improvised from a basic format of pre-recorded laser light generations as the audience's feedback — applause, *aaahhs,* cheers — tells the laserist what to do more of. "Lean back in your seats and get into it," Rollefstad tells an audience before his "Laser Floyd" laser-show.

But... how to describe the experience?

Laser Fantasy is a 50- to 55-minute pyrotechnic veil dance of laserlight, a psychedelic Rorschach test every second. It's Technicolor Spirograph designs and diffusion patterns, a *2001*-special-effects trip past tethered stars and ring nebulae, through streaming tunnels of incandescent gas clouds. Laser Fantasy at its mildest is a melding of string-art-in-light, of multi-color sparklers and incendiary comets' tails (during Pink Floyd's technological mood music); but unleashed (with, say, Lynyrd Skynyrd) it is geometry amid flux and chaos, oscilloscope waves gone awry, maelstroms and plasma vapors and galaxies being formed and sundered before your eyes. All in cobalt-blue, cupric-chloride-green, flourescent-sodium-yellow and neon-red (at frequencies of 488, 514, 568 and 647 nanometers, respectively). The colors blend also; sometimes into hues I swore couldn't or didn't exist, or were only illusions.

Light patterns are synchronized with and choreographed to the music (though, being a "live" performance, the laserist can occasionally mis-anticipate the beat).

Rollefstad's krypton-gas ion laser feeds four coherent beams of color into separate galvanometric scanners (small mirrors on precision-oscillating motors). Much like a television's cathode ray tube, the beam's termination on the screen — a dot — is scanned so rapidly that it begins to look like a line due to the eye's persistence of vision. Through an array of mirrors and prisms, accompanied by about 150 knobs, switches, and potentiometers, the laserist can manipulate or modulate the laserlight pattern's color, intensity, relative position, shape, size, and texture using built-in oscillators, analog electronics, multipliers and optical amplifiers. Portions of the program which are difficult or impossible to create spontaneously are pre-recorded. Rollefstad said that, while the laserist could virtually "sit back and ride out" the show,

Here's an example of what a laserist can do with light.

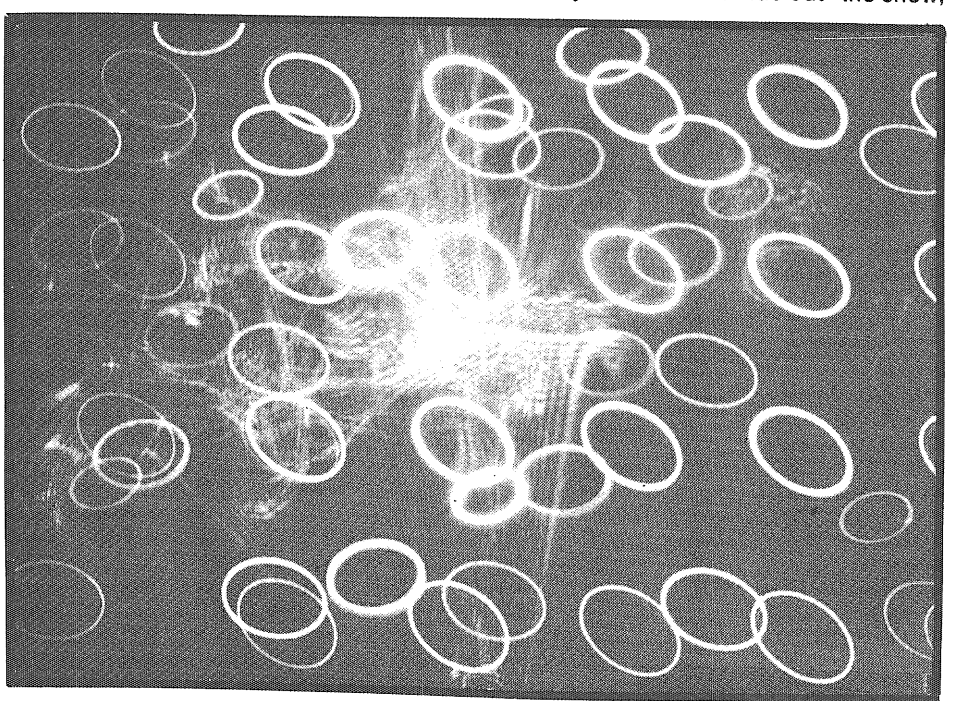

Photo Courtesy of Laser Fantasy

ROLLEFSTAD

LASER FANTASY LASERSHOWS - Call 227-2700 for a recorded message

Laser Floyd (Floyd Rollefstad, laserist)

1. Dark Side of the Moon, side 1
   a. Speak to Me
   b. Breathe
   c. On the Run
   d. Time
   e. Great Gig in the Sky
2. Welcome to the Machine
3. Comfortably Numb
4. Another Brick in the Wall
5. Echoes
6. One of These Days

Tuesday through Sunday 9:00 P.M.

Rock Voyages (Bob Mueller, laserist)

1. Roundabout (Yes)
2. Pinball Wizard (The Who)
3. Eruption (Van Halen)
4. You Really Got Me (Kinks)
   by Van Halen
5. Roll with the Changes (REO)
6. Wheel in the Sky (Journey)
7. Paranoid (Black Sabbath)
8. Free Bird (Lynyrd Skynyrd)
9. Stairway to Heaven (Led Zepplin)
10. Spirit of Radio (Rush)

Tuesday through Sunday 10:15 P.M.

Dreamscapes (Jeff Silverman, laserist)

1. William Tell Overture (Rossini)
2. Mars (Holst)
3. Love on the Line
   (Barclay James Harvest)
4. 0 to 60 in 5 (Pablo Cruise)
5. Two-Part Invention in D Minor (Bach)
6. Stars and Stripes Forever (Sousa)
7. Day After Day (A. Parsons)
8. Toccatta (Sky)
9. Entangled (Genesis)
10. Concerto . . . (A. Gagnon)
11. The Battle (Wakeman)

Saturday and Sunday 8:00 P.M.

he controls the laserlight and renders a true "live" performance limited only by his familiarity with the material and his own creativity.

Rollefstad has also built a new control console which he calls the Rainbow 4-AK. He said he is thinking of setting up in Boston with it, but that he hasn't decided if he will split operations or just pack up and leave the Twin Cities. (His lease ends March 1, he said, but he will have to decide sooner than that.)

Cavalier, North Dakota native Rollefstad earned his B.S. in computer science and then his master's in physics, with three specialties in optics, in 1976 from the University of North Dakota (where, incidentally, he was editor of the now-defunct *North Dakota Engineer* for three semesters during his junior and senior years). After that, he studied at the University of New Mexico at Albuquerque for an additional semester.

"While studying in North Dakota," Rollefstad has said, "lasers were just a hobby for me. My plans then were to go into the medical research field, specifically to pursue the use of lasers in optometry and ophthalmology."

But during spring break he caught a lasershow in Los Angeles. "It was then," Rollefstad later explained, "that I decided on laser entertainment as a career." He quit New Mexico only days before the semester was to end and began designing his own Rainbow laser projection equipment.

"No bank in their right mind would talk to us," said Rollefstad. So relatives backed his venture. His operation is now worth about $75,000, according to various estimates, if you count his new control console but not his labor. He also consults with most every other lasershow company in the country to subsidize Laser Fantasy.

The show is doing better than it was. But then, survival of a small business nowadays can be regarded as no small feat. Laser Fantasy hasn't gotten much publicity while here, possibly due to the lasershow catastrophe at the IDS tower some years back. Besides, people seem to have the idea that lasershows are strictly for air-heads, pot-heads, heavy-metal-heads or persons with pimple problems.

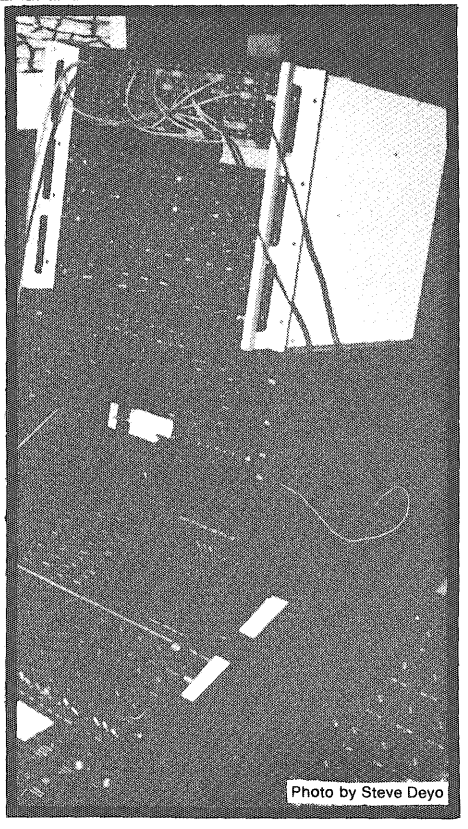

Photo by Steve Deyo

Shown here is the console the laserist uses in producing a light show.

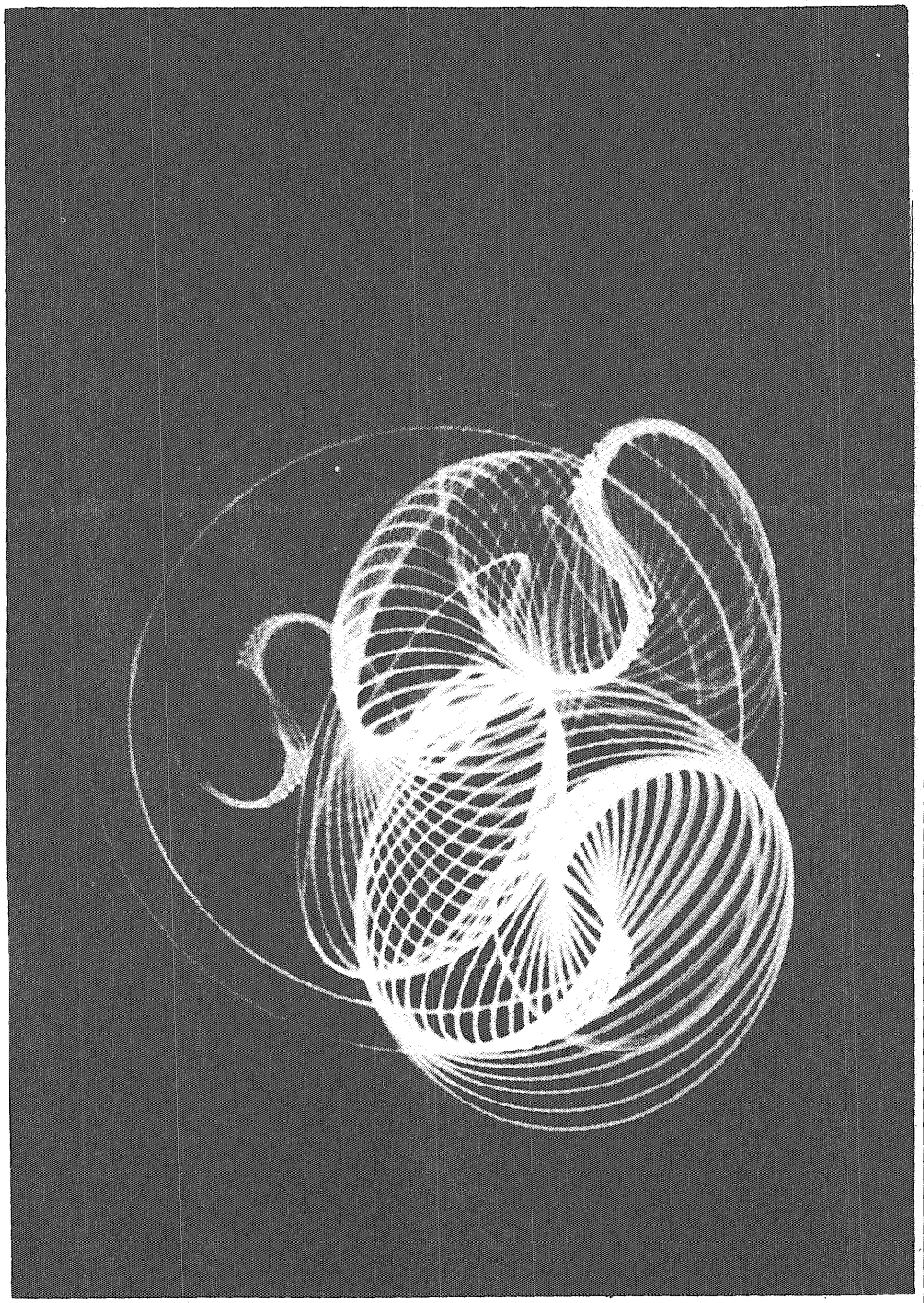

Photo Courtesy of Laser Fantasy

Another look at laser art.

Much of Rollefstad's material, in my opinion, will appeal to the 18-28 age category, true; but the "Dreamscapes" repertoire is more eclectic and laid-back than the others, and could draw people clear up in their forties. Or, *should* draw them. The fact remains it doesn't, maybe for the reasons mentioned in the previous paragraph.

About 30 U.S. cities now have lasershows, permanent or temporary. Lasershows began to appear in major U.S. cities in the early 1970s, generally showing in planetariums. Laserium, the largest-staffed lasershow in the country, is said to have been astonished when members saw Rollefstad's show. In an aside conversation, "Dreamscapes" laserist Jeff Silverman quoted them as saying they had "never seen anything better" and that they couldn't even figure out some techniques that Rollefstad had designed.

About himself, Silverman, a linguistics major at the University (but not in attendance this quarter), said, "I'd never even seen a laser before (I started here as a laserist), even though I'd taken a couple (of) physics courses." (He had seen a want ad for the position of theatre manager and applied for the job.) Anything to do with art and lasers, he ex-

Laser Fantasy

plained, sounded sophisticated; and he needed a job at the time. After interviewing him, Rollefstad decided he could use Jeff for his artistic interest and aptitude — the same reason Rollefstad hired his other laserist, Bob ("Rock Voyages") Mueller, a sophomore in architecture at the University, also not in attendance this quarter.

Rollefstad doesn't seem concerned with letting his public relations get ahead of itself. (In fact, Laser Fantasy's desperate pleas for publicity in the Cities have largely been unanswered.) "(I want to) keep it small and under control," said Rollefstad. "I want to do justice to the media." He keeps a checklist of possible improvements to his show in what is labelled "Floyd's Cosmic Ideas Notebook" laying on a control room workbench opposite the theatre's projection windows, littered with wire-splicing tools and materials.

He usually changes formats every few months "if I think I can get the audience for it." "Rock Voyages," currently Rollefstad's most "razzly-dazzly" show, began the second week in October. It contains, says Mueller in his pre-show remarks, "The heaviest images we can do." If you seat yourself close enough to the screen, its swirling, colliding, racing forms are said to draw you into the patterns, creating the illusion that you are falling into a cloud or rotating through space — in general, the "cosmic" experience intended by Rollefstad. One stock "razzle-dazzle" effect, however is a momentary blinding flash the intensity of combusting magnesium which ends some of the more rambunctious "Rock Voyages" numbers.

Rollefstad remodelled the 700-seat Norstar theatre into a 400-seater by moving the screen forward to enhance the effect of "getting into" the images. The two shows I saw, "Laser Floyd' and "Rock Voyages," were full and almost sold out, respectively.

Admission is $3.50 for adults, but save your program and get half-price on your return visit. Also, Laser Fantasy T-shirts, $6.00 on initial outlay, will get you in at half-price any time you wear the shirt to a lasershow.

Two final things. No smoking (of anything) is allowed in the theatre. First, the Fire Marshall prohibits it; second, it disrupts the laser beams. And a word on attendee comportment: it could be a rowdy crowd.

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Steve Deyo is a graduate student in journalism. He was editor of *Technolog* last year, and just can't seem to stay away.

U.S. POSTAL SERVICE

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

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

1. TITLE OF PUBLICATION	A. PUBLICATION NO.	2. DATE OF FILING
Minnesota Technolog	5 3 5 8 4 0	9/30/81
3. FREQUENCY OF ISSUE	A. NO. OF ISSUES PUBLISHED ANNUALLY	B. ANNUAL SUBSCRIPTION PRICE
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Minnesota Technolog Board of Publications, Rm 2, ME, 111 Church St. SE, Minneapolis, MN 55455

EDITOR *(Name and Complete Mailing Address)*

Pete Marsnik, Rm 2 Mechanical Engineering, 111 Church St. SE, Minneapolis, MN 55455

MANAGING EDITOR *(Name and Complete Mailing Address)*

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11. I certify that the statements made by me above are correct and complete. *(Signature and title of editor, publisher, business manager, or owner)* Peter G. Marsnik

PS Form 3526, June 1977

Reader Replies...

Editor:
Fantastic! The news of the inaccuracy of the ICBMs has really put my mind at ease. Now, instead of worrying about the Soviet missiles destroying our Minuteman missiles and the surrounding people, we only have to worry about the surrounding people.
What a relief!
—Stephen A. MacLennan
EE Senior

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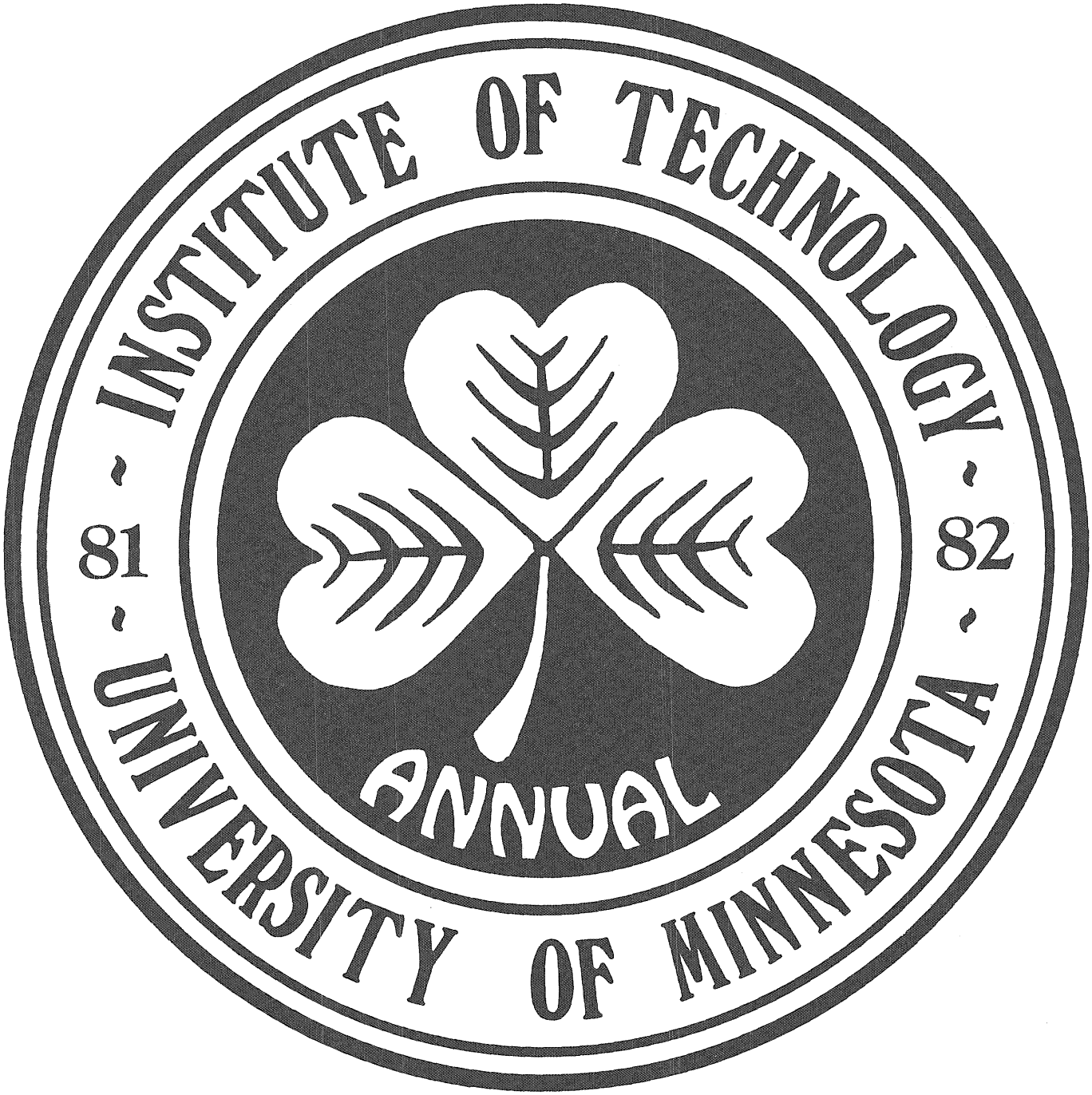

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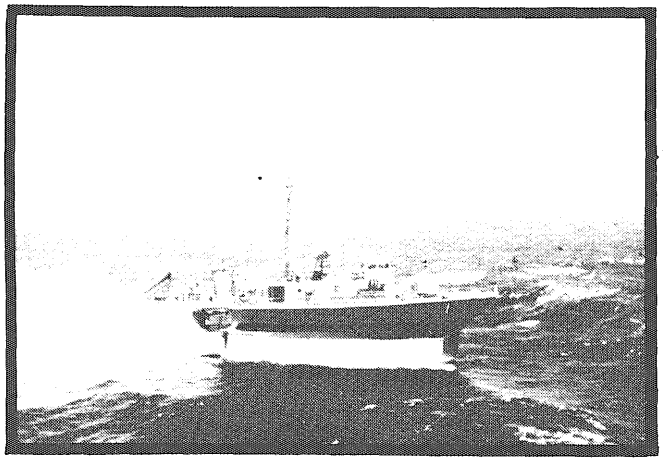

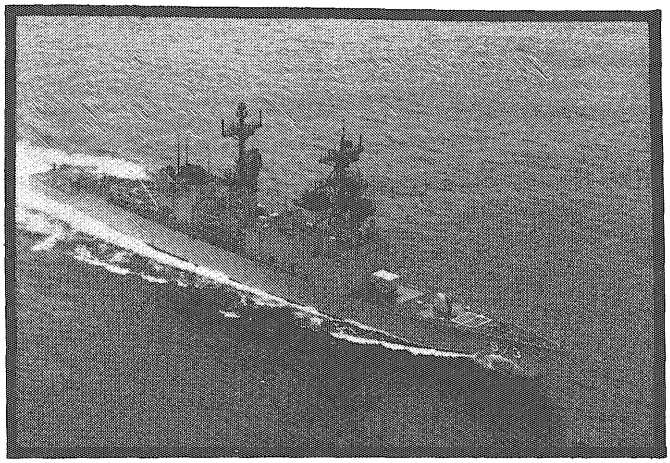

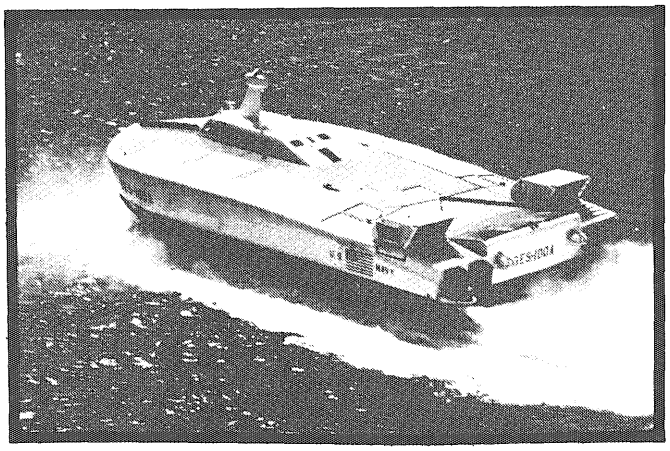

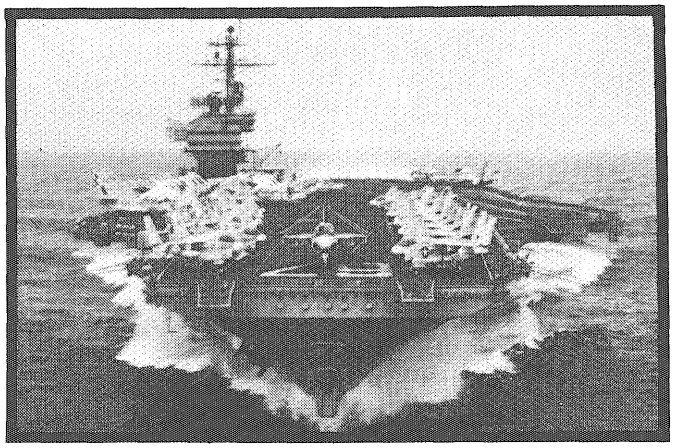

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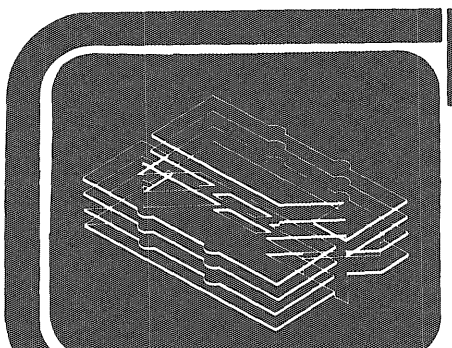


Brain Teasers and Belly laughs

What becomes of doughnut holes after the doughnuts are eaten?

IBM makes a fortune cutting them up in little pieces and pasting them on cards.

"Who's there?" asked St. Peter.

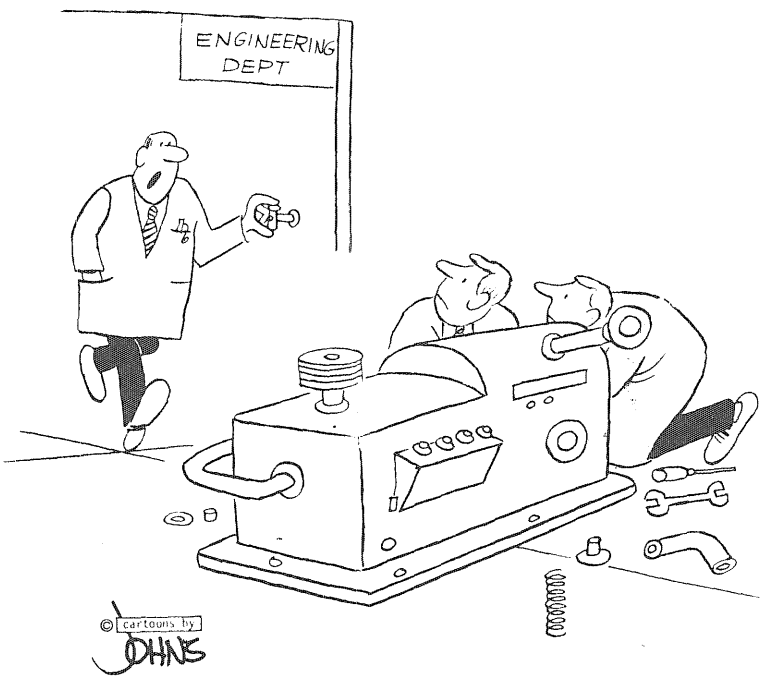
"It is I," came the solemn reply.

"Go to Hell," he answered. "We have to many English majors already."

A Fine Arts student was painting a view of Lake Calhoun when he noticed an engineer watching him.

"Ah," said the artist, "perhaps you, too, are a lover of nature's beauties. Have you seen the golden fingers of dawn spreading across the sky, the crimson stained sulphurous islets floating in the lake of fire of the sky, the rugged clouds at midnight blotting out the shuddering moon?"

"Not lately," said the engineer, "I've been on the wagon all quarter."



"HOLD IT, MEN... WE'VE HAD A BREAKTHROUGH AND THAT WHOLE UNIT IS BEING REPLACED WITH THIS"

Did you know that a circle is a line which meets its other end without ending... or that a supersaturated solution is one which holds more than it can hold...

An engineer of a large instrument company was looking over drawings and specifications for a new instrument which had been ordered by one of the firm's largest clients. Attached to the paper were the coded instructions, "MILTDP-41." Not being familiar with these designations, the engineer looked in his technical journals, but was unable to find them. Finally, he placed a long-distance call to the customer.

"Would you mind telling me what "MILTDP-41" means?" he asked.

"Sure, I'll tell you," the customer said. "It means, 'Make it like the damned picture, for once!' "

The human brain is wonderful. It starts working the moment you wake up in the morning and doesn't stop until you are called on in class.

CLASSROOM QUOTES:

— It should now be obvious that...

— We now make a few evident assumptions...

— By making use of the conservation of energy, conservation of linear and angular momentum, Maxwell's equations and the first and second laws of thermodynamics, we find that we may readily derive...

— Using relations learned in freshman math...

— ... giving us a simple and powerful theoretical tool.

FLUNK NOW!

Avoid the end of the quarter rush.....

A man moved into a well-to-do, but stuffy neighborhood, and was mowing his lawn one hot day with his shirt off. After several minutes had passed a patrol car pulled over to the curb and the cop walked over to the man.

"Don't you know you're breaking the law?" growled the cop. "We don't allow indecent exposure in this neighborhood."

The man, convinced he was acting perfectly innocently, shrugged his shoulders, which exasperated the cop.

"Why, what would people say if your wife mowed the lawn dressed like that?"

"They'd say I married her for her money," the man replied.

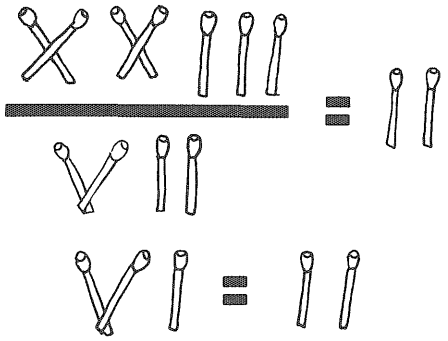
Love makes the world go around. But then, so does a swallow of tobacco juice.

The only difference between Al Quie and the *Titanic* is the *Titanic* had a band.

Here's some more Brain Teasers for you. Ellen Sussman won herself a "Do I.T. with an engineer" T-shirt by solving all the puzzles in Fall I first. You can do the same by solving these puzzlers before anybody else. Bring your answers to Room 2, Mechanical Engineering. Incidentally, Ellen was the editor of the I.T. Yearbook last year.

(Answers to this issue's problems will appear in the Winter I).

1. Make the following equations correct by moving only one match in each equation.



2. If PORK/CHOP equals C, and C is greater than two, what different numbers do PORK and CHOP represent? Given: None of the letters represents the digit zero.

3. How many three-digit numbers are twice the numbers formed by reversing the order of the digits?

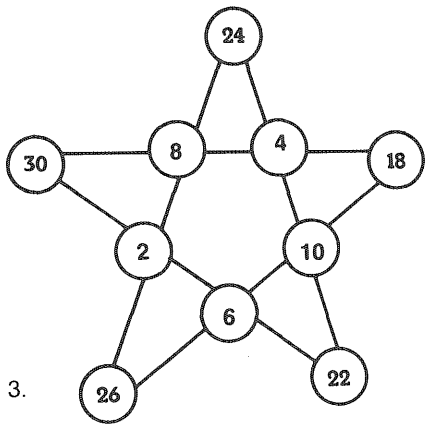
4. John spent one-tenth of his life as a child, one-fourth as a student, and worked for three years before he married. He had three children whose ages differed by two years; the first arrived after three years of marriage. At the time of John's death, the sum of the ages of the children was 93. How old was John when he died?

5. Sam did well for the Do-It-Right Sales Company, selling by phone and chatting pleasantly with his customers. But this irked the new Sales Manager, who felt salesman ought to be on the road visiting customers personally. So Sam went out, as instructed. His customers were one mile apart along the highway, which, counting the nine miles between them, would give him a quick trip. Sam followed the company rules that allowed him to visit each customer just once, and be paid 30¢/mile. He devised the route shown here, which is 45 miles long, without duplicating visits. As shown, he drove from customer 1 to 10, then back to 2, etc.
Sam was clever, but he could have planned the trip to earn even more mileage, with a little more thought. Can you find it?

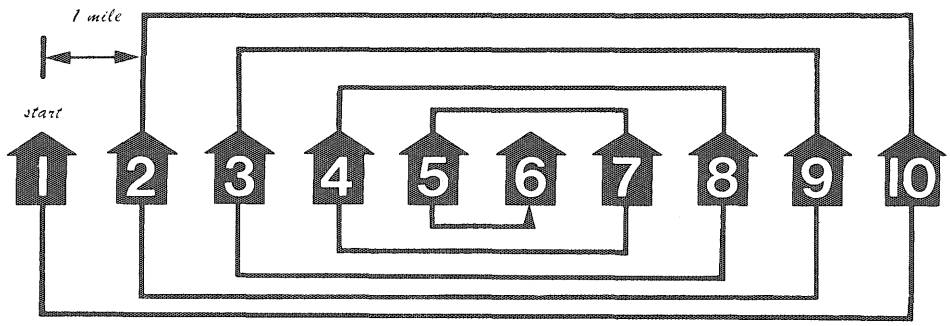
Answers to Brain Teasers in Fall I:

1. Any base greater than or equal to three.
2. Start both timers. When the seven-minute timer runs out, put in egg. After eleven-minute timer is done, flip it over. When it is done the second time, the egg has been in fifteen minutes. Although this was not the quickest way to boil the egg, it was the simplist. (2 moves)

3.



4. The ship rises with the tide. Seven feet.
5. Pitcher — Jones
   Catcher — Smith
   First Base — Brown
   Second Base — White
   Third Base — Adams
   Shortstop — Miller
   Leftfield — Green
   Centerfield — Hunter
   Rightfield — Knight



Future Shock!

age	65
years worked	40
retirement benefits	0

Many of the 50 million Americans who are covered by private pension plans think they'll automatically qualify for benefits when they reach retirement age.

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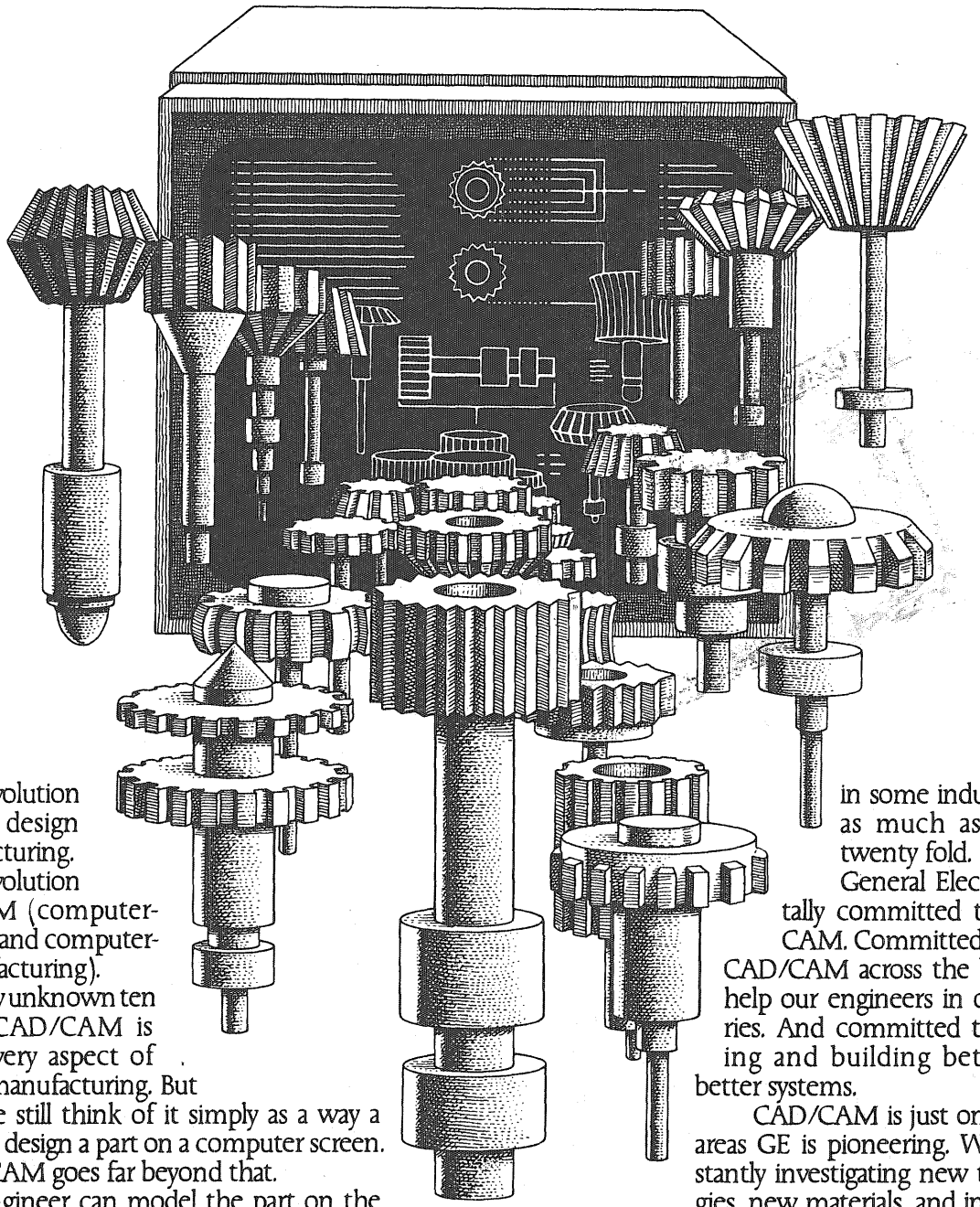

There's a revolution going on in design and manufacturing.

The revolution is CAD/CAM (computer-aided design and computer-aided manufacturing).

Virtually unknown ten years ago, CAD/CAM is changing every aspect of design and manufacturing. But many people still think of it simply as a way a designer can design a part on a computer screen.

CAD/CAM goes far beyond that.

The engineer can model the part on the computer in three dimensions. In color. Even put two or three parts together on the screen. Then, use a computer to analyze the design. And produce a finished engineering drawing at the press of a button.

Instead of trying one or two design solutions, an engineer can use the computer to try 3,000 or 4,000.

But there's more.

The engineer can calculate on the screen the tool path required to machine the part. Then produce the numerical-control data tape. Or electronically transfer the data directly to the machine to produce the part.

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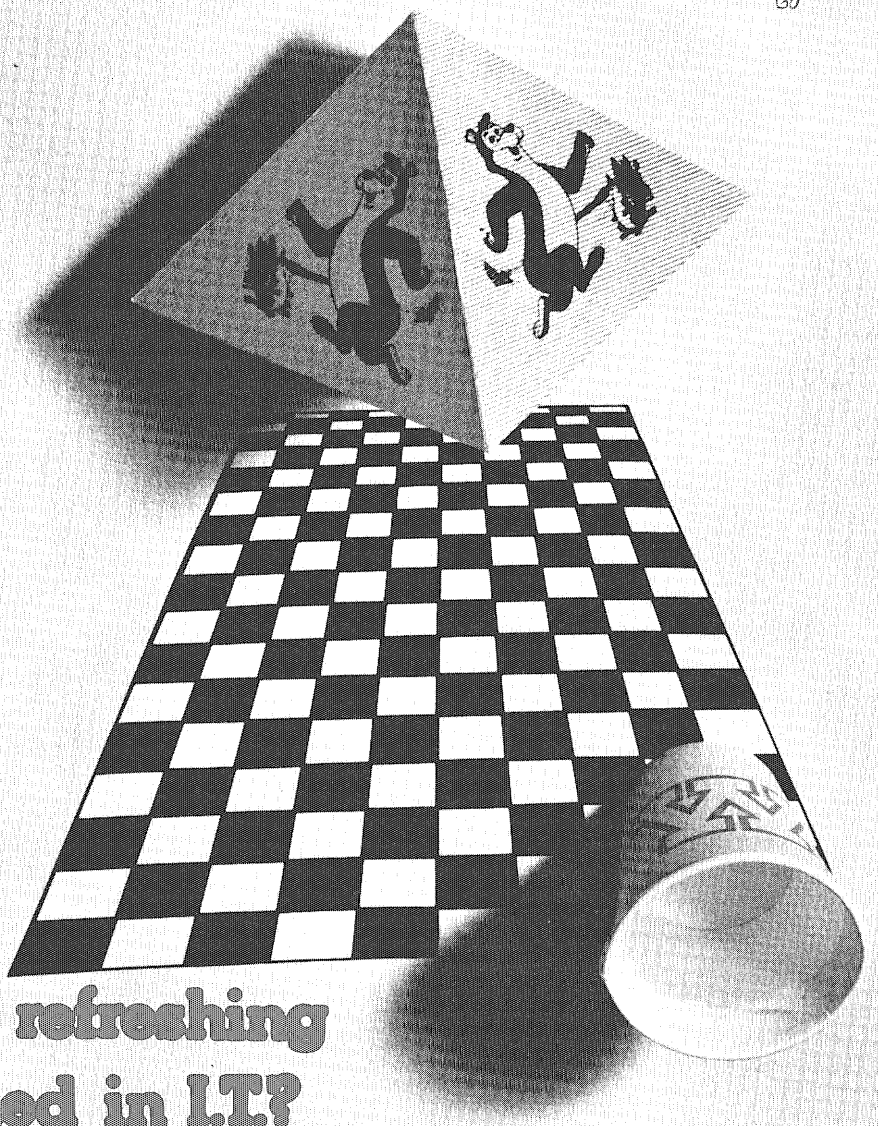

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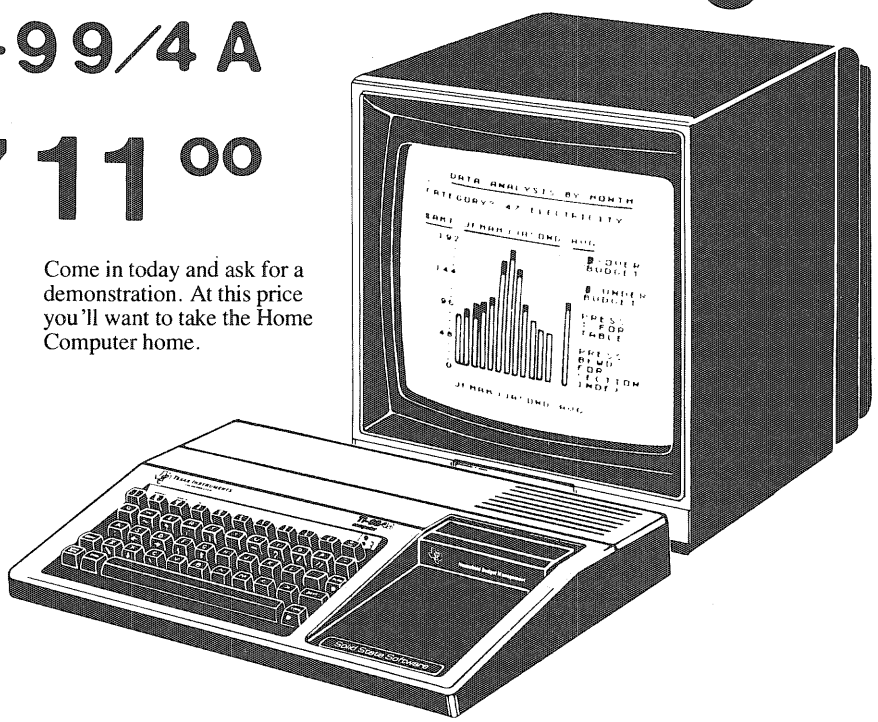

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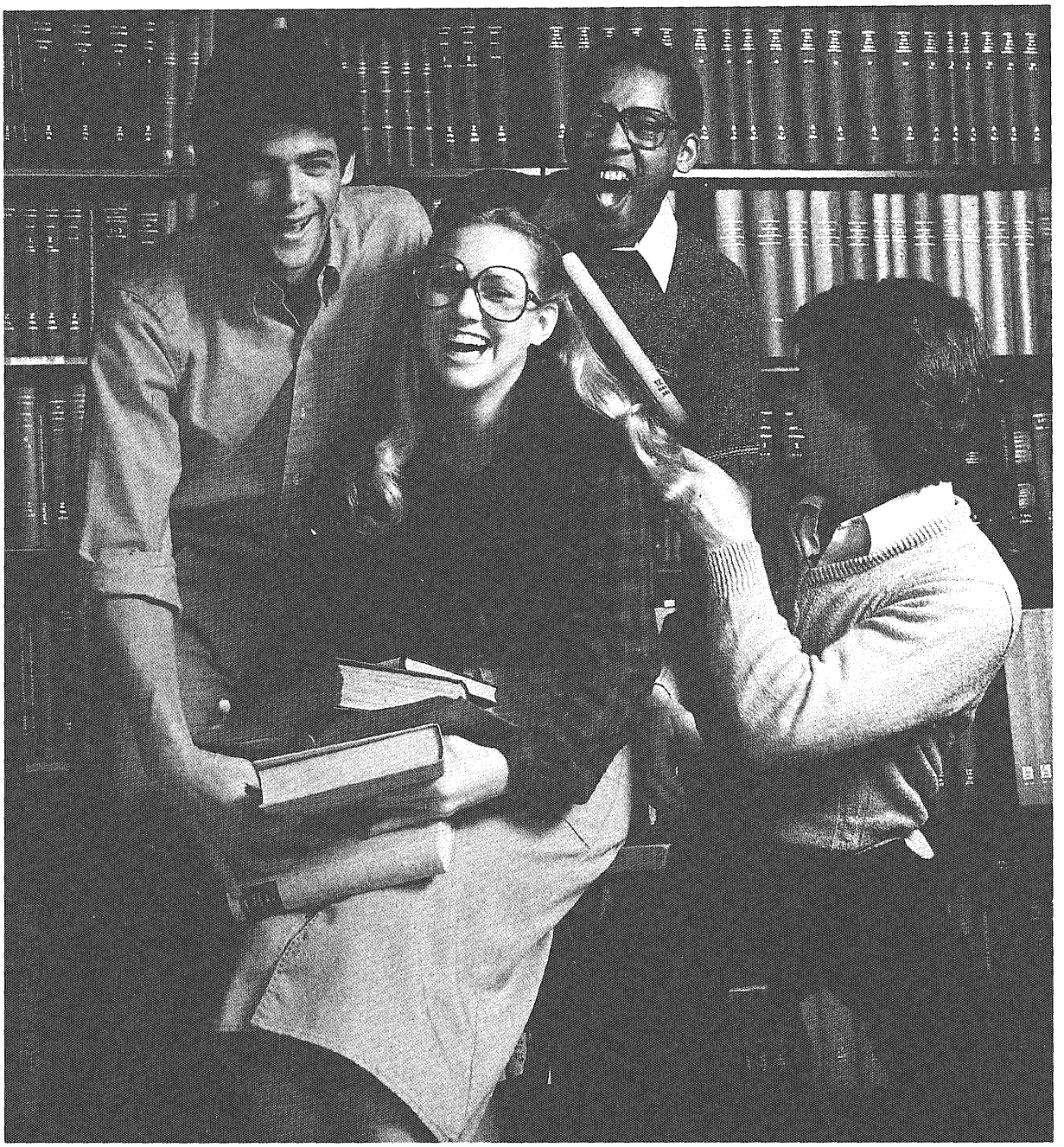

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Editor's Log

EDITOR'S LOG—Stardate 011582

It appears the natives are restless, what with all the talk of deficits and budget cuts coming from the house with the golden horses across the way in St. Paul. And well they might be. After all, when the chips are down and the tuition is up, they are the ones who will pay through the nose, if they can afford to pay at all.

Something has got to give somewhere. The Institute of Technology has set another record. Last quarter, 5,969 students were enrolled. That's a 5.6% increase from fall quarter 1980, just one year ago! Since 1974, the number of students here has risen from about 4,000 to almost 6,000, an increase of 50%. In this class institution that we believe ourself to be, one would expect a similar rise in the number of faculty and teaching assistants, right?

Wrong! Just to cite one example. In 1975, there were 380 students enrolled in the upper division in Mechanical Engineering, with a faculty of 29. In 1981, the number of upper division students had risen to an all-time high of 781, but the size of the faculty remained at 29. The enrollment more than doubled, but the number of teachers remained unchanged. On top of that, fewer graduates are going on to graduate school each year, so the number of teaching assistants per capita is also down. Across the board, one would find mechanical engineering to be not the exception, but the rule.

Due to the severe overcrowding, IT will limit admission to Mechanical and Chemical Engineering beginning in 1982-83. Transfer students will be encouraged to remain at their institution as long as possible before transferring to IT. Junior transfer students with a GPA of 3.2 will be admitted (up from 2.8), and GPA's between 2.8 and 3.2 will be examined individually before admission. That seems awfully selective for a land grant institution.

Then again, what are the other alternatives? Who knows. But something has to be done, and this is a start, whether wise or not. It is necessary.

What happened to all the money the state used to have? Another good question that nobody has a solid answer to. Maybe it left with all the hot air rising out of the capital. Maybe it left with all the hot air rising out of the domed stadium when the roof caved in. Maybe there never was any in the first place. Maybe this is all just a bad dream.

I'm afraid the natives aren't having a bad dream. They're living a nightmare. And only time will tell what will happen as the nightmare continues.

Pete Marsnik just received a GSL. He used the money for the down payment (very down) on the *Technolog* Lear jet, which he now uses for frequent visits to the Twilight Zone.

Peter G. Marsnik

Peter G. Marsnik
Editor

Staff

minnesota TECHNOLOG

Undergraduate Magazine of the Institute of Technology, University of Minnesota

$\sum_{n=3}^{\infty} a_n$ **Vol. 62, No. 3, Winter I, 1982**
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"We do I.T. for YOU"

COVER BY SCOTT HOU

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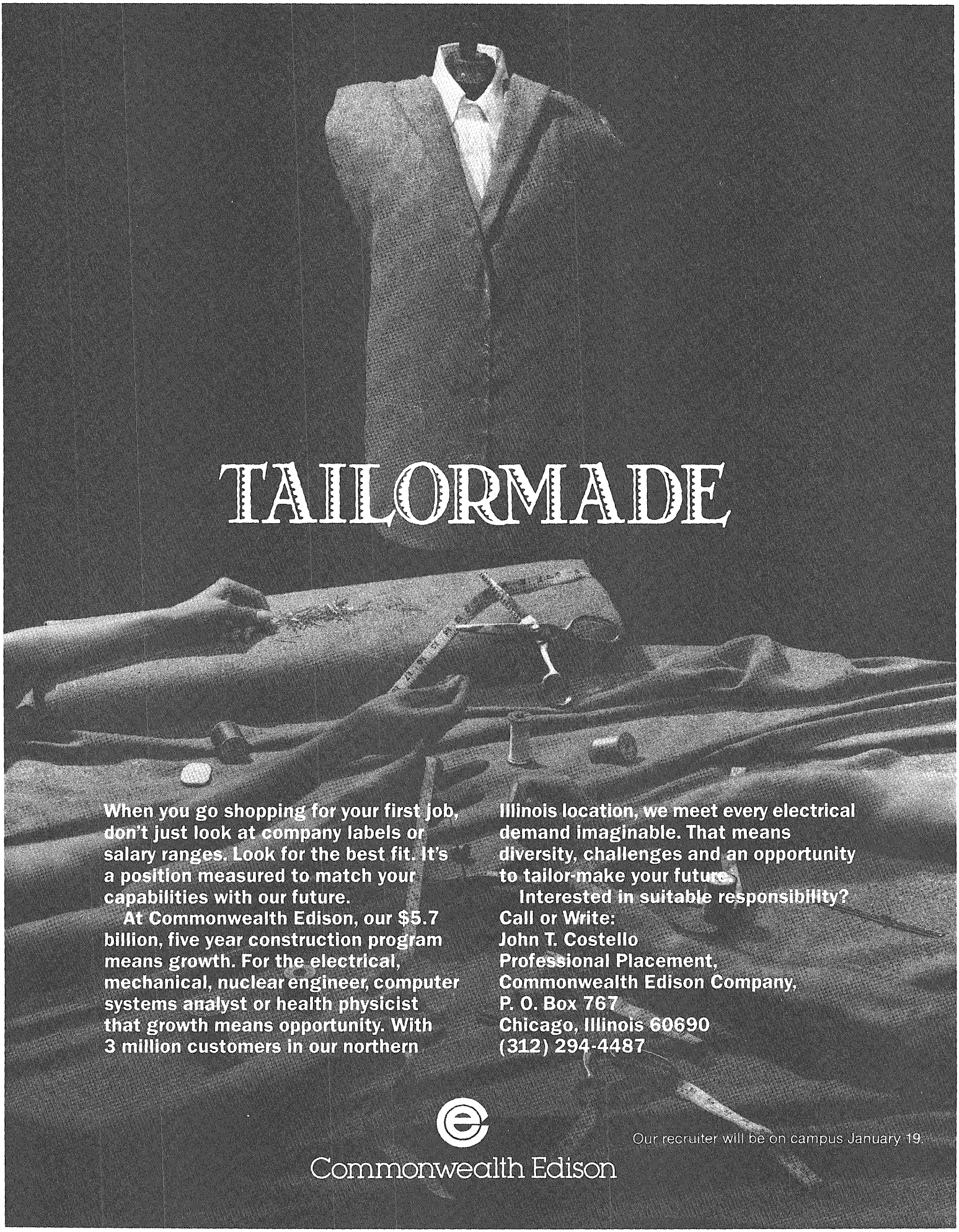
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The Brotherhood of Hamm's®

EDITOR'S NOTE: This feature contains two stories. The first is on the history of the Hamm's Brewery and the process of making that golden beverage that is so vital in the lives of so many engineering students. The second takes an in-depth look at the modern method of filling kegs, using the Sankey™, along with some of its advantages. Technolog thanks Vince Lechman, Assistant Personnel Manager at the St. Paul plant and the Olympia Brewing Company for the tour.

by Pete Marsnik

"From the land of sky blue waters..."

The slogan has been around for over one hundred years, since 1865, when Theodore Hamm opened his brewery in St. Paul, Minnesota. The Sioux Indians, riding proud and tall in their war saddles, had called the country *Makoce Minni Sota*,- "Land of the sky blue water."

Over the years since its beginnings in the Indian war days, Hamm's grew into one of the largest brewing operations in the nation. By the late 1950's and into the early 60's, it ranked third in America (ask your dad—everybody drank Hamm's). The company had even remained open through the prohibition years, producing 'near beer' (less than 1% alcohol), malt syrup, industrial alcohol, soft drinks, syrups, confectioners supplies, sardines, cigars, and even corn cob pipes.

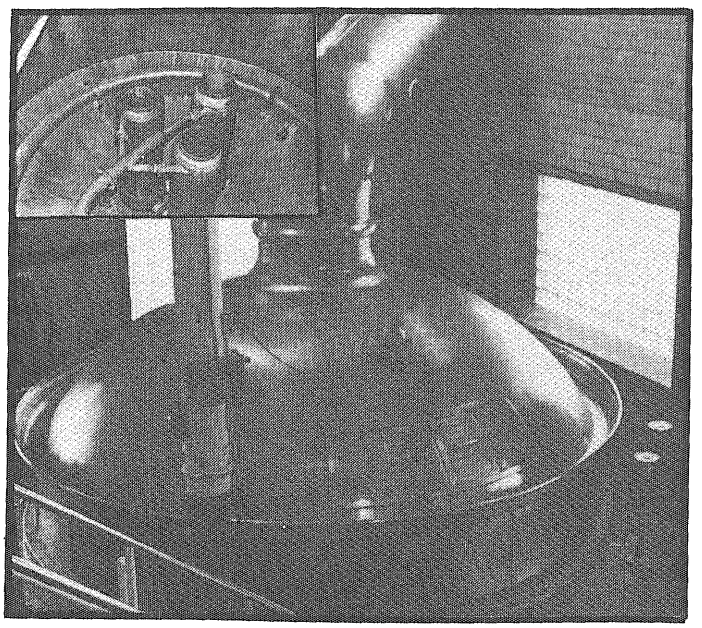
By the end of the 1960's, however, an ownership change took place in which Heublein, Inc. bought out the last of the original Theodore Hamm family. Heublein is mainly a hard liquor and cordials company, and they made several changes. These changes included recipe changes for the beer, and a new advertising campaign which called for the firing of the cartoon bear (which was one of the most effective commercial cartoon characters ever developed). In the process, several Hamm's beer lovers were alienated, sending the company in a nosedive. Sales dropped, and the beer fell out of the top ten.

Things went from bad to worse, and finally Heublein sold Hamm's to the present owner, Olympia Brewing Company, in 1975. The people at Oly brought back the original recipe, rehired the bear, and are now working on bringing back the customers who had gone for their gusto elsewhere. Olympia currently ranks eighth among brewers in America.

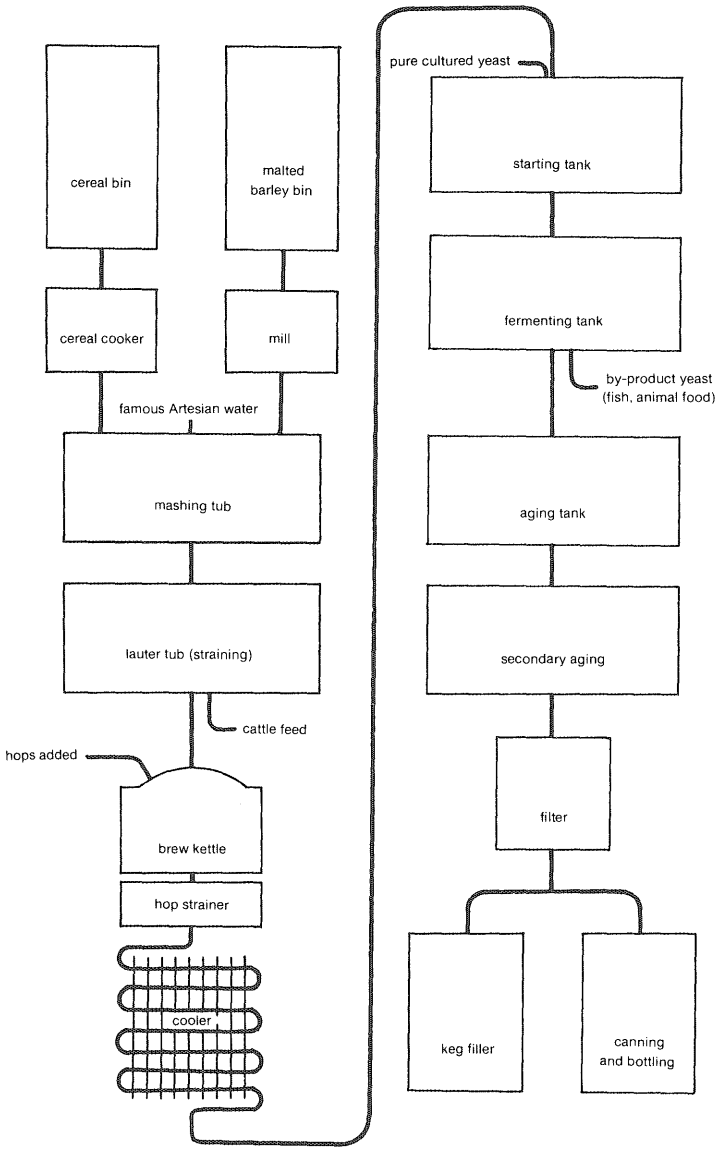
The Olympia Brewing Company now has three breweries. The original is in Tumwater, Washington. In addition they own the Hamm's brewery in St. Paul, and they recently acquired the Lone Star brewery in San Antonio, Texas. They brew Hamm's, Olympia and Lone Star beer, as well as Oly Gold, Hamm's Light, Buckhorn and several others. Out of the St. Paul plant, they service beer drinkers in twenty midwestern states.

Let's take a trip into the plant in St. Paul and see how this spiritous malt beverage is made. First, we must go out into the plains. Crop ingredients in beer are barley, finely ground corn and hops. Four different types of barley are used, most of them coming from Minnesota, North and South Dakota.

The malting of the barley is the first step in the brewing process. Malting is the germination of the barley. Outside of water, barley malt supplies the greatest bulk of material used in brewing. About one bushel of barley is used to produce one barrel of beer (1 barrel equals 31 gallons). It is the barley malt that give a beer its characteristic color, body and flavor.



The 500 barrel brew kettle. This is one of the copper kettles still in use at the Hamm's brewery. Nowadays, most brew kettles are made of stainless steel. Insert shows the inside of a brew kettle, which is empty for cleaning.



The malting process takes about nine days. First, the barley is soaked in water, then transferred to germination compartments in which carefully controlled temperature, moisture and oxygen causes uniform germination or sprouting. After reaching the exact stage of growth, gentle heating halts germination. A prolonged heating of the barley malt toasts the malt, which in turn provides the color for dark beer.

After malting, the enzymes in the finished barley malt are ready to produce the fermentable sugar necessary to form the alcohol and carbon dioxide in beer. The barley malt at the St. Paul plant is received at the brewery already malted, so the nine days for malting are not included in the time of the brewing process.

The most important element in brewing beer in any brewer's eyes is the water. After all, over 90% of any beer is water, so it has to be good. Olympia is very proud of the water they use. The water from their Artesian wells in Tumwater is very similar to the water that occurs naturally from the Artesian wells 600 feet beneath the ground at the St. Paul site. The company feels the mineral content and quality from this water is ideal for brewing just as it comes from the ground. Hence the phrase, "It's the water" on the Olympia labels.

To start the brewing process, the barley malt and corn are boiled separately in the water for about an hour. This is the "mashing" process. The barley and corn are then mixed, forming the adjunct grain, as it's called. The addition of corn is to increase the volume of fermentable sugars available for brewing. It also makes the beer less heavy, or less filling, although it contributes nothing to the taste. Some brewers use rice instead of the corn, with the same result. Most European beers are brewed using only barley malt in the brewing, which results in the heavier, fuller quality found in those beers. The amount of barley malt and corn that are used depends upon the recipe for a particular brand of beer, and of course is not divulged to the public.

This schematic diagram shows the entire brewing process at the Olympia Brewing Company in St. Paul, from the grain bins down to the bottling, canning and keg filling. Illustration by Scott Newland.

After the two ingredients are mixed, the liquid already has its golden color (or dark color if toasted barley malt was used) and a sweet aroma, from the fermentable sugars being extracted. Strainers are used to take off the unfermented liquid, which is put into a 500 barrel brew kettle. Here it is boiled for about 90 minutes, and the hops are added. The addition of the hops is for seasoning and aroma of the finished beer. The hops used here come from the Yakima Valley in Washington state. (In fact, 90% of the hops in the world come from the mountains of Washington.)

Seven to eight hours after the process began, the unfermented liquid, called wort (pronounced "wert") had been produced. It is strained one more time to remove the hops, then cooled down to 50° F., where it is ready to begin the fermentation process. The spent grains are not discarded after they have been used. They are dried, and contain 25-30% concentrated protein, which is sold as cattle feed.

Pure, cultured brewer's yeast is added in the starting tank. The yeast is responsible for the fermenting process, yielding the alcohol and the carbon dioxide gas. Separate yeasts are used for the individual beers also, as it affects the flavor as well. As the yeast is a living organism, for every pound of yeast the brewery uses, three to four pounds are returned. The best of this is saved for future brews, while the rest is dried into a

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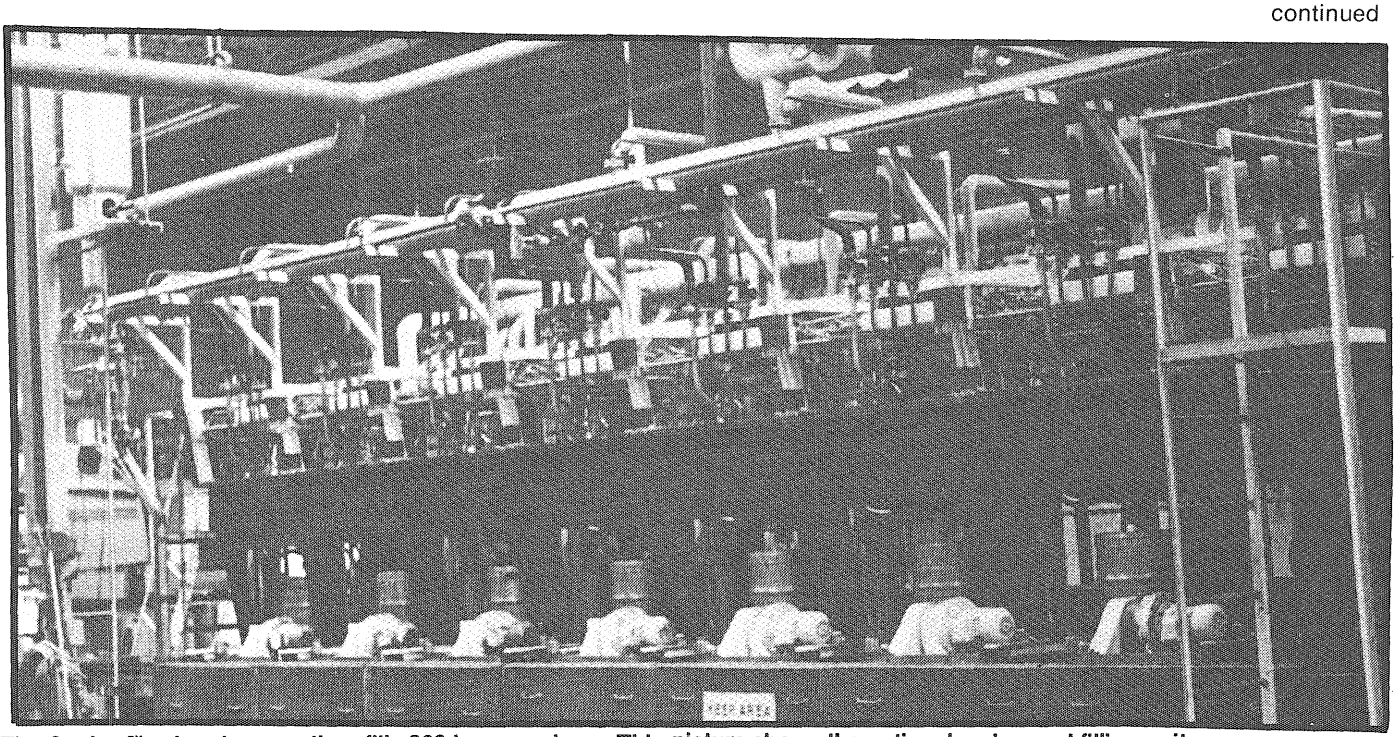

The Sankey™, when in operation, fills 360 kegs per hour. This picture shows the entire cleaning and filling unit.

by Jim Stickney

Picture this: You have been put in charge of buying the beer for the party tonight. So, here you stand in your neighborhood liquor store waiting for that old oval-shaped aluminum barrel with the familiar cork in the side. However, out comes a shiny stainless steel straight-sided can, and without the cork in the side. Now, to you loyal Hamms, Millers, or Budweiser drinkers this is of no big surprise. But, to those of you who are not avid supporters of these companies, this new half-barrel (or 16 gallon keg as it is called in Minnesota) might arouse the curiosity. The reason for this change is the English engineered Sankey™. (Yes, Virginia, there can be engineering innovations in the traditionally old fashioned beer brewing industry.)

The Sankey™ is a process by which an empty keg can be cleaned and refilled through the same hole that the beer is drawn, thus eliminating the need for a second hole and cork. Unlike the old process of filling kegs (still used by all but the above companies) the Sankey™ is completely automated. Being automated made it necessary to eliminate the awkward oval kegs and replace them with more easily manageable straight-sided ones. The Hamms Brewery in St. Paul was the *first* United States brewery to install the Sankey™, eleven years ago. Since then, Miller and Budweiser have done the same. According to Dick Stark, Brewing Supervisor in charge of the Sankey™ at Hamms, the reason for the limited change over is the cost of the new kegs. At one hundred dollars a keg, the changeover gets to be quite expensive, especially for the larger breweries which have many kegs.

The old method of filling kegs involves a number of separate steps, each with its own separate steps, each with its own separate pair of hands to operate. First, the keg is brought from the truck to the drilling station where the cork is drilled out (occassionally along with some of the aluminum). The keg is then run through a series of washing and rinsing, both inside and out. The washing is done with a caustic solution (which eats away a thin layer of aluminum each time) and rinsing with hot water. Each keg must then be inspected by inserting a light into the cork hole (bung hole) and examining as best as possible. (Of course, there is no possible way to examine the cork hole side of the keg.) The tap hole is then plugged, by hand, and the keg filled with beer. The filling is done by a hose and nozzle similar to a fire hose. Finally, the cork is pounded in by hand and the keg brought out to be loaded.

The Sankey™ can be thought of as one single operation that includes all of the above steps and consequently requires only one operator. Fork lifts bring the pallets of kegs, stacked three high, from the trucks to the Sankey™. The depalletizer systematically feeds the kegs onto the line that will carry them through the process. The kegs arrive with both the tap up and the tap down, but must be fed through with the tap down. Therefore, the top and bottom of the kegs are slightly different, one being

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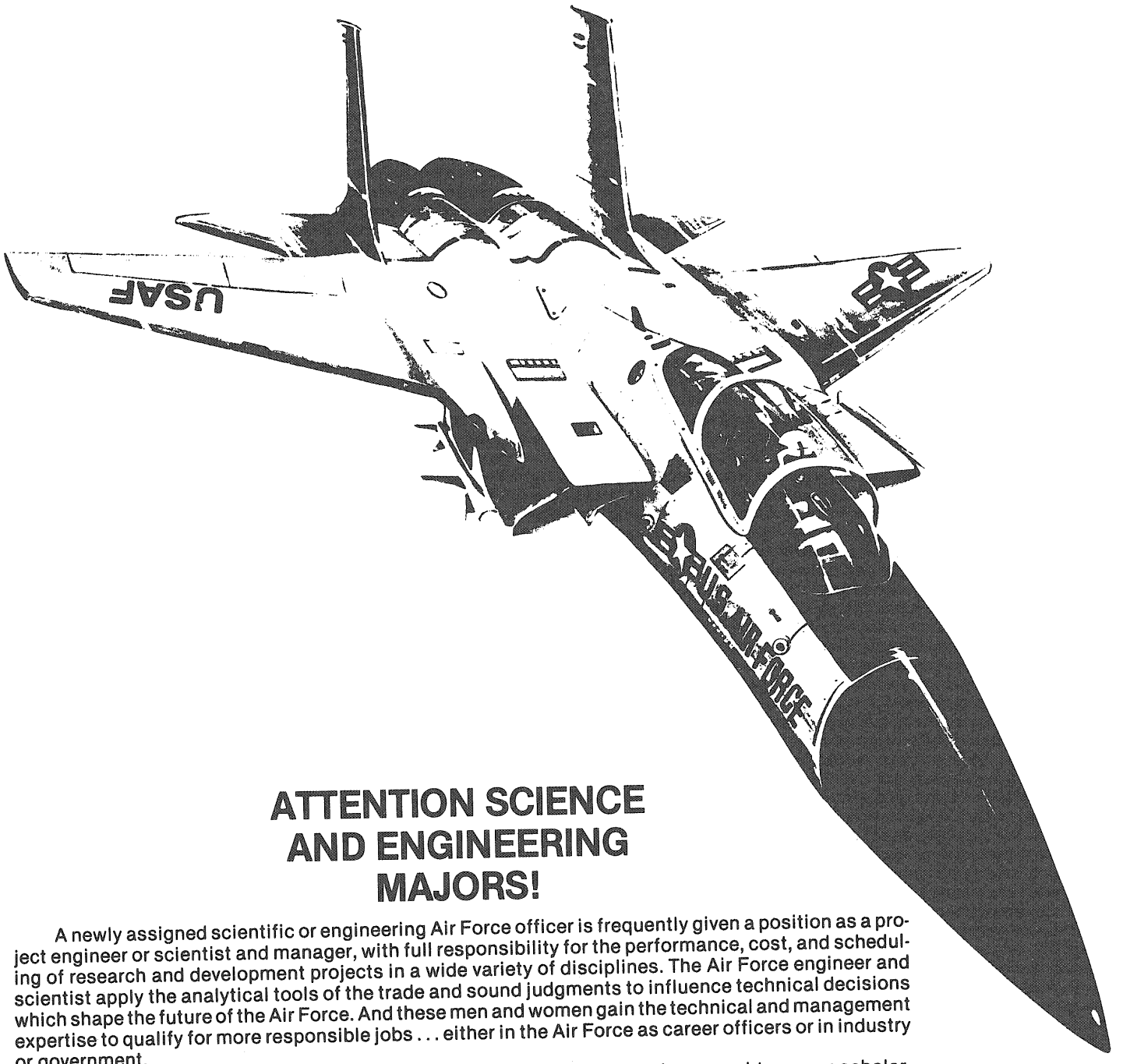

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powdered form, and sold as an animal food supplement.

After ten days in the tanks, fermentation is complete. The process takes place in 90 enclosed tanks, each holding about 26,000 gallons. If one were to total all the fermenting beer in the 90 tanks in the fermentation building, and portion it out at a rate of 50 cases a day, 365 days a year, it would take 58 years to drink the building dry.

Once fermented, the beer moves to the aging cellars. The aging cellars are nearly identical to the fermentation area, except that the tanks are larger. Here, the yeast has been removed, and the temperature has been reduced to 30° F. The beer ages for about three weeks. However, during the aging process, nature reacts slightly different with each brew. This is compensated for by combining beer from tanks throughout the cellar areas and blending them with others. This gives the desired uniformity in alcohol content, color and flavor.

Aging beer is also filtered on two occasions. The filters are called diatomaceous earth filters. They are similar to what is used in a swimming pool filter, only on a much larger scale. This filtration removes any remaining yeast and gives the beer its clarity and brilliance.

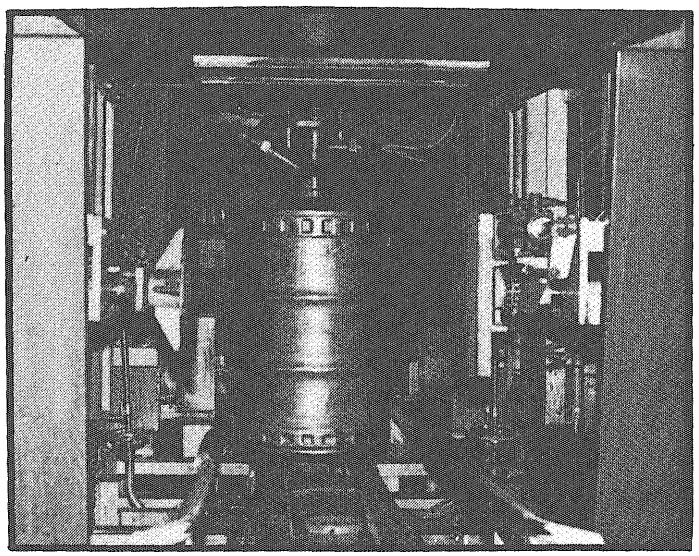
Several times during the fermentation and aging processes, samples of the beer are examined in the lab as part of the quality control. It is checked for alcohol content, and so that it meets government standards for premium beer. Premium beers (Hamm's, Oly, Budweiser, Miller, Pabst Blue Ribbon, Schmidt, etc.) all have an alcohol content of between 3.5 and 3.6 percent.

After aging, there is only one more step before packaging. That is a trip through the "government cellars." The "government cellars" are appropriately named in that all the beer produced is metered and taxed here. The federal government collects $9.00 per barrel, while the state takes in about $2.50 per barrel. That means, for every 16-gallon keg (actually 15.5 gallons) of domestic beer you buy, you pay Uncle Sam $4.50 and the state $1.25!

Once through the "government cellars" the beer splits in two directions. In one direction is the keg-filling area and the Sankey™, which is described totally in the accompanying article. The other direction leads to the bottling and canning area.

Most of the bottles used by the Olympia Brewing Company are recyclable. The average life span of one of these bottles is about nine trips through the plant. The 12-ounce bottles are washed and rinsed as they are carried from a lower floor through a washer unit. The sterilized bottles then receive a pre-fill inspection to make sure they are clean. They then move directly to the filler. The filling unit (two such units are employed) has an output of 450 bottles per minute. The beer is flowing into the bottle at 33° F. to help control the foam or head on the beer. Also, the velocity that the beer flows into the bottle helps control overflow. After being filled, the bottles move to a similar unit that puts a crown or cap on each bottle.

Once filled and capped, a fill detector scans the bottles to make sure each is filled to the correct level before moving to the pasteurizer.



Here is where the keg sits while the steam, detergent, more steam, and finally beer go through it.

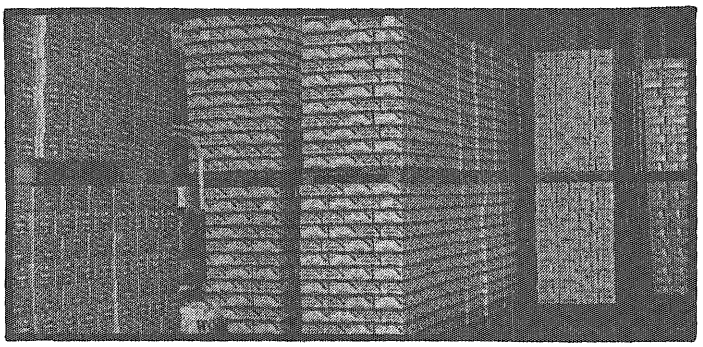
deeper than the other. This difference allows for a mechanical check by the Sankey™ to determine whether the keg must be flipped over or allowed to pass. If the tap is up, the Sankey™ clamps onto the keg and flips it, sending it off to the washer. Since there is no bung hole to allow the cleaner into the keg and since the keg is now stainless steel and not aluminum, a stronger heavy duty alkaline cleaner can be used, as compared to that used in the old process. The keg is scrubbed with this solution and rinsed with hot water, before being fed into the main part of the Sankey™.

The keg is fed into one of the eight racks of the Sankey™. Here, the inside of the kegs are cleaned and the beer loaded. The first step is a pressure check to make sure there are no holes or cracks within the keg. If the pressure is not perfect, the keg is rejected. Cold water is then used to rinse out any left over beer in the keg. The water is forced out by superheated steam at 275° F, which raises the temperature of the keg to 120° F. The temperature of the keg is constantly being monitored so that the next step will not begin until the previous step is completed. Detergent is then pumped in to clean the inside of the keg. Again, superheated steam is used to force out the excess. This step raises the temperature to 200° F. Hot water is then used to rinse out the detergent, and steam brings the temperature to a high of 212° F. The washing is now complete, and the keg is turned right-side-up for the remainder of the process. Fifteen to twenty pounds of CO_2 is then added, forcing out any condensation that may have accumulated. Finally the beer at 31° F is fed into the keg. The top is then sterilized, the keg weighed and counted, and a dated cap is placed on the tap. The reason for dating each keg is that, unlike canned or bottled beer, keg beer is not pasteurized and must be consumed within 30 days. The entire operation is carefully governed by a series of checks and with the aid of electronic eyes. If anything should go wrong a bell will sound and the operator can make the needed adjustments.

What once took Mr. Stark fifty-six employees to do, now only takes seven. These seven employees of Hamms fill all of the kegs that come out of this particular brewery. Working on shifts, they can produce up to 360 kegs per hour. Even though automation brings about many advantages, this is not the Sankey's strong point. The biggest advantage, and the one that the Hamms people seem to be proud of, is the ability to produce kegs of beer bacteria free. Even though the inside of the kegs are cleaned out in the old process, they are still subjected to the air around them from cleaning to the final corking. The Sankey™, on-the-other-hand, never subjects the inside of the kegs to the surrounding air, thus making it virtually impossible for bacteria to enter.

You might want to keep that in mind the next time you go in to buy the keg for your party.

One final note, the new kegs are much easier to carry, and stainless steel does not soil your clothing the way aluminum does.



More beer than you need for your next party sits in the storeroom at the Hamm's brewery. These stacks of 12-packs are waiting for shipment to twenty states in the Midwest.

The bottled and canned beer is pasteurized to prolong shelf life by stopping any secondary fermentation. It is done by varying degrees of hot water sprayed over the bottles (or cans). The bottles enter the pasteurizer at 33 degrees, and are gradually heated up to 140 degrees. It is held there for ten minutes, then cooled back to room temperature. Leaving the pasteurizer, each bottle is visually inspected, then labeled and packed into cases of 12 or 24 bottles. As soon as the bottles are dropped into the case, they are conveyed to the shipping department, and within a few days (20 days at the most) are on their way to the consumer.

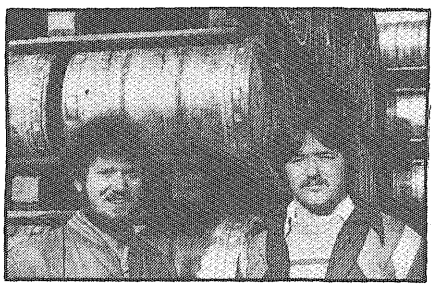
The canning is a similar filling operation, although the cans are already labelled. After a pre-filling cleaning, the cans are filled at a rate of 1100 cans per minute (11,00 six-packs per hour). Once filled, the lids are sealed on before going to the pasteurizer. After pasteurization, the cans also go through a fill detector to make sure they are full, and are then packaged into six-packs, 12-packs and 24-packs.

Now, after about 32 days since the process began, the beer is ready for consumption. Olympia produces 2.5 to 3 million barrels of beer annually at the St. Paul plant, although the capacity is as high as 4 million barrels.

While every brewery has its own process, they are all basically the same, and the Hamm's plant in St. Paul is a good example to look at to understand the way this beverage is made. "We're proud of it," Ray Weisner, brewing operations manager, told *Technolog*. "We (St. Paul plant) have the best manpower and installation in the country."

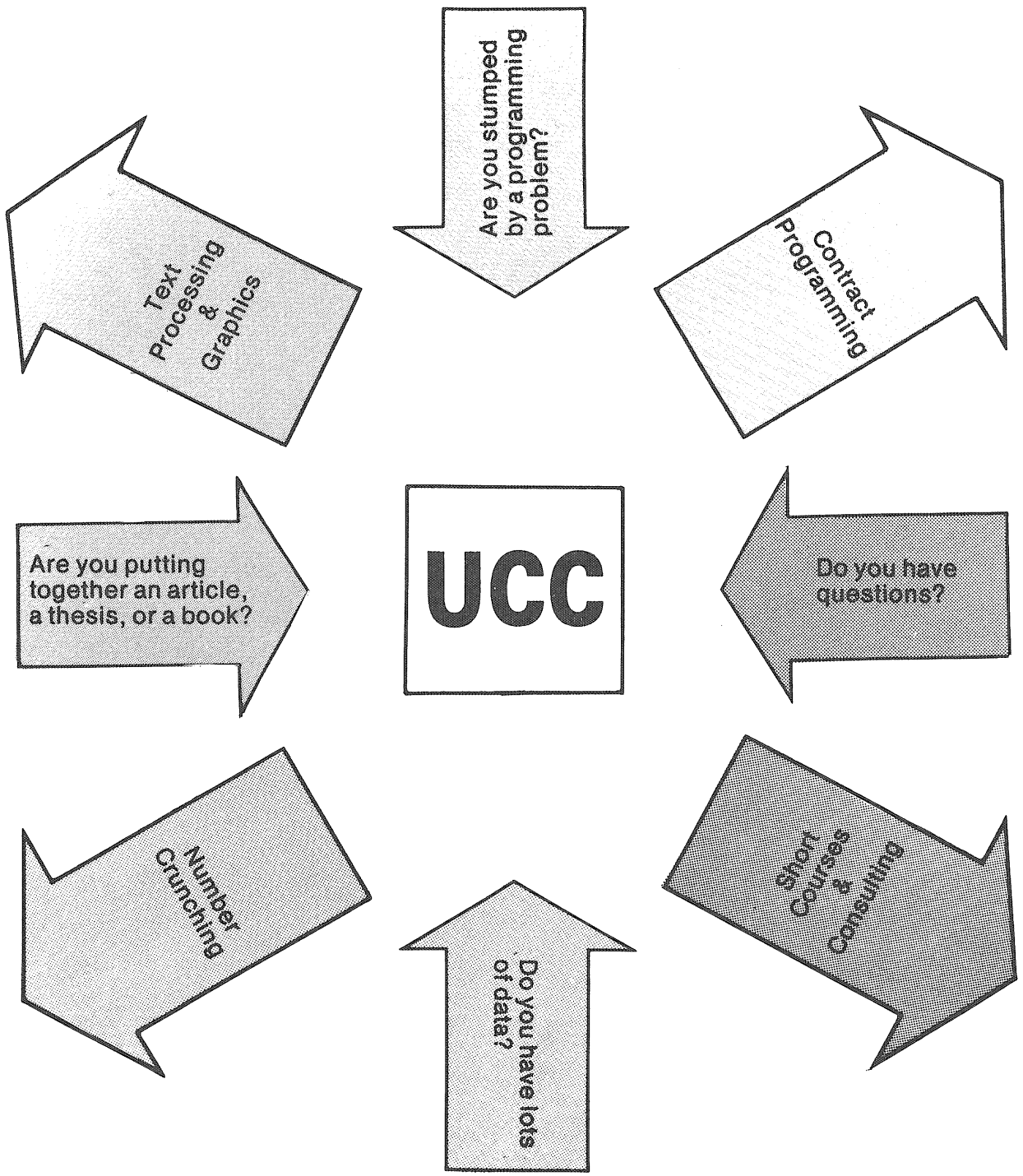
Weisner is especially proud of the Sankey™, the technological breakthrough for filling kegs. "It's been running for about ten years, and Budweiser (Anhauser-Busch, Inc.) and Miller Brewing Company have been up here several times, and now both use the process." Those two companies make 49% of all the beer brewed in America.

minnesota TECHNOLOG



Pete Marsnik and Jim Stickney are seniors in chemical engineering. Neither commented on why they wrote the story, but with arms twisted, admitted they "tolerated" the taste of an ice cold brew.

What Kind of Computing Problems Do You Have?



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What Happened to the Moon Rocks?

By Jeanne Hanson
University News Services

As the space shuttle soared in its orbit, the 800 pounds of moon rocks brought back to Earth on earlier Apollo missions are still making scientific news. Studies of moon rocks and moon dust are now beginning to yield as much information about the Sun and the solid-core planets of our solar system as they are about the moon.

Two moon rocks—"Rock 1061" and fragments of "Great Scott"—are still carefully locked in a safe in the laboratory of **Robert Pepin**, a planetary physicist at the University of Minnesota Institute of Technology and science advisor to NASA, in charge of lunar samples for the Apollo 14, 15, 16 and 17 missions. Pepin has been studying these and 92 other samples since the era of moon exploration by the Apollo astronauts.

Like lab groups in Switzerland, India, Japan, California and Missouri, Pepin must guard his working collection. NASA's curator of planetary materials, who still circulates some 1,000 small samples every year among all participating labs, requires the use of registered mail and other security measures, said Michael Duke, chief of the planetary and earth sciences division at NASA's Johnson Space Center in Houston.

But the real secrets are kept inside the rocks. Sophisticated techniques developed to measure their composition (techniques now applied to Earth geology and even the study of mineable minerals in meteorites) have allowed researchers to construct the "biographies" of the moon samples.

"Rock 1061" began as lava more than 3.6 billion years ago, when the moon's surface was bubbling with lava and alive with volcanoes, Pepin said. Its neighborhood was Mare Tranquillitatis, a massive old lava flow visible from Earth as a large grey splotch to the right and a bit above the Moon's equator. As the lava cooled, it mixed with a bit of lunar crust, then lay quiet for hundreds of millions to billions of years.

During the next stage of its life a meteorite crashed near "Rock 1061". With no atmosphere to slow down and burn up meteorites, every square inch of the moon's surface has been pulverized and dusted with meteorite debris, mixing the material in all the lunar samples. Even the helmets of the astronauts were pitted with tiny meteorite particles, Pepin said.

The shock wave from the meteorite hit cemented "Rock 1061" into a crumbly clod called a breccia. "Then Apollo astronauts Armstrong and Aldrin stumbled upon it and picked it up," Pepin said.

"Great Scott" was a 20-pound boulder found by Apollo 15 astronaut David Scott on the edge of Mare Imbrium, the largest dark grey splotch visible on the moon's surface. The original boulder was so large Scott could barely lift it. Pepin's share weighs about a gram.

More solid than "Rock 1061," "Great Scott" is a basalt, smooth lava rock from the moon's interior. Forced to the surface by a deep meteoric hit, it cooled about 3.3 billion years ago, and lay on the floor of the immense crater. The 20-pound chunk was knocked off by later meteorites.

Moon rocks like these have written the 4.5 billion-year history of the moon. By studying them, researchers have learned enough about the physics of cratering to develop a new theory of dinosaur extinction on earth, based on a possible meteorite hit here. They have also learned about volcanic processes and their role in the evolution of all the solid-core planets and satellites, such as the Earth, Venus, Mars, Mercury, Saturn's moon Io, and meteorites, as well as Earth's moon. The origin of the moon as a spin-off from the newborn, condensing Earth at the solar system's birth, looks more likely now, Pepin said.

The rocks and soil, together called the "regolith," are also rich in information about the Sun, he said. Particles from the Sun—called the "solar wind"—have steadily bombarded the moon since its formation. With no atmosphere, water, or wind to deflect or disturb them, they lie in layers on the moon's surface. This "archaeology of the Sun" extends from 4 billion years ago to a mere handful of years ago when the samples were collected. Pepin studies the fossil atoms and flare tracks by heating moon rock and soil fragments, then measuring the gases that escape.

"We've established that the Sun is a variable, not a constant, star, although its changes should not be drastic for the Earth's climate," Pepin said. The Sun once produced a lighter isotope of nitrogen in its nuclear interior than it does today. And, in cycles of 22 years to several thousand years or more, it varies in its output of ultraviolet light, X-rays, and perhaps even its total radiation. Levels of gases such as helium, xenon, argon, and neon and krypton have varied by a factor of two to five throughout the Sun's history, according to Pepin's research and that of his colleagues.

The moon rock challenge continues, he said. Researchers must now compare moon rock evidence to evidence locked in the Earth's tree rings and in the deep ice of Antarctica, to be able to write the history of the Sun. They must try to detect other wind elements in the moon rocks and somehow study the moon's deep interior and its mysterious loss of magnetic field.

"Lunar research is not dead," Pepin said. "It's just moving into new phases." Adds NASA's Michael Duke: "The moon is still our best window on evolution."

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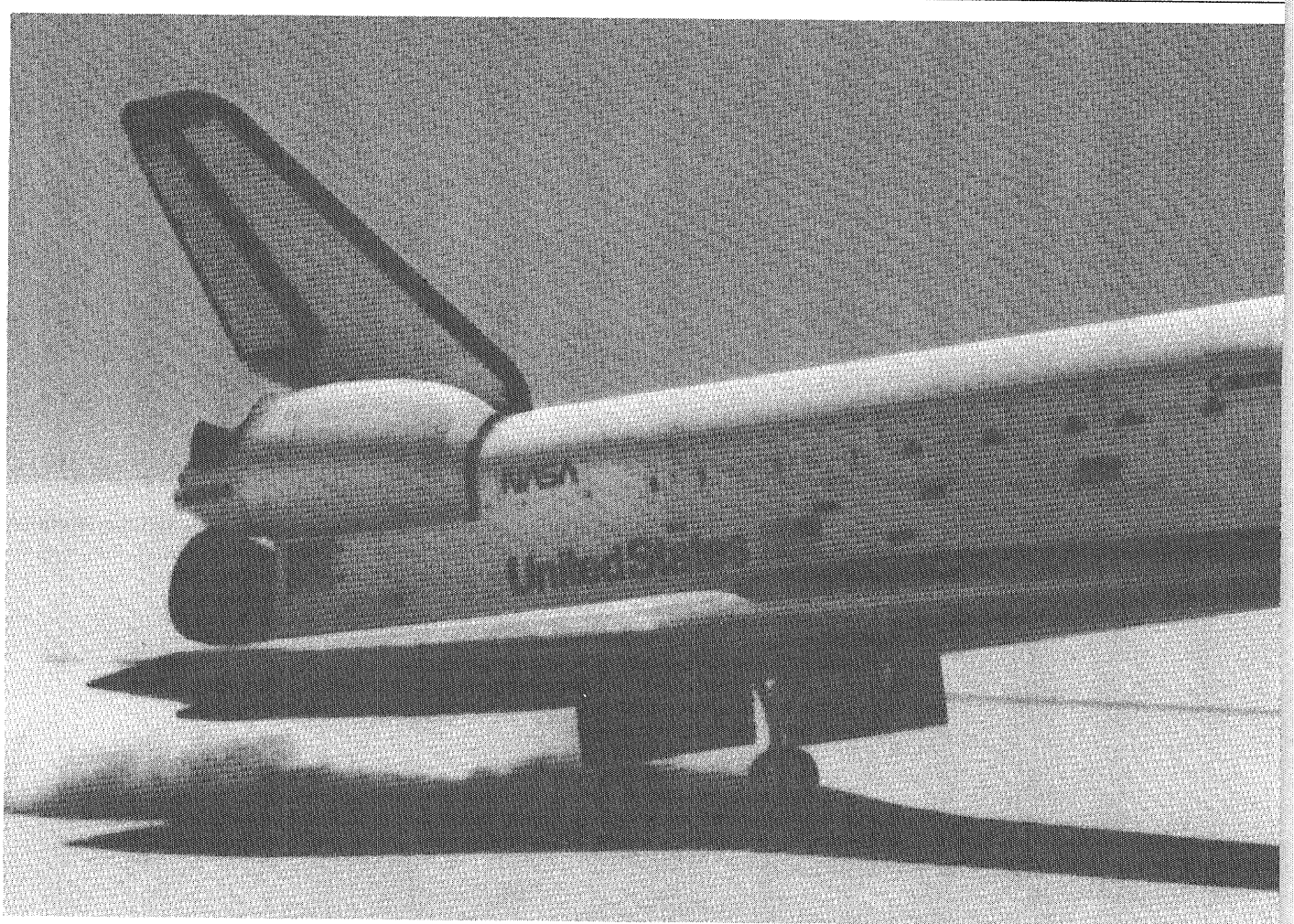

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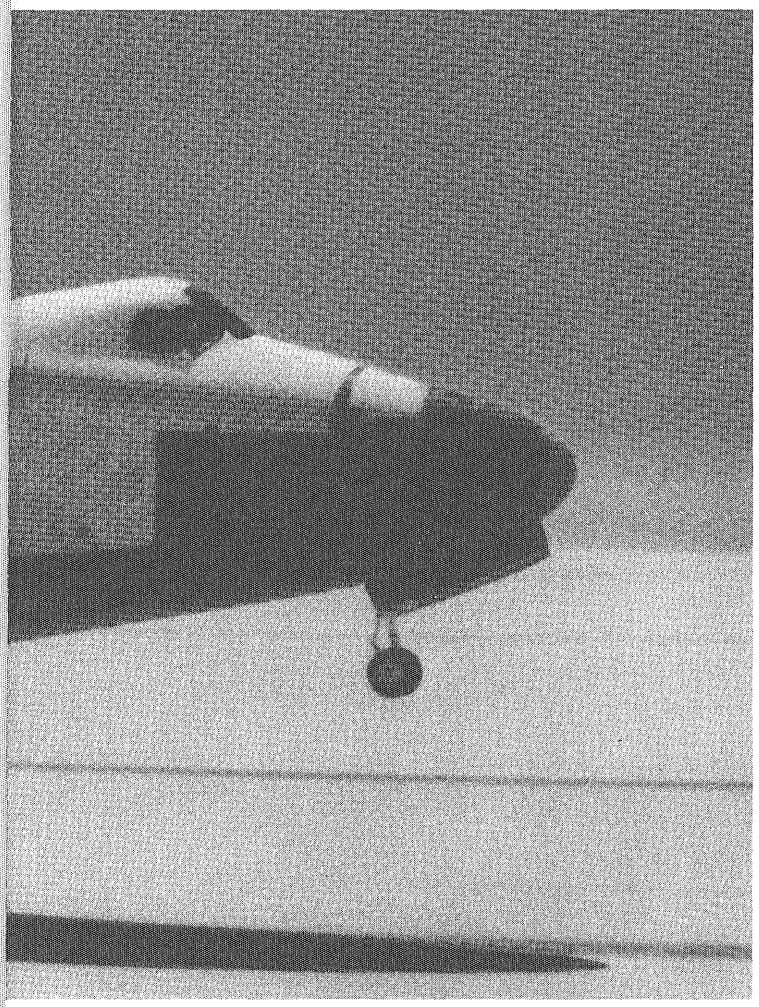

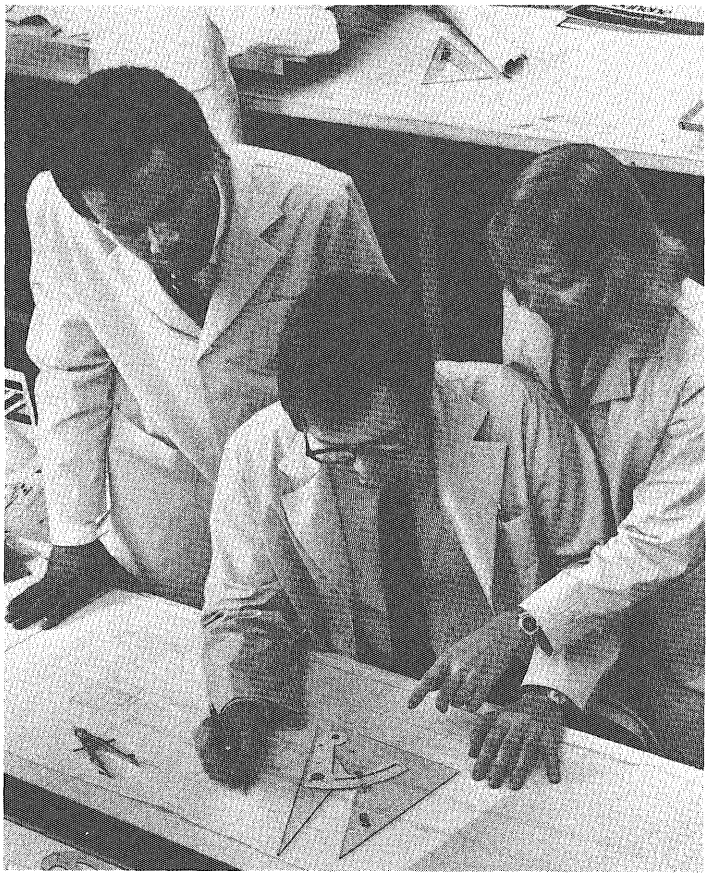

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"Substantial cost savings, greater metal price stability and decreased energy requirements are some of the benefits provided by the new penny," according to Angela M. Buchanan, Treasurer of the United States. Ms. Buchanan emphasizes that only by changing the composition of the penny can the U.S. assure the uninterrupted supply of coins sufficient to satisfy the needs of consumers.

The **Department of Geology and Geophysics** at the University of Minnesota has been selected to receive a $125,000 grant from the Atlantic Richfield Foundation. The purpose of this grant is to support doctoral students and junior faculty in science and engineering at American universities of the highest caliber. The grant is hoped to make academic careers more attractive to the outstanding men and women at the U of M.

H. E. Wright was Visiting Fellow in the Department of Geomorphology and Geography at the Australian National University in Canberra in May and lectured there and at universities in Sydney and Hobart, as well as examining geological, limnological. and ecological field projects in Tasmania, Victoria, New South Wales, and Queensland.

At the Conference on the Dynamics of Molecular Collisions in Plymouth, New Hampshire, July 27-31, Professor **W. Ronald Gentry** of the Chemistry Department was promoted to chairman of the next conference and Professor **Donald Truhlar** was named vice-chairman. Thus, Professor **Gentry** will be chairman in 1982 and Professor Truhlar in 1985. Minnesota will become the third school to provide two chairmen since John Fenn and James Cross of Yale, who served in 1965 and 1981 and Bruce Mahan and Yuan Lee of Berkeley who served back-to-back in 1976 and 1978.

Professor **Donald Truhlar** has been appointed to a four-year term on the Visiting Committee for the Chemistry Department at Brookhaven National Laboratory. He will be replacing Professor Martin Karplus of Harvard University on this committee.

Plans for the first year, Sept. 1, 1982 - Aug. 31, 1983, of the Institute for Mathematics and its Applications are beginning to take shape. The general topic for the year is Statistical and Thermodynamic Approaches to Phase Transition.

The fall semester, from September through December, 1982, will be coordinated by Oscar Lanford and will concentrate on Statistical Mechanics and on Chaotic Behavior and Turbulence in Dynamical Systems. Lanford and P. Collet will be in residence for this period. Other participants will include G. Gallavotti (September and October), J.P. Eckmann (Sept. 1 - Oct. 15), M. Aizenman, L. Gross, J. Lebowitz, E. Lieb and Ja. Sinai.

James Serrin will coordinate activities on Continuum Thermodynamics and Phase Transition, which will be concentrated in the Spring and Summer of 1983. Participants will include B. Coleman, R. Ellis, M. Feinberg, D. Owen, and C. Truesdell.

The winter period will be devoted to the application of statistical and continuum methods to the study of the physical and chemical properties of materials undergoing phase transition. More details on this part of the program will be available later.

J. Serrin and B. Ninham will participate for the entire year, and S. MacLane will be in residence from January to March.

An important purpose of the Institute is to produce interactions between mathematicians, both "pure" and "applied", and scientists and engineers. There will be a number of lecture series, going from an elementary level to the research frontier, as well as individual lectures, seminars, and discussion groups.

Professor **Subir Banerjee** has a new research grant from U.S. Dept. of Agriculture, SEA-AR, to develop a new method for determining magnetic signatures of the erosion products of soil.

Professor **Edward Silberman**, of the Department of Civil and Mineral Engineering and the St. Anthony Falls Hydraulic Laboratory, University of Minnesota, will be retiring at the end of this year. Professor **Silberman** received B.S. and M.S. degrees in Civil Engineering from the University of Minnesota. Following this, he worked in water resource assessment, flood control, and drainage with the Minnesota State Planning Board, the Corps of Engineers, the Minneapolis Dredging Company, the Tennessee Valley Authority, and the Civil Aeronautics Authority. In 1946 he joined the St. Anthony Falls Hydraulic Laboratory as a Research Associate. He became an Assistant Professor in 1948, Associate Professor in 1951, and Professor in 1957. He served as Director of the St. Anthony Falls Hydraulic Laboratory from 1963 to 1974. He has taught courses and conducted research in water resources management and in fluid mechanics, especially boundary layers and turbulence. He has also supervised hydraulic model studies.

Professor **Silberman** will maintain an informal relationship with the Laboratory. He will also be performing private consulting in special problems in hydraulics and in water resources management.

Applications for 1982 engineering scholarships from the Consulting Engineer Council of Minnesota (CEC/M) are being accepted through January 31, 1982.

The $600 annual awards are given on the basis of scholarship, character, and interest in the field of consulting engineering. The scholarship competition is open to all engineering students currently in their sophomore or junior year in an accredited engineering course. Three civil & mineral engineering students, all from the University of Minnesota, shared a total of $1,800 in the 1981 competition.

The winning applications in Minnesota will also be forwarded to a national scholarship competition sponsored by the American Consulting Engineers Council. Scholarships of up to $4,000 are available to the national winners. CEC/M will announce state winners and present scholarship checks at its 32nd annual meeting to be held in June, 1982.

Application forms and additional information on the scholarship program can be obtained from Robert C. Mayeron, CEC/M Scholarship Committee chairman, at PSC/Professional Services Group, 835 North County Road 18, Minneapolis, Minnesota 55441. His telephone number is 612/546-1300.

CEC/M is an association of 126 private engineering firms dedicated to the advancement of consulting engineering and the maintenance of highest ethical and technical standards in engineering. Job placement services are available to engineering graduates through the CEC/M office. Contact Earl Oxley at 612/922-9696 for information.

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Engineers and geologists at the University of Minnesota are creating an underground heat-storage bubble to test the feasibility of saving summer waste heat for use in colder months.

This week, in the first stage of the largest experiment of its kind, water heated to 100 C (212 F) is being pumped 820 feet underground into a thick layer of slow-moving, well-insulated watery sand called an aquifer. Some 80 percent of the heat should be recovered when the water is withdrawn.

Because nearly three-fourths of all major American cities lie over aquifers of some kind, this storage of heat energy has great potential for solar and district heating, said James O'Gara, engineer and aquifer project director at the university. Smaller projects using cool water have begun in Stonybrook, N.Y., and with warmer water, in Bethel, Alaska, at Auburn University in Alabama, and in several European and Far Eastern countries. Minnesota's is the only attempt to test the feasibility of injecting heat in summer, then retrieving it for use in winter.

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The Exxon Education Foundation has announced a $15 million grant program in support of engineering education. The program, believed to be the largest of its kind ever undertaken by a corporate foundation, will be financed by special one-time funding from the Exxon Corporation in recognition of the 100th Anniversary of the company's founding in 1882.

The money will be used to create 100 teaching fellowships and to provide 100 salary support grants for junior faculty in the engineering fields. The grants will be made to 66 U.S. colleges and universities.

A six-month intensive study by the Exxon Education Foundation showed that undergraduate engineering enrollments are the highest they have ever been and that there are serious shortages of faculty in certain key fields of engineering. The faculty shortage stems in part from the fact that industry is hiring engineers immediately after they receive their bachelor's degrees at starting salaries that make graduate study and junior faculty positions financially unattractive by comparison.

In order to increase the numbers of graduate engineering students in programs that lead to Ph.D.'s and to teaching careers, the Exxon Education Foundation will award 100 Exxon Teaching Fellowships. Beginning in the 1981-83 academic year, each fellowship will continue for three years and will provide full tuition, fees and a stipend to cover living costs. The stipend is set at a level to allow the recipients to attend school on a year-round basis. It will be $12,000 in the first year, $13,500 in the second, and $15,000 in the third.

If you are interested in more information on the Exxon Fellowship Program, consult the university of your choice.

Of the $15 million, the University of Minnesota received $400,000. The grants ranged from $50,000 to $500,000, so Minnesota is very near the top. $200,000 is in the form of fellowships for doctoral candidates in ChemE, MechE, Mining Eng. and Earth Sciences/Geology. The other half will be in the form of monies intended to augment salaries of junior professors in ChemE and MechE.

This year the 10-1/2 inch refracting telescope of the Department of Astronomy will be open for public viewing on the first and third Fridays of each month, weather permitting. The telescope will be open from 7:30 to 9:00 p.m. only if more than half the sky is clear. The telescope is located in Room 450 of the Physics Building, 116 Church St. S.E.

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The American public currently expresses "cautious optimism" that technology can deal with the problems of nuclear plant safety and radioactive waste management, according to a recent study of the Battelle Human Affairs Research Center in Seattle, Washington. Results of the study, compiled from numerous public attitude surveys, were revealed at a special session on "Educating the Public About Nuclear Power," sponsored by the Education Division of the American Nuclear Society, and held during the Society's Winter Meeting at the San Francisco Hilton Hotel.

Stanley M. Nealey of Battelle presented the report which summarizes nuclear attitudes over several years before and after the Three Mile Island (TMI) accident, including some data as recent as Fall 1981. Addressing the question of who favors and who opposes nuclear power, the Battelle study shows that women consistently are 10 to 15 percent less in favor of it than are men. The TMI accident scarcely affected men's attitudes, the study shows, and seems to have had only a one-time effect on public attitudes toward nuclear energy in general.

The American Nuclear Society was founded in 1954 as a not-for-profit international scientific, engineering and educational organization. It has a worldwide membership of over 13,000 persons and is dedicated to the peaceful application of nuclear energy.

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The regents of the University of Minnesota have presented two Outstanding Achievement Awards, to **Earl E. Bakken** and **Richard D. Mollison. Bakken** is a distinguished graduate of the University of Minnesota; founder and chairman of the board of Medtronic Inc., which has become the largest manufacturer of heart pacemakers in the world; developer of the first portable battery-powered pacemaker; founder of the Bakken Museum of Electricity in Life, which is internationally recognized as a valuable educational resource; is an innovative leader in the field of biomedical engineering; and has contributed to the health and welfare of society. **Mollison** is also a distinguished graduate of the University of Minnesota; chairman and chief executive officer of Texasgulf Inc.; exploratory geologist, responsible for discovering and developing Kidd Creek, one of the most significant ore bodies found in recent years; skilled executive, who instituted an innovative employee shareowner plan and a mine safety program cited for its excellent safety record; internationally respected mining engineer and industrial manager; and an a active supporter of community projects to improve the quality of life.

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ENGINEERING REGISTRATION STUDIES, the organization which provides study aids nationally for the engineering registration examinations, announces its program of home study courses in preparation for the April 1982 exams.

The program includes the popular ENGINEER-IN-TRAINING review course, two review courses in CIVIL ENGINEERING, and a review course in ELECTRICAL ENGINEERING.

These courses have gained wide approval throughout the country by individual candidates, universities, and organizations.

Further information may be obtained by writing or calling Engineering Registration Studies, P.O. Box 24550, Los Angeles, California 90024, Tel. (213) 208-5469.

Architects in church design have always striven to represent in their work the spiritual relationship of the human to the divine in an environment appropriate for worship. New building methods and materials from Birdair Structures, Buffalo, NY, a division of Chemical Fabrics Corporation, North Bennington, VT, are facilitating this task in surprising ways. An interesting example is the new St. Anne's Church in Seaford, Australia, near Melbourne. As the first permanent fabric structure in Australia, it has been designed to represent the tent which sheltered the Ark of the Covenant during the journey to the Promised Land.

St. Anne's architect, Dennis Payne, was able to realize this concept through the use of the unique, new interactive graphic computer system from Birdair Structures. The system provides reinforced membrane analysis — a project feasibility examination that continually adjusts for every specification change in the development and design of a fabric structure. The computer not only delineates the structure as it will appear, but also tests the design and modifies it for every stress factor under consideration. This new method of design assistance is an invaluable aid in every aspect of the design process. What would normally take three weeks of drafting and engineering can now be accomplished in only three days.

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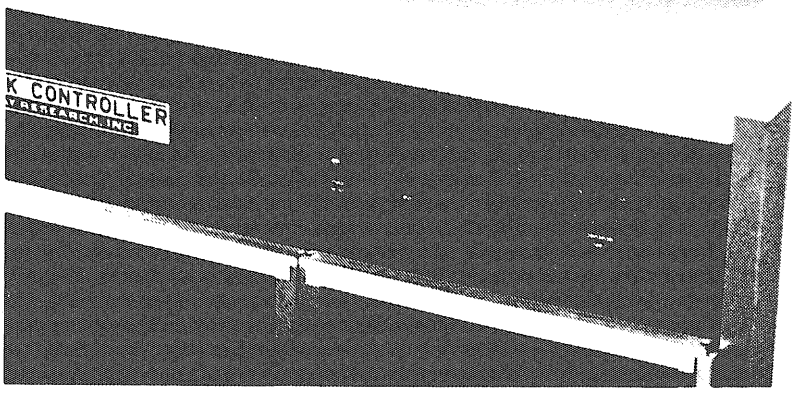

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DO I.T. UNCLASSIFIED

by Scott Dacko

Today the freshmen entering IT have it made. They're living on easy street. As a matter of fact, all of us have it pretty good compared to 10-15 years ago. Could you imagine yourself coming into IT immediately having to choose a major, and then going through four grueling years without any tutorial help? For some, it would be worse than increased tuition.

The Department for IT Unclassified Students was formed for those very reasons; students were simply not prepared enough to choose a major immediately; and once in IT, classes were tough and students were on their own.

In 1963, 45% of the entering freshmen in IT dropped out of IT by the end of fall quarter. 60% dropped by the end of the school year! They were doing below C-grade work, and had either completely dropped out of school or transferred to CLA. The faculty and administration were very concerned about this, because of the fact that students enrolled in IT are known to be the best on campus.

In order to correct the situation, a committee task-force was formed to look into the matter. After countless student surveys and interviews, they came to two conclusions: One was that many students didn't like the fact that they had to commit themselves to a major when entering IT (they weren't getting proper guidance in high school to be able to make a prudent decision). The second was that students felt they did not have enough opportunities to meet with their professors to get help in the course subject matter. The committee's finding was presented to the IT administration in a written report. The report contained two recommendations: One was that students be permitted to come into IT as an "Undecided" student, the other was that the departments should look into ways of providing more assistance to students in subject matter. An "undecided" program was thus formed. A few faculty volunteers from various departments would meet during scheduled hours in the College Office to talk to Undecided students about majors offered in IT.

"In 1963, 45% of the entering freshmen in IT dropped out of IT by the end of fall quarter. 60% dropped out by the end of the school year!"

In 1966 a tutorial program was formed. Professor John Clausen, who at that time was a full-time professor in Mechanical Engineering, and who is now the Director of Lower Division Programs, recommended to the Dean that the Math Department set up some tutorial help, primarily with graduate students. The outcome was that a pilot program was established in which Undergraduate Teaching Assistants were used. They were put in the dorms, on campus, and even off campus in the Metro area.

Since Professor Clausen always had quite an interest in this, the Dean's Office asked him in 1969 if he would like a position on the Dean's staff and if he'd take over some of these new responsibilities. He accepted. Since that time he has worked hard to expand the peering services for Undecided students (now the term is "Unclassified") and to further develop support services for all IT students.

Today, less than 10% of the entering IT freshmen drop out by the end of fall quarter, and that percentage is to be expected. The Department for IT Unclassified Students, which has incorporated the support services for IT students, has helped tremendously in the retention of IT freshmen. The following programs are currently integrated into the Department to help its 450 Unclassified students, as well as all IT students, to explore the many opportunities in IT.

Advisors. Faculty members from varying departments come into 23 Lind Hall on a regular basis throughout the quarter to meet with students. They are assigned a number of Unclassified students as their advisees. The students are encouraged to talk with as many faculty advisors as possible.

Peer Advisors. IT Honor students, juniors and seniors representing different fields in IT, are able to give Unclassified students the student view about the many opportunities in IT.

Orientation Courses. Many departments offer 1-credit courses to students to introduce them to various fields in IT. There are introductory courses in ME, Aero, EE, AgE, and CE which are open to all students.

Math Review Materials. Review materials for the freshman sequence of Calculus (1211/21/31) are distributed by the TA's to students every two weeks each quarter. Students are urged to take it like a test. Detailed solutions are given.

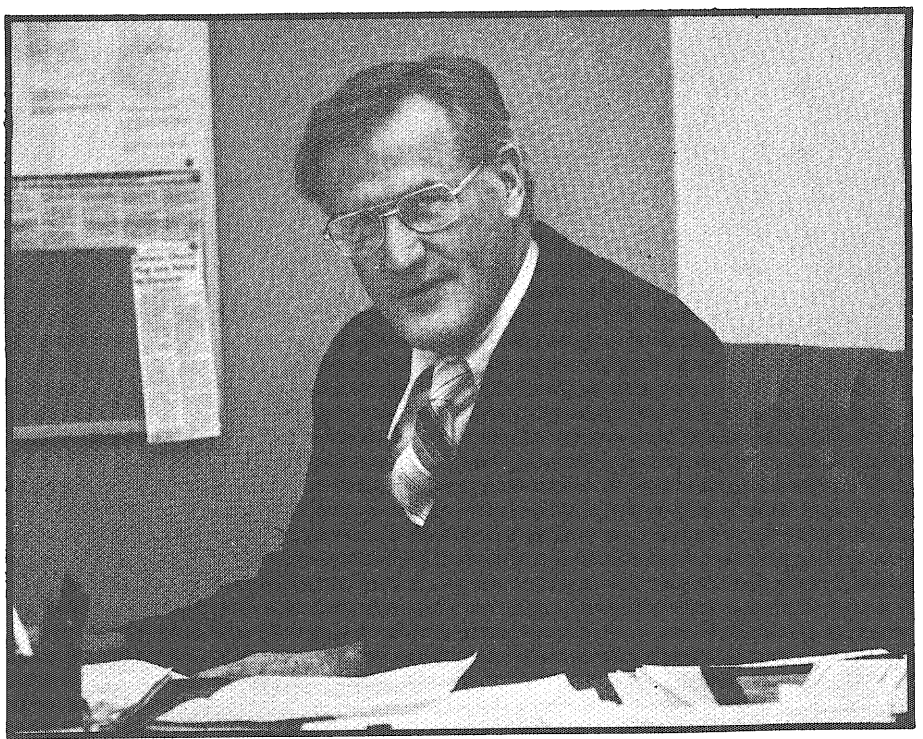
Old Chemistry Exams. Old exams from Chemistry 1004/1005 are available for review to all students in 23 Lind Hall.

Video Tapes. For both Chemistry 1004/1005 and Physics 1271, video tapes are available to all students in the Learning Resources Center in Walter Library.

Visits to 3M. 75 3M employees in a variety of fields have volunteered to talk to students about their work. Visits can be arranged for any interested students.

Tutorial Program. Undergraduate Teaching Assistants are available to all IT students in 24 Lind Hall, all residence halls, and six metropolitan high schools. They offer assistance in math, physics, chemistry, computer science and other IT courses. A tutorial schedule is available in 23 Lind Hall.

IT Student Guide. A booklet designed to make life easier for all new students coming into IT was put out this fall. It is a source of invaluable information.



Professor John Clausen, along with all the other work he does for the students of I.T., is also the faculty advisor for *Technolog*.

Professor Clausen and Dean Stueben have also been working in some new developments in the departments which will soon materialize. These are to meet the needs of the increasing enrollment in IT.

PLATO Computer Equipment. This will be obtained winter quarter, and will be a tremendous asset in meeting instructional needs. PLATO can be used for instruction in all subject matter. The equipment will be placed in the tutorial room.

More Video Tapes. As more funding becomes available, tapes will be made for Physics 1281/91, and other IT courses as well.

Professor Clausen is the one primarily responsible for the development of these programs. He comments on his feelings about them:

"Since I first came here, I've always enjoyed working with students. I've always been very sensitive to the size of the institution, and have always tried to think of ways to try to personalize and humanize the whole educational process. It bothers me greatly to see a student come from around the Metro area, walk into lecture, sit next to a different student each time, not even greeting each other, take a few notes, get up, get on the bus or carpool and go home and not have much interaction with faculty and other students. I've always had an interest in trying to improve that situation.

"When I was a full-time professor in ME, I would see my advisees, and they would complain they couldn't see the TA's in math, they couldn't see the professors...it was demoralizing, devastating to see students leave the college."

Professor Clausen thinks we have improved that situation with such activities as the tutorial program. "My philosophy of

"I've always been very sensitive to the size of the institution, and have always tried to think of ways to try to personalize and humanize the whole educational process..."

the people that work for me and with me in that operation is that they try to help students in any way they can—and to do it in a kind manner; to make the learning process as positive as possible."

The Department does a lot of good for IT. It was created out of need, and is needed today as much as always. Both the Department—and its director, Prof. Clausen—are tremendous assets to IT, along with the many other people in IT administration and the College Office, the professors, the honor students, students in student organizations, and all IT students.

A sense of community is becoming increasingly more developed in IT. You must admit, it's as much a part of the College as is homework, final exams, and IT Week.

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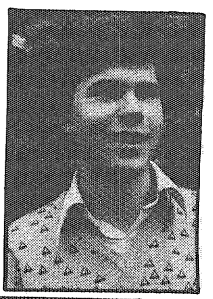

Scott Dacko, a sophomore in Mechanical Engineering, is becoming a regular in *Technolog*. He doesn't do it just to see his picture in the magazine, though. He actually enjoys it (and he's good at it).

Hurry, hurry, hurry... January 29th is the last day you can order your I.T. Annual for 1981-82!

It's full of pictures of students, student organizations, faculty, departments, projects and I.T. events that will be nostalgia in a few short years.

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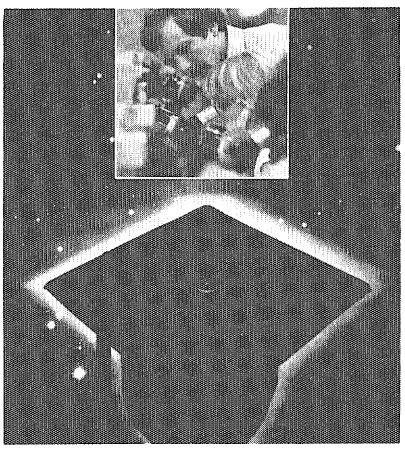
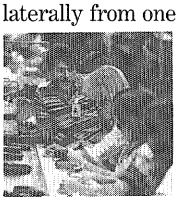


laterally from one specialty to another as well as move up. Without changing jobs.



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Or send data sheet to: George Berryman, Texas Instruments, P.O. Box 225012 Corporate Staffing, M.S. 67, Dept. CJ4, Dallas, Texas 75265

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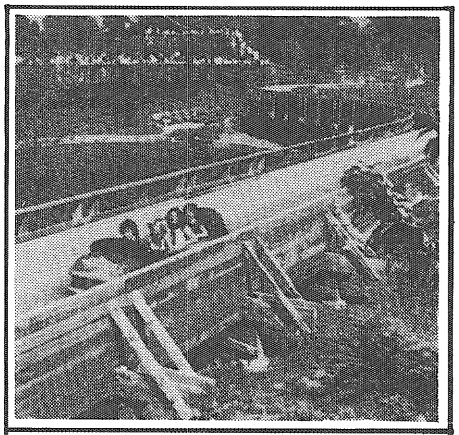

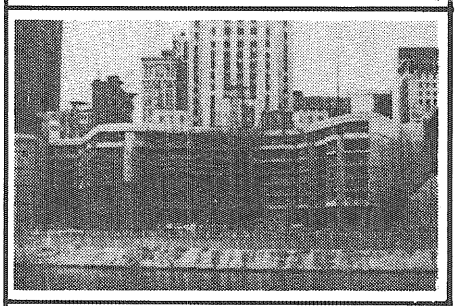

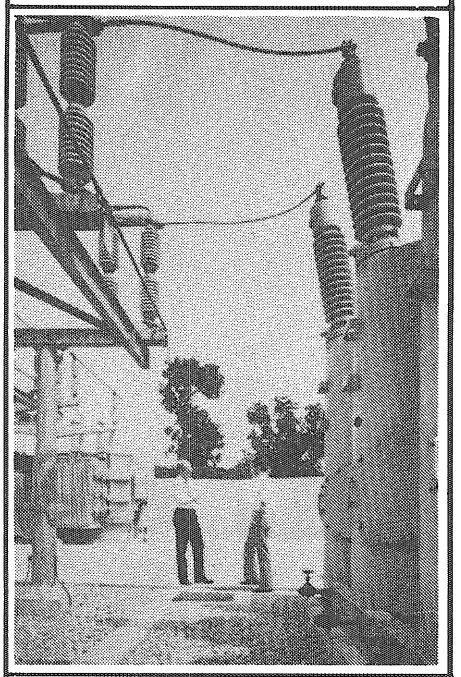

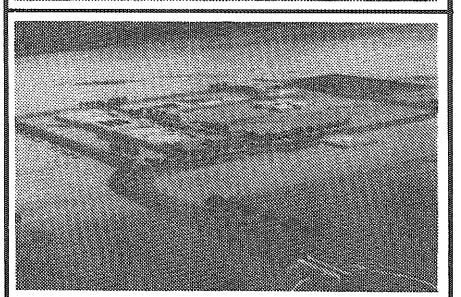

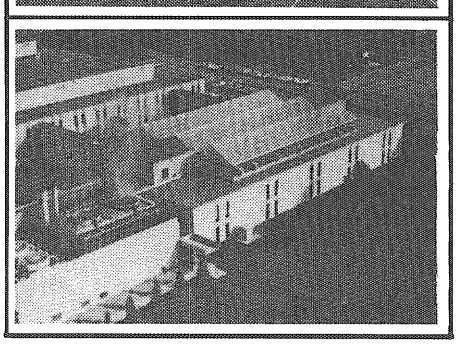

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The Consulting Engineers Council of Minnesota would like to help you get started in a career as a consulting engineer. Upon request, CEC/M will send you scholarship information, a career guide and a list of Minnesota engineering firms. Write the address seen below. It could be your start in a career unlike any other in engineering.

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KOZMOS:

A Personal View of a Wierd Universe

by Terry Hanson

Commmmmmme with meeee, on a journey of exasperation. Together, we'll explore the infinite mysteries of the Universe. Mysteries that have provided puzzlement and frustration to billions of Umans for longer than historians can even remember. Mysteries so vast and extensive that they will undoubtedly provide job security for astronomers as far into the future as people are able to pay taxes. If you wait around, I'll show you moons and planets that make North Dakota look unbelievably exciting. I'll show you stars so cool, compact, and heavy they would make terrific paperweights. I'll show you galaxies that make New York City look like a cow town. And, if the moral majority doesn't protest too much, I'll show you how life evolved from tiny one-celled creatures, fighting for survival in a warm sea, to marvelously complex creatures called Uman beings, capable of nearly infinite confusion as to why we are here and what the heck is going on. But we've only got about 50 minutes before "Wall Street Week" starts, so let's get going.

According to the National Bureau of Standards, the Universe began about 16 billion years ago, at precisely 6:15 am, Central Daylight Time. It was as if the cosmic alarm clock had gone off and God had decided to get out of bed. At first, there was only a bunch of high-energy particles zooming around, trying to figure out what to do. After a while, they began to get tired of all that, and they started to band together to form atoms and molecules. No one knows why they did this. Maybe they just got lonely. At any rate, to make a long story short, pretty soon there were huge clouds of rotating dust, then stars, galaxies, life, and even 32-bit micro-processors. Things had come a long way since the old days.

Of course, we didn't figure all this out by ourselves. We had help. Guys like Ptolemy, Kepler, Galileo, Newton, Einstein, and Mr. Wizard all pitched in to give us a hand in getting a perspective on things. One wonders why such a great mind like that of Isaac Newton would be moved to spend his time figuring out the laws of physics, when there were so many other things for a rich guy like him to do. But think about what was happening back then. There was no TV, no football, no X-rated video cassettes. The plague was going on in London, so you couldn't even go into town for a few beers. In fact, there wasn't anything to do but sit around and develop integral calculus.

Of course, the ancients were into astronomy too. But in those days, even the smartest guys were just ignorant nerds. They made all kinds of stupid mistakes and concocted crazy theories about how the rest of the Universe affects your life. Sheesh! Many of them built amazing monuments that were aligned with the movements of the stars and planets. The significance of these is still disputed, but many were certainly of astrological significance. Why did they go to all that trouble? Because Jean Dixon hadn't even been born yet!

Illustration/Steve Smith

Take the Great Pyramid for example. This impressive structure, which is clearly aligned with the movements of the Earth, must have taken decades to construct and required the labor of countless thousands of grunting slaves, all working for substantially less than the minimum wage. For a long time, the reason for the project has been as elusive as that for the MX missile system. However, we now know that the gigantic monument was designed to harness mysterious cosmic forces that could keep the Pharoah's razor blades sharp forever!

But the greatest mystery of all is the mystery of life itself. How did it get started, where is it going, and what has it been doing with itself all these years? It is believed that life probably got started in the ocean, just off the coast of Malibu. Imagine what it must have been like! Zillions of microscopic creatures engaged in an endless orgy of eating and sex, with never so much as a thought about getting a job or paying their taxes. For hundreds of millions of years they lived and died like that, and all so we could drive fast cars and play frisbee.

But the smarter ones realized that there just wasn't much future in being a microbe. They climbed onto pieces of debris, waited for the perfect wave, and hung ten all the way to the beach. Southern California was barren as a cue ball in those days and the opportunities were unbeliveable. Soon, life had really made a name for itself. But we're almost out of time, so let's jump ahead a few billion years now to the age of the dinosaurs.

A long time ago, on a continent far, far away, before the dark times, before the military-industrial complex, giant spaced-out reptiles roamed the primeval jungles. Their brains were exceedingly small, and there was very little they could do but stomp around, make a lot of trouble, and eat each other for lunch. Life consisted of a hollow, endless struggle to find a place in the sun, with no regard for the rights of others or the consequences of one's actions. It must have been horrible. Worse even, than the real estate industry.

But is there life on other planets too? Almost certainly. Somewhere out there, where no man has gone before, other intelligent creatures are probably wondering the same things we are: Does life have a purpose, can money buy happiness, and when will we finally get cable TV? They, too, may build giant domed stadiums, watch football every weekend, launch space craft with LP record albums attached, and run up amazing scores at "Space Invaders" and "Asteriods."

What then, does the future hold for us? Will the Sun swell up to become a red giant star, so hot we can roast marshmellows by its light? Will the Earth become a giant deep freeze, covered with glaciers and ski resorts? Will we be replaced by computers and forced to find employment as "extras" in big-budget George Lucas movies? Or, will some hip, young extraterrestrials blow in from a neighboring galaxy and help us get it all together? No one knows, but plenty of people are willing to tell you.

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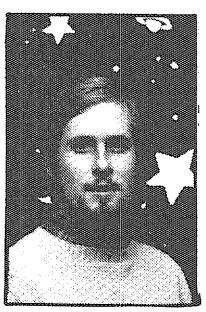

Terry Hanson is a graduate student in the science journalism M.A. program at the school of journalism. To best appreciate this article, you must read it aloud, mimicking Carl Sagan's peculiar dialect.

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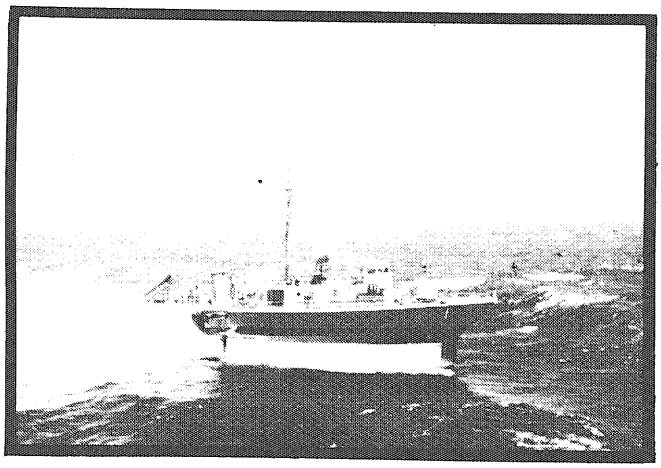

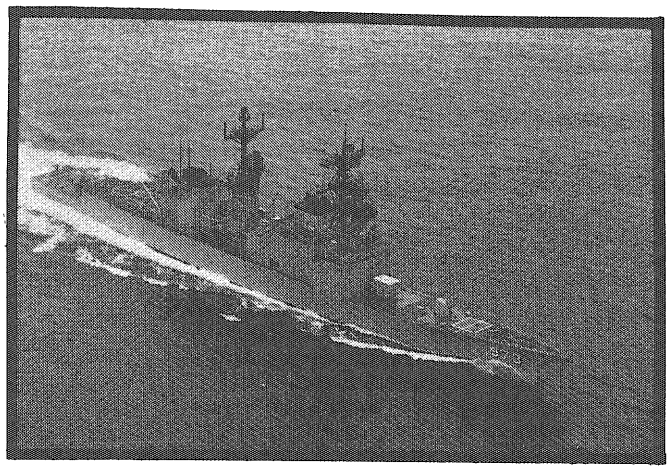

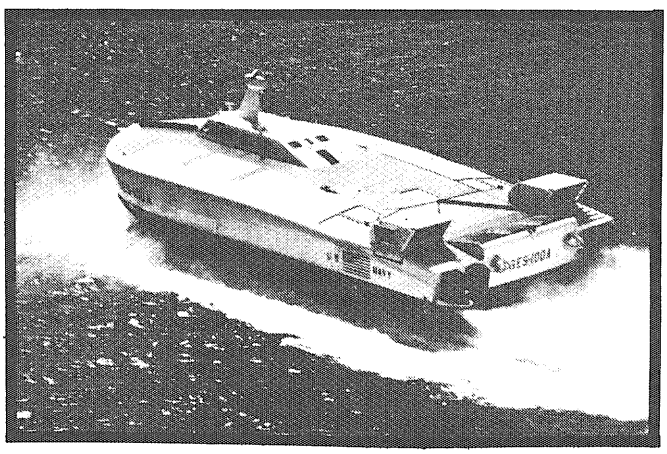

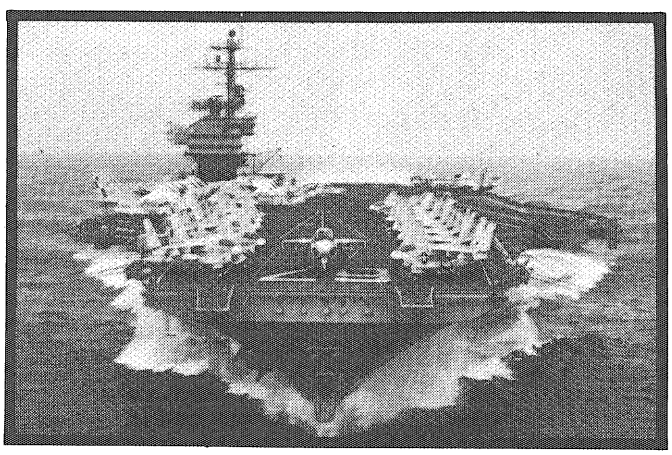

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For more information, speak to the Professor of Naval Science on campus.

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THE NAVY

Brain Teasers and Belly Laughs

Last summer at one of the ROTC summer camps one of the cadets was sent down to a stream to get some drinking water for the platoon. He had not been gone long when he came running back to the camp empty handed and panting.

"Sir," he exclaimed, "There's a big alligator in the stream, and I'm afraid to get in the water."

"Don't worry, son," said the sympathetic officer, "that alligator is probably four times as afraid of you as you are of him."

"Well, sir," replied the cadet, "if that alligator is only half as scared as I am, that water ain't fit to drink."

Then there was the country girl who, while milking a cow, say a boy coming up the road. She called to her father, "Oh father, there is a boy coming up the road."

Her father promptly replied, "Go into the house."

She called back, "But father, he is a forester."

"Then take the cow with you," he replied.

Q: What is the capital of Minnesota?
A: About $3.85

And then there was the freshman who thought a logarithm was a forester's song.

Mike and Pat were a famous baseball battery, Mike the pitcher and Pat the catcher. One day after a game, they got into a heated discussion on the topic of the hereafter. Pat said that baseball was such a good game, they had to play it in heaven. Mike agreed that it was a great game, but didn't think they played it in heaven. After a while, they came to an agreement. Whoever died first would come back in the spirit to tell the other what he found out.

Two weeks later, Pat was struck by an MTC bus while crossing Washington Avenue and was killed. Mike had forgotten about the deal he had made until another week later, when he heard a voice from above call his name. Lo and behold, it was Pat.

"I've got good news and bad news for you, Mike," Pat said.

"What is it?" Mike answered back.

"The good news," Pat went on, "is that they do play baseball in heaven. The bad news is that you're pitching on Friday."

A farmer was phoning a veterinarian. "Say, Doc," he said, "I've got a sick cat. He just lays around licking his paws and doesn't have any appetite. What shall I do for him?"

"Give him a pint of castor oil," said the vet.

Somewhat dubious, the farmer forced the cat to take a pint of castor oil. A couple of days later he met the vet in town.

"How's you sick calf?" asked the vet.

"Sick calf! That was a sick cat I had."

"My gawd, did you give him the pint of castor oil?"

"Sure did."

"Well, what did he do?" inquired the vet.

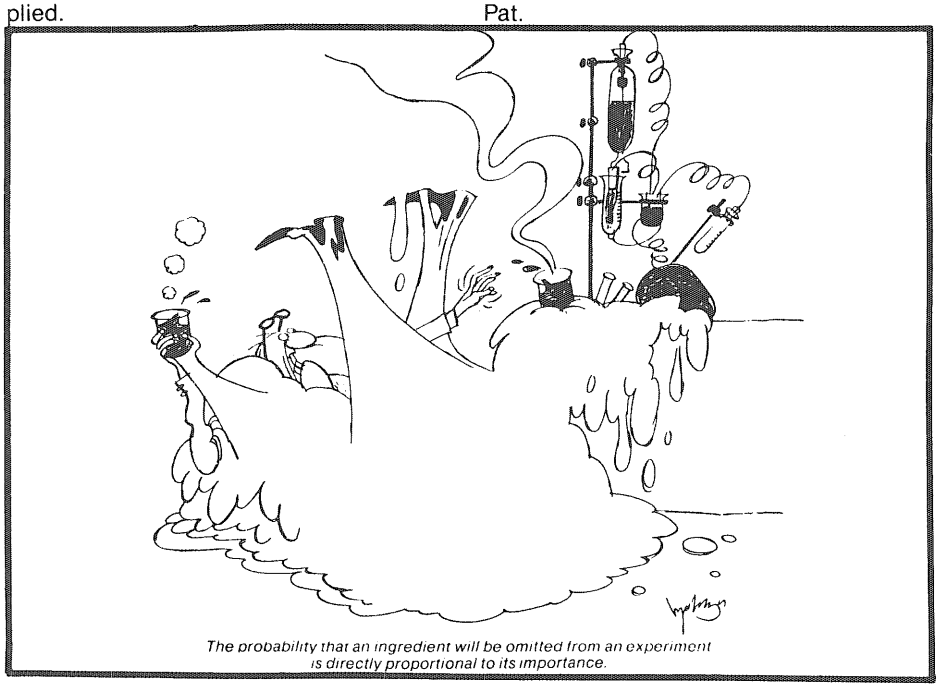
"Last time I seen him," said the farmer, "he was going over the hill with five other cats. Two were digging, two were covering up, and one was scouting for new territory."

An engineer is said to be a person who knows a great deal about very little and who goes along knowing more and more about less and less until finally he knows practically everything about nothing; whereas,

A salesman, on the other hand, is a person who knows very little about a great deal and keeps knowing less and less about more and more until he knows practically nothing about everything.

A purchasing agent starts out knowing practically everything about everything, but ends up knowing nothing about anything, due to his association with salesmen and engineers.

Famous last words: "Hell, he won't ask us that."



The probability that an ingredient will be omitted from an experiment is directly proportional to its importance.

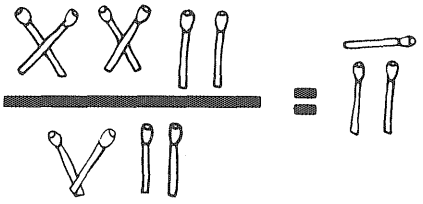
"I shall now demonstrate what I have on my mind," said the professor as he erased the blackboard.

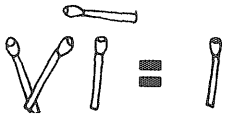
• • • • • • • • • • •

Been doing some research on the origin of old sayings and phrases, and think I've stumbled upon the beginning of that great old cheer, "Hooray for our side!" I guess it was first heard on the day Lady Godiva rode sidesaddle through the streets of Coventry.

David Norlander was the winner of the T-shirt for the Fall II issue's Brain Teasers. Here are the answers.

1. There were several correct answers for this one. Here's what Dave did:





2. PORK=9447, CHOP=3140, C = 3

3. None.

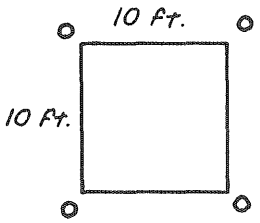
4. John was 60 years old.

5. The longest trip for Sam was 54 miles.

Here's some more Brain Teasers for you to try. As always, be the first to solve them, bring your answers to Room 2, Mechanical Engineering, and you can win yourself a T-shirt.

1. You are given 12 coins. One of the coins is different from the others, but you don't know if it is lighter or heavier. (The other eleven coins are identical.) You are provided with a weighing balance. Identify the special coin in three weighings and determine if it is lighter or heavier than the others. All coins look alike.

2. John has a swimming pool with an area of 100 square ft. The swimming pool has a tree near each corner as shown. John wants to enlarge his pool. He would like it to be 200 square feet, and that the trees be neither cut down nor in the swimming pool. Show the new swimming pool and the dimensions.



3. Once upon a time there were three princes that all wanted to marry the daughter of a king. As she could not decide which of the three to choose, the court mathematician developed the following procedure. He ordered three white and two black signs. He then covered the eyes of the princes and put one of the signs on the back of each of them. The first prince came forward. His eyes were uncovered so he could see the other two. He then guessed his color, but was wrong. The other two could not hear what he said. The second prince came up. His eyes were uncovered so he could see the color of the last prince. He guessed his color, but was wrong. The third prince came forward, his eyes were uncovered, and he said, "My color was___". He was right. Describe the logic that the third prince used, and what color he had.

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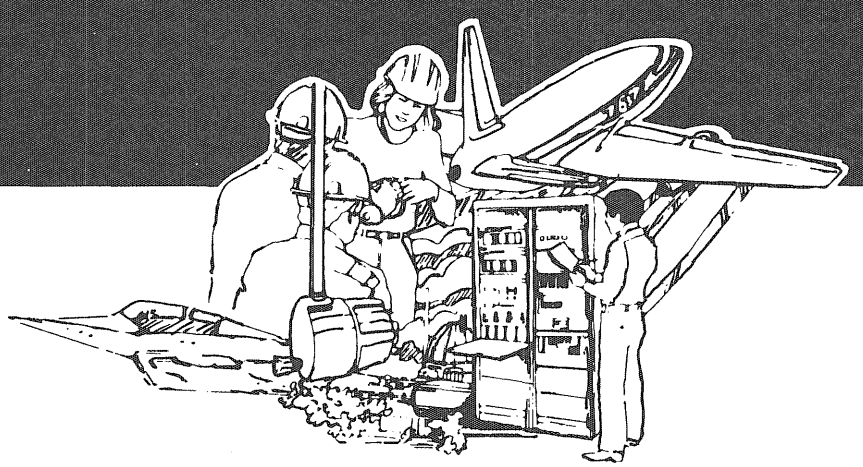

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Entrant Qualifications

I. Contest is open to all University of Minnesota students registered during the 1981 quarter.

II. Entrants must be of amateur status, I.E., never have previously published a work of fiction for monetary payment.

III. *Minnesota Technolog* and Minnesota Technolog Board of Publication staff past or present are ineligible to enter.

Entry Qualifications

I. Entries must be typed, double-spaced, with one-inch margins on 8½" x 11" paper. Each entry must be accompanied by three photocopies of the manuscript. Each entry must bear an attached cover page with the story title, author name, home address and daytime phone number. DO NOT PUT AUTHOR'S NAME ANYWHERE ELSE ON THE MANUSCRIPT.

II. All entries must be original submissions of science fiction or fantasy.

III. Entries may not exceed 5,000 words.

IV. Entrants may submit more than one entry.

V. Deadline for entries is March 1, 1982. Send all entries to:

Minnesota Technolog Science Fiction Writing Contest 1982 (MTSFWC 82)
Minnesota Technolog
Room 2, Mechanical Engineering Building
111 Church Street S.E.
University of Minnesota
Minneapolis, Minnesota 55455

VI. Any entry not conforming to these rules may be disqualified and excluded from consideration. . Decision of the judges is final.

Entry Judging

I. Manuscripts will be assigned an entry number on receipt and will be identified by title and this number alone until judging is complete.

II. Contest winner will be notified by the judges, after judging is complete.

III. Decision of the judges is final.

Winning Entry Publication

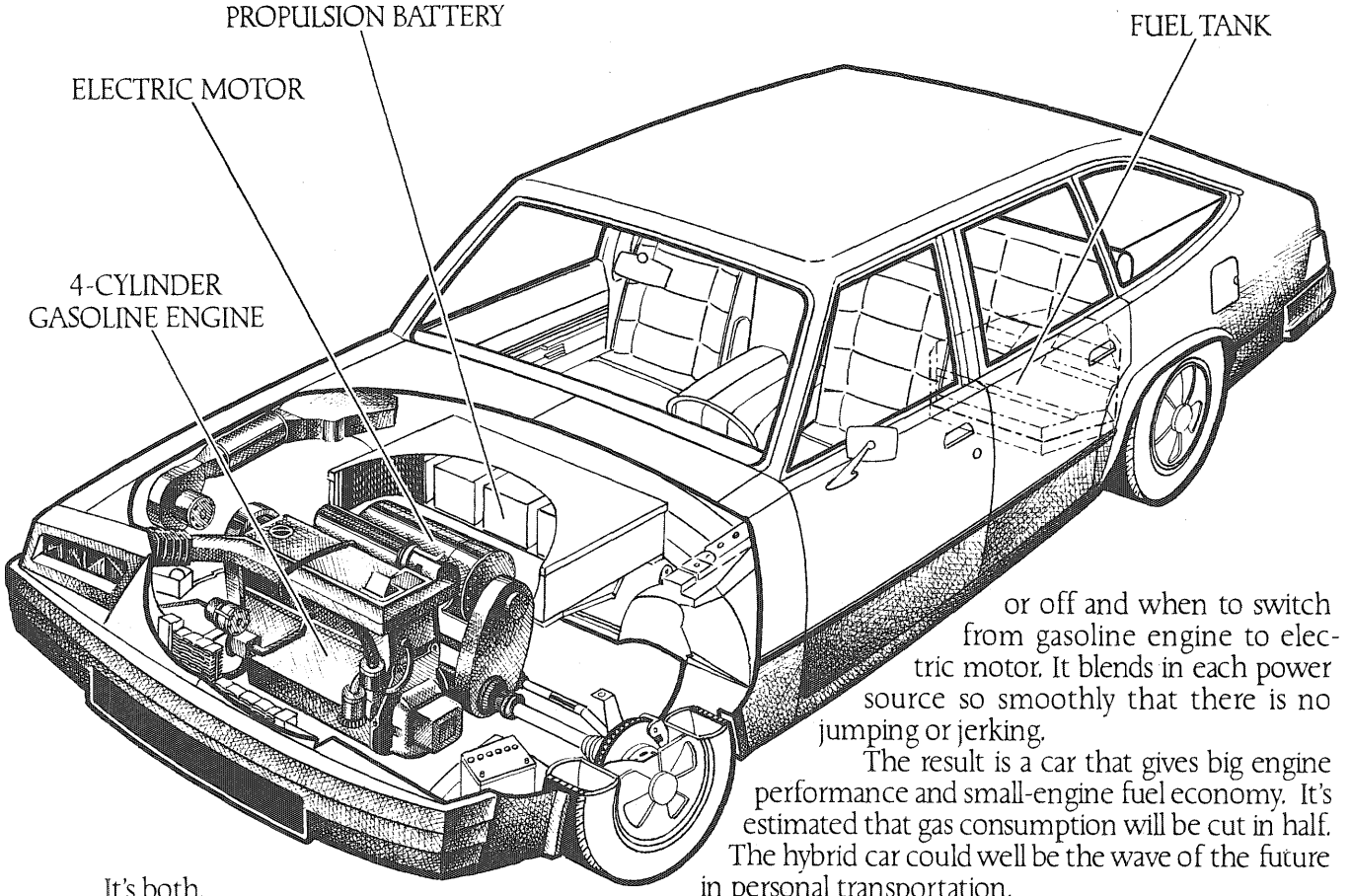
I. *Minnesota Technolog* retains first publication rights to all winning manuscripts. Other rights remain with the author.

II. Contest winner will be announced in the Spring II, 1982 issue of *Minnesota Technolog.* Remaining submissions may be picked up by the authors until May 15, 1982 when they will be discarded.

III. Contest-winning story will be published in Minnesota Technolog: first-place winner, Spring II 1982; prize: $75.00

QUESTIONS ABOUT THE ABOVE ENTRY RULES should be addressed to Pete Marsnik, Editor at Minnesota Technolog (373-3298)

Is it an electric car that runs on gasoline, or a gasoline car that runs on electricity?



It's both.

It's a hybrid car being developed by General Electric for the Department of Energy. It's powered by both a gasoline engine and an electric motor.

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The electric motor will be used primarily for speeds from zero to 30 mph, and the gasoline engine for most highway driving. When you need extra power for passing, the electric motor automatically kicks in to boost the power.

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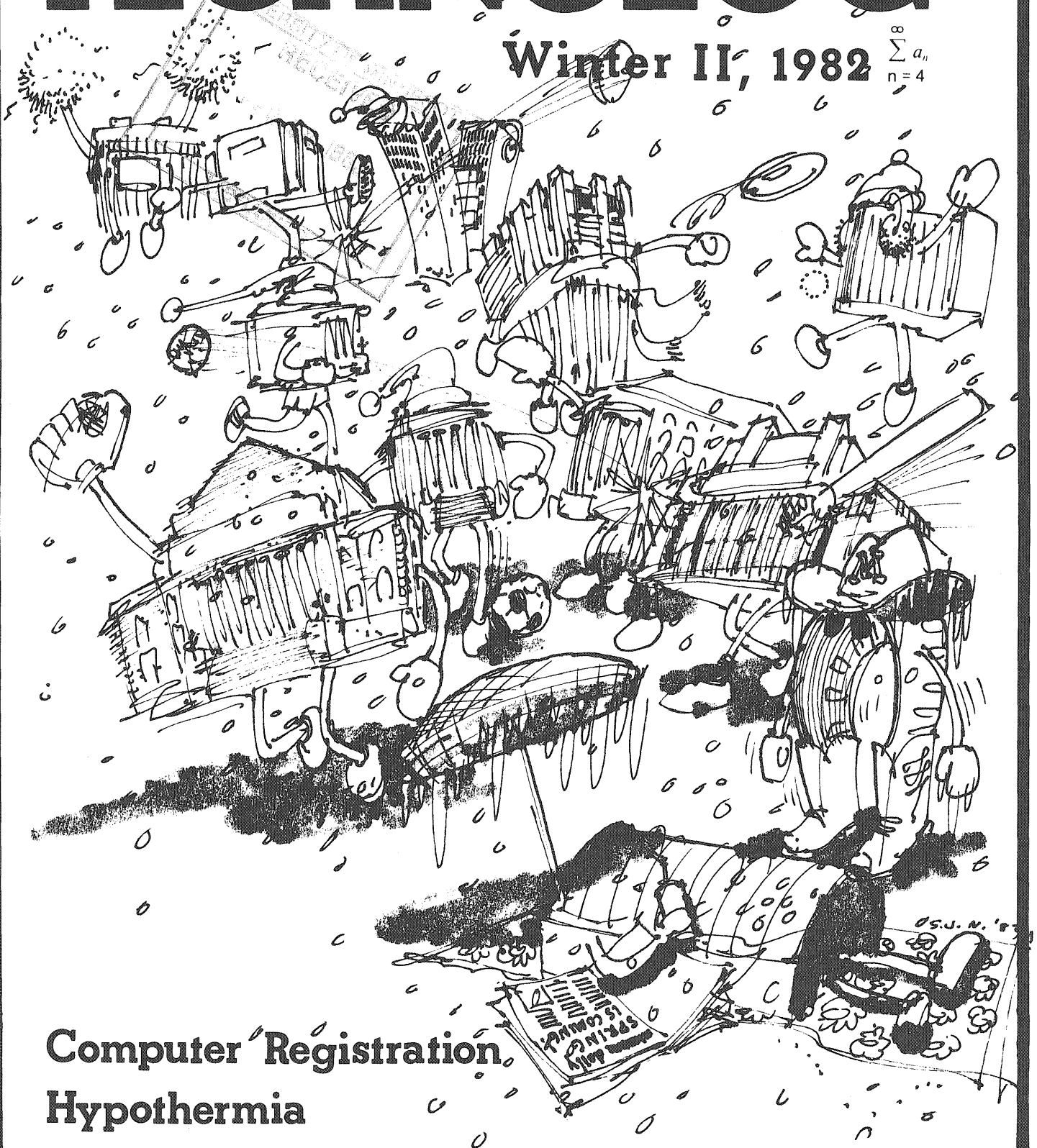

Computer Registration

Hypothermia

more

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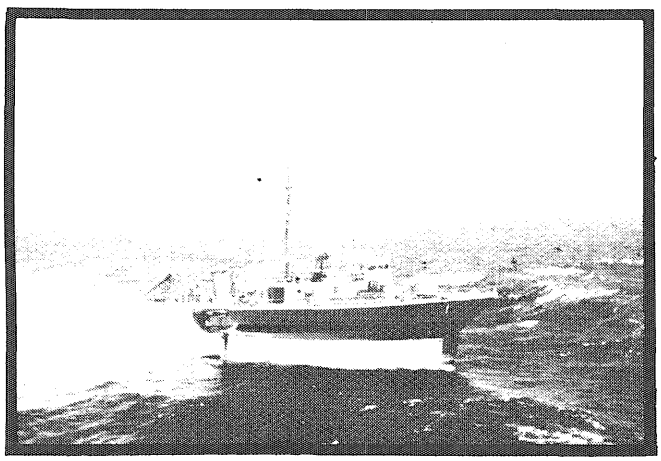

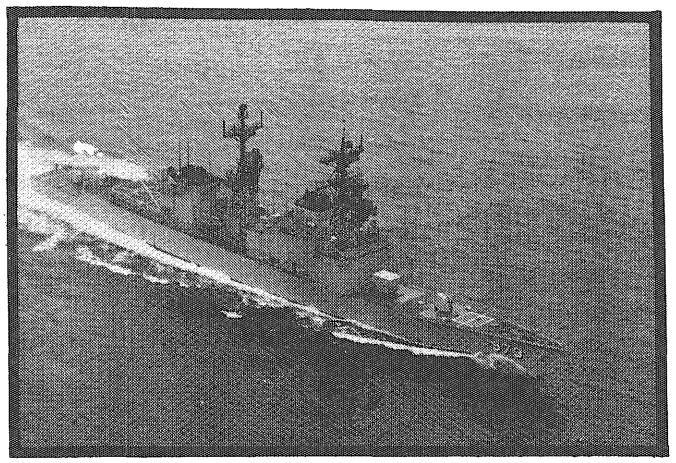

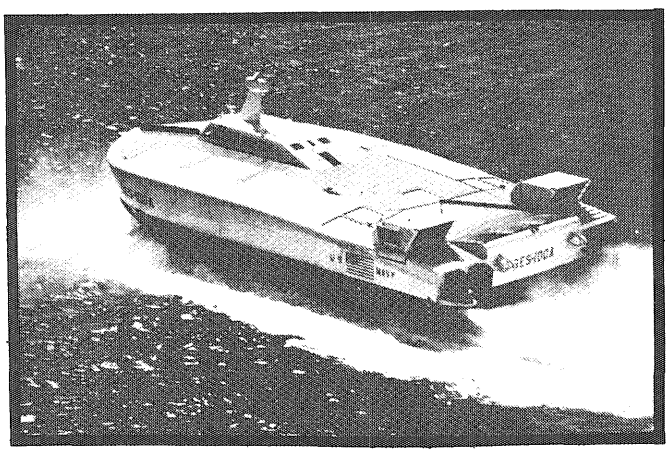

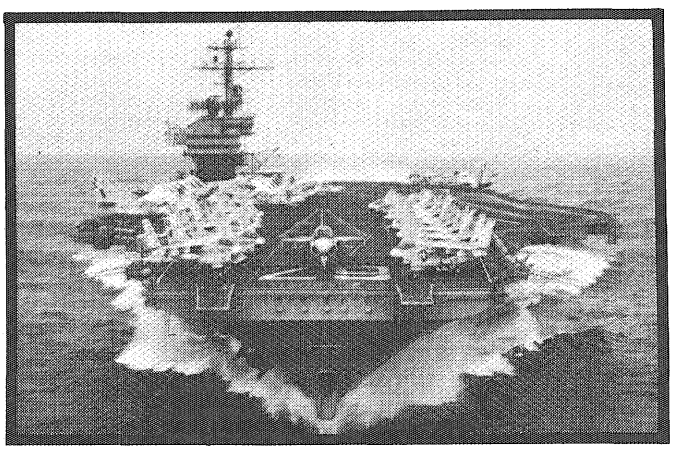

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Editor's Log

Communication. It's a big word these days. It has everyone buzzing, especially in the engineering world. Seems as if the attitude is that if you can communicate, that is, convey ideas from your mind to the minds of others, especially non-technical minds, you can go a long way. It's worth developing the skill.

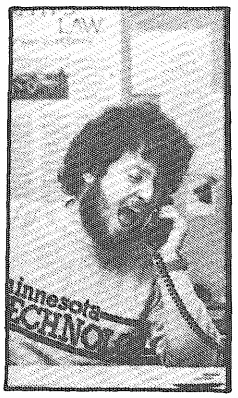
I believe that this type of technical communication will become even more important from day to day into the future. One look at the newsstand of today compared to one ten years ago will support my point. While years ago, about the only scientific reading you would find in most places was, say *Scientific American*, now you will find literally dozens of technical magazines, some geared toward the scientific mind, and some geared to the non-technical mind trying to discover and understand the scientific world we live in.

There is a responsibility among the engineers and technicians of the world to not only study science and develop breakthroughs and advancements, but also to educate the general public. If the general public could know and understand certain problems, maybe there wouldn't be so much skepticism in such areas as alternate energy sources.

Technolog hopes to enlighten you with this issue. While we can't tell you what made it snow so much last month, we can tell you what to do if you're out in the cold, how to register on the new computer system, and more. We'll also entertain you with the regular Brain Teasers and Belly Laughs. Why not seek out a quiet snow drift, build yourself an igloo, and settle down and enjoy this issue. Happy reading.....

Peter G. Marsnik

Peter G. Marsnik
Editor



As this issue of *Technolog* was being but to bed (journalistic lingo for finishing production), Pete was already planning his spring break—a much needed vacation in Tropical Minnesota.

Staff

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Undergraduate Magazine of the Institute of Technology, University of Minnesota

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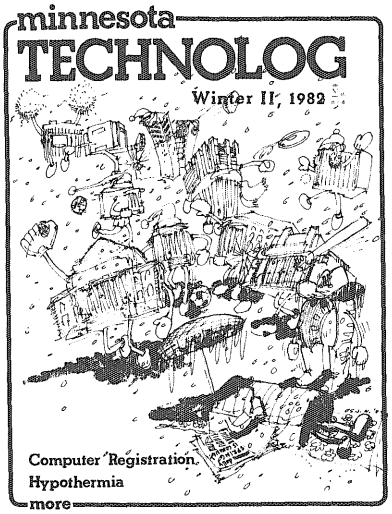

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Letters to the EDITOR:

Dear Editor:

I find it sad that a misspelling can be found in a college magazine (see "A Personal View of a Wierd Universe"). Granted, IT students have never been known for their expertise in the written word, but I have trouble understanding how this error could have been missed.

IT students have a great deal on their minds, I know; but if we neglect learning necessary skills (such as knowing when to pick up a dictionary) this technical college is no better than a higher level of vocational school.

Stephanie Phelon
EE junior

Send Your Letters to...

Minnesota Technolog
Room 2, Mechanical Engineering Bldg.
U of M
Minneapolis, MN 55455

Please try to keep your letters to 300 words or less, and you must sign it to have it printed.

ERRATA:

Terry Hansen's name was inadvertently spelled wrong in Winter I. We spelled it Hanson by mistake. Sorry, Terry!

Also, photo credit to **Brian Brown** for the pictures in Winter I's "Brotherhoood of Hamm's" article was omitted.

Society of Women Engineers presents on Friday, February 26, 1982 The Fourth Annual Career Fair and Banquet.

The Career Fair will be held in Architecture Court, 10 am-4 pm.

40-plus companies from around the country including Honeywell, Texas Instruments and Pillsbury are represented.

The banquet and Reception will be held at the Prom Center, 6 -10 p.m.

The evening's guest speaker will be Professor James Connolly, speaking on "Technical Communications."

For more information, and reservations, call Barb Kehne, Terry Daly or Kathy Hawley at 376-2721 or stop by the SWE lounge, 230 TNCE.

All IT students welcome.

Luis Castellanos mines copper with software.

Most copper is found deep underground. But the Bell System's 995 million miles of copper cable have tons of it above and below ground. That copper provides vital circuit paths to transmit customer voice, data and video signals for today's Information Age needs.

And Luis Castellanos, seven years out of undergraduate school, supervises one of the groups that helps Bell System companies "mine" all that copper. He works with one of the largest computer hardware and software systems in the world—the Trunks Integrated Record Keeping System (TIRKS). Every day it "mines" the vast Bell network for available circuits and equipment. As a result of efficient use of network facilities, the Bell System saves millions by eliminating the need for certain capital expenditures.

Plus, there's more to TIRKS than "mining copper." It also configures circuits and assigns components needed for each circuit path. That allows Bell companies to respond faster to customer requests for complex services like video and data transmission. Employees are more productive too, because TIRKS helps them set up circuits and forecast facility needs.

Before TIRKS was available, keeping track of communications circuits and facilities required enormous amounts of paperwork and manual calculation. Every day, the average Bell System company handles orders involving 1500 circuits and up to 7500 individual components associated with them. Each detail has to be specified and accounted for.

Now, thanks to people like Luis, TIRKS keeps track of all that information instantaneously using computers. Information is up-to-date. It's instantly available. And it's more accurate.

According to computer scientists like Luis, the benefits from TIRKS are just beginning. He believes that, as more computer hardware and software systems like TIRKS interact, new benefits for customers may be possible, as well as additional productivity increases for employees.

Luis joined Bell Labs with a B.S. in computer science from Pratt Institute. Under a company-sponsored graduate study program, he attended Stevens Institute of Technology for his M.S. in computer science. At the same time, he worked part-time assuming responsibility for a large piece of TIRKS software. Working with design teams, he gained valuable insight from experienced members. Now, his technical performance has earned him a promotion to supervisor.

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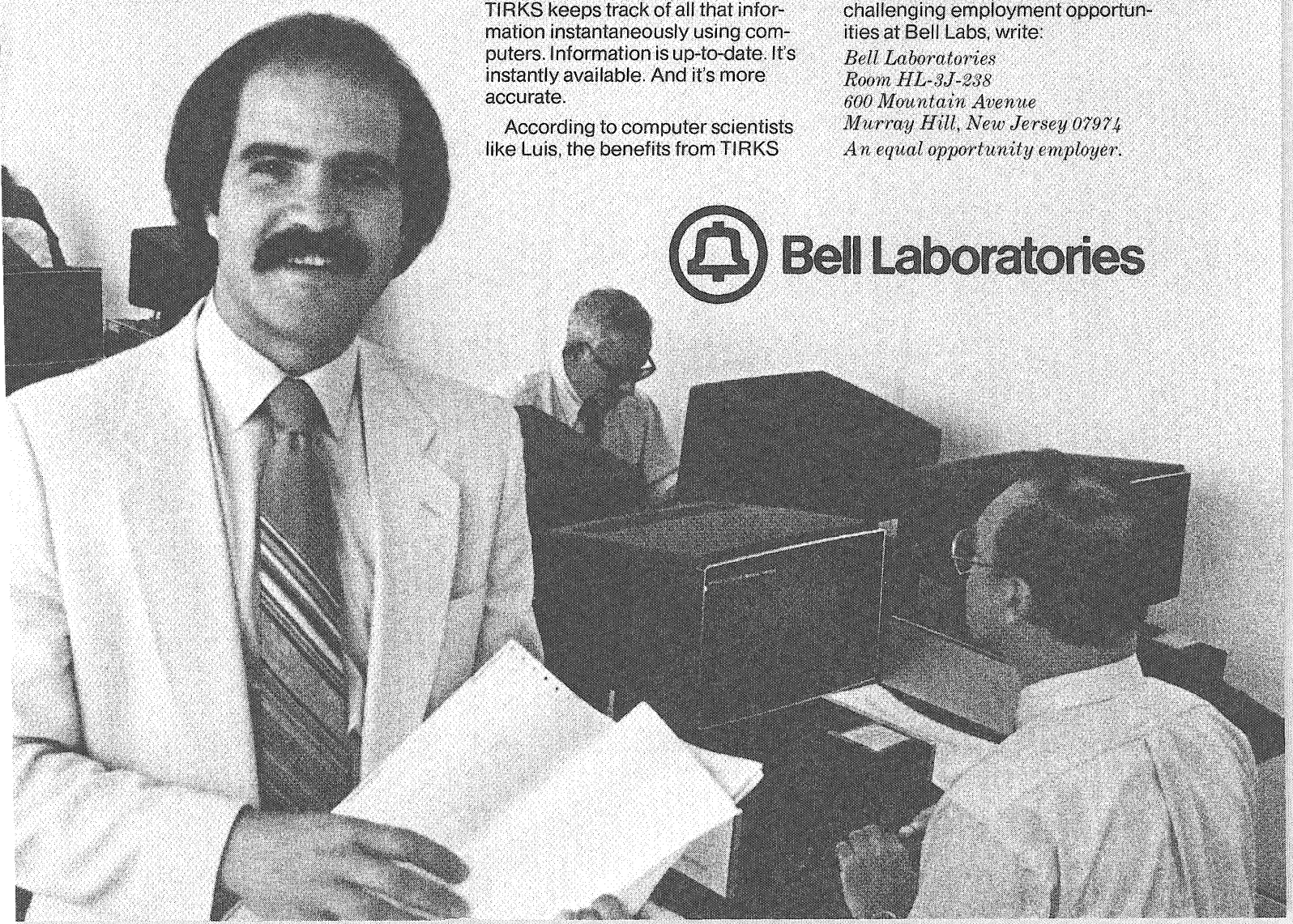

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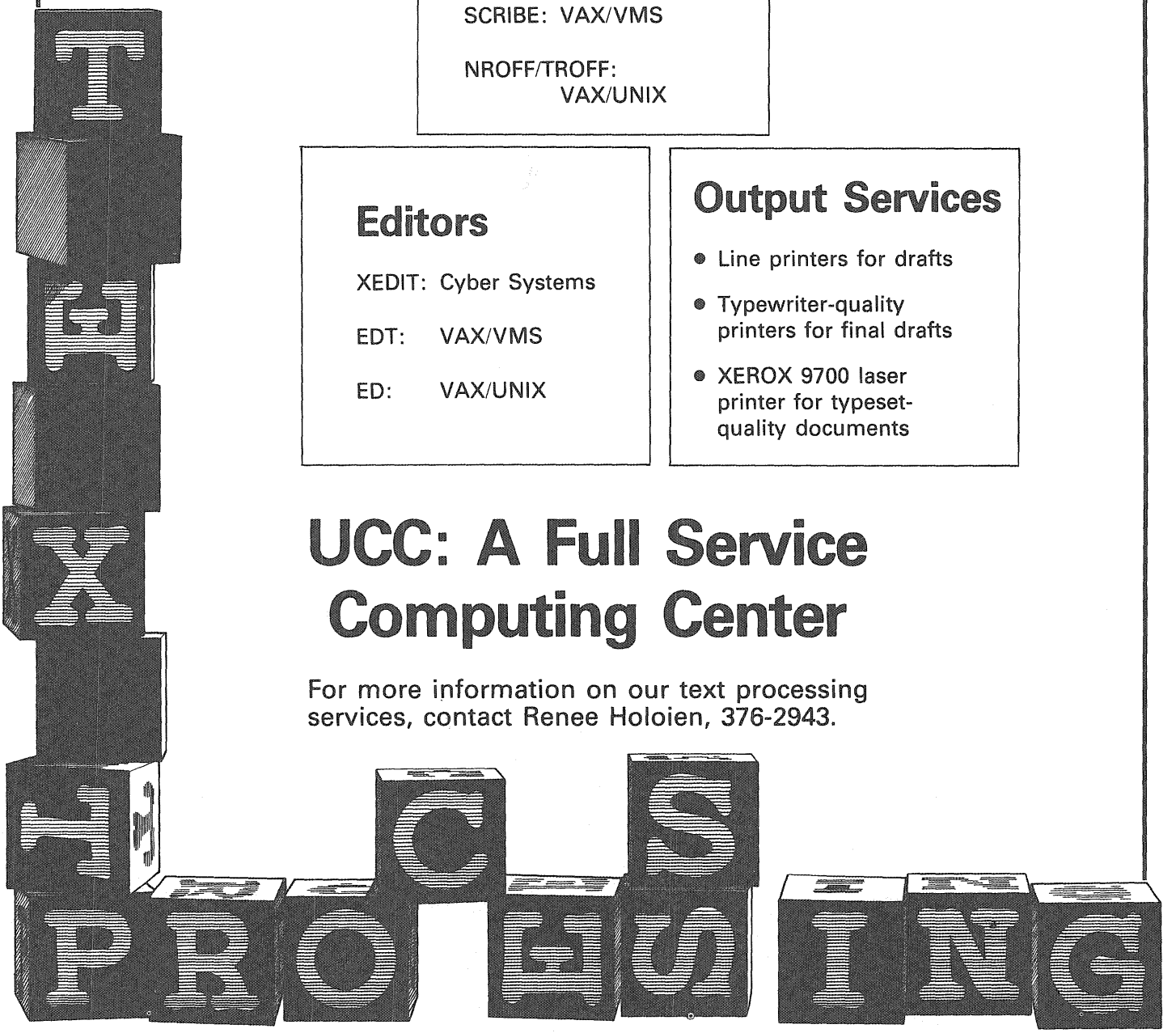

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OUT IN THE COLD

EDITOR'S NOTE: In view of the beautiful Minnesota winter we have been experiencing this season, *Technolog* felt this story would be educational as well as interesting.

By Paul Dienhart
University News Service

It's that cold day when everything goes wrong.

You're striding along on cross-country skis, jacket open, breaking into a sweat in spite of the bitter cold. Suddenly, one of your skis hooks under a branch near the surface of the snow. As you somersault through the air you hear the ski crack in half. It's five miles back to town, but you grit your teeth and begin wading through the snowdrifts.

They find you toward evening, sitting in the snow a half mile from shelter. Your tracks indicate you wandered in circles before you collapsed. They can't find a pulse or detect any breathing. In desperation, a rescuer trained by the American Red Cross gives you external chest massage. Your heart, which had been beating slowly under your rigid muscles, is jolted into a wild, uncontrolled beat that ends in heart failure. "We did everything we could, but I'm afraid we were too late," a loved one is told. "I'm sorry."

"You can't assume a person is dead because they're cold. It's amazing how much witchcraft is involved in treating hypothermia victims. Until recently, we didn't know much more about how the body regulates temperature in the cold than those Benedictine monks who strapped brandy flasks on St. Bernards.

The speaker, Robert Pozos, is a physiologist who came to the School of Medicine at the University of Minnesota, Duluth, from Southern California. "I was shocked at the temperature changes that Minnesotans take for granted," he said. "Since most of my work has dealt with tremors and shakes, I decided to study the shiver response.

The result was a laboratory that was among the first to show what happens when the body temperature is lowered to the point of hypothermia. The lab Pozos runs with physiologist Larry Witmers contains a huge plywood and fiberglass tank filled with 39-degree Lake Superior water. A computer helps monitor the heart beat, tank.

Although University safety rules allow Pozos to lower the body temperature of volunteers by only two degrees centigrade, he can still detect the onset of hypothermia. "I've talked to volunteers two days after the test and they don't remember half the stuff that went on," Pozos said.

Pozos said Kennedy's repeated dives into the cold ocean could have made him hypothermic.

A well-known example of this reaction could be Sen. Edward Kennedy's failure to report the death of Mary Jo Kopechne until several hours after the plunge off the Chappaquiddick bridge, Pozos said. Kennedy's repeated dives into the cold ocean

Illustration/Steve Smith

could have made him hypothermic, he said.

"Personality changes are one of the first indications of hypothermia," Pozos said. "People who never swear will suddenly begin to cuss. We've had people in the tank go into profound depressions. When that starts we pull them out right away." The tank volunteers are free to get out at anytime, and there is always a physician present in case of problems.

After personality change, the next warning is a loss in judgement which causes people to do irrational things. Then, when the body temperature drops to around 90 degrees, the muscles become rigid. At 86 degrees circulation slows enough so that people begin to lose consciousness. Death from heart failure occurs around 71 degrees or lower.

"Shivering, personality change and stiff muscles are the keys to recognizing someone who is getting hypothermic," Pozos said.

Pozos' work is especially concerned with finding the best survival techniques for wilderness emergencies, far away from professional care.

"In water, don't splash," he advises. "The more you move your limbs the more heat you lose. Get as much of your body out of the water as possible. Water takes heat from you 20 to 30 times faster than air. If there's a chance of help and you can get part of your body out of water—wait. You will lose heat much more rapidly by swimming."

Last year 85 people died in Minnesota waters, and the state Department of Natural Resources estimates that half the deaths were the result of hypothermia rather than simple drowning.

'More people die of hypothermia on land because they're more scared of the water than they are of air," Pozos said. He has this advice for stranded cross-country skiers: first thing to do is wipe the perspiration from your body. Then find shelter, insulate yourself from the cold ground and eat the food you have with you. Then, wait.

"We don't recommend heroic measures in the wilderness," Pozos said. "It takes tremendous energy to walk five miles in deep snow. This assumes you had the sense to bring some food and matches."

"Always think like a Minnesotan! Think pessimistically. Think: what if...?"

In treating hypothermic victims, Pozos disagrees with the current dogma of the American Red Cross. "They recommend chest massage, but they haven't been able to provide me with any data for that procedure. The hypothermic heart is very sensitive to malfunction. The colder the heart gets, the more likely it is to go into fibrillation (uncoordinated twitching). When that happens you have to continue the massage or the blood flow to the brain will stop. That isn't practical in the boondocks."

"Always think like a Minnesotan! Think pessimistically. Think: What if...?"

In the wilderness, Pozos advises rescuers to make sure the respiratory passage is clear, to take off the cold clothes, and to wrap the person in blankets for natural rewarming. "Watch them closely and give them fluid when they can manage to drink. Don't put them next to bonfires or throw them into hot tubs."

Pozos has found Minnesotans especially curious about the effect of alcohol on the body's reactions to cold. Scientists have long believed that alcohol makes a person cold faster. But Pozos' tests show the opposite.

He explained: "Alcohol dilates blood vessels near the skin. That's why drunks have red faces. The brain gets the message: 'You're OK, you skin is nice and warm.' And that's why drunks don't shiver. Shivering makes you lose heat faster.

"Alcohol also minimizes the freakiness. Cold hurts. You get in that tank and you know it hurts, unless you've been drinking. The more you panic and thrash around, the more heat you lose. We also have some evidence that alcohol protects the heart from fibrillation.

"Alcohol can get you into trouble in the cold, but once you're in trouble, we don't think it's harmful to your chances for survival.

"When I first got into this work six years ago, I thought there had to be a lot of answers around," Pozos said. "Getting cold is as old as mankind. But I found out there was a lot more information on reactions to heat because of military operations in hot climates. Of course, if Minnesota, the icebox of the United States, didn't have the answers, who would?"

Depending on the situation, these changes can occur very rapidly. But it is also possible to suffer from hypothermia and never get past the early stages. "Cases can range from a vigorous old man who is too tight to turn up his thermostat, to a marathon runner racing in a cold breeze," Pozos said. Testing runners at this year's Grandma's Marathon in Duluth, he found individuals with body temperatures several degrees below the point where volunteers are pulled from his tank.

"Alcohol dilates blood vessels near the skin. That's why drunks have red faces. The brain gets the message: 'You're OK, your skin is nice and warm.' And that's why drunks don't shiver. Shivering makes you lose heat faster."

The hypothermia lab in Duluth is funded by the University's Sea Grant program, the graduate school, Stearns Lifevest company and, recently, the U.S. Navy. Pozos is writing the first book for the layman on hypothermia. "The biggest contribution we've made is getting this lab going," Pozos said. "It's given us the chance to finally get some facts about the body's reaction to the cold."

minnesota TECHNOLOG

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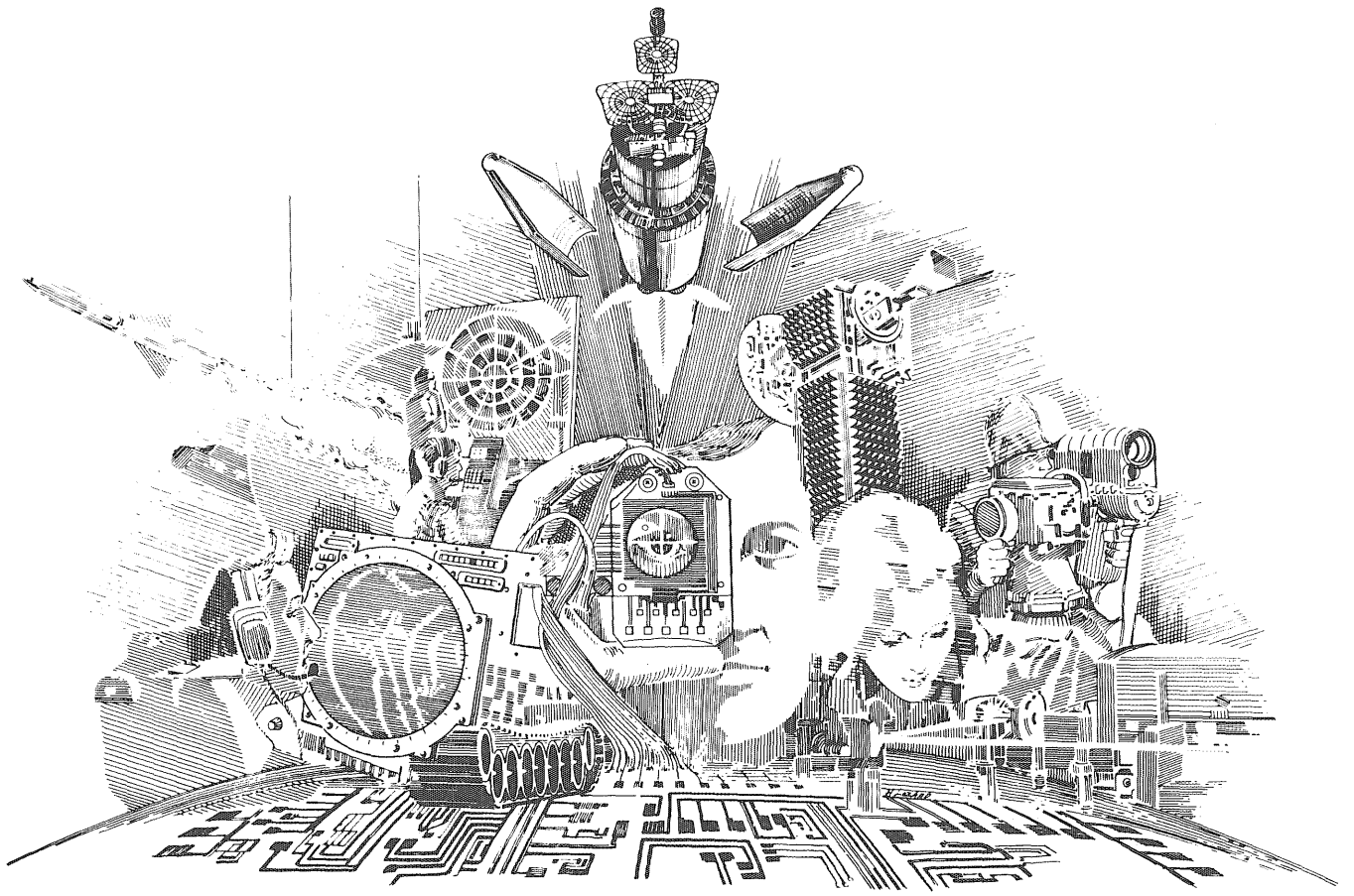

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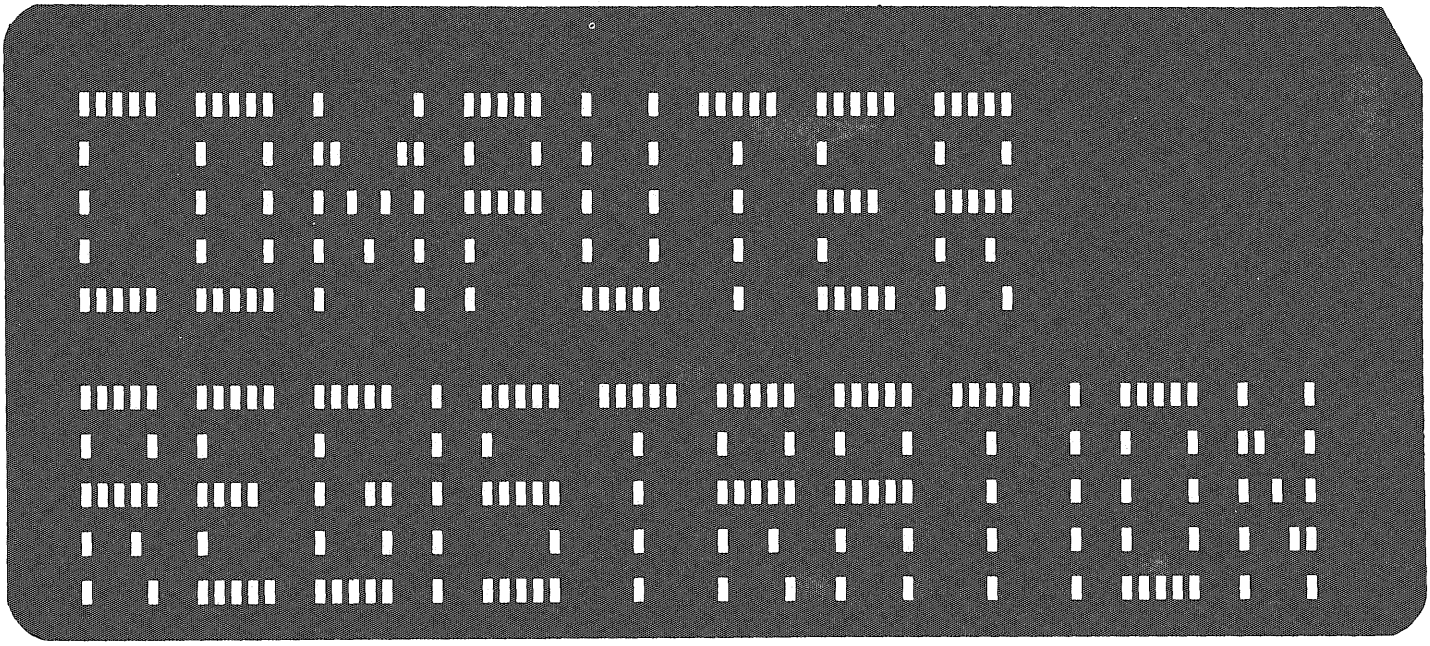

The following is an interview with Ben Sharpe. Mr. Sharpe is the Institute of Technology Director of Admissions. He has also been lending a helping hand to the changeover to computerized registration. Spring quarter registration begins on February 22, so *Technolog* interviewed Sharpe to discover the how and why of the new system.

TECHNOLOG: When will registration begin?

SHARPE: The first day of spring registration is the 22nd of February. It will last about the same length of time as it has in previous years. It will consist of two alphabetical registration queue. The first one will be seniors and graduate students, so those people will obviously have preferential treatment for classes. The other queue, following the same alphabetical order, will be juniors, sophomores, freshmen and adult specials. It will be quite different. It will be quite a change for most students to get used to.

TECHNOLOG: Are there any glitches in this system?

SHARPE: It will facilitate seniors to graduate on time, but yes, there will be glitches. The class (freshman, sophomore, junior or senior) that a student is, will be calculated based on total credits. So for a transfer student coming in with a gob of credits, maybe a previous degree or whatever, who is only a sophomore in terms of curriculum, may be a senior or even a super-senior in terms of total number of credits.

TECHNOLOG: For what reasons is the U of M switching to computer registration?

SHARPE: Several. You have to realize the University has been working on this for something like twenty years. For a school of the size and complexity of Minnesota, with so many colleges and branches (Duluth, Waseca, etc.), it is not just a simple matter of building a system and plugging it in. One reason is that it will hopefully be cheaper once the system is operating, in that it will require fewer people to run. In terms of I.T. for example, we will no longer be running our own tally area. There will be one registration area initially for spring quarter, and they are thinking of setting up satellite areas around campus to be more convenient for students. The system will hopefully be speedier and more convenient for students. For example, this will differ from college to college, but specifically for I.T. students, they will pick up their registration material in Fraser Hall. They will present something called a Student Status Notice in order to get a class schedule. This notice will be sent to the student two weeks prior to registration. It will tell the student's advisor, major, registration date in terms of the alphabetical queue, and will identify any registration holds they might have, and where they can get them cleared up. Inside the schedule there will be a registration form, similar to the old registration form, with the addition of a new call number for each course section. This is in addition to the already recognizable ME 1025, for example. This registration form still requires an ID card imprint from the major office. They take the form back over to 202 Fraser. In Fraser Hall, they will punch in the student's ID number and go through what is called validation.

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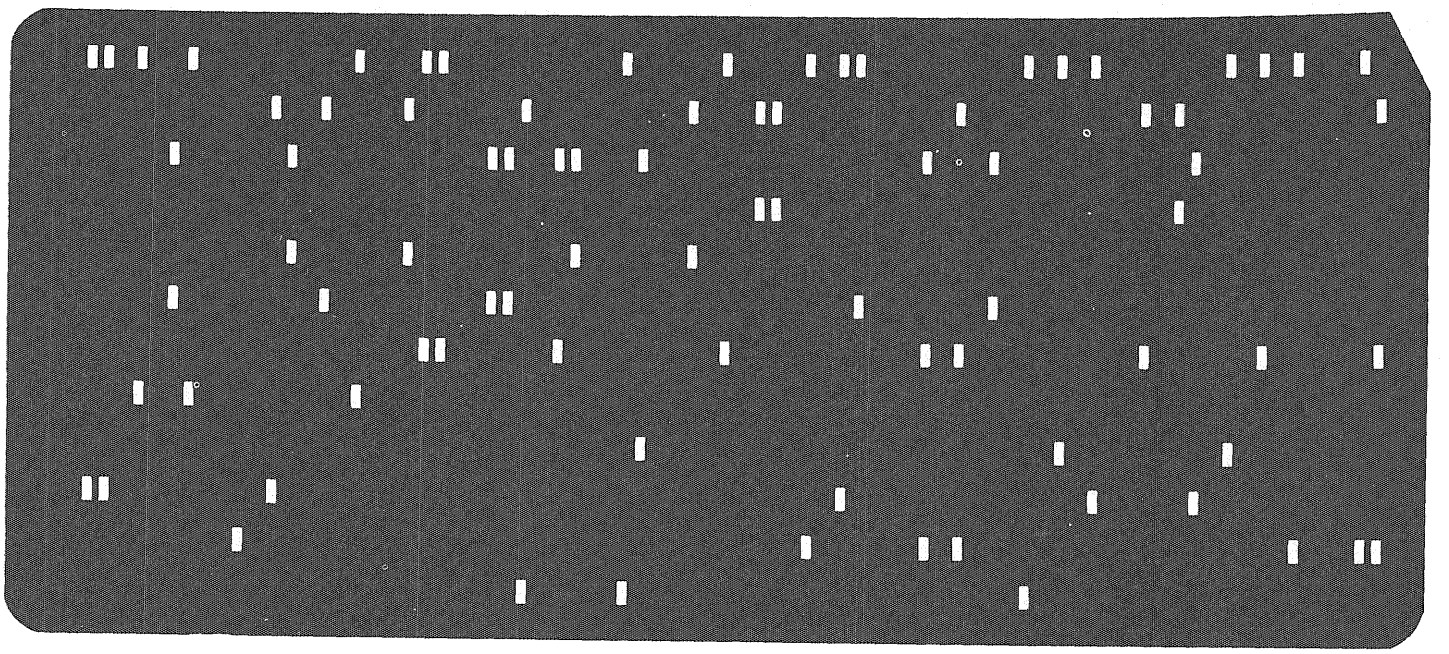
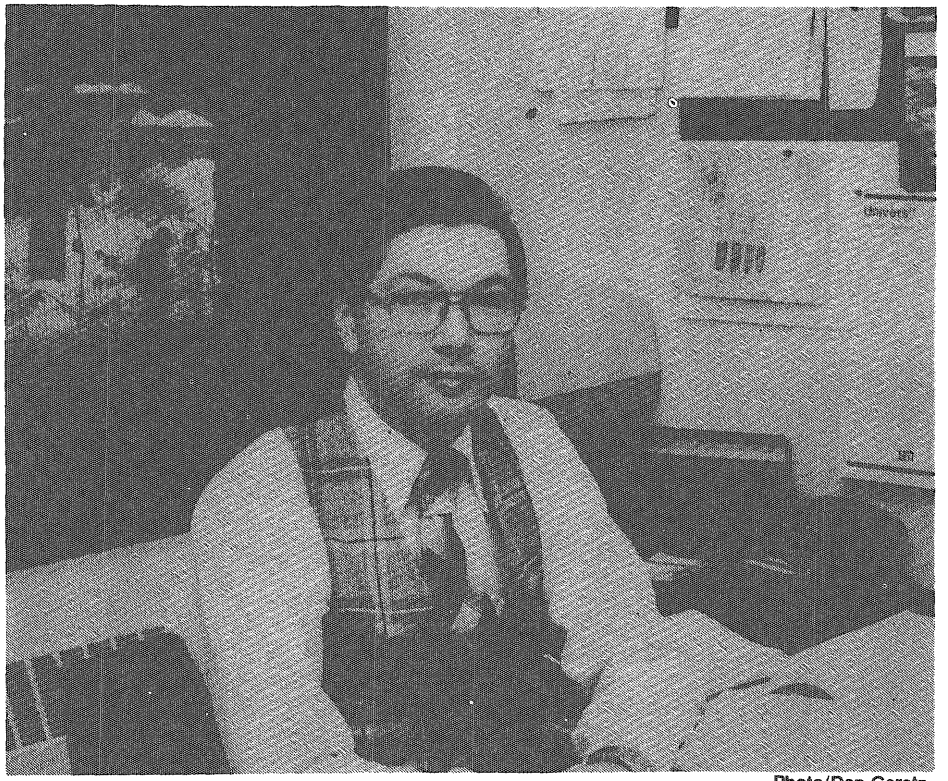


Assuming the student is validated, which takes about a minute or so, the student will then go over to one of the computer terminals, where the call numbers are punched in. The computer is designed in such a way that if a student asks for a specific course that is closed, the computer will come back and say, "This section is closed, but there is room in blank, blank and blank." After this is done, the computer will print out a form called the Student Confirmation Form. The upper half is the fee statement, and the bottom half is the schedule that the student will show to faculty the first day of class, taking the place of the course entry cards.

TECHNOLOG: How long will this take?

SHARPE: When they started the program in Duluth, it was taking a student about three-and-a-half to four minutes to go through from validation to getting their fee statement, so it's an infinitely faster system than things in the past. Another duty of the system is, if the student cancels a class, the computer automatically creates a space. What we're hoping for in I.T. is that it will be a better utilization of our resources. Right now, with course cards, the whole class could cancel, and all we can go by is that there are no class cards in our registration area. So as far as we were concerned a class was full, when in actuality, it may have been empty. The computer would accomodate this.



Photo/Dan Geretz

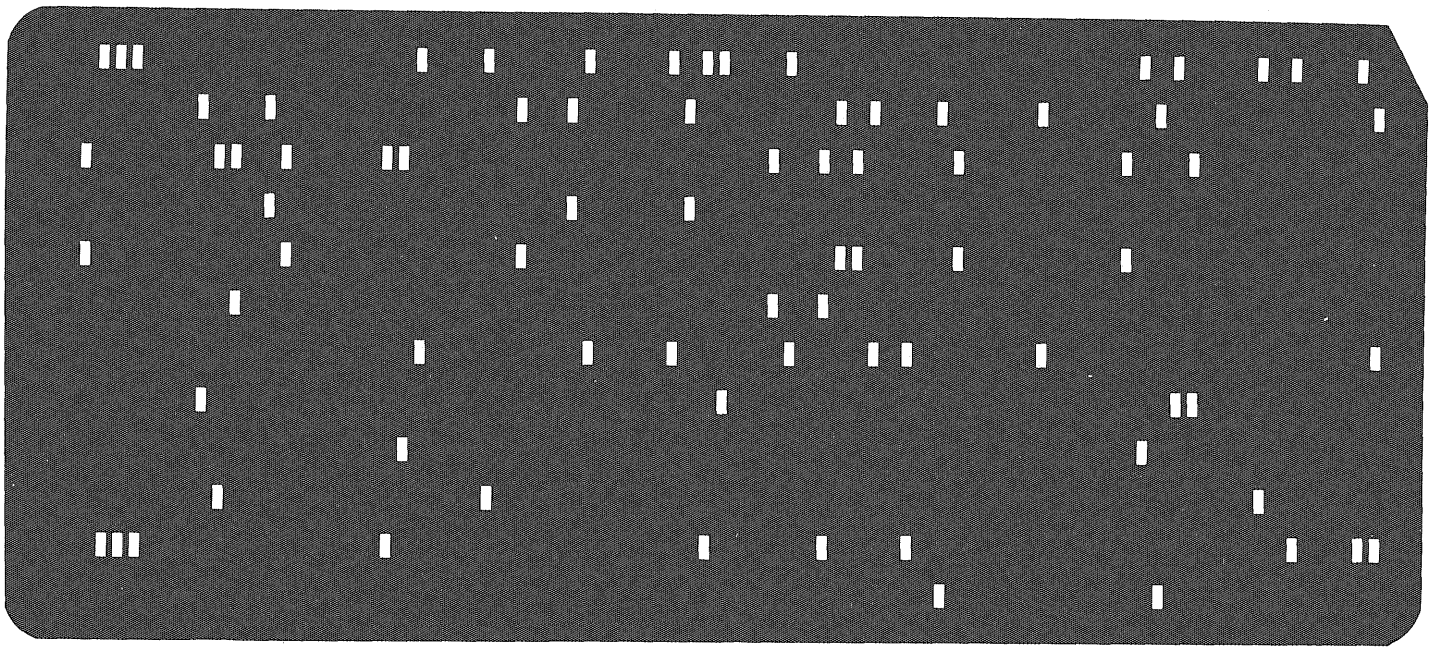
Ben Sharpe

TECHNOLOG: So this is the same system used at UMD?

SHARPE: Right, it was piloted up there.

TECHNOLOG: How effective has it been?

SHARPE: It's been real good. They started it last spring, and last fall they expanded it to Morris and the other outstate branches. They ran into some unique problems for fall. The major one was students from UMD who came down here for the summer session because they live here. The way the record system is designed at the University, as soon as you move from one campus to another, your whole transcript comes down with you. So the student would go back to UMD for fall quarter, punch in his ID number for validation, but he wouldn't be there. We're not anticipating any problems like that for spring, but next fall it's a potential problem. I'm not sure how they're going to deal with that. The other problem is students who were here many years ago. When they were here, they were on the old handwritten transcript. They don't have a record. Also, there is the question of how to handle newly admitted students to the University. They have to have something in the computer in order to register. Little things like that still have to be resolved.



TECHNOLOG: There's a saying, "To err is human, but to really foul things up requires a computer..."

SHARPE: They also say, "Garbage in, garbage out!"

TECHNOLOG: With 50,000 persons, many of whom, at the mention of 'computers, cringe, registering this way, will there be thousands walking around grumbling, "The computer did it!"?

SHARPE: You can't satisfy everybody. The operators will provide an interface between the computer and people trying to register. So there is a personal interface. That doesn't mean a student won't occasionally get frustrated because of closed classes. The computer certainly isn't a panacea, due to budgetary problems, overcrowding problems, etc., particularlly in some majors in I.T.. Yes, classes will still be closed; yes, students will still be frustrated in not being able to get what they want. This certainly isn't the computer's fault. I think the fact that there is an operator there and the student is doing the registration in person rather than sending something in and receiving something back in the mail tends to make the whole thing more personal. Hopefully, that will take the edge off everybody's anxiety.

TECHNOLOG: So then there will still be lines to wait in, but not so many as with the old system?

SHARPE: Hopefully the lines will be faster and not as long. Spring, I think, will be a little longer than initially planned, because it is all in Fraser Hall. But, after we've got the satellite system, then it should cut down on the lines.

TECHNOLOG: How does Minnesota's system of registration compare with other large institutions, say, within the Big Ten?

SHARPE: The University of Minnesota is unique in that this registration is common with Duluth, Morris, Waseca and Crookston and the Twin Cities campuses, both Minneapolis and St. Paul. That's a lot of folks. All the course numbers all different, each college has different regulations, policies, etc. All of these have to be accomodated. That's a big, complicated system. Madison, in particular, is still back in the card carry-out system. They open their fieldhouse, and you go in and go from table to table. Many of the other Big Ten schools are on some form of computer registration. But they're looking at a form of registration for a particular school, rather than something like the University of Minnesota which, with all its other campuses, is unique.

TECHNOLOG: Any final thoughts?

SHARPE: We're hoping to minimize the amount of red tape and things the student is going to have to go through. This is, of course, a new system for all of us, not just the students. So we're working with central administration, trying to smooth off the rough corners. One big thing to mention is the Student Status Notice. It's not a permit to register, as you don't absolutely need to register. However, it has some very useful information on it, like when you register, and any holds. So if you've changed addresses or if your address is wrong on your transcript, please update your address as soon as possible. That's the school address. It has to be the student's responsibility, or else he won't get any registration form. If you move, it's your responsibility to let the University know where you are.

TECHNOLOG: Thank you very much.

SHARPE: Thank you.

...We're trying to minimize the amount of red tape and things the student is going to have to go through. This is, of course, a new system for all of us, not just the students....

Have you moved? New address?

Make sure the University has your correct school address. If your address is wrong on your transcript, you won't be getting your **Student Status Notice**. That's not as cardinal a sin as losing your ID, but it could make registration take longer than it does already! Remember, you are responsible for letting the University know where you are.

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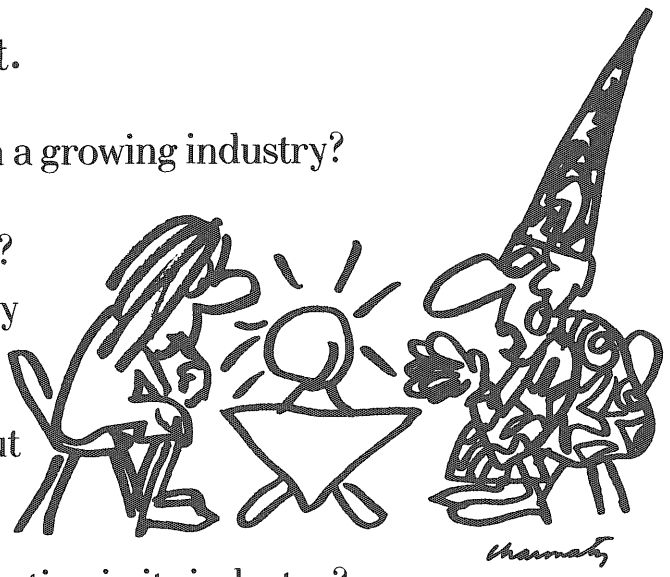

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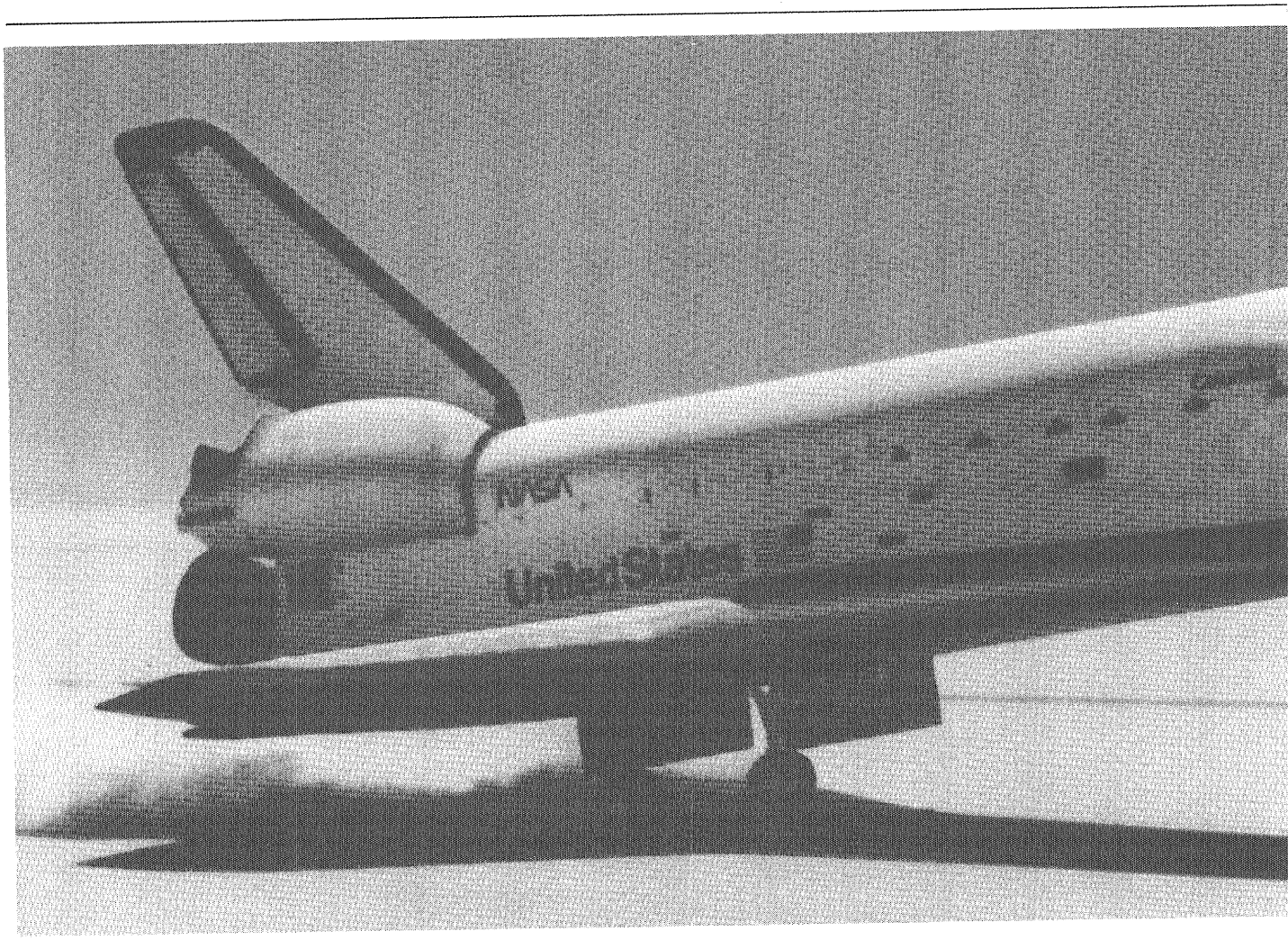

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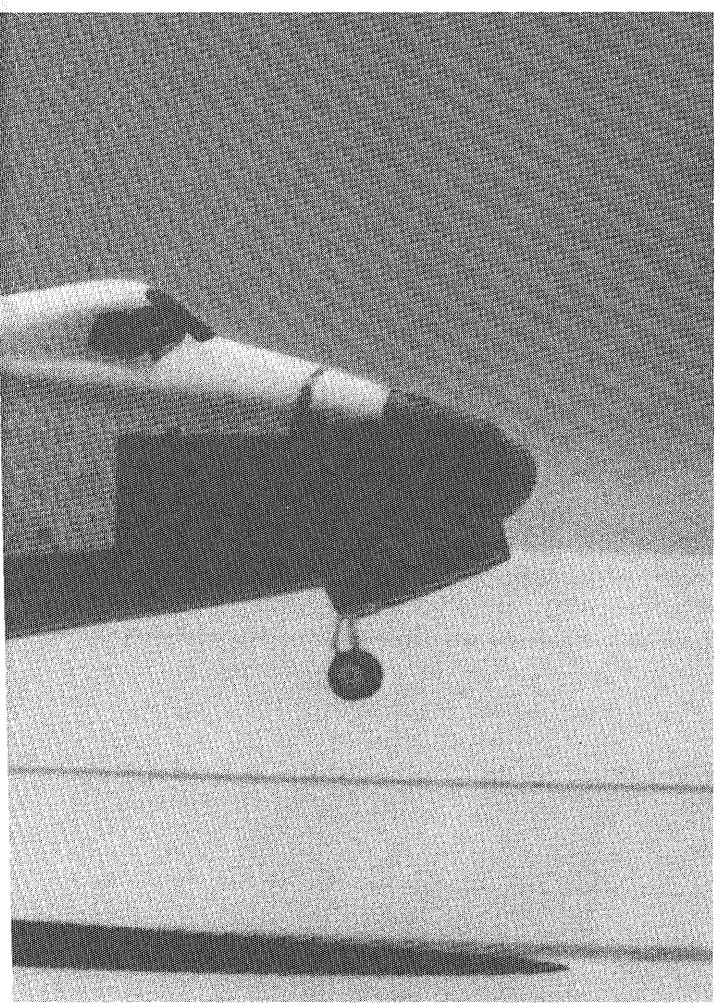

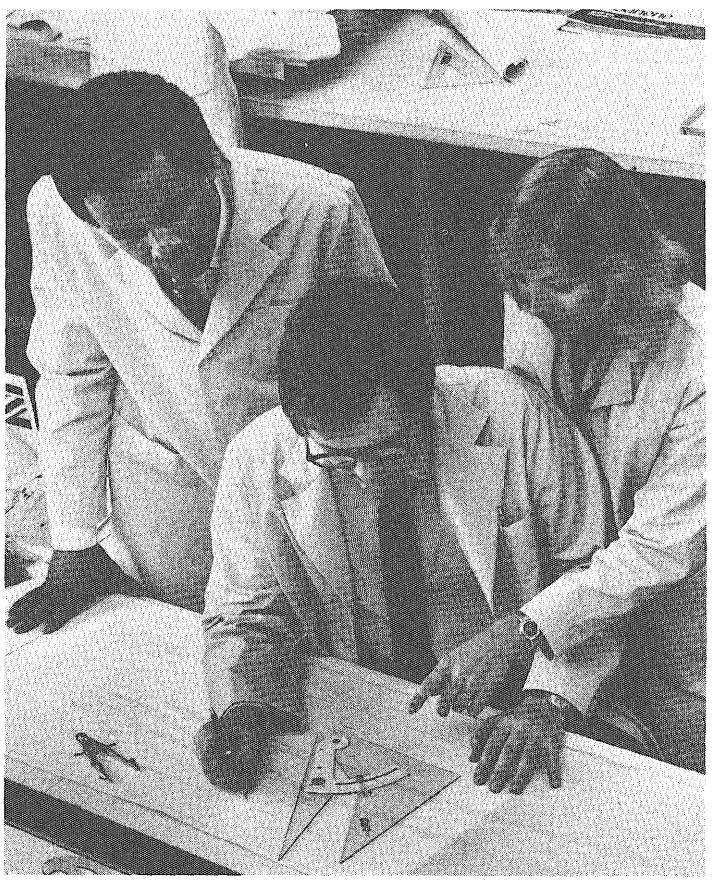

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"The Past, Present, and Future of Wind Energy", M.L. Jacobs, president, Jacobs Wind Electric Inc. Mr. Jacobs will be presenting this program on the last day of winter quarter classes, Friday, March 12, at Coffman Union Lecture Theatre. Jacobs has been in wind power for over 50 years, and sold thousands of wind generators in the 1930s, 40s, and 50s. Don't miss this rare opportunity to meet this dynamic individual.

The Committee for International Agriculture and Rural Development is sponsoring, **"The Role of Appropriate Technology in International Development."** The series of lectures runs Thursday through Saturday, February 11-13 at the St. Paul Student Theatre.

Schedule:

THURSDAY, FEBRUARY 11

1:30 pm **"What is Appropriate Technology"**, Dr. Luther Gerlach, Anth. Dept., U of M.

2:30 pm **"Appropriate Technology for Water and Sanitation"**, Peter Buijs, Engineer, Experience Inc., Washington, D.C., Dr. Frank Miller, Anth. Dept., U of M.

FRIDAY, FEBRUARY 12

9:00 am **"Appropriate Technology for Agriculture"**, Dr. Buchele, Ag. Eng., U of M.

2:30 pm **"Appropriate Technology for Energy Needs"**, Tom Lawland; Dr. Gerlach; Dr. Goodrich, Ag. Eng. U of M.

SATURDAY, FEBRUARY 13

Short courses and case studies.

Congratulations to **Dr. Ted Davis**, head of the **Chemical Engineering and Materials Science** departments at the **University of Minnesota**, for receiving two awards. He received the Notre Dame University's Peter C. Reilly Lecturer Award in Chemical Engineering, and the California Institute of Technology William N. Lacey Lectureship in Chemical Engineering. Davis has also been involved in some 'hot' research on oil recovery from shale or coal.

The **1982 World's Fair** is just around the corner. It will be running from May 1 through October 31, 1982 in Knoxville, Tennessee. Make plans to attend now. The theme of this official international exposition is "Energy Turns the World." Eleven million visitors are expected to attend the fair.

And now a word from Plumb Bob:

If ledgers were still kept on paper, approximately seventy-five companies would have an expense listed on their 1982 ledger under the title: "Technology Fair — IT-week, U of Minnesota". Why do companies bother with the expense of such fairs? Wouldn't the time and resources involved be more useful working in other ways? Not so, judging from the response of participants from last year's fair. Far from being a waste of money, the investment was sound. But the question remains: "How did the participants benefit by attending the Tech Fair?"

A newcomer to the business world, when considering a situation involving investment or expenditure, might expect some type of rapid, tangible return. For instance, an executive may encounter a fantastic deal on the purchase of seventy-five thousand paper clips. Now in a broad sense, the purchase of a needed item at a reduced price constitutes an investment. What happens next? The money disappears from the executive's checkbook, paper clips stack up in the files. The return is both immediate and tangible.

Advertising costs are also an investment. If McDonald's puts down seventy-five thousand dollars in advertising, they certainly expect to induce revenues in excess of that amount. However, that result is not guaranteed. They are playing a 'consumer market' as uncertain as any stock market.

Consumer markets are different for different companies. If we let McDonalds's customers equal set A and IBM customers set B, their intersection may exist, but such an insignificant subset of clientele is the main target of neither IBM's nor McDonald's advertising.

The investment by a company joining the Tech Fair is made for both the immediate and long-term purposes. Last year the favorable public exposure provided by the Fair was the immediate goal of many participants. Visibility in the community was enhanced and company recruiters made viable contacts. Several firms displayed new products. With one exception, those present said the Fair lived up to or exceeded their expectations. The companies considered these benefits cost effective.

The Fair is primarily a meeting of students and industry. Emphasis is placed upon exposure to careers in the science and demonstrations of the application of technology in product design, manufacture and use. Many students used the chance to speak with representatives concerning career interests.

The returns of advertising, whatever the consumer market, are quite variable. (This is why some advertising managers are paid more than others!) Businesses then, seek opportunities to present themselves in 'consumer-rich' environments, where the probability for return is greatest. A factor that encourages many companies to attend the Tech Fair is the chance to meet not only the students and researchers who will develop tomorrow's technology, but also those who will make up the bulk of tomorrow's high technology consumer market.

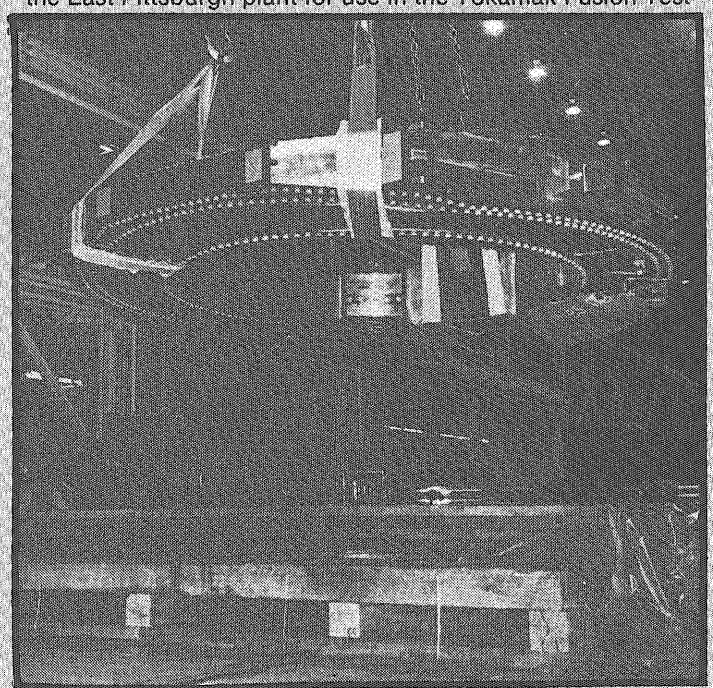
A group of Minnesota scientists have discovered a chemical produced by a species of algae that kills other algae, according to an article in the Jan. 22 issue of *Science* magazine.

The discovery offers the potential for ridding lakes of overabundance of algae that can rob water of dissolved oxygen vital to other aquatic life, and can ruin recreation with its odor and unsightly scum. Finding a way to produce the chemical economically and testing its effectiveness and safety will take an estimated five to seven years.

The freshwater blue-green algae *Scytonema hofmanni* produces a chemical that kills other green and blue-green algae. "We've isolated the compound, characterized its chemical structure and looked at its effectiveness under laboratory conditions," said Florence Gleason, who directed the research at the **University of Minnesota Gray Freshwater Biological Institute.**

Gleason and her colleagues are now trying to find ways to produce large amounts of the chemical economically, either by chemical synthesis or by finding an organism that produces more of the chemical.

Now at Princeton University's Plasma Physics Laboratory is this 11-ton magnetic field coil, here being lowered onto a shipping skid. It is the first of identical coils being manufactured at the East Pittsburgh plant for use in the Tokamak Fusion Test



Reactor (TFTR), flagship project of the U.S. Department of Energy fusion energy program. The Princeton lab will use the water-cooled electromagnets in proof-of-principle experiments designed to achieve fusion energy "breakeven" for the first time. The strong magnetic field they provide will hold the fusion plasma, expected to rise to sun temperatues—100 million degrees Celsius. This demanding environment required extensive testing and verification of all brazing, insulating and winding techniques before manufacturing was begun to ensure reliable performance of the coils during TFTR test operations.

SERI's **Thermochemical and Electrochemical Research Branch** has demonstrated a pilot gasifier for producing methanol from biomass. The 1-ton-per-day gasifier developed over the last several years is now ready for industry scale-up to commercial sizes.

Methanol is a clean fuel especially suited to transportation uses, and a number of fleet tests in the U.S. and abroad are finding that either blended with gasoline or pure, it offers advantages over gasoline as an automotive fuel. It is presently made primarily from natural gas in the U.S., but it can also be made from biomass, peat, or coal. Because coal occurs in large concentrations, coal/methanol plants are likely to be enormous. Projected plants would make 5,000 to 25,000 tons per day (0.5 to 2.5 billion gal/yr) and cost $1 to $5 billion.

Biomass (and peat) occur much more widely, but in much smaller concentrations. Therefore the scale appropriate to biomass/methanol plants is likely to be much smaller than for coal. Paper mills in the U.S. use at most 2000 dry tons per day of wood and this would seem to be the largest methanol plant practical from biomass. Agricultural residues, being from annual crops, occur in smaller concentrations, but are very widely available in farming regions.

Most of the technology necessary for converting biomass to methanol is in existence today, and is common to gas, coal, or biomass feedstocks. However, no gasifiers for converting biomass to methanol synthesis gas are yet commercially available, although gasifiers exist which could be modified for synthesis gas production. The SERI gasifier was designed especially for methanol synthesis production. It uses oxygen instead of air, and by extending the char bed, all the tars and oils generated from the biomass are cracked to gas. (Most other gasifiers produce tars which require extensive cleanup before the gas can be used.) Sixteen test runs have now been completed on the gasifier. Early runs were used to shake down the equipment and learn the proper startup and operating conditions. Typical runs last 8 to 12 hours.

At the conclusion of the atmospheric pressure runs, a number of cylinders were filled with compressed gas. Chem-Systems, Inc., in New Jersey, then converted this gas to methanol and gave their opinion that the gas was excellent for methanol synthesis. The last few runs have been at 150 psig, using a lock hopper to feed the wood pellets or chips. High-pressure operation is desirable for methanol synthesis and reduces energy requirements for the process. Future runs will determine the upper limits of the gasifier throughout, effects of moisture, and behavior with various types of fuels.

Plans are now being made by a major agricultural manufacturer to scale a gasifier to convert 110 tons per day of agricultural or wood residues to 55 tons of methanol in completely automated plants which could be located as central points, for instance, at farm co-ops. An alternative use for this technology is the manufacture of ammonia, using similar technology. Ammonia is presently manufactured from natural gas. If it is made from biomass residues, the growing cycle will be closely coupled to the energy conversion process.

Over 3,500 people in 30 states and the District of Columbia are under contract to build hardware and provide services for the Clinch River Breeder Reactor Plant Project in Oak Ridge, Tennessee. The Clinch River Project is the nation's first large-scale demonstration breeder reactor.

According to the latest project figures showing employment at the end of the fiscal year 1981 on September 30, the state with the largest number of employees working on Clinch River Project contracts is California with 1,095. The Clinch River Project work in California is centered in General Electric's Advanced Reactor Systems Department at Sunnyvale and at the Atomics International Division of Rockwell International at Canoga Park. Both organizations serve as reactor manufacturers for the Clinch River Project. Minnesota has three workers on the project.

The Clinch River Project is a joint effort of government and private industry. A breeder is a nuclear power plant that produces more fuel than it consumes as it generates electricity. The plant is intended to demonstrate a technology that has the potential to tap an energy resource larger than the estimated energy of the entire world's supply of coal, gas, and oil.

The Clinch River Project is the largest utility industry commitment ever made to a single research and development effort. The project is supported by the Breeder Reactor Corporation, which is composed of the 753 utilities from across the nation who have pledged $257 million to build and operate the plant.

minnesota TECHNOLOG

The Challenge...

In today's complex technological society it takes exceptional planning and engineering to build a better tomorrow. The Corps of Engineers' dedicated civilian professionals . . . engineers, planners and environmentalists, biologists, economists, landscape architects . . . are working on a variety of jobs in a variety of places in the U.S. and overseas to improve and protect the quality of life for all citizens. We plan, design, construct and operate water resource projects, build and improve our nation's ports and harbors, build hospitals and housing projects for the Defense Department. The development of these projects must be carefully balanced with the preservation of our natural environment. The balance is precarious, the challenge extreme. As a civilian employee with the Corps of Engineers you will be joining an organization that believes people are our most important asset. People who respond to a challenge with commitment, skill and innovation. You can help us meet the challenge. Ask us and we'll tell you more about a career with the Corps of Engineers.

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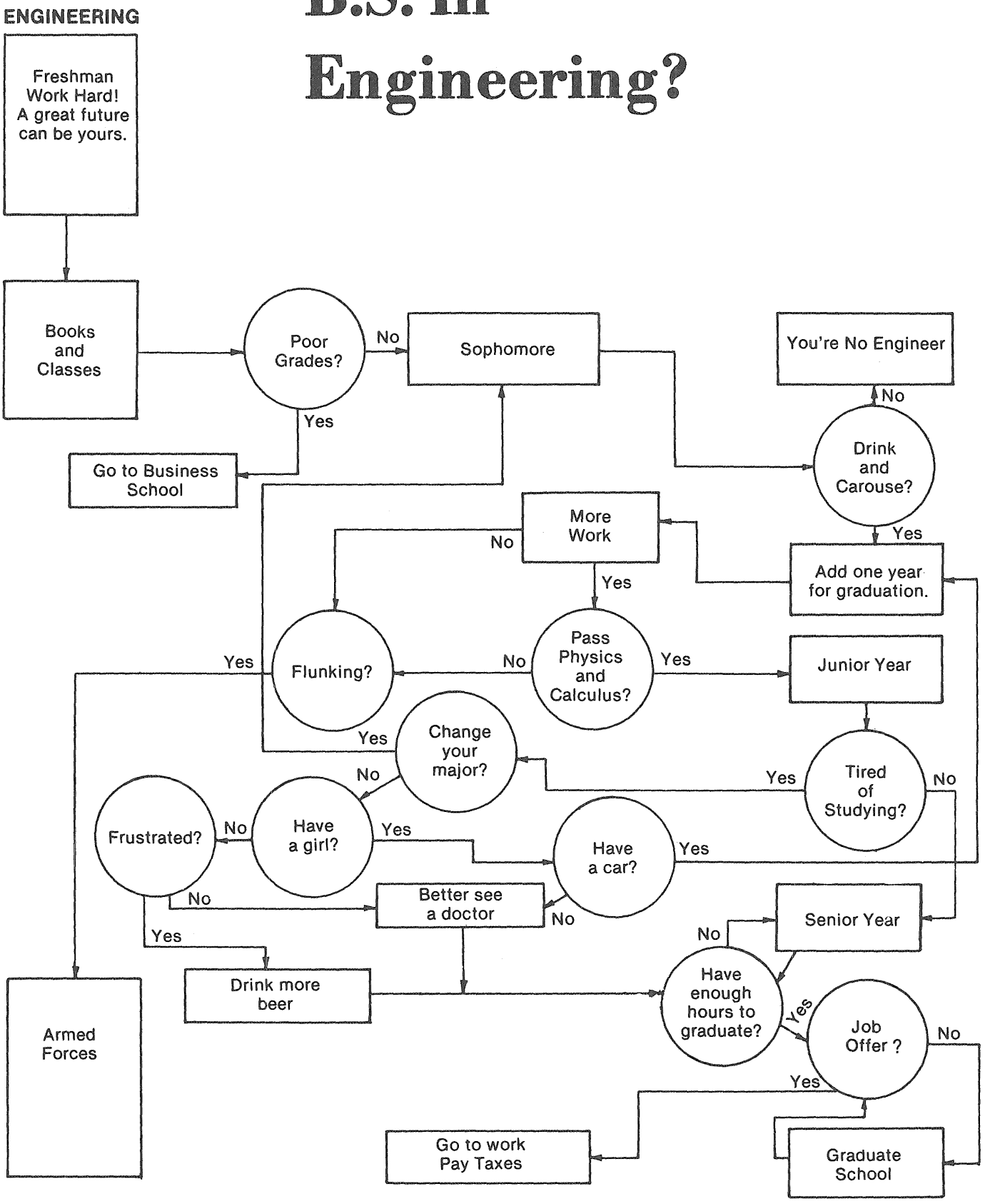
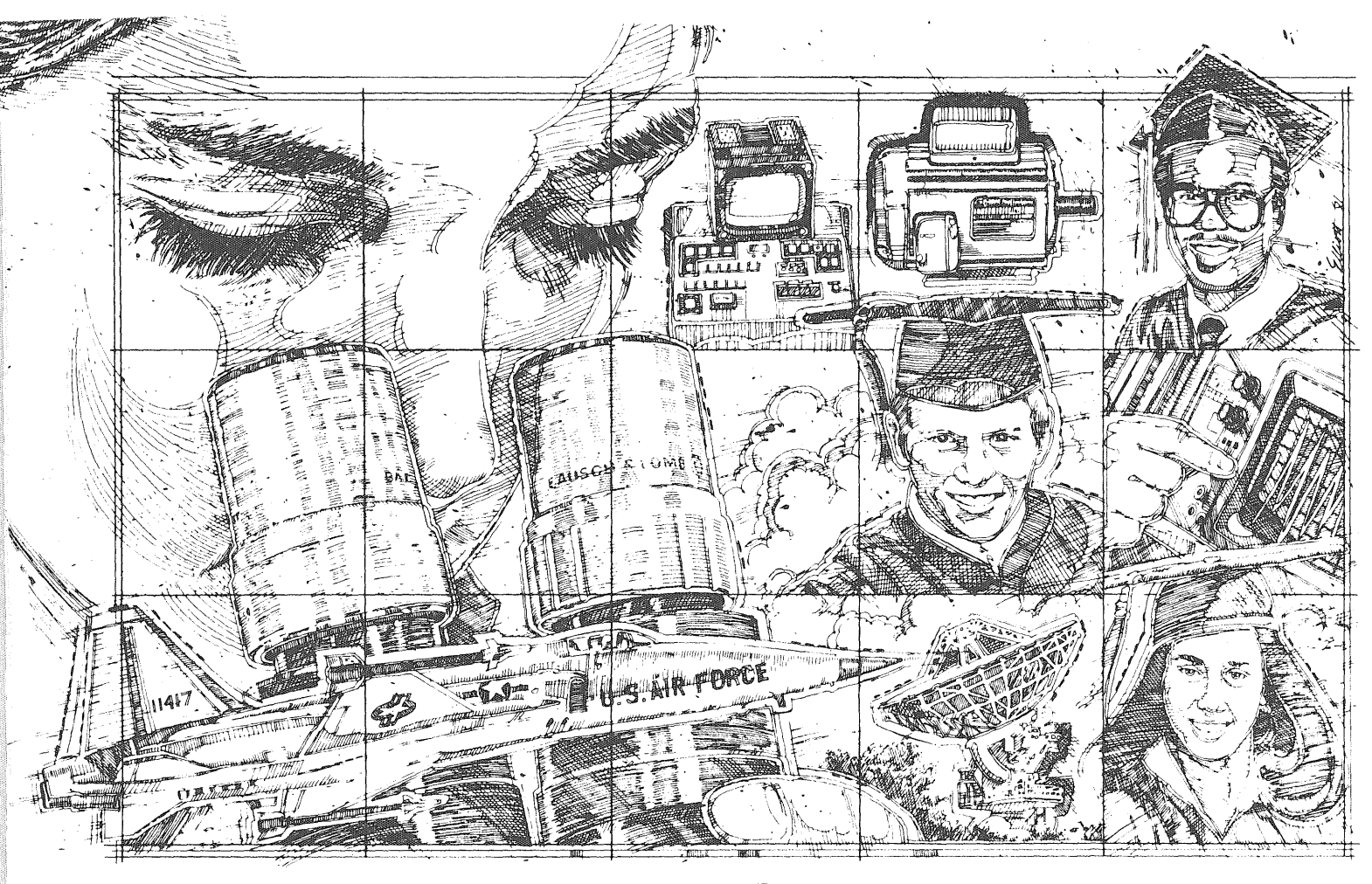
B.S. In Engineering?



from the USC Engineer



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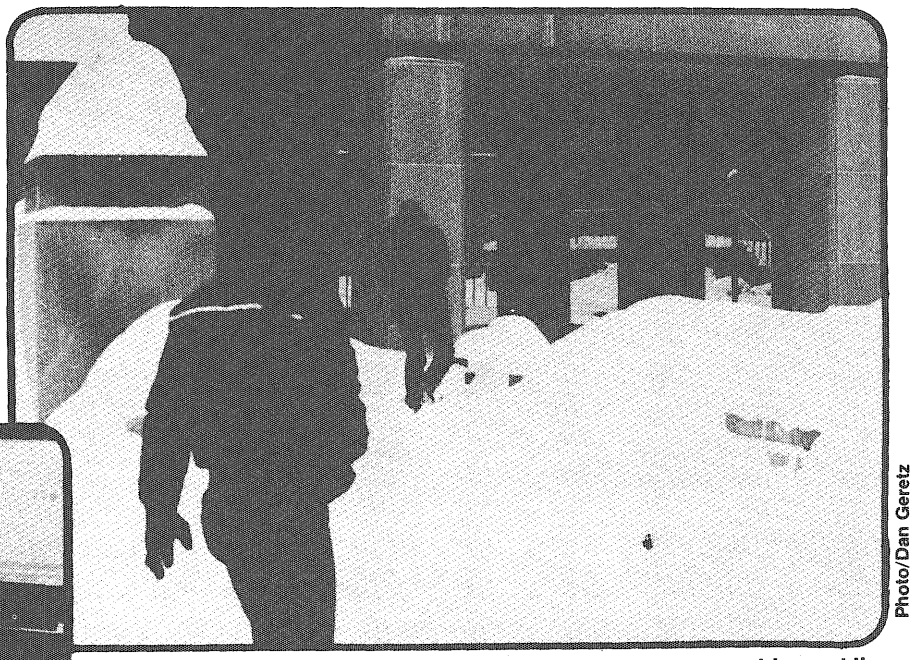
DISCIPLINE	Electrical Engineering	Mechanical Engineering	Industrial Engineering	Physics	Mathematics	Accounting	Business Administration	Computer Science
Design	●	●						
Structural Analysis		●						
Systems Analysis	●	●		●	●			●
Failure Analysis		●						
Optics	●			●	●			
Electronic Systems	●							
Product Assurance	●	●						
Logistics			●				●	
Computer Applications	●							●
Finance						●	●	
Planning		●	●				●	
Administration							●	
Quality Assurance	●	●						
Manufacturing		●	●					
Procurement							●	
Cost Estimating						●	●	
Contracts							●	
Plant Engineering		●	●					
Program Management	●	●		●			●	
Marketing	●	●		●				

snow WHAT?

Winter Quarter can often be the most depressing time of the year. This year, Old Man Winter has done his part as well, with a vicious mixture of snow and cold such as few can recall. *Technolog* dug into the scrapbook and produced some pictures of the season. If winter is getting to you, hang on! T-minus five weeks (plus or minus a few days) to Spring Break '82!



Photo/Dan Geretz

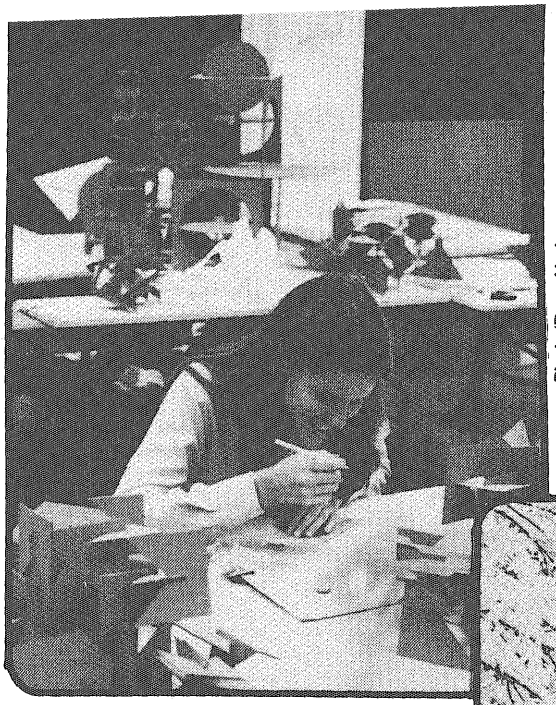
Photo/Dan Geretz

Hard core Minnesotans searching out the next issue of *Technolog*.

"Hello,...Arctic Cat?"

Photo/Dan Geretz

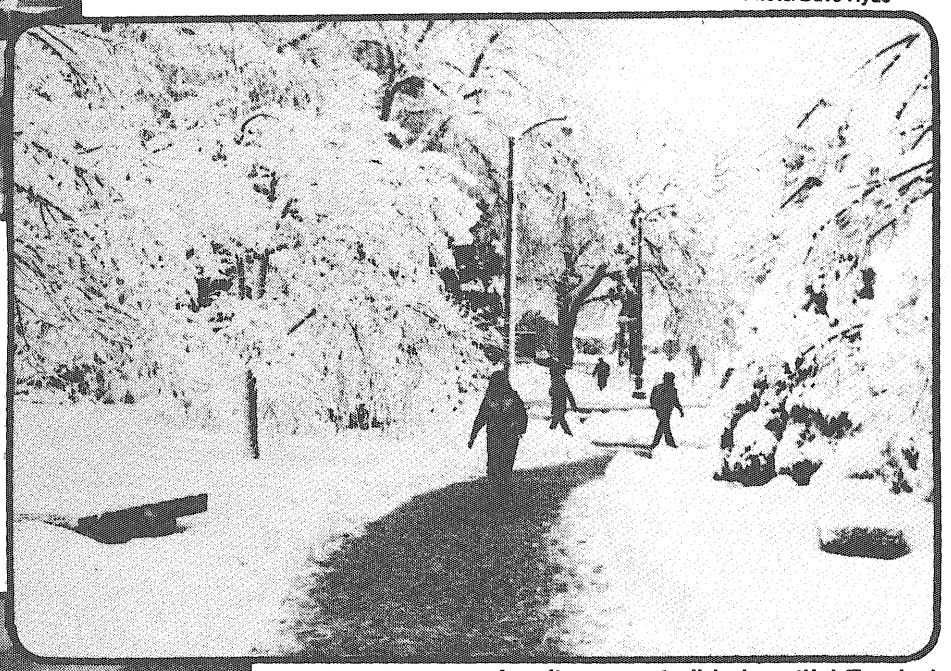
Three EE's designing an electrostatic snow precipitator. (Or are they watching the Color Radar Weather?)



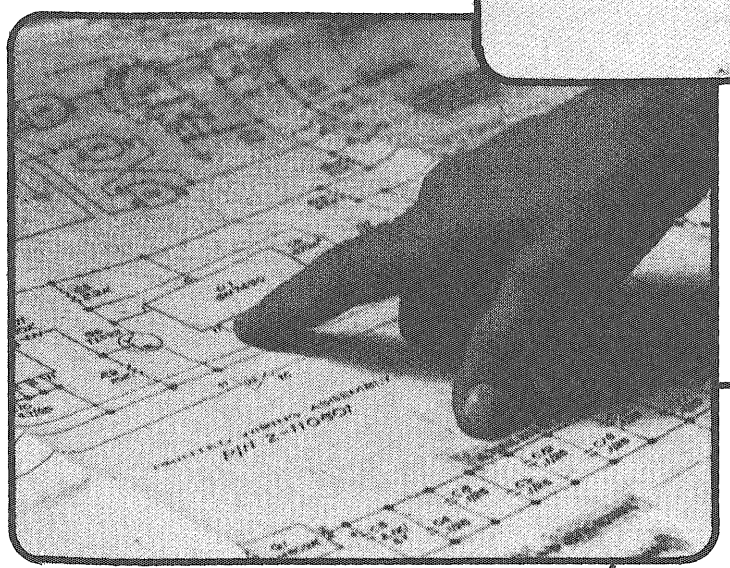
Here's a hard-working architecture student designing a snow-proof domed stadium.

Photo/Dave Hyde

Photo/Dave Hyde

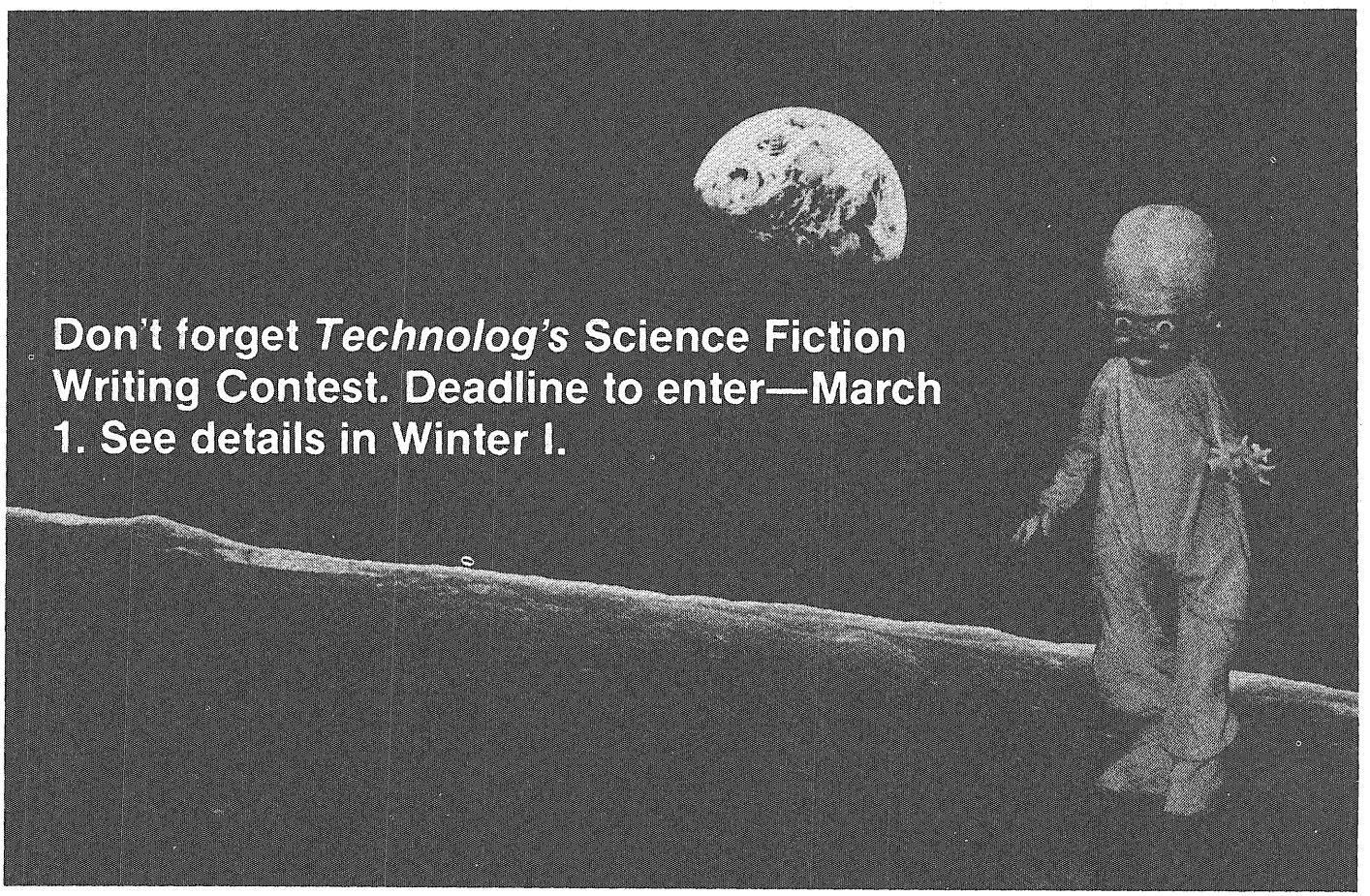


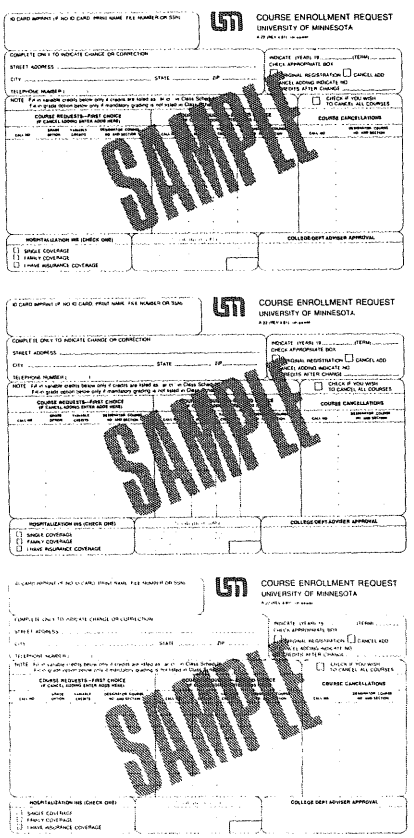
An afternoon stroll in beautiful Tropical Minnesota.



"It's a snow emergency...is this an east-west or a north-south diode?"

Panoramic view of the Minneapolis skyline from the 3rd Avenue bridge, January 22, 1982.





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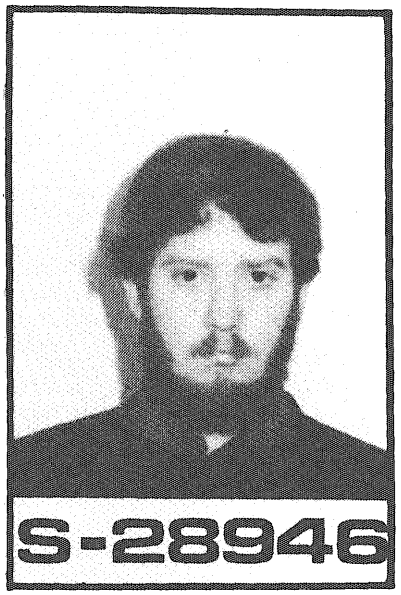

Editor

We are now taking applications for the 1982-83 *Technolog* editor.

This position is open to any full-time student of the University of Minnesota, but IT students are preferred.

It's an excellent opportunity to gain practical experience in communications and marketing, and to make contacts with industry. You will also be representing IT students to industry and other engineering colleges.

You must be responsible, willing to see work through to completion, and be able to supervise. The $600.00 per quarter salary won't buy you a Lear jet, but it will keep you in beer money (it might help with rent, too).

For more information, contact Pete Marsnik or Kent Christensen (373-3298), or leave a resume and a letter of application at Room 2, Mechanical Engineering.

Two other editorships will be opening for the 1982-83 school year. They are for the IT Connection, and the IT Annual.

$1800 REWARD

Graduate to a higher challenge. Texas Instruments.

For years you've been proving to your professors just how good you are. Now it's time to prove it to yourself.

With a higher challenge. With Texas Instruments.

Prove yourself where innovation's the rule, not the exception.

As a matter of corporate policy, TI has built-in budgets for new, innovative ideas. If you have a revolutionary concept that deserves to be put to the test, the money's there.

That's just part of the TI challenge.

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No technology is hotter, or more fantastic, than microelectronics. And no company is hotter in it than TI.

Example: The TI 59 handheld calculator has more than twice the primary memory capacity of the three-ton computers of the 1950s.

And look at these credentials. TI is:

- The world's leading supplier of semiconductors.
- The inventor of the integrated circuit, the microprocessor, and the microcomputer.
- The inventor of the handheld electronic calculator, and the LCD digital watch.
- The designer and producer of the most complex MOS chip.
- The inventor of single-chip solid-state voice synthesis.
- The largest producer of microelectronic memory products.
- The world leader in Very Large Scale Integration.
- The primary supplier of airborne radars to the U.S. defense program.
- The leading developer and producer of infrared and laser systems.
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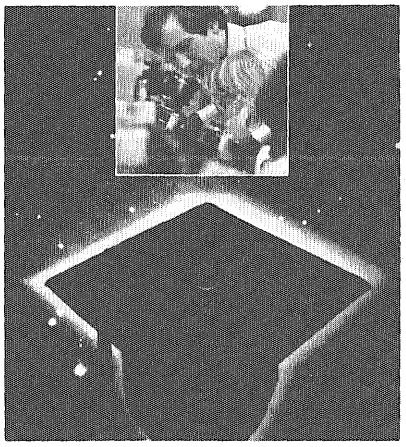
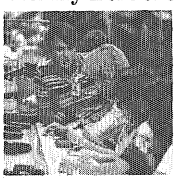
Prove to yourself where you have the freedom to grow.

Because TI is like many companies in one, you have the opportunity to move



laterally from one specialty to another as well as move up. Without changing jobs.



TI's advanced system for lateral career mobility lets you move up faster. Because the freedom to move sideways is the best way to compare technologies and define career goals early on.

The frequently published TI *Job Opportunity Bulletin* lists openings at all TI facilities and gives TI people first crack at them.

Prove yourself where it counts.

TI has been acclaimed as one of America's best-managed companies because we've stayed young and vital while growing big.

One major reason for our high energy is our move-up environment. New people

don't get buried at the bottom of a pecking order. So if you get a good idea your first week on the job, it gets heard. And you get rewarded.

At TI, you get every chance to show what you can do. And prove what you deserve.

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TI has hometowns in 19 countries on six continents. You'll find manufacturing in Singapore, Dallas, Tokyo, Nice, Buenos Aires, and many other cities around the globe.

TI has hometowns to match your lifestyle. No matter where you call home. From New England to Texas to California.

Texas Instruments is interested in graduates from the following specialties:

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- Metallurgy
- Metallurgical Engineering
- Chemical Engineering
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- Mathematics
- Plastics Engineering
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Campus Interviews

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One or more of these groups may be interviewing on your campus. Check with the Placement Office for interview dates:

Or send data sheet to: George Berryman, Texas Instruments, P.O. Box 225012 Corporate Staffing, M.S. 67, Dept. CJ4, Dallas, Texas 75265

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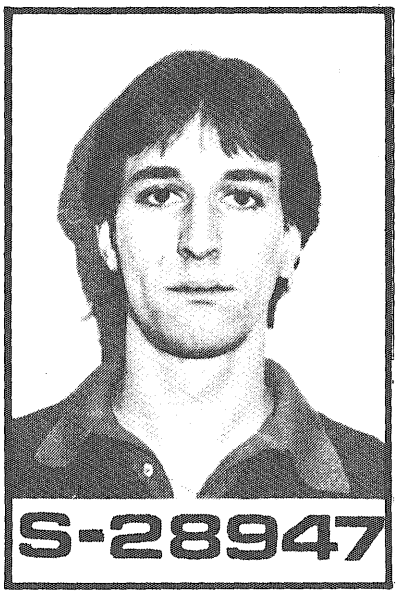


Business Manager

We are now taking applications for the 1982-83 *Technolog* business manager.

This position is open to any full-time student of the University of Minnesota, but IT students are preferred.

This position is an excellent chance to gain hands-on experience in marketing and communication, and to make contacts with industry. You will also be representing IT students to industry and other engineering colleges magazines in the country.

$300.00 per quarter is not a lot, but it beats flipping burgers'

For more information, contact Pete Marsnik or Kent Christensen (373-3298), or leave a resume and a letter of application at Room 2, Mechanical Engineering.

$900 REWARD

Brain Teasers and Belly Laughs

The fire engine went screeching down the street, past a small bar. A very woozy character stumbled out of the bar and started to chase the fire engine. He ran for five blocks, but simply wasn't able to catch up with it, and finally collapsed against a handy lamp post and shook his fist at the departing engine.

"Okay," he screamed, "then keep your damn peanuts!"

Three football players at different schools had flunked their classes and got together and talked about their misfortune. The man from S.D. said, "That calculus was just too damn much." The man from N.D. State said, "It was the trig that got me." The guy from Iowa said, "Did youse guys ever hear of long division?"

The year is 2075, and the Martians have taken over the earth. One of their foods is human brains. So Zip, a hungry Martian, went down to his neighborhood grocery store to buy a pound of brains.

Zip: "What ya got for brains today?"

Grocer: "We got some engineer brains for 50¢ a pound, some pre-med brains for $1.00 a pound, and some forester brains for $4.00 a pound."

Zip: "Why so much for the forester brains?"

Grocer: "Do you have any idea how many foresters it takes to get a pound of brains?"

Then there was the mechanical engineer who took his nose apart to see what made it run.

A man in the insane asylum sat fishing over a flower bed. A visiting sociology student, wishing to be affable, asked, "How many have you caught?"

The fisherman returned, "You're the ninth."

Engineer on telephone: "Doctor, come quick! My little boy just swallowed my calculator."

Doctor: "Good heavens, man, I'll be right over. What are you doing in the meantime?"

Engineer: "Using log tables."

Some of the E.E.'s have a new game going. Three guys rent a hotel room and each brings a quart of Old Screech. They sit and drink for an hour, then one of them gets up and leaves. The other two have to guess which one left.

Boss: "Shame on you. Do you know what we do with office boys who tell lies?"

Boy: "Yes, sir, when they get old enough the firm sends them out as salesmen."

Two characters had been drinking merrily for some time when one lost his grip on the bar and fell face-down on the floor.

"That's what I like about Slim," his companion remarked. "He's dependable—always knows when to stop."

Experience is a wonderful thing. It enables you to recognize a mistake when you make it again.

FIRST LAW OF LABORATORY WORK: Hot glass looks exactly the same as cold glass.

WILDLIFE PORTRAIT

Studentia forestus

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

The winner of the Brain Teasers in Winter I was Shoui Tsai. Here are the correct answers:

1. Separate the coins into three groups of four each:

A = (A1, A2, A3, A4)
B = (B1, B2, B3, B4)
C = (C1, C2, C3, C4)

1) Take groups A and B and weigh one against the other. Let's assume that group A was heavier (lighter) than group B. If they were even, go to (6).

2) Take coins (A1, A2, B1) and weigh agianst (A3, B3, C2). If (A1, A2, B1) is heavier (lighter), go to (3). If (A3, B3, C2) is lighter (heavier), go to (4). If they are even, go to (5).

3) The coin we are looking for is among (A1, A2, B1). Weigh A1 against A2, if A1 is heavier (lighter), that is our coin. If A2 is heavier (lighter), that is our coin. If they are even, B2 is our coin and is lighter (heavier). End.

4) The coin we are looking for is among (B1, A3.) Weigh A3 against C1. If A3 is heavier (lighter) than C1, then A3 is the coin we are looking for, or else B1 is the coin we are looing for and is lighter (heavier). End.

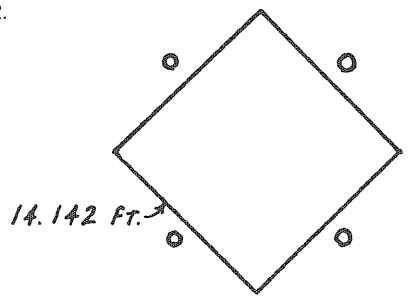
5) The coin we are looking for is among (A4, B3, B4). Weigh (A4, B3) aainst (C1, C2). If (A4, B3) was heavier (lighter) than (C1, C2), then our coin would be A4 which is heavier (lighter). If (A4, B3) was lighter (heavier), then our coin would be B3, which is lighter (heavier). If they were even our coin would be B4, which is lighter (heavier). End.

6) The coin we are looking for is among group C. Take (C1, C2, C3) and weigh them against (A1, A2, A3). If (C1, C2, C3) is heavier (lighter) go to (7). If they are even, go to (8).

7) Weigh C1 against C2. If C1 is heavier (lighter), then C1 is our coin. If C2 is heavier (lighter), then C2 is our coin. If they are even, then C3 is our coin and it is heavier (lighter). End.

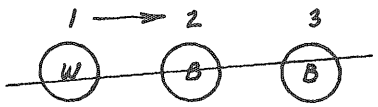
8) C4 is our coin. The only detail to find is whether it is heavier or lighter. Weigh it against C1. End.

2.

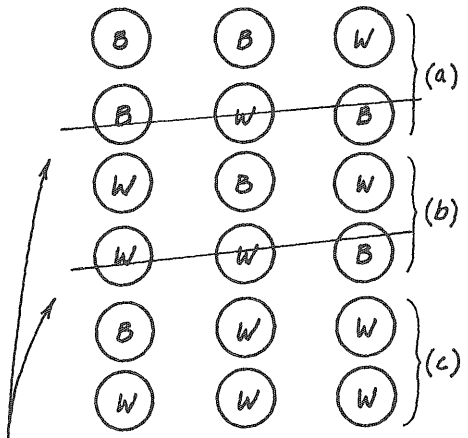


3.

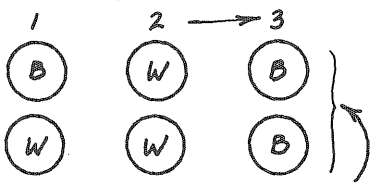
What the first prince would see:



Discarded since he was wrong.

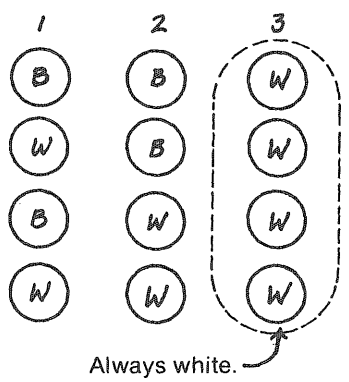


What the second prince would see:



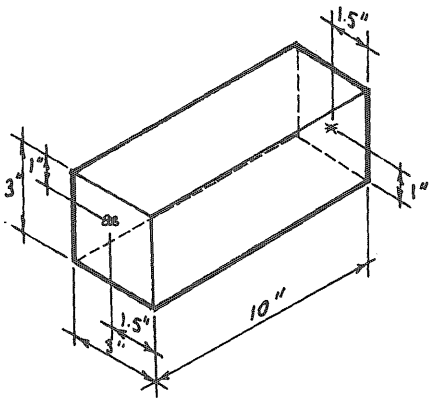
These two discarded since he would know he had white.

The third one:



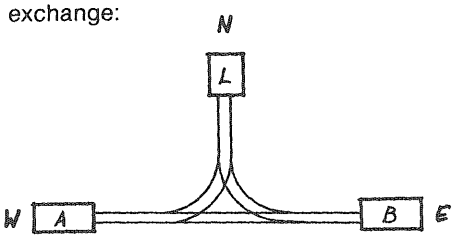
Here are three more Brain Teasers for you to solve. Be the first one to answer them correctly and win a T-shirt. Bring your solutions to Rm 2, Mechanical Engineering:

1. A spider and a fly are located on opposite ends of a solid parallelepiped (on its surface) as shown in the figure. The solid is made of glass, therefore the spider can see the fly. The spider would very much like to eat the fly for dinner. Mr. Spider is a very good mathematician. He says to Mr. Fly, "I would very much like to eat you for dinner." The fly answers: "If you can get me in less than 13 inches, I won't move." Mr. Spider had the fly for dinner.
Note: The parallelepiped is solid glass, the spider can only move on the surface of the solid. How did he do it?



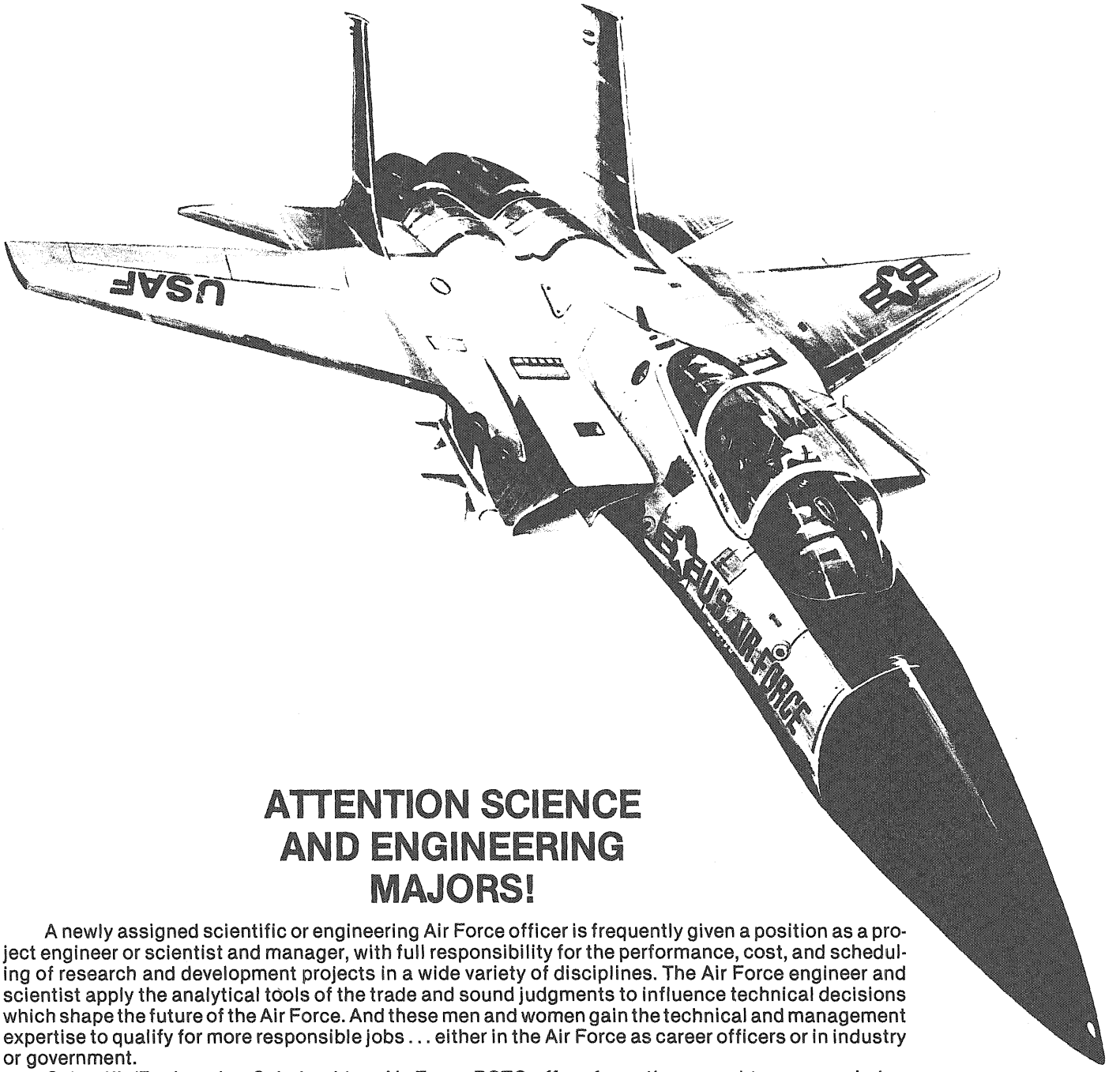
2. Three priests and three cannibals have to cross a river. They have a boat that can hold only two persons at a time. The three priests know how to row, but only one cannibal knows how. Devise a sequence of events so that they could cross the river without the priests being killed by the cannibals. The problem is that you cannot leave more cannibals than priests at any moment because they will kill the priests.

3. The following situation arises in a train exchange:



Train A is in the dock to the left, B in the right one and the locomotive at the north dock. Trains A and B have to be exchanged. The problem is that you can not leave a train in the middle of the tracks, but only in one of the docks. The locomotive is the only means of moving the trains. Find a way to exchange the trains.

AIR FORCE ROTC



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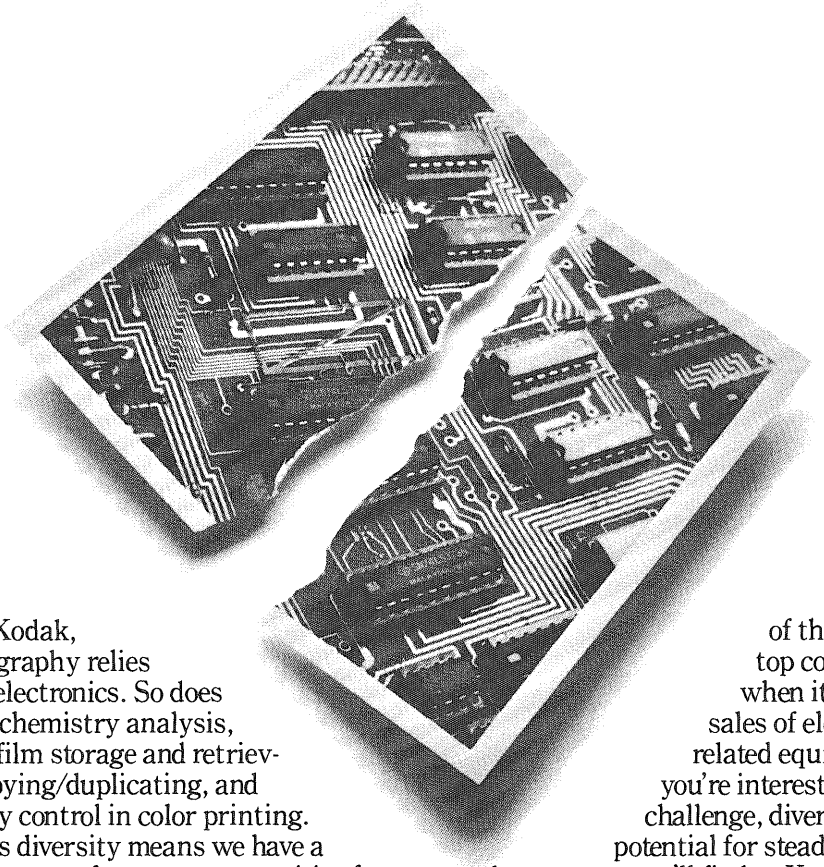
Department of Aerospace Studies
Room 3 Armory
15 Church Street S.E.
University of Minnesota
Minneapolis, Minnesota 55455

If you stop reading now, you may short circuit your career in electronics.



At Kodak, photography relies upon electronics. So does blood-chemistry analysis, microfilm storage and retrieval, copying/duplicating, and quality control in color printing.

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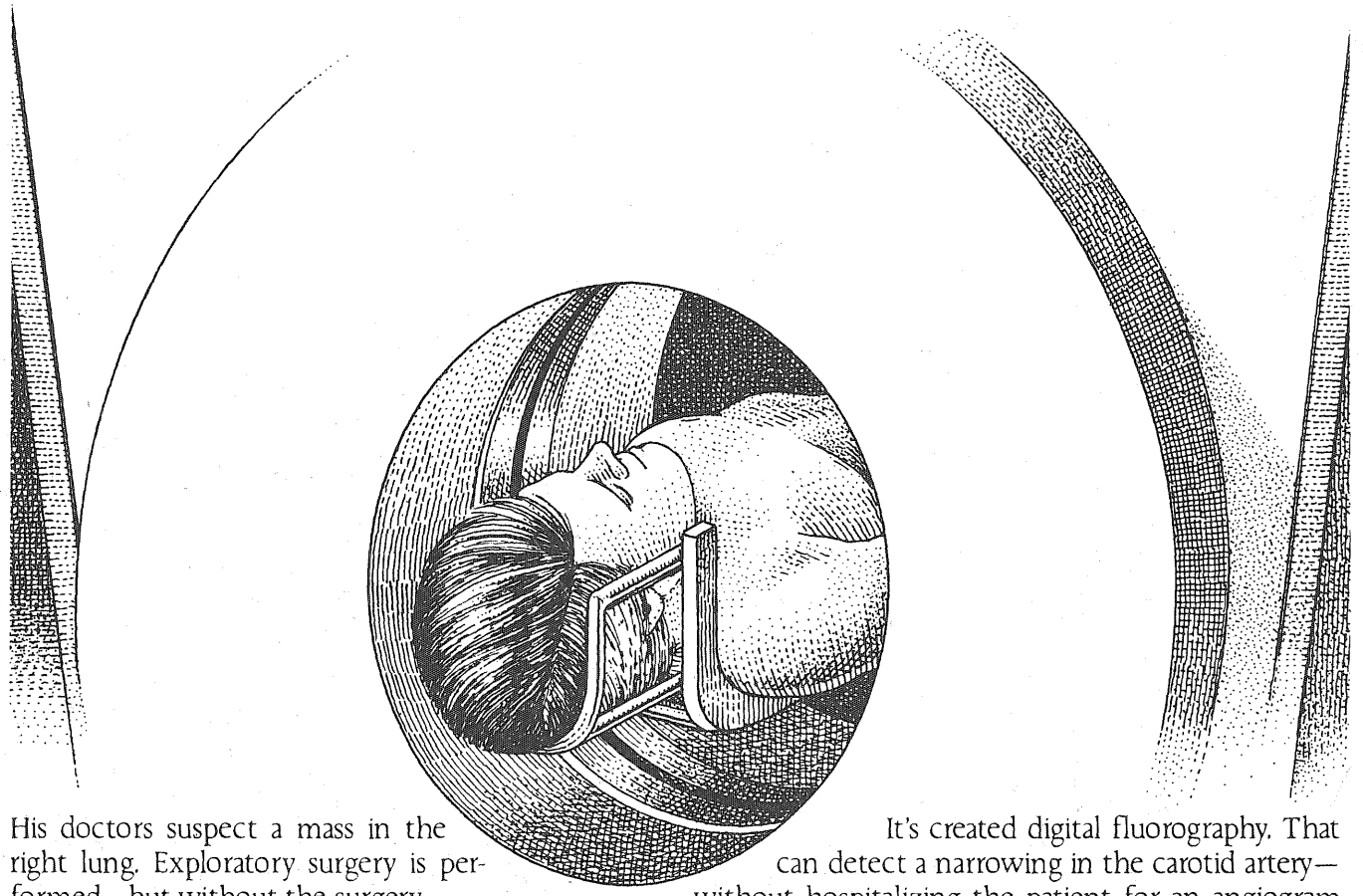
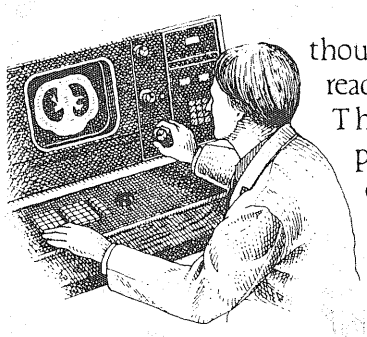
The silicon chip. It's replacing the scalpel.



His doctors suspect a mass in the right lung. Exploratory surgery is performed—but without the surgery.

This is made possible because of a major advance in radiology called the CT Scan (short for computed tomography).



The CT Scan provides thousands of digitized X-ray readings of a patient's body. Then, using a computer, it synthesizes the data into a series of cross-sectional or tomographic images—all within seconds.

The detail is incredible. Often a diagnosis can be arrived at immediately—so the patient is spared the knife.

But it's the heart of the computer that's the real miracle. The silicon chip.

The silicon chip is responsible for a new wave in microelectronics and a remarkable revolution in medical diagnostics.

It's created the digital ultrasound imager. That helps doctors visualize the womb of a pregnant woman with sound waves to monitor fetal development.

It's created digital fluorography. That can detect a narrowing in the carotid artery—without hospitalizing the patient for an angiogram.

General Electric is committed to finding new ways to make the computer chip serve. In medicine. And in other industries.

For instance, we're investing 100 million dollars in our new GE Microelectronics Center.

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Spring 1, 1982

Digital Recording
Geothermal Heat Storage
Technical Communication
more

Editor's Log

The future. What does it hold for you?

Of course, nobody can answer that question for certain, but it is possible to look ahead to some of the sights you will see along the road. This issue of *Technolog* will zero in on some future subjects.

I took my pen in hand and wrote a story on geothermal and pseudo-geothermal energy storage. Could this become an important alternate energy source in years to come? Quite possibly it could.

Rein Teder looks ahead at the world of music and digital recording. If you've never had the opportunity to listen to an album recorded this way, try to get ahold of one to listen to. It'll knock your socks off!

Former *Technolog* managing editor Denny Sullivan looks more specifically at your future in an opinion piece about engineers rising to management positions, with little or no training. This is a serious problem in today's industrial world. What is gong to be done about it?

Finally, Terry Hansen took a ride over to the Department of Rhetoric to find out about a relatively new program in technical communication. With so much emphasis on communication these days, this program might become very important and popular.

All this plus the regular features of *Technolog* are right here. All you have to do is turn the page....

Peter G. Marsnik

Peter G. Marsnik
Editor

Spring is here!

Staff

minnesota TECHNOLOG

Undergraduate Magazine of the Institute of Technology, University of Minnesota

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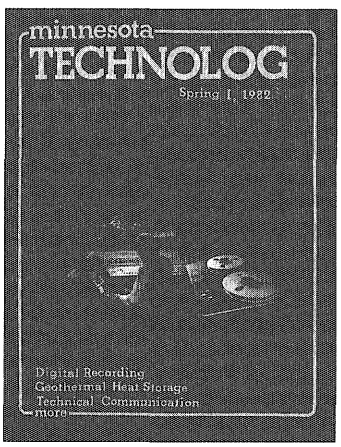
Vol. 62, No. 5, Spring I, 1982
ISSN 0026-5631
"We Do I.T. for YOU!"
ECMA



The cover shows the 3M Digital Mastering System in use at Sound 80 Studios, Minneapolis.

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I T WEEK

MAY 3-7

EVENTS:

monday- friday

Calculator Race (Hewlett-Packard: HP 41C First Prize)
Foosball Tournament (NSPE)
Ping Pong Tournament (NSPE)
Pool Tournament (NSPE)
Paper Airplane Contest (AIAA)
Truss Contest (Civil Engineering)
Marathon-Forester Chase (Prof. Moran-Aero)
Electronic Games Tournament (HKN)
Orienteering (MINIT)
Egg Drop (ASME)
Airplane Contest-prof's vs. students (Sigma Gamma Tau)
Solar Flat Plate Collector Contest (Triangle- Russ Peterson)
Dunk Tank (Triangle)
Calculator Toss (Theta Tau)
Non-combustion Car Race (SAE)
Tricycle Pull (Agricultural Engineering)

Backgammon
Volleyball Tournament
Car Rally
Balloon Toss
Tricycle Tug-a-war
Frisbee Tournament
Tricycle Race
Bed Race
Wheelbarrow Race
Tug-a-war
Toobie Contest
3-legged Race

MINNESOTA EXPOSITION- WEDNESDAY, 6:00 P.M., Architecture Court
I T SPAGHETTI DINNER- THURSDAY, 7:00 P.M., Shevlin Hall
I T PICNIC- FRIDAY, 12 NOON, Northrop Mall
I T DEPARTMENT TOURS- Concurrent with the TECHNOLOGY FAIR
DEMONSTRATION TENT- Concurrent with the TECHNOLOGY FAIR, Northrop Mall

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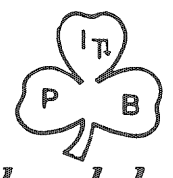
TECHNOLOGY FAIR

Wednesday 9 a.m.– 4 p.m. 6 p.m.– 9 p.m.
Thursday 9 a.m.– 4 p.m.
Northrop Mall



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Letters to the EDITOR:

Send Your Letters to...

Minnesota Technolog
Room 2, Mechanical Engineering Bldg.
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Minneapolis, MN 55455

Please try to keep your letters to 300 words or less, and you must sign it to have it printed.

Dear Editor:

As a former I.T. student (undergrad),. current grad student of the School of Management and an employee of Control Data Corp., I continue to enjoy *Technolog* and believe it is an excellent, high quality publication.

Please accept this $10.00 check for one year's subscription.

Keep up the good work!

Mark P. Rozycki
I.T. graduate

Dear Editor:

I was blithely following in the facetious flow chart reproduced from USC in the Winter II *Technolog*, when I hit the compartment marked "Have a girl?". My reaction to this bit of sexist garbage was not so much militant anger as disappointment and exasperation. We all know that not every engineering student is male; why must we tolerate the perpetuation of such residual chauvinism? The offensive portion of the chart could have easily been modified or deleted, and the *Technolog* editors would have demonstrated themselves to be more enlightened than their counterparts at USC.

M. Bjornerud
Geophysics junior

The flow chart in Winter II was designed to be entertaining, and Technolog apoligizes to any who may have been offended.—Ed.

A NEW TWIST IN MUSIC: DIGITAL

by Rein Teder

Music lovers should be mad as hell and unwilling to take it anymore. We have gotten used to the miserable quality of the discs that record companies have been selling us for years. Most of us have come to accept what should be intolerable levels of noise and distortion as part of the recording process. We are accustomed to a dynamic range that goes from loud to damn loud. There used to be an excuse for this.

Along with apathetic quality control standards in the record manufacturing industry itself, the biggest culprit responsible for the infidelity of most albums on the market today is the analog tape recorder. "Analog" means the kind we are all used to. The same basic principles that govern the operation of a compact cassette recorder are used in any 24 channel professional analog tape machine. The home unit and the professional tape recorder share a weak link in the audio chain: magnetic tape. Magnetic tape restricts dynamic range, and introduces noise, distortion, and a host of other tone colorations and problems.

These effects might not be so bad if the music had to be subjected to them only once. Modern recordings, however, are almost always done with many overdubs, submixes, and remixes. Consequently the music that gets mastered onto an album is many generations of tape removed from the original performance, and each generation of tape has added noise, distortion, and other funnies.

Finally, there has come a virtually distortionless recording media that allows unlimited overdubbing without signal degradation: digital records. Digital recording offers us a dynamic range and clarity of sound a world apart from conventional analog recording. (Ozzie Ozborn and AC-DC fans may skip this article.)

ANALOG TAPE

A review of analog recording is in order. In analog recording, the basic form of the signal remains more or less the same at each stage in the recording process. We do things to get the frequency response flat and such, but, for the most part, the oxide particles on the tape are magnetized in a pattern that resembles the signal being recorded. A strong signal leads to a strongly magnetized tape.

This very straight-forward idea has some practical problems. The electronics involved are predictable and well-behaved, but the magnetic tape itself is neither. The process of magnetizing a tape and subsequently reproducing a signal from that tape does not lend itself to precise mathematical analysis. Many highly variable physical parameters can and do affect the performance. Therefore, it stands to reason that any imperfections in the system, such a variations in the oxide coating thickness on the tape, will directly impress themselves upon our treasured musical signal.

It will never be possible to make analog tape recording much better than it already is.

None of these problems are going to go away. In my work with the Telex Communications Corporation assisting in the design of a state-of-the-art analog tape recorder, I have learned that analog tape recorder design is very near the theoretically achievable limits. It will never be possible to make analog tape recording much better than it already is.

DIGITAL

Digital gets around the problems of magnetic tape by not relying on it as a clean undistorting storage medium, which it isn't. The basic idea of digital recording is simple: the digital recorder converts the musical signal into a series of numbers and stores these numbers as a computer would store data on magnetic tape. Upon playback, these numbers are used to reassemble the musical signal, which is not the worse for wear and tear.

Numbers representing the signal and used throughout the digital system are, of course, binary. This means that, unlike in analog recording, particles on a digitally recorded tap are always fully magnetized in either of two directions. Also, there are extensive error correcting schemes employed. All this makes a digital recorder practically impervious to problems such as oxide coating thickness variations. If such a "dropout" in the tape does occur, the error correcting scheme usually allows the recorder to reconstruct the missing data exactly, or at least make a very good "guess". The result is almost no degradation in the signal.

The process of converting the musical signal from analog into digital is illustrated in Figure 1. The input may assume any voltage within a certain range, and it

RECORDING

varies continuously with time. The analog to digital converter (ADC) samples the signal at discrete intervals of time, and assigns to it a numerical value. These values are quantized; they occur only at discrete intervals. In the example shown, the quantization interval is one, and the signal is sampled once per second. A practical digital system would sample much more often and allow much greater resolution.

The speed and resolution requirements of the ADC are great indeed—typically 65,000 quantized signal levels and greater than 40,000 samples per second. This generates a huge amount of data; the above numbers work out to about 700,000 binary digits per second, plus about half that much data every second for an error correcting scheme!

Hardware to meet these requirement is very sophisticated and at the forefront of technology. It is expensive. With improving technology, however, even that drawback is disappearing. A stereo digital tape recorder is now price competitive with a top-of-the-line professional analog machines, once you have paid for the noise reduction equipment needed for the analog unit.

CURRENTLY AVAILABLE

These days you can go to almost any record store to buy a digital album. By "digital" album they mean that the music was originally recorded on digital equipment. The vinyl disc itself is, of course, conventional and analog. Clearly only a very small fraction of the money you lay down goes to pay for the recording equipment that produced an LP. So why are digital albums so much more expensive? I believe it is because they sound much better so people are willing to pay extra. Also, the quality control in digital albums

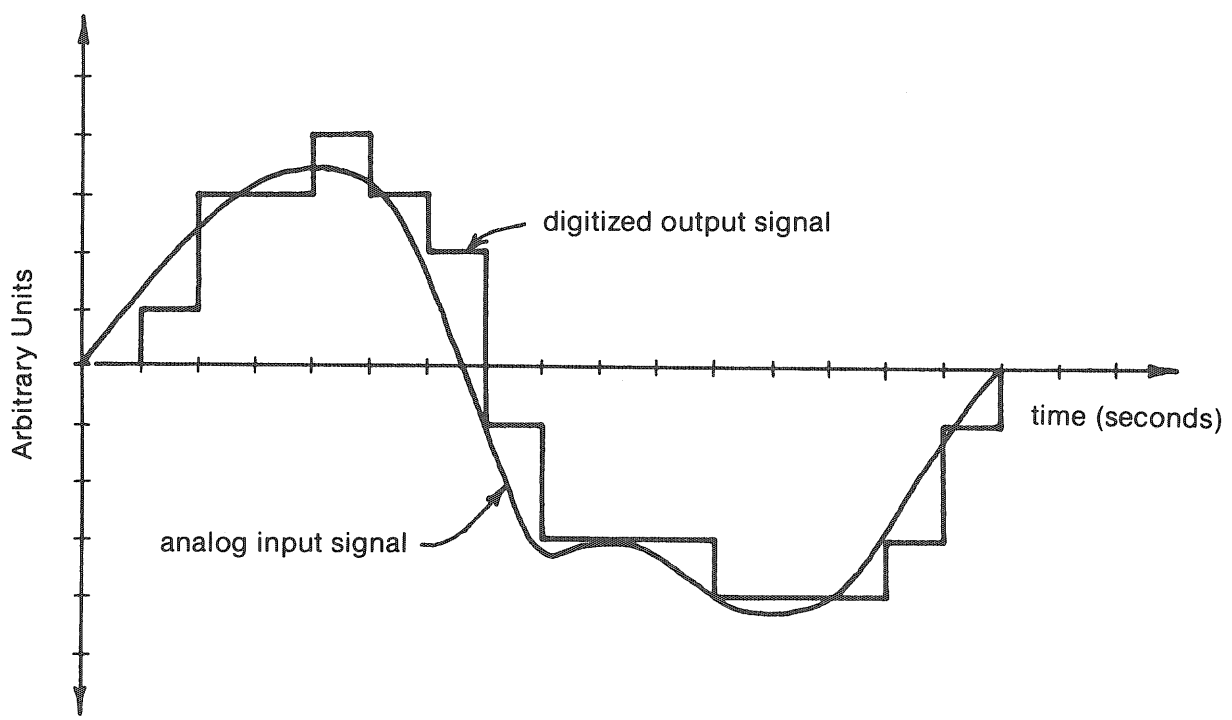


Figure 1. Analog to Digital Converter Operation.

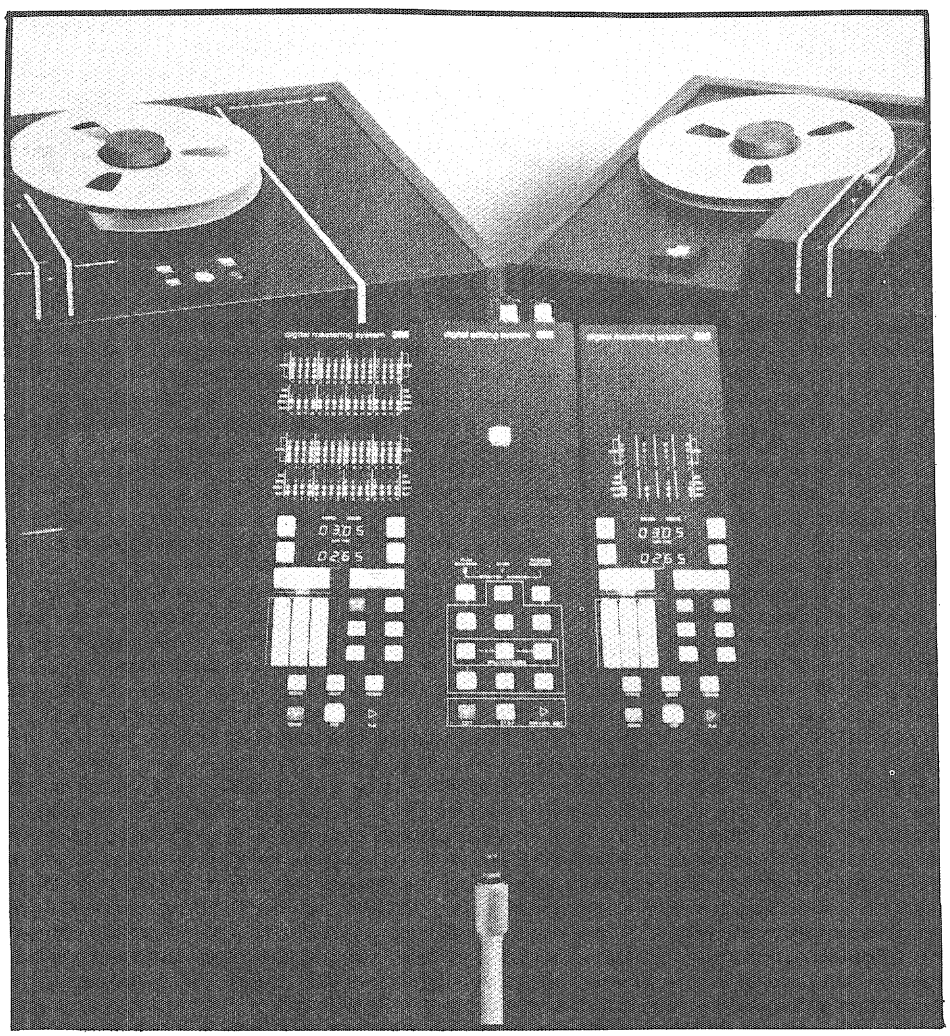
is usually better, but that should not contribute that much to the retail price.

We are going to see more and more digitally recorded albums, and eventually they will dominate the market. This will bring the price down. Already, major artists like Rickie Lee Jones and Steely Dan have released digital albums. Understandably, major studios with expensive 24 channel analog recorders will be slow to convert to digital, but convert they will.

The spectacular fidelity and relative inexpense of two-channel digital recordings have led to a rebirth of non-overdubbed stereo recording. While the trend has been toward more and more multi-tracking—the rhythm section need never meet the horns—it has in recent times become once again respectable for superior musicians to perform as an ensemble, mixing down live in the studio and with no overdubs. The musicianship on these recordings is often outstanding. When musicians know that they don't have the option of going back and redoing a part, they often perform better. For an example of this "direct to digital" format that will knock your jazz-fusion socks off, listen to David Grusin's *Mountain Dance*. Suddenly, all the money you spent on a decent stereo will seem worthwhile.

So why are digital albums so much more expensive? I believe it is because they sound much better so people are willing to pay extra.

Photo courtesy of 3M



3M's Digital Editing System. The state of the art in digital recording technology.

THE FUTURE

The conventional LP manufactured from a digital recording is certainly an improvement over its analog counterpart, but it is still subject to the limitations of the vinyl disc. Those limitations will be lifted in about a year with the release of a new format: the Compact Digital Audio Disk (DAD). The DAD, a joint Philips-Sony development, will bring digital fidelity into the home, and eventually our cars and portables. Consider a S/N ratio of greater than 90 dB (means you can't hear any hiss), no wow, flutter, or rumble, and 0.05% distortion (you can't hear that, either). All this from a disc 120 mm (4.7 inches) in diameter.

Most intriguing about the DAD is its extensive error correction scheme. Because of it the DAD will be almost totally immune to dust, scratches, and outright abuse. It is theoretically possible to drill a 2 mm hole in a DAD without affecting its performance. These features will also make DAD less sensitve to the ill-effects of poor quality control in manufacture.

Projected prices for the discs themselves will be close to those of conventional LPs. Initially the player will be priced to be competitive in the hi-fi middle

market. This, along with widespread dissatisfaction with the LPs of today, should lend to rapid consumer acceptance of the DAD. Eventually the DAD will dominate the market.

alike can become more concerned with the music itself, and less hampered by the limitations of the equipment. Digital records will allow us to hear musical subtleties we never heard before.

The EQ networks necessary in analog recording messup the phase something awful, but digital is much more predictable. This could lead to a whole generation of stereo equipment and recording with a depth and realism we are unaccustomed to.

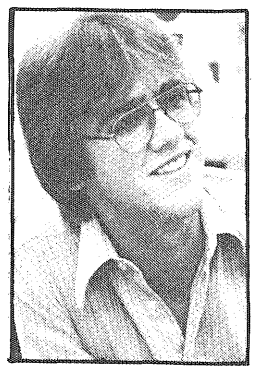


Photo courtesy of *Items*

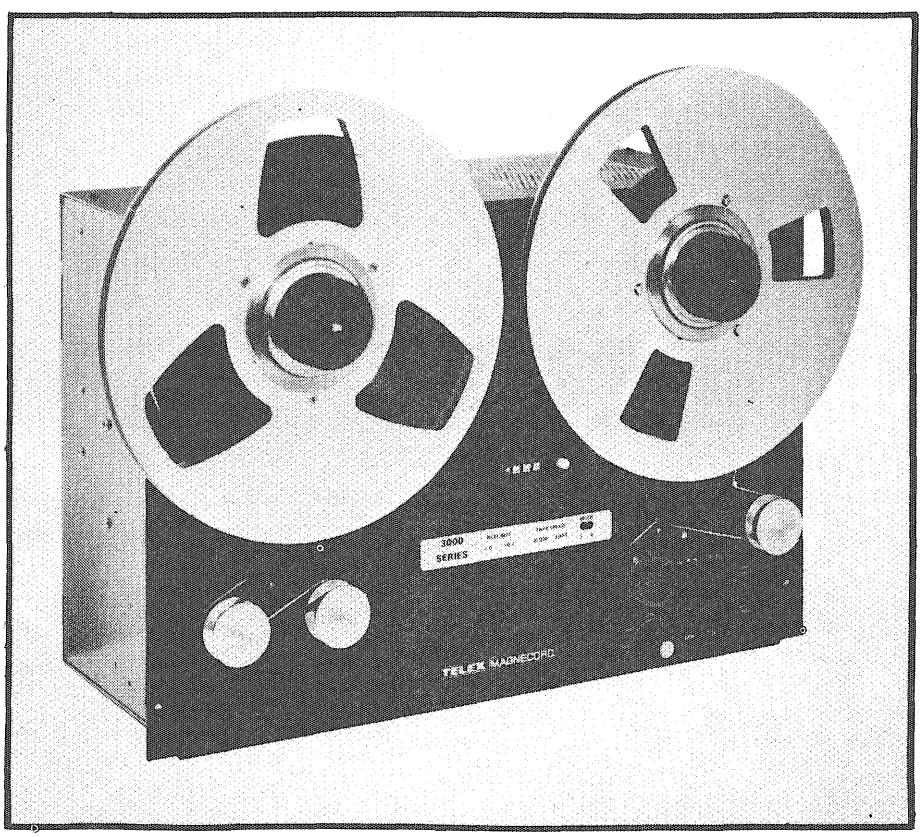
Rein Teder is a senior in Electrical Engineering, interning with Telex Communications, Inc. In his spare time he fights the IT stereotype and plays jazz piano.

This kind of quality in time will force engineers to be more concientious in the studio. For example, in today's recordings little attention is paid to an aspect of musical sound called phase coherency. In a phase coherent system, all of the harmonics that make up a musical signal receive an equal amount of time delay. This is important because these time delays, or phase relationships, help our mind's ear reconstruct the stereo image. Because of phase relationships, in a good stereo recording the piano does not sound like a point source; it has physical dimensions and we hear it that way. Analog tape engineers don't like to talk about phase relationships—I know I don't. The EQ networks necessary in analog recording mess up the phase something awful, but digital is much more predictable. This could lead to a whole generation of stereo equipment and recordings with a depth and realism we are unaccustomed to.

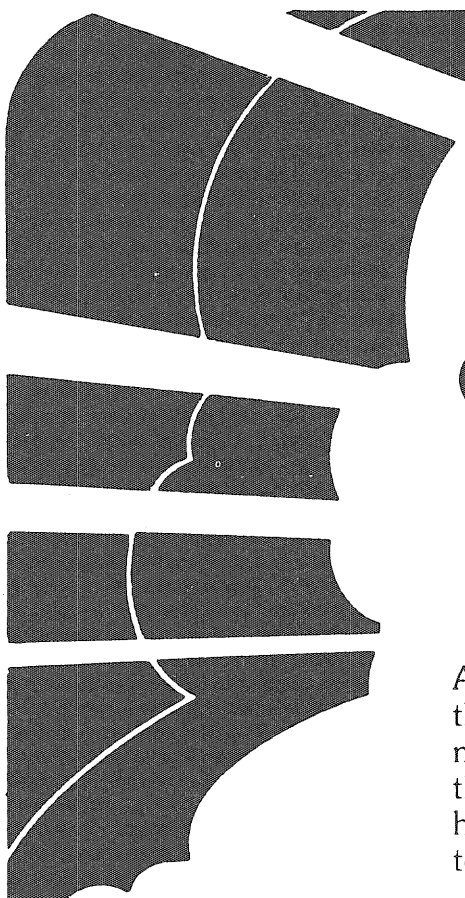
Digital technology is changing our music reproduction systems. The point of this superb fidelity is to make technology more transparent; musicians and listeners

minnesota TECHNOLOG

Photo courtesy of Telex



A state of the art analog tape transport. Telex would like to show you the electronics that go with it, but they are not finished. This has been the project Rein Teder has worked on over the last year and a half.



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SOLVING THE ENGINEER / MANAGER SYNDROME

Editor's note: Opinions expressed in the following article are not necessarily those of *Minnesota Technolog*, the University of Minnesota, the Institute of Technology, or the Board of Publications.

by Denny Sullivan

In our technical, industrial society, the engineer is highly valued as the person most capable of transforming theory into products. This ability allows engineers to earn top dollar while quickly moving into positions with increased challenge and responsibility.

Very often, however, this means that an engineer must change his or her primary focus from engineering to management. Whether it be in a project environment, in production, or in marketing, the most technically talented engineers move out of exclusively technical areas fastest. Often they are unprepared to make this transition and find themselves frustrated and unable to perform at standards they normally demand of themselves.

Most employers have found it necessary to play the role of an educator in preparing engineers for management and, more often than not, make use of narrowly focused short courses as a quick way to make managers out of engineers. This issue could be addressed more effectively if management topics were made an integral part of the engineering curriculum.

Today over two-thirds of those with undergraduate degrees in engineering hold positions that require some degree of managerial competence. Over one-half of the executives in the U.S. have a background in engineering. It is predicted that this trend will continue as we face new productivity challenges and increased competition from other nations.

While some companies are still looking for the "whiz-kid" M.B.A., engineers are moving rapidly into areas traditionally staffed by business students. Employers see young engineers as key players in addressing challenges they face in areas like energy, resource use, manufacturing, information management, and environmental issues.

The need for engineering expertise is so great that many high technology companies have developed special "fast track" career paths specifically designed to move engineering talent into decision making positions quickly. As John Alden, Accreditation Director of the Accreditation Board for Engineering and Technology, has said, "The younger the age group of managers studied, the greater percentage of engineers in it. This undoubtedly indicates a basic trend which is gradually changing the profile of the engineering profession."

In most corporations it is supposedly possible, at least theoretically, to remain totally immersed in a research environment and still keep astride of engineering counterparts in management. However, very few organizations have had much real success in implementing "dual ladder" programs. Salaries and responsiblities of engineers in management soon out-strip those of engineers in purely technical jobs.

Even on the technical side of the "ladder", higher levels do require some degree of management skill, although it is often not reflected in the job title. It has been estimated that over half of the engineers who start out planning to remain in a technical job will be moved into management within three to five years of graduation w th a B.S.

Wilber Mier, recently appointed dean at Penn State University, reports that an informal survey of nearly 30 chief executive officers revealed an overwhelming majority who strongly supported giving engineering students work exposure to management concepts. Traditionally, however, many pre-engineering programs attract students who are less than anxious to develop skills in economics, communications, and the social sciences.

Upper level engineering curricula tend to reinforce this by forcing students into areas of specialized technical study. Few programs even recognize management classes as possible electives in a comprehensive degree plan. Whether for fear of a watered-down curriculum or because of an inability to see the issue, engineering educators seem to be unwilling to respond.

Companies report that this transition from engineering to first line manager is a primary bottleneck affecting productivity in industry.

As a result of this deficiency found in most engineering programs, engineers often go through a period of disillusionment soon after embarking on their new careers. They soon discover that the real priorities in industry don't rest in building a better mousetrap, but instead center around making a profit. After a few years, many engineers will be re-educated and asked to leave technical work behind.

Companies report that this transition from engineer to first line manager is a primary bottleneck affecting productivity in industry. Many companies respond by spending large amounts of money to maintain management development programs, while some expect

their people to get an M.B.A. before advancing, and still others expect new engineering managers to pick up necessary skills in a sink or swim environment.

As America faces new challenges in productivity, the need for highly competent engineering managers will increase. Because of changes in the work force and economic changes in the marketplace, Japanese "people management" styles are being emphasized, more or less, in every major corporation. In this kind of setting, sharp management skills become essential. The emergence of quality circles and participative management drive the need for solid management ability down lower in the engineering ranks than ever before. This type of management requires a knowledge of "soft" sciences like the psychology of motivation and group behavior and an understanding of human needs and creativity—a long ways away from subjects like multivariable calculus and heat transfer that engineering students normally concentrate on.

Ideally, all engineers would graduate with a basic understanding in these areas: engineering, financial/resource management, and people management. Since few undergraudates are willing to spend the six to eight years necessary to accomplish this, some sort of hybrid program needs to be developed.

Engineering schools like the University of Illinois, University of North Dakota, Southern Methodist University, University of Vermont and the University have already done exactly this. They all offer accredited bachelor of sciences degrees in Engineering Management. For example, the first two years in the University of Missouri's program is virtually identical to other engineering programs on that campus. The third and fourth years, however, are a mix of classes in engineering, economics, business and management. 31% of the total credit hours in the last two years are devoted to business and management oriented subjects. Missouri reports that most of their students are hired for jobs in production supervision, industrial engineering, project management and technical marketing.

A 1976 survey showed that graduates with this degree average double their starting salaries after six years and received an average of 4.5 promotions during that time. Women engineering students in particular seem to have discovered the utility of this type of degree. The 1981 freshman classes of the schools offering a B.S. in Engineering Managmeent report a 50% enrollment of women, compared to less than 20% in other engineering degree programs.

Private industry, too, has started addressing the issue of engineering managment. Honeywell, Inc., for example has dedicated over a million dollars to train nearly half of all their engineering managers in management skills. Companies like John Deere, Standard Oil of Ohio, Westinghouse, and Hewlitt-Packard, to name only a few, are also convinced of the need for competent engineering managers and have stated similar programs.

As the need for engineers with man-

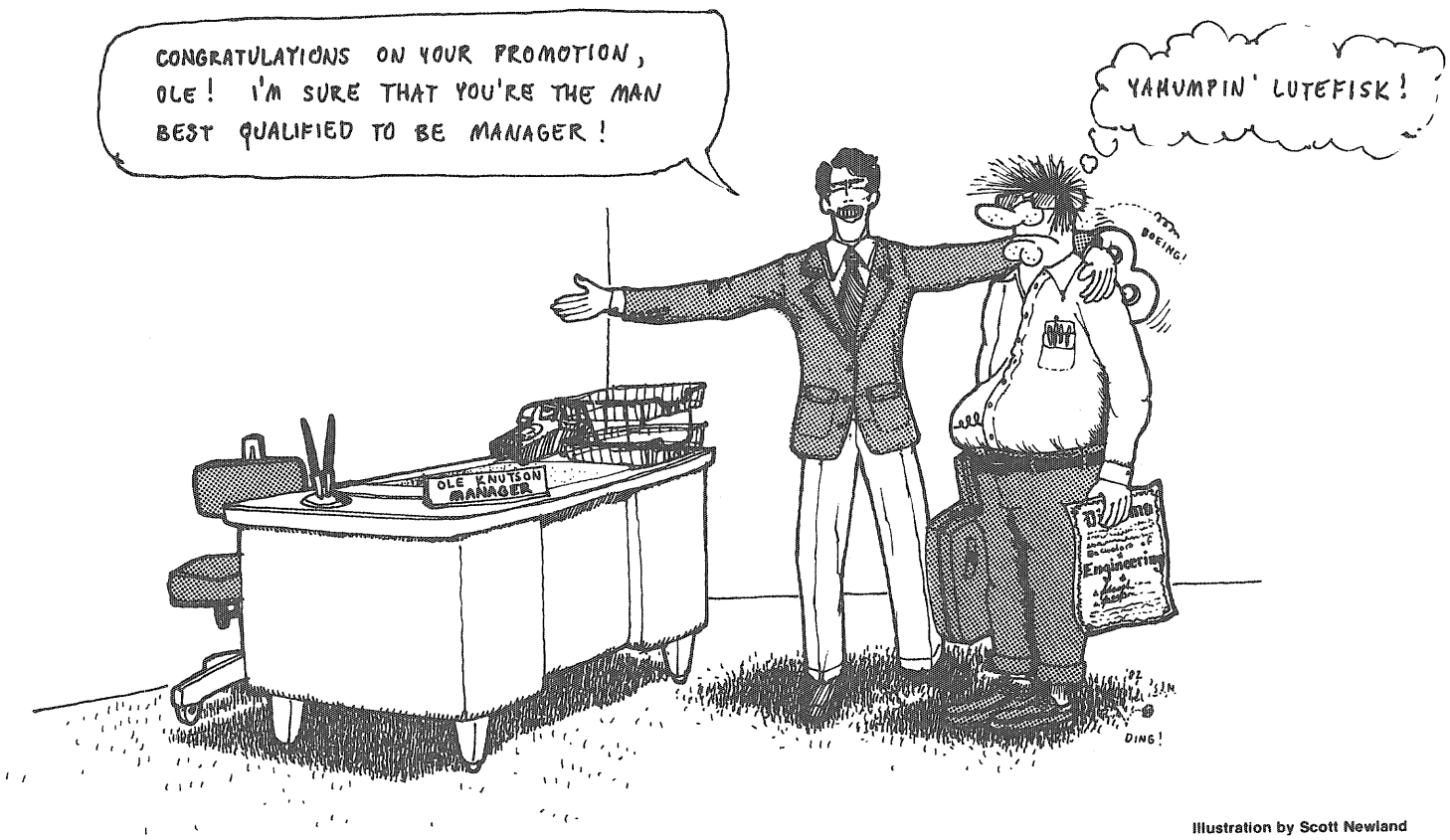


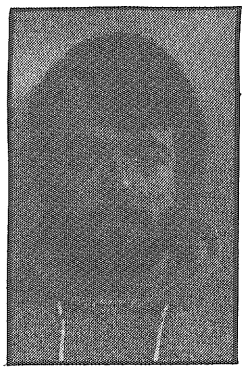
Illustration by Scott Newland

EDITORIAL/OPINION

agement training becomes more and more critical, leaders in engineering education. like the Institute of Technology, have a major repsonsibility to both students and industry, as well as society in general, to implement changes in the engineering curriculum that will allow us to better face the challenges of the future. At a bare minimum, all engineering programs should include a "survival kit" of economics and management topics dispersed among the regular engineering courses. Better yet, an engineering management program should be developed here at the University of Minnesota and students made aware of its potential after graduation. Failure to implement these kinds of steps is sure to leave I.T. students unprepared to meet one of the greatest challenges to ever face engineers.

Employers see young engineers as key players in addressing challenges they face in areas like energy, resource use, information management , and environmental issues.

minnesota TECHNOLOG



Denny Sullivan is a senior in chemical engineering, soon to be a member of the industrial world. He served *Technolog* as managing editor during the 1979-80 school year.

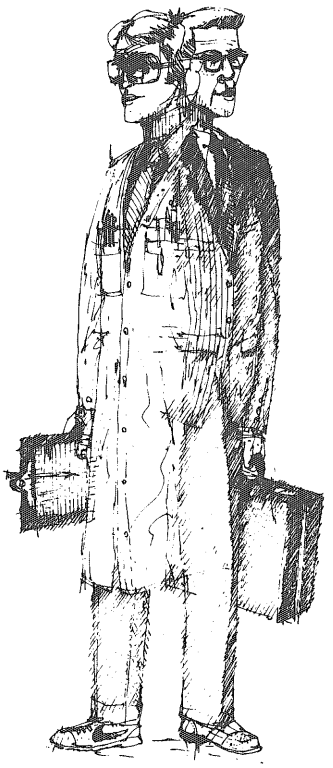


Illustration by Scott Newland

Log Ledger

I.T. Week is just around the corner!

The first week of May is time for you to leave the ranks of boring students who only eat, sleep and study. By designing a high-performance paper airplane, for example, or a grade A egg-catcher, and entering in the I.T. week '82 will provide multifaceted competition opportunities: chess, calculator toss, egg drop, solar flatplate collector contest, many types of motion races, calculator race; in short, I.T. week is filled with good things to do in the spring. So start psyching up! The paper airplane contest, toothpick truss design contest, orienteering competition; all I.T. can find something(s) this year.

A few notes: **The Minnesota Exposition**, featuring the multi-media presentation *Minnesota Wellspring*, talks by your infamous dean Roger Staehle, and possibly by Al Quie and John Rollwagen, president and CEO of Cray research, will be held on Wednesday, May 5 at 6 pm in the Architecture court.

The I.T. spaghetti dinner will be Thursday, May 6 at 7 pm in Shevlin Hall. Company reps and all interested students are invited. If you have any questions about I.T. week, simply call the Plumb Bob office in room 5 Lind Hall. The phone is 373-7729 and Nancy Penrod, the hardworking president of this fine organization, will be the most knowledgable person to speak to.

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Terry Hansen's article in Winter I *Technolog* was picked up by a small radio station,KFAI,for use in a weekly science fiction program. Congratulations, Terry.

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Technolog has received permission to print during spring quarter. Earlier, **President C. Peter McGrath's** directive banning all publications spring quarter made it look very bleak. However, *Technolog* appealed to the committee enforcing the directive, and won permission, although the size will have to be reduced in compliance with the budgetary cuts.

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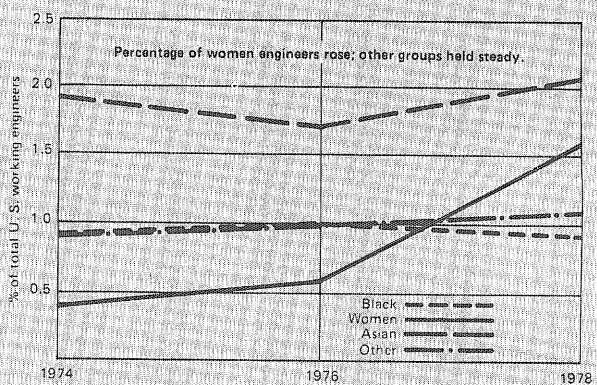
During the years 1974-78, the percentage of minorities and women among employed U.S. engineers grew slightly, with most of the increase coming from the influx of women, says a recent report from the National Science Foundation (Washington, D.C.). While representation of blacks, Asians, and other minorities (Hispanics, native Americans, and others) held steady, the absolute number of women engineers almost



quintupled (from 4,400 to 22,500), and their percentage jumped from 0.5% to 1.6%. Moreover, women's share of the entire U.S. science and engineering work force grew from 7.8% to 9.4%

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How do you put a price tag on the value of the existing stockpile of uranium tails that would be used to produce a new fuel in breeder reactors? Try this on for size.

"A stack of one thousand $1,000 bills—a total of one million dollars—tightly pressed together is approximately 5 inches high. Therefore, $1 trillion would make a stack of $1,000 bills 79 miles high. The stack representing the equivalent dollar value of the tails based on the conservative price of $31.25 per barrel for oil would be 5,272 miles high. That stacks up to $66 trillion."

The comment above describing the vast energy potential of the nation's uranium tails appears in the current issue of *Electric Perspectives*, a magazine published quarterly by Edison Electric Institute.

According to authors Henry Piper and David Hambright in an article entitled "Using What We've Got," the United States does have an energy problem, but the exact nature of the problem is not widely understood. Piper is Chief of the Licensing Branch of the Public Safety Division for Project Management Corporation (PMC). Hambright is also employed by PMC as Chief of the Technical Information Branch. PMC is a member of the government-and-private-industry partnership dedicated to developing the Clinch River Breeder Reactor in Oak Ridge, Tennessee.

"We do not have a shortage of energy resources," the article states. "Our problem is that we are not fully utlizing the ones we possess. Nuclear reactors could produce electric power for

decades, even centuries, from material that is available today. The technolgy for doing so is well developed and ready to be demonstrated."

International Harvester announced it has entered into an agreement with the National Aeronautics and Space Administration to develop a computerized graphic information system to forecast agribusiness needs.

The new system is intended to supplement IH's agricultural industry market research program and will demonstrate commercial application of NASA remote sensing techniques.

In making the announcment, Dr. Stephen J. Gage, IH staff vice president, science and technology said, "The overall objective of this project is to design, construct, and test a geographic information system that will help determine agricultural industry business and equipment needs and better allocate resources. Using IH's agricultural information system, land-based data such as crop conditions and production activity and high altitude remote sensing information, we hope to identify changes in farming practices and their associated business and scientific implications."

The system, to be jointly developed by IH and NASA Earth Resources Lab personnel, will combine land-based and satellite data on soil, water, terrain, crop, climate and economic conditions. The information will then be analyzed using mapping techniques to produce an integrated picture of agricultural trade areas.

The information system will be developed over a three year period, and will demonstrate the abilty to apply remote sensing techniques to industrial applications, the Company said. Information resulting from the project will be made available on an industry wide basis.

At the end of 1981 there were 263 nuclear power plants operating in 23 countries, including 76 units in the United States, according to survey figures compiled by the editors of *Nuclear News* and published in the February 1982 issue of the American Nuclear Society monthly publication.

The magazine's semi-annual "World List of Nuclear Power Plants" shows that 23 units began operation during 1981, representing an increase of 19,735 megawatts (MWe) of capacity (up 14.6 percent over 1980). This brings the world total of nuclear capacity to 154,607 MWe.

While in many countries there had been a slowdown in ordering nuclear plants (the last U.S. order was in 1978), heavy ordering of plants in the early 1970s will produce major increases in operating nuclear capacity in each of the next few years.

Nuclear Power Plants Now Scheduled

Est. Date of Commercial Operation	Number of Plants		Net MWe	
	World (Including U.S.)	U.S.	World (Including U.S.)	U.S.
Operating (as of Dec. 31, 1981)	263	76	154 607	56 790
1982	33	7	26 085	7 666
1983	32	12	28 177	12 044
1984	47	14	42 390	15 387
1985	27	7	26 826	7 667
1986	28	12	28 055	13 793
1987	22	6	19 722	6 988
1988	14	4	13 708	4 778
1989	9	2	8 556	1 807
After 1989	54	26	53 950	30 734
TOTALS*	529	166	402 076	157 654

*The above table is from the latest *Nuclear News* "World List of Nuclear Power Plants" (this issue, pp. 83–102), which lists information as of December 31, 1981.

Total compensation payments to top executives in the mining industry increased 15% to an average of $136,000 in 1980, according to a new survey of executive compensation conducted by Arthur Young & Company for the Financial Executives Institute. This compensation level tied with the chemical and petroleum industries as highest among the 24 industries studied in the recently published biennial survey, entitled "Executive Compensation."

Chief executive officers of mining companies at all levels of sales volume averaged $311,900 among bonus-paying companies, while nonbonus paying companies paid an average of $207,000.

Among other top executives in this industry, the chief operating officer had a total average compensation increase in 1980 of 23%; the top financial executive, 24%; the top marketing executive, 14%; the top human resources executive, 17%.

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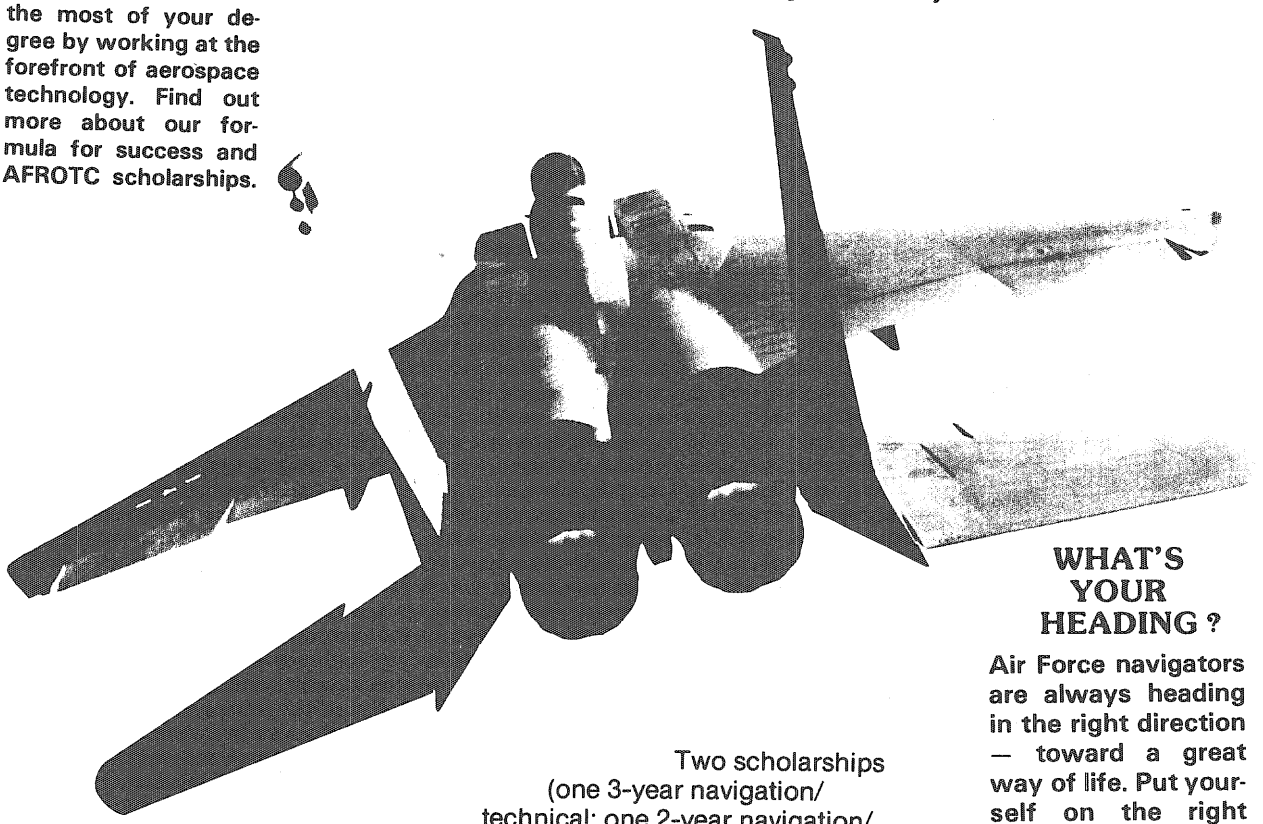
Two scholarships (one 3-year engineer; one 2-year engineer) are available now for qualifed students. Estimated starting salary after graduation is $16,400 and after 5 years would be $36,700.

Each scholarship provides:

- Full tuition
- Textbook reimbursement
- $100 a month allowance (tax-free) during the school year



Two scholarships (one 3-year navigation/ technical; one 2-year navigation/ technical) are available now for qualified students. Applicants must be in a technical academic specialty. Estimated salary after graduation is $17,900 and after 5 years would be $39,200.

WHAT'S YOUR HEADING ?

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HEAT STORAGE:

by Pete Marsnik

Geothermal heat is heat that is generated from within the earth. This heat occurs near the earth's surface in many parts of the world, as evidenced by volcanoes and hot springs, for example.

For many years, man has harvested this heat for use in his society. As an example, the Italian railroad is powered by a volcanic area north of Rome. Other examples include New Zealand, which makes effective use of geysers, and Iceland, which gets a large part of its energy supply from the earth's natural heat.

In recent years, with a world-wide energy pinch, there has been a push to capture more of this natural, relatively cheap source of heat. But the problem lies in the fact that most folks don't have a volcano or geyser in their backyard to use for heating. This is creating an interest in the geological sector these days to (1) explore for more areas where steam wells and high temperatures can be tapped, and (2) find ways of extracting heat at lower temperatures.

However, even with substantial breakthroughs in the exploratory field, there must be something more if this source is to develop fully. Currently there is also a drive to study and develop man-made geothermal situations. That is, using the heat capacity of the earth to store heat and then get it back for use. These man-made geothermal situations will be the focus of this article.

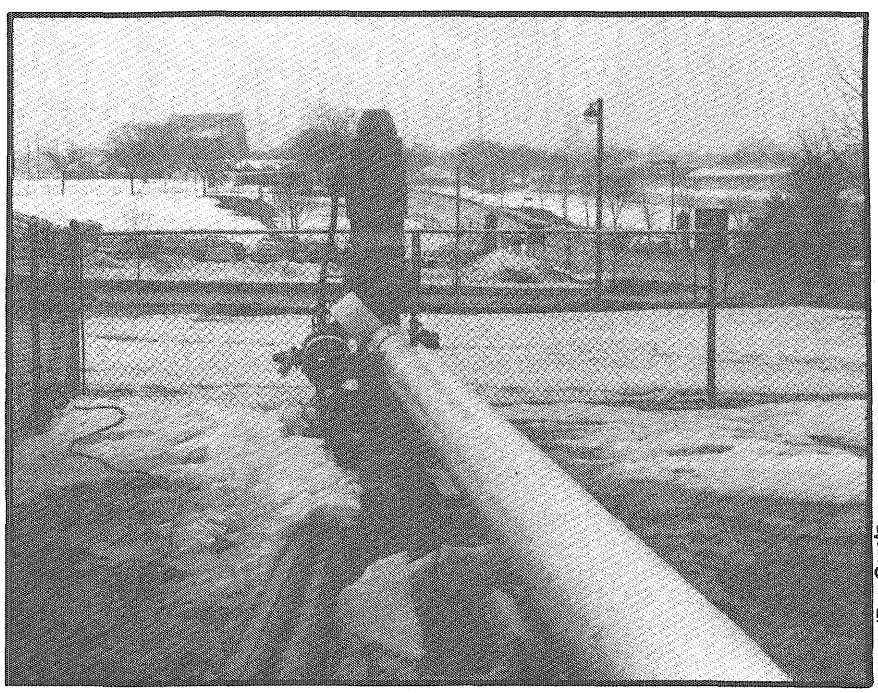
To illustrate this, let's look at a power plant. Roughly two-thirds of the combustion energy used in a power producing plant is lost to the surroundings as waste heat in the conversion process. This explains why there is such a large amount of thermal pollution around power plants. One would wonder whether or not any of that heat could be used. The answer is yes, and it is in several areas.

An example is Scandinavia, where no natural energy source exists. They use waste heat in part of a district heating program. In the 1960's, the Chinese started a district heating plan in Shanghai using ground water that had been heated. They also use the system for air conditioning in the summer months. At present, about ten major Chinese cities use district heating on a large scale. Closer to home, Minneapolis, St. Paul and Duluth all used district heating several years ago. (St. Paul is currently reviving its district heating plan, although switching from steam to hot water, which is easier to handle). As is obvious, there is a definite link between district heating and power plant waste.

While district heating is a fine use for waste heat from power plants in the winter months, there is more waste in the summer months, with no apparent use. (i.e., Nobody cares to heat the Metrodome when the Twinkies are playing in it in July and it is 95 degrees anyway.)

But wouldn't it be convenient if there was some way to store this heat for future use? The revival of district heating creates a big impetus to find such a storage means. What is needed is a large, thermal mass, insulated so it will store heat sufficiently.

If water is used as the storing medium (cheap, high heat capacity), you must find out how much heat it can hold. For every degree of heat put into one cubic meter of water, it would cost 0.5¢ if the heat came from coal, 1.5¢ if the heat came from number six fuel oil or from gas, and 3¢ if the heat came from number two fuel oil. Therefore, to heat the water up to about 100° C, about 35-40¢ worth of heat could fit into each cubic meter. Now comes the time to build your tank. Suppose it should hold $1-2 million worth of heat. It would have to be at least one million cubic meters, or one hundred meters on a side, and be very well insulated. It's inconceivable at present that any man-made struc-



Photo/Dan Gerertz

Aquifer Thermal Energy Storage (ATES) unit as it looks on the ground near the physical plant on the St. Paul campus. The ATES reaches 600 feet beneath the surface of the earth to store and remove thermal energy.

UNDERGROUND

ture could be built on such a scale at a competitve cost. As an engineer, it would be impossible to justify this cost.

So, according to Matt Walton at the University of Minnesota Geological Survey, who has studied geothermal and pseudo-geothermal heat extensively and world-wide, as a practical matter, you must turn to the earth.

There are three conditions that must be present, said Walton. First, it must be naturally occurring. Second, it must be insulated and isolated so that it doesn't lose heat. And third, it must be situated such that heat can be put in and taken out at an acceptable rate.

How does one store thermal energy economically, and get it into and out of the ground efficiently?

"There is a great deal to be gained," mused Walton of the idea. "There are large fluxes of transient energy flow. If you can capture the 'delta T', you can have a huge energy source in Minnesota." He explained that your grandpa did this to an extent when he cut ice blocks out of the frozen lakes and used them in the icebox in warmer weather.

At the U of M, there is a particular experiment in man-made geothermal energy going on. Called the Aquifer Thermal Energy Storage (ATES), it is going on near the heating plant on the St. Paul campus. Walton heads the study, and he explains the concept, which is to study high temperature heat storage.

The idea is to find a deep aquifer, hundreds of feet beneath the surface of the earth. An aquifer is a porous layer such as limestone that lies between two impervious layers of rock, such as shale. The experiment uses the stationary groundwater of the Franconia and Ironton-Galesville Aquifers (see Figure 1), which are located between the St. Lawrence and Eau Claire confining beds. The reason it is stationary is that there is an artesian basin formed under the Twin Cities metropolitan area, so there is relatively little flow out of the mass of water.

The Franconia and Ironton-Galesville

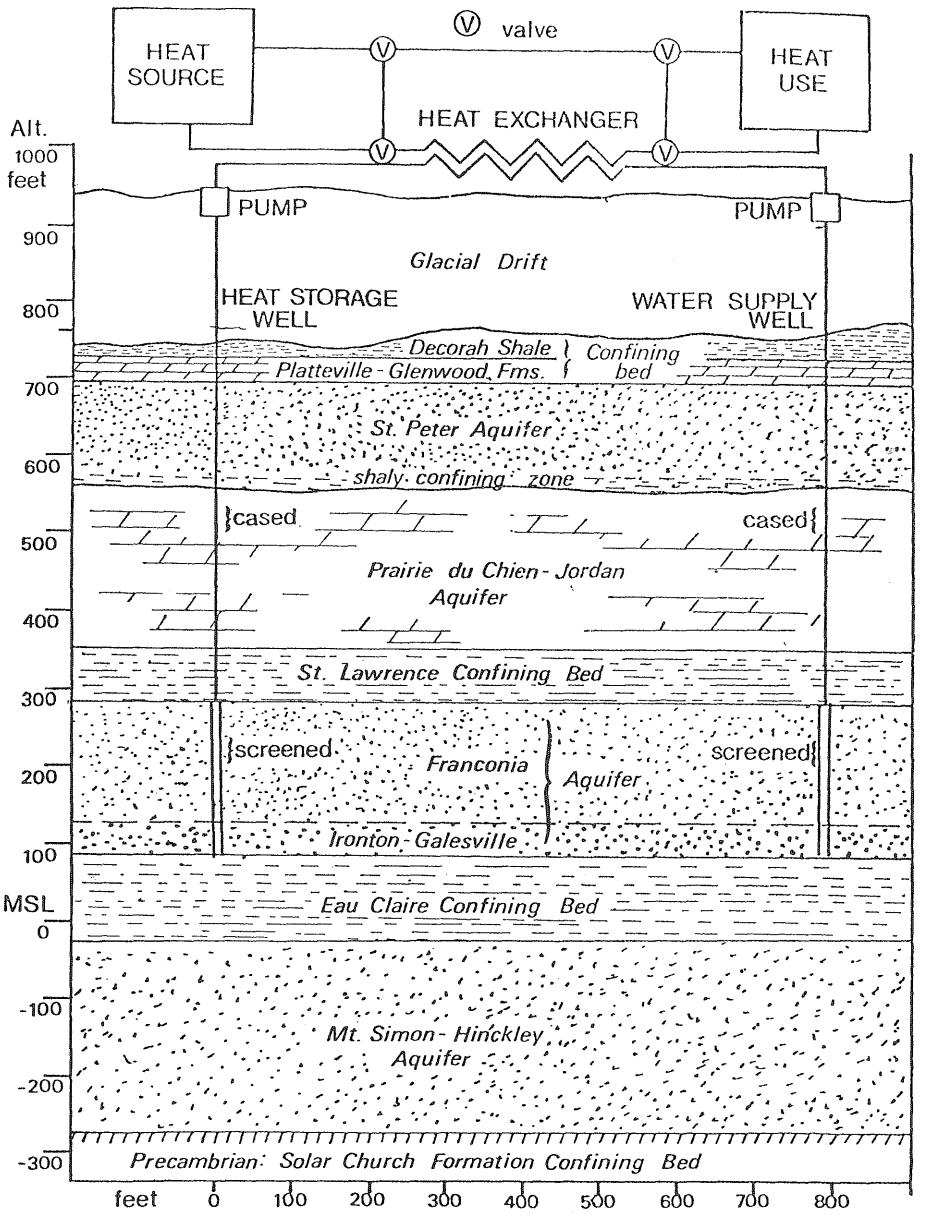


Figure 1. Aquifer Thermal Energy Storage (ATES). This schematic diagram shows the layers of the earth's crust and the heat exchanger at ground level. The experimentation uses the Franconia and Ironton-Galesville Aquifer, and began operation one week ago.

Aquifer was selected because it is not quite as good as the St. Peter or Mt. Simon-Hinckley Aquifers, which are used commonly throughout the twin Cities. The basinlike structure gives the experiment a non-consumptive water supply.

The system in Minnesota is the major experiment in the world for storing hot water. The reasons they want to make it work at high temperatures are twofold. First, if it works, it may be implemented for the high temperature heating system on the St. Paul campus. Second, and much more important, it will study the border between heat storage for space heating and heat storage for power. In space heating, with an efficient heat pump, even groundwater at a natural temperature of 50 degrees Fahrenheit could be used. However, in heat storage for power, a much higher temperature is needed, about 300° F.

The second part of the study is of particular interest for solar energy study. Since very high temperatures can be attained with solar collectors, it would be profitable to store the sun's energy to be recovered to drive a power plant. Integrating solar collecting to steam power generation would open doors to a whole new arena in the energy world.

It all sounds wonderful, doesn't it?

"We're skeptical," comments Walton. "The heating and cooling of the water is going to have some kind of chemical reaction on the aquifer. We're wondering what that will be." Walton explained that heating the water causes carbonates to precipitate out and silica to dissolve, and cooling has the reverse effect. This could cause scaling in the pipes, or maybe precipitate mineral material in the aquifer in a way that would block the pores. Also, clays could cause clogging. Clogging has been a problem in some experiments of this nature.

ATES will run on an eight-day cycle. For eight days water will be heated up by running it through the heat exchanger (see Figure 1) between the heat source and the campus and pumped 600 feet down to the aquifer. The hot water will be stored for eight days, then pumped back up for eight days, again going through the heat exchanger, now using the heat that had been stored for campus heating.

The way the hot water goes into the ground is another cause for concern for Walton. Computer simulations show that as you put heat into cold rock, two fronts are formed, a water injection front and a heat front or thermocline. As the hot water hits the cold rock, the water loses heat, until eventually the rock temperature will rise to 300° F. When this heat is pulled back, it is not a square function. The initial water comes back at 300° F, but the temperature declines rapidly. The high temperature water is only available for a short time. Walton warns that it is doubtful that high temperature water can be stored and brought back at high temperature. Of course the heat could be brought back, but that would require a heat pump, which is an added cost.

The simulation, using the eight day cycle, shows that 49% of the heat could be recovered on the first pass. After five passes, this would increase to 53% (because the rock is becoming warmer). Scientists at Auburn University have achieved 76% recovery, but they are working with water at 55° C (130° F). However, projected to an annual cycle of injecting water for six months, then recovering for six months at twice the rate, the simulation shows up to 86% heat recovery.

"But that's still a guess," Walton said. "We talk about heat transfer through a semi-infinite porous medium, which is fine for the estimates, but that's not what we have down there."

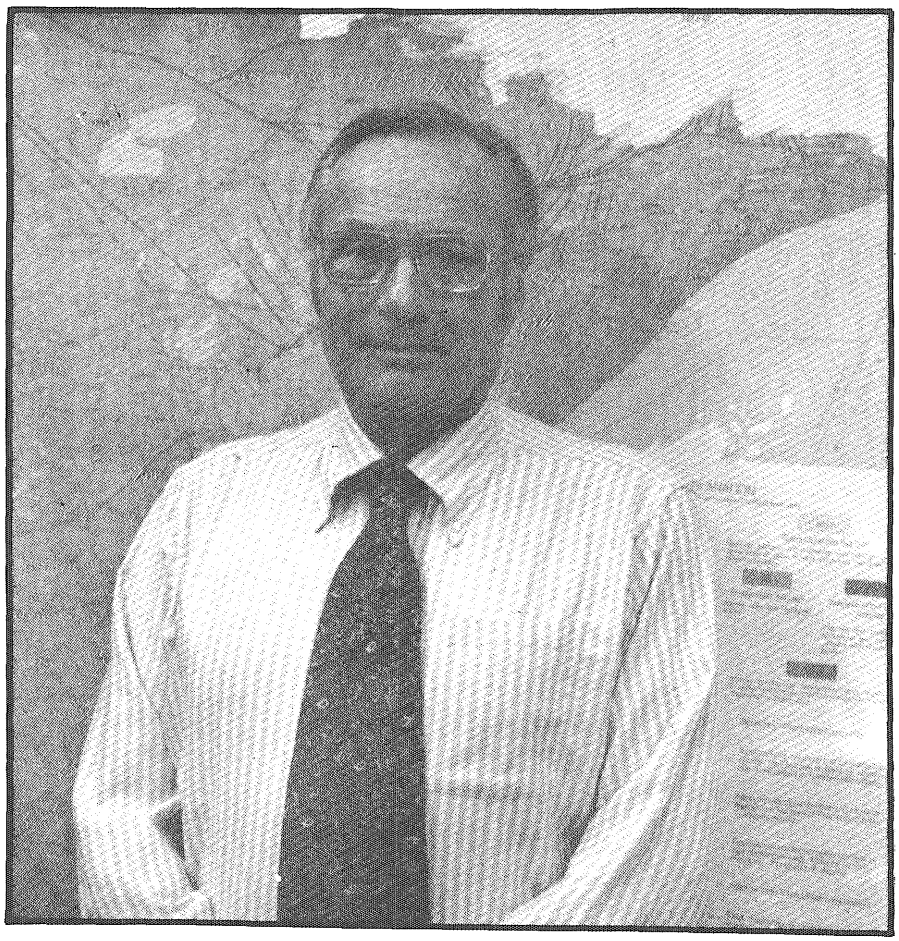
Later, he added, "If waste energy, solar energy and summer heat are to be captured, there is a great deal to be gained. We (Geological Survey) think it is a worthwhile experiment." The operation began late in winter quarter.

Currently, twelve nations throughout the world are studying different forms of man-made geothermal heat storage. One of the studies is occurring in the northeastern corner of Minnesota in Ely.

Born a mining community in 1888, Ely was built on the east end of the Vermilion Iron Range, and was the home of an iron ore mine until 1967 when taconite mining took over the region.

Unlike the neighboring Mesabi and Cuyuna Iron Ranges, which are open pit, the Vermilion Range has mines underground. In Ely, there is an underground mine with an open pit on top.

While in operation, 84 million tons of iron were mined out of Ely. As in most mining operations, there is a sizable



Photo/Dan Geretz

Professor Matt Walton, director, Minnesota Geological Survey standing in front of a hydrogeological map of the state.

amount of waste in iron mining, so while it is an estimate, it is safe to assume that at least 100 million tons of rock were taken from the ground. That's a pretty good sized hole.

Once the mine shut down for good, so did the pumps that kept the ground water out of the mine, and slowly the hole began to fill. It began to fill faster when the city rerouted the storm sewer system into the pit. No connection exists between the mine and nearby Shagawa Lake or any other lake. Yet, the water level is still 17 feet below the level of Shagawa Lake. That should paint a picture of the huge volume of water there. It is at least 25 million tons of water.

Nobody knew of the potential that was filling in Ely until two years ago. An Ely man had purchased the land near the old shafts to use one of the buildings as a warehouse. He later decided to build his home on the land, and was curious about the possible use of the water to heat his home. He called Walton for assistance. Walton said that surely, using a heat pump, it was possible.

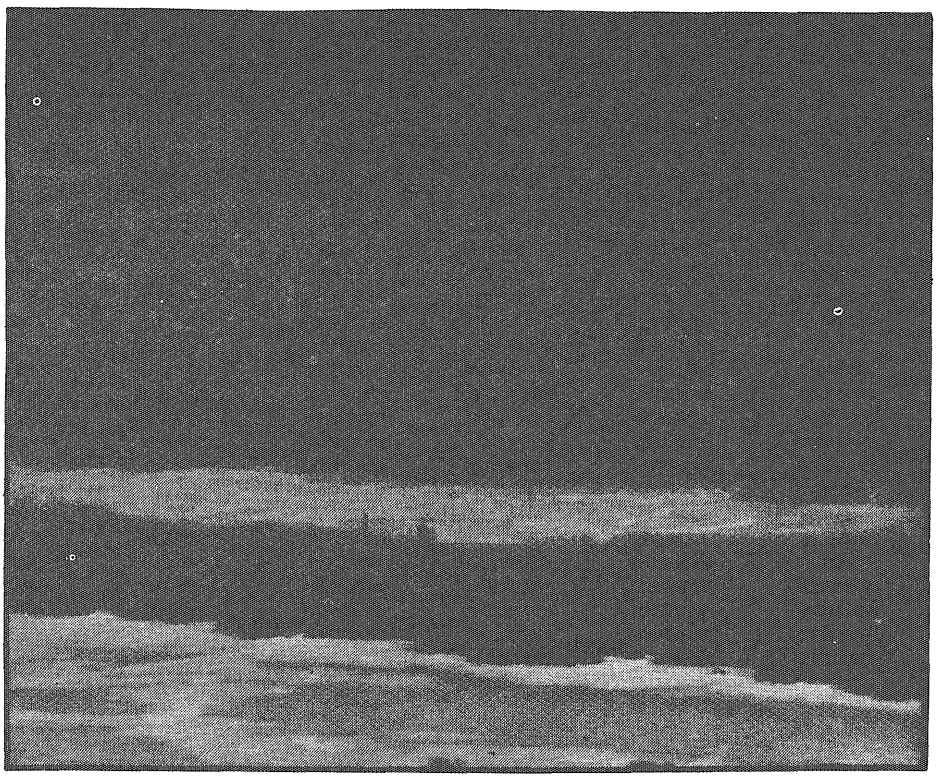
Several months later, Walton got a call back. Would it be possible to use the ground water to heat Vermilion Community College, located just across the pit on the edge of town. Walton didn't know, but said he would plan a fishing trip up that way and go take a look. One look at the size of the water supply, and Walton said there would be enough Btu's in that water to heat the whole city of Ely (pop 5,000) and then some.

A comparison of heat generated from pure electrical resistance and heat generated from burning fuel oil in Ely (fuel is more expensive up in the sticks!) showed that they are about equal. Therefore, using heat pumps with coefficients of efficiency of about 6 (which is attainable), Ely could get about six times as much heat for the money. Try offering any homeowner, especially one in northern Minnesota, a heating bill one-sixth of what he's paying now. It shouldn't be difficult selling the product.

Currently, a company hired by the city is studying the feasibilty, and the city has received a state grant plus a Walter grant for the heat capacity of the mine.

Here again, a problem arises, warns Walton. "The rocks in Minnesota are as old and cold as you can get," he asserted. "If they take heat out with no heat going back in, eventually they will chill the mine, or 'mine' all the heat out of it.

But here's where the beauty of the Ely mine comes in. The pond on top has four million square feet of surface area. By mid-summer each year, the first five feet of water is 70° F. Why not harvest that water, pumping it down into the hole for use in the long, cold winters. In effect, the pond become a huge solar collector, and the mine is the storage facility.



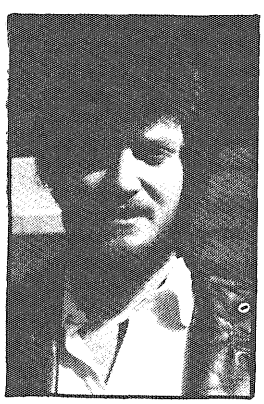
This photo shows the town of Ely as viewed from the north. At the bottom of the picture is the south shore of Shagawa Lake. The open pit is frozen now, and is located right between the town and the lake. On the north end of the pit, you can see the mine shaft.

Photo courtesy of L. Katauskas

Since this discovery, a Twin Cities based computer company has shown interest in the area. The two major products from any computer compay are information and heat. Cooling water is a major cost. A computer center built in Ely would then have a cheap source of cooling water while supplying waste heat to the mine and also to the city directly in winter. As Walton says, using the Chicago stockyards expression, "You're getting everything out of the pig but the squeal!"

This idea also has just as big an application in air conditioning in desert areas, where water chilled during the chilly nights could be pumped into the ground to be stoed for use during the heat of the day. In fact, Walton is on his way to Saudi Arabia to consult on just such a project.

Man-made geothermal systems are catching on all around the globe. Sweden, Switzerland, and Denmark all have projects, to name a few. Each project is individual, but they all follow the same principles. In fact, the Swedes have found that it pays to mine a hole (for no mineral) just for this purpose. While these systems probably won't revolutionize the world, they are another step in the right direction.



Pete Marsnik grew up two blocks away from the open pit in Ely. He also graduated from Vermilion Community College in 1980.

Text Processing: We Put It All Together

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SCRIBE: VAX/VMS

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XEDIT: Cyber Systems

EDT: VAX/VMS

ED: VAX/UNIX

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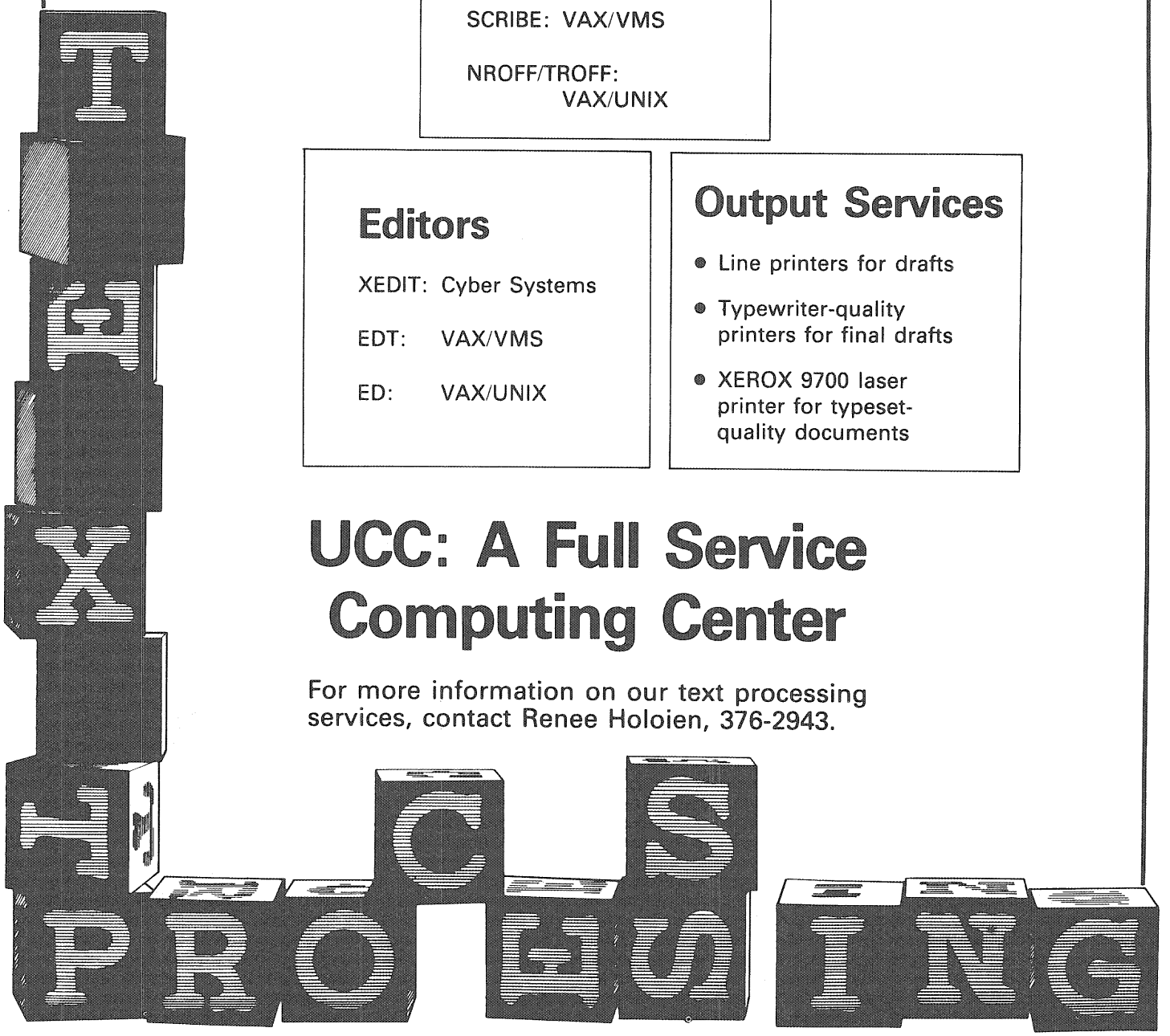
- Line printers for drafts
- Typewriter-quality printers for final drafts
- XEROX 9700 laser printer for typeset-quality documents



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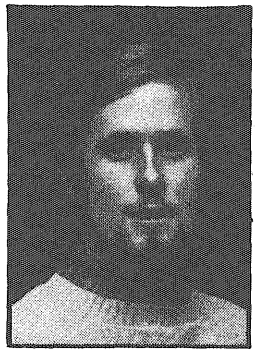
TECHNICAL COMMUNICATIONS



by Terry Hansen

Terry Hanson is a graduate student in the science journalism M.A. program at the school of journalism.

If it hasn't happened already, sometime during your life you are likely to encounter a technical or scientific document written in a style some wit once described as "stream-of-consciousness technical writing." While the author may have had a good technical understanding of his topic, the way it was put down on paper gives you the feeling that you've just crossed over into the twilight zone. As you sit there reading an endless, rambling dissertation full of countless irrelevant details, you almost expect Rod Serling to step suddenly from behind a shelf of journals or a row of filing cabinets and launch into a terse description of your sad plight.

Or, perhaps you have written a few mind-numbing technical documents yourself. Whatever the case, it is certain that life in our technological society would be easier if technical information could be supplied to those who need it in a more clear and concise manner.

It may come as a surprise that an entire University of Minnesota program exists to teach students the very skills necessary to do this. Although this news may conjure up visions of hidden classrooms in a dark sub-basement of one of the engineering buildings, you won't find it there. Instead, the technical communication program is administered by the Department of Rhetoric, located in Haecker Hall on the St. Paul campus.

Professor Victoria Winkler, director of the program, explained that about 80 students are currently enrolled—about 60 as undergraduates and 20 as graduates. The graduate program is designed to provide a Master of Agriculture Degree, a practitioner's degree similar to the Master of Business Administration. The graduate program is thus designed to teach practical skills useful in business and industry rather than more general theory. A minor in technical communication also is offered, she said.

Students majoring in the undergraduate program are required to develop competence in five areas: writing and editing, oral communication, visual communication, organizational communication (managerial style, decision making, etc.), and communication theory and research. Also required are courses in the natural sciences, an internship, and 20 credits of "technical electives" in an area that a student expects to be writing in. Examples include medicine, biological science, engineering, computer programming, and agricultural science.

Winkler said the program is designed to develop both communication skills and technical credibility. She said professional technical communicators in a hiring position seem to have two sets of requirements depending on whether they are working in high technology areas or with low-level users such as in the word-processing industry. The first group says, "Give me someone who knows the technology. I can teach them to write," while the second group says, "Give me someone who can write. I can teach them the technology." She said, "I think we've tried to strike a balance between those two positions."

While Winkler teaches courses in written communication and rhetoric theory, Professor James Connolly specializes in oral presentations. Connolly developed his interest in technical communication during the early years of the space program when he began to work with Honeywell engineers. "The aerospace industry was the first wherein the state of the art moved so rapidly that marketing was of no value whatsoever," he said. It was necessary for the engineers who were developing the complex systems to go to NASA and explain what it was they were working on.

"The main thing I've discovered in working with engineers on the outside," he said, "is that they know to move in a corporate setting, to be promotable, they have to be articulate." Aside from developing the engineering skills, Connolly said, "the traditional concept of engineering did not include those kinds of skills, understandings and abilities that are necessary when you get on the outside." Connolly attributed this in part to the difference in goals and perspectives between the academic world and industry.

Connolly said the key to developing verbal communication skills is overcoming fear. "People who don't make presentations are afraid," he said. "It always seems like it's a kind of mystery. It's not."

Winkler said until very recently, students entering the program have been those who started in engineering or in the hard sciences. After a year or two, they decided they weren't cut out for those areas and transferred into the technical communication program. However, this seems to be changing she said. "This past year," she explained, "we've been drawing more and more students who have heard about the program and are coming into it as freshmen because this is what they want to do from the very beginning."

Winkler said about one-third or one-quarter of the students are "non-traditional college students". She defined these as older people going through mid-life career changes, displaced homemakers coming back into the work force or people who didn't finish a degree and are coming back into the technical communications program.

Winkler said starting salaries for those completing the program range from $18-22,000 for those in the "hard-core" technical writing areas to $14.5-17,000 for the "soft-core" writing areas. Hard-core technical writers are those with high-technology or hard science backgrounds, while soft-core writers have backgrounds in humanities and the social sciences. "The reason salaries are lower in that area (soft-core)," she said, "is because the people from our program are competing with people from journalism, English, elementary school teachers who have decided they don't want to teach any more or social workers."

Soft core writers might work on projects like company news letters, financial statements, benefits packages, press releases and advertising," she said. Hard-core writers would develop more science

and technology-related presentation and documents.

Winkler said some of the companies that have hired their students include Control Data, Honeywell, M.T.S. Systems, 3M, Cenex and several insurance companies and banks. Both Connolly and Winkler said faculty members have extensive contacts within the industry. In addition, Winkler said they have been doing a lot of networking with several local professional societies including the Society for Technical Communication, the International Association of Business Communicators and the Society of Logistics Engineers.

Dick Burnham, a 28-year old undergraduate in the program, recently received a job offer from Bechtel Power Corporation. Dick said he graduated from high school in 1971, came to the university but dropped out after about a quarter. He said he wasn't ready for it at that time. He said in 1978 he returned to the College of Liberal Arts but his interest in science and math led him to enter I.T. After experiencing some of the "meat and potatoes" required, he decided he didn't want to be an engineer after all. "At that point, I was really floundering," he said.

After a thorough examination of other programs offered by the university, Dick discovered the technical communications program. "I just felt that that was me and that's what I wanted to get into," he said.

Asked what he didn't like about the program, Dick responded, "I really have to think hard to find something I don't like." Dick has taken his technical electives in the earth sciences including classes in geology, environmental geology, and oceanography. He said what he has learned about audience analysis has been the most helpful to him.

Frank Mangan, a 30-year old graduate student in the program, was not certain about his ultimate goal once he graduated. "The program has opened a number of avenues I never even considered before I got into it," he said. As an example, he cited his experience as an intern with the science and technolgy research office of the state legislature.

"I like variety," he said. "I'm not keen on the stereotype of a technical writer as someone who puts together manuals. I've had eight years of experience in the business world and after that, I think there's less of a reason to have a clear-cut objective. There's a lot of variables in picking a career track."

Before entering the program, Frank said he had a B.A. in English from Northern Illinois University and had worked as a market analyst and a buyer. He said he became dissatisfied with his job as a buyer and took a career development course to help him decide what to do. He said the results of a Strong-Campbell Interest Inventory helped point him toward the technical communication field and he decided to enroll full time.

The technical communication program was initiated in 1971 by the Head of Rhetoric Department, Professor Thomas Pearsall. At that time the program had only two students. 'The whole technical communication field is a relatively new one," said Dr. Winkler. "Most companies who needed people to do this work either got engineers who could write and retooled them to do it, or brought people in who they could teach the technology to, or called upon a secretary who'd been with the company for thirty years." She said Pearsall is considered a founder of technical communication as a discipline.

Professor Pearsall said he first developed an interest in the subject while teaching American literature at the Air Force Academy. He said he was attending a meeting of the National Council of Teachers of English when he happened to drop in on a technical communicaiton session. The topic turned out to be to his liking. Later, he volunteered to teach technical writing at the Air Force Academy and came to the conclusion that the text book in use left a great deal to be desired. He then wrote a new text, the first of several books he has written on the subject.

When Pearsall first came to the University of Minnesota in 1969, no technical communication program existed here. In 1970, he was asked to chair a sub-committee on curriculum development for the Society of Technical Communication. At that time, he said, there were only about eleven programs on the subject in the entire nation. (There are now about 28.) At the same time, he said, it occurred to him that all the people necessary for a program were here. He wrote up a proposal and it was approved the following year.

Professor Winkler said the program should not be too vulnerable to possible budget cuts. 'We're operating under the assumption that it's one of the stronger programs because it's drawing so well," she said. "We don't anticipate a problem."

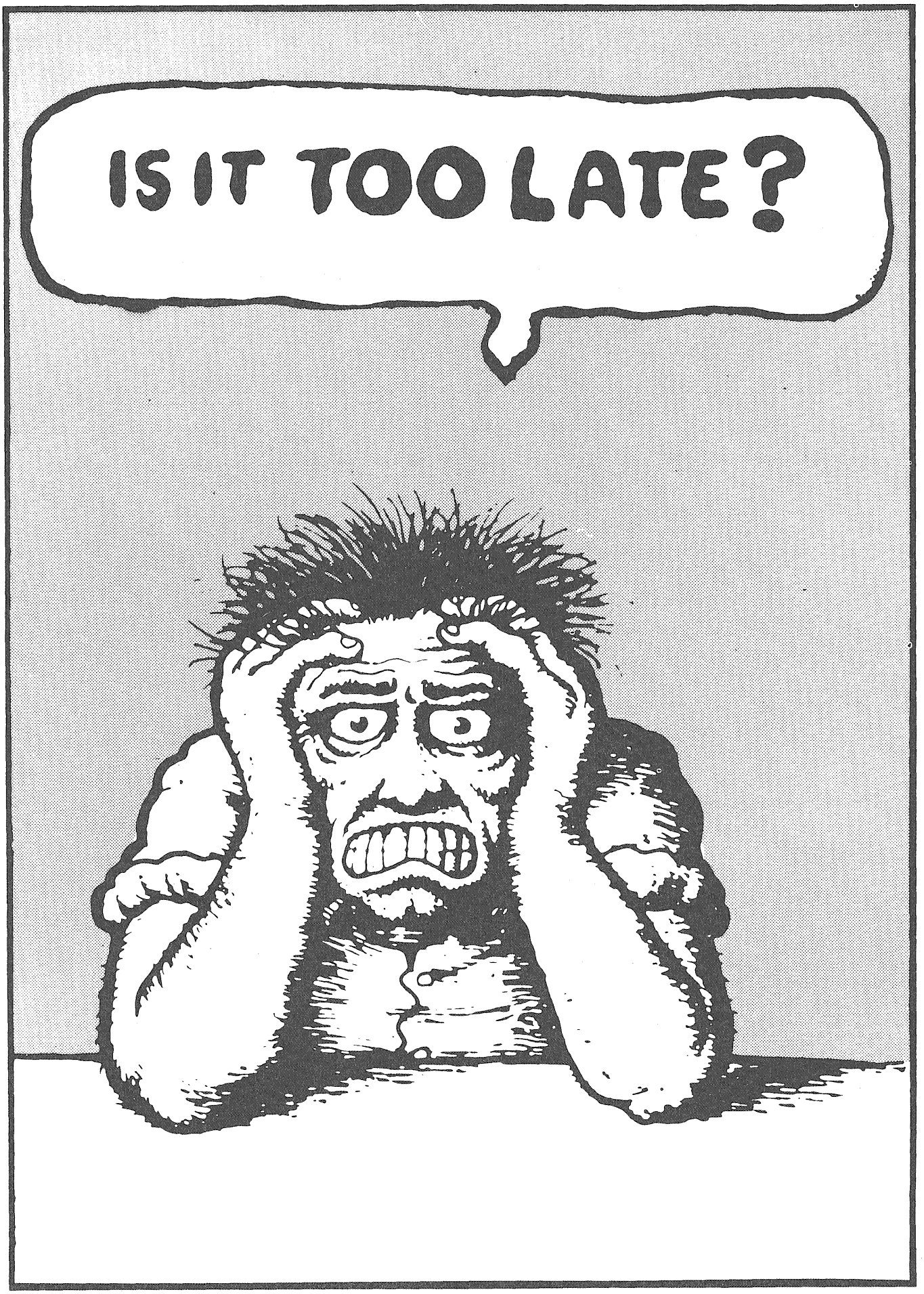
Modern electronic technology has had a major impact on the field of techincal communication. Most students in the program use word-processing CRT's just as they will when they graduate and begin their career, she said. In addition, several courses offered as part of the program deal with the impact of new technology.

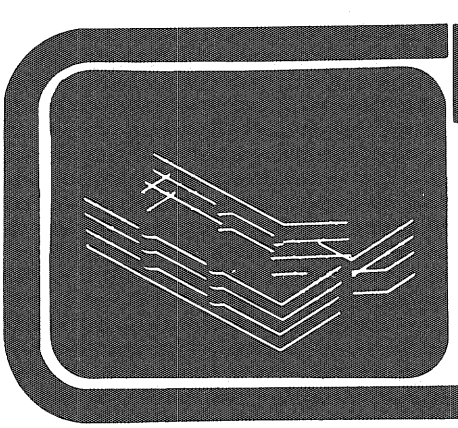
When asked about future technological developments, Dr. Pearsall said, "It's almost impossible to predict what the final impact will be." However, he cited some obvious changes that will come about. Many types of printed manuals will be phased out, he said, and the content will be stored in electronic memory instead. "It will make revision of technical documents much easier," he said. A user will simply call up the pages he needs on a screen. Pearsall also said videodisk technology will be particularly important for training purposes.

Asked if computerized documenation aids similar to computer-aided-design (CAD) systems will be used, Pearsall said he is consulting with a Minneapolis-based ocmpany that is develophng just such a system. "That, I think is right down the road. "One of the problems is making that a paying position." Such systems are particulary vulnerable to software pirates, he explained.

Photo/Dan Geretz

Professor Victoria Winkler, director of the technical communication program. The Technical Communication major is part of the Department of Rhetoric, housed in Haecker Hall in St. Paul.


IS IT TOO LATE?



Brain Teasers and Belly Laughs

There is no time like the present to postpone things you don't want to do.

LAW OF PROBABLE DISPERSAL:
Whatever hits the fan will not be evenly distributed.

LAWS OF EXPERIMENTATION:
1. If reproducibility is a problem, conduct the test only once.
2. If a straight line fit is required, obtain only two data points.

GROUND RULE OF LABORATORY WORK:
If you don't know what you're doing, do it neatly.

One letter you'd like to see:

Dear Coach:
Remembering our discussions of your football men who were having troubles in English, I have decided to ask you, in turn for help.

We feel that Paul, one of our most promising scholars, has a chance at a Rhodes scholarship, which would be a great thing for him and our college.

Paul has an excellent academic record for this award, but we find that the aspirant is required to have other excellences, and ideally should have a good record in athletics. Paul is weak. He tries hard, but he has troubles in athletics.

We propose that you give special consideration to Paul as a varsity player, putting him in the backfield if possible. In this way we can show a better college record to the Rhodes committee.

We realize that Paul will be a problem, but you often said, cooperation between our departments is highly desirable.

His work in the English club and on the debate team will force him to miss many practices, but we will see that he carries an old football around to bounce (or whatever one does with a football) during intervals in his work.

We expect Paul to show entire good will in his work for you, and though he will not be able to begin football until late in the season, he will finish the season with good attendance.

Sincerely yours,
John Johnson, Chairman
English department

Student: What is the first lesson in chemistry?
Teacher: Don't lick the spoon.

A professor recently received a blue book from one of his more philosophical students. It read in full: "After serious reflection, I have concluded that there is both truth and beauty in these examination questions. The truth is that I don't know the answers and the beauty is that I don' t give a damn."

The professor, not amused, added the remark, "Ergo Flunkis."

Q. Why does Dolly Parton buy all her bras at Datsun?
A. That's the only place she can find a 280Z.

The shortest distance between two points is under construction.

A zoology major was told to provide an exhaustive study about fleas. He laboriously trained a medium-sized flea to jump over his finger every time he said "Hupp." The then he pulled off two of the flea's six legs. "Hupp," he grunted. The flea jumped over his finger. Off came two more legs. "Hupp," repeated the student. Again the flea jumped. Then he pulled off the flea's last two legs. Alas, the flea no longer moved. The student nodded sagely, and wrote in his report, "When a flea loses all six of its legs, it becomes deaf."

Teacher: Now spell straight.
Small student: S-T-R-A-I-G-H-T.
Teacher: Good. Now, what does it mean?
Small student: Without water.

Will Rogers' wit was already well developed when the beloved humorist was a college freshman. At college during one of his first classes, the teacher asked him, "Where are your books?"

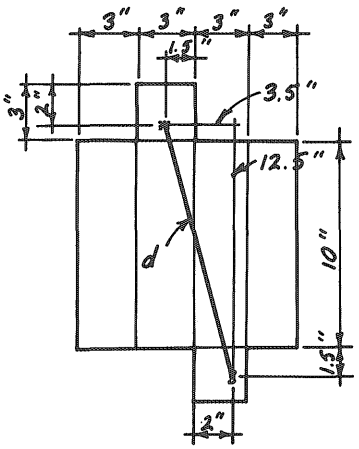
"I ain't got none," replied Will.

"What would you think of a man going to work without any tools?" demanded the teacher.

Quipped Will, "I'd say he was the boss."

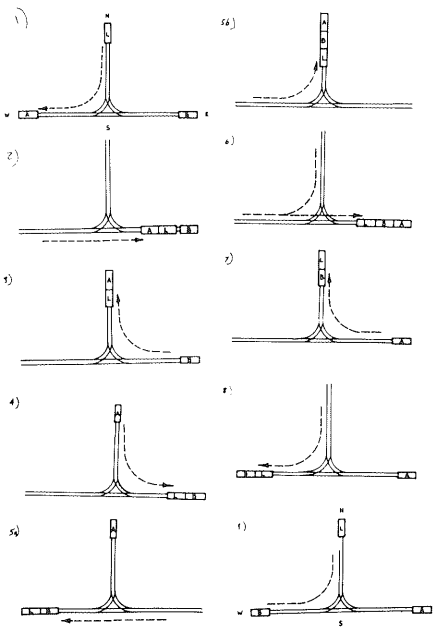
Tom Snyder beat everyone to the T-shirt for answering the Brain Teasers in Winter II. Here are the answers he arrived at:

1. distance **d** = 12.98 inches
   The spider ate the fly.



2. First, two cannibals get in and cross the river (the one who can row is along). One stays on the other side, while the one who can row comes back. The remaining cannibal gets in and is taken across by the cannibal that can row. The rowing cannibal comes back, gets out, and the two priests row to the other side. One priest gets out, one cannibal gets in and the priest and cannibal row back to the original bank. Here the cannibal gets out and the rowing cannibal gets in and rows across the river. The other cannibal gets in in place of the rowing cannibal, and they row back to the origianl side. The cannibal gets out and the priest gets in. They go across the river, where they both get out and send the rowing canibal to pick up the other cannibals in two trips across the river.

3.



Technolog would like to extend thanks to **Ben Goldstein**, an instructor in EE for donating the Brain Teasers for each issue. Here's four for this issue. The same rules apply. Be the first to answer all the questions correctly and win yourself a "DO I.T. with an engineer" T-shirt.

1. There are ten sacks, each containing ten spheres, weighing one gram each, except for one bag, in which the spheres weigh half a gram less. In *one* single weigh, determine which bag has the different spheres.

2. A census taker was going from house to house doing his job when he was greeted by a man at the door of a house who said he lived there with his three daughters.

"How old are your daughters?" he was asked.

The man answered, "The product of my daughters' ages is equal to 36."

"That's not enough," replied the census taker, "I'll need another clue."

So the man said, "The sum of their ages is equal to the house number across the street."

The census taker thought, then said, "That still isn't enough."

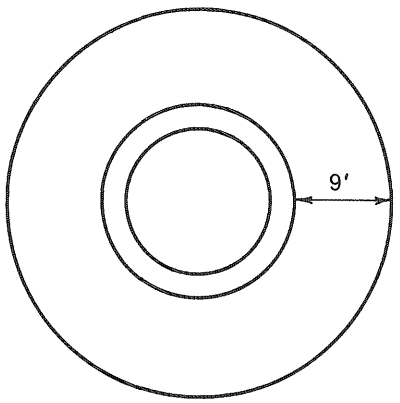
"Okay," replied the man, "my oldest daughter has blue eyes."

The census taker said, "Thank you," wrote down their ages, and left.

What are the ages?

3. Using four fours (four 4's) and the four basic operations (add, subtract, multiply, and divide), construct equations for the numbers 0 through 10, inclusive.

4. There are two swimming pools shown below. The outer pool is dirty and you don't want to go through it to get to the inner pool, which is nine feet away from the outer edge. You have two planks eight feet long. How do you use these boards to get to the inner pool without getting wet. (You have no hammer or nails.)



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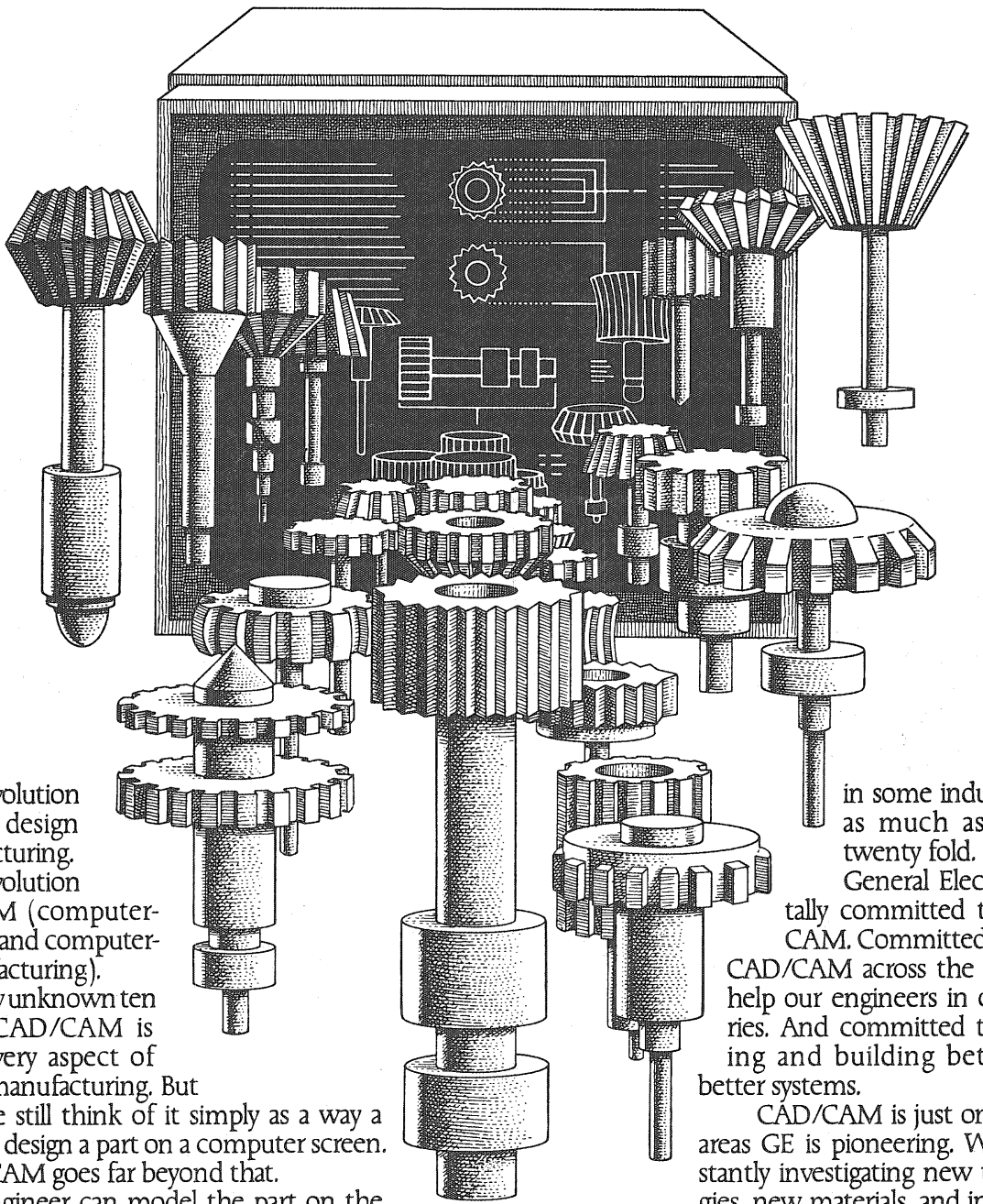
Design and test a part 3000 different ways. Before you make it once.



There's a revolution going on in design and manufacturing.

The revolution is CAD/CAM (computer-aided design and computer-aided manufacturing).

Virtually unknown ten years ago, CAD/CAM is changing every aspect of design and manufacturing. But many people still think of it simply as a way a designer can design a part on a computer screen.

CAD/CAM goes far beyond that.

The engineer can model the part on the computer in three dimensions. In color. Even put two or three parts together on the screen. Then, use a computer to analyze the design. And produce a finished engineering drawing at the press of a button.

Instead of trying one or two design solutions, an engineer can use the computer to try 3,000 or 4,000.

But there's more.

The engineer can calculate on the screen the tool path required to machine the part. Then produce the numerical-control data tape. Or electronically transfer the data directly to the machine to produce the part.

What once took weeks can now be done in hours. That's why CAD/CAM is increasing productivity in some industries by as much as ten or twenty fold.

General Electric is totally committed to CAD/CAM. Committed to using CAD/CAM across the board to help our engineers in our factories. And committed to designing and building better and better systems.

CAD/CAM is just one of the areas GE is pioneering. We're constantly investigating new technologies, new materials, and innovative applications for existing technologies — in such areas as energy sources, microelectronics, aerospace systems.

This all takes talent. Engineering talent.

If you'd like to know more about engineering opportunities at GE, check your Placement Office or write to: Engineering, Building 36-504, Schenectady, NY 12345.

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Spring II, 1982

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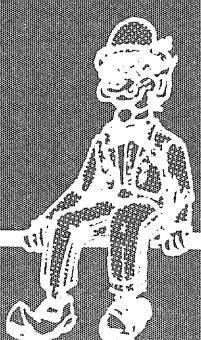
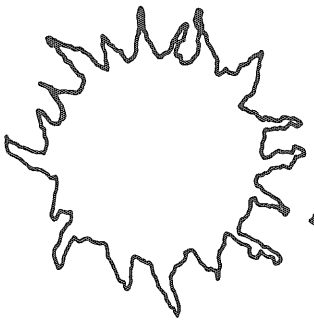
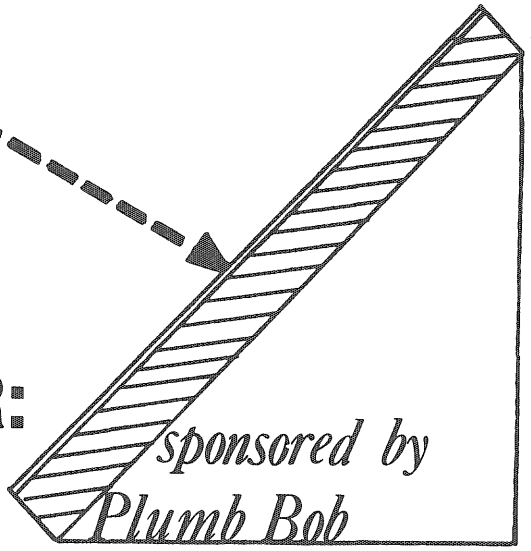




INNOVATIVE TECHNOLOGY ON DISPLAY.....



I.T. WEEK TECHNOLOGY FAIR: MAY 5 & 6

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CELENESE CO.
CONTROL DATA CORP.
CRAY RESEARCH
DATA CARD CORP.
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MAJOR SYSTEMS DIV.
DEFENSE SYSTEMS DIV.
SEMICONDUCTOR DIV.
STANDARDS ENGINEERING SOCIETY
TENNANT COMP.
TEXAS INSTRUMENTS INC.

ALSO DISPLAYS BY I.T. DEPARTMENTS AND STUDENT ORGANIZATIONS

The TECHNOLOGY FAIR will be held on the Northrop Mall at the following times:

Wednesday, May 5	9:00am to 4pm and 6:00pm to 9:00pm
Thursday, May 6	9:00am to 4:00pm

Editor's Log

When it comes time for graduation, the aspiring engineering student will don his/her best conservative suit or dress, shave his face, and comb his hair. Why? Because he/she wants to create an image, a good impression when he sits down in the interview.

But are the suit and tie a natural environment for Mr. Engineer, or would he rather be in a flannel shirt with raggy blue jeans and four days growth on his face? Whether one falls at either end of the spectrum, or somewhere in between, most people will do something to make a good impression at a first meeting, to create a favorable image.

The University of Minnesota is trying to create an image as well. Last quarter, President C. Peter McGrath sent down a directive putting a freeze on all spring quarter publications. All, regardless of how they are funded. It seems that there are more than 150 publications coming out of this university, and McGrath wants to create an image that everybody is cutting back and chipping in to save money.

Minnesota Technolog has received permission to publish spring quarter, along with eleven other publications. This right was won after quite a struggle. Twenty-four others requested permission to publish and were denied. The other 120-odd publications took the cut with a stiff upper lip and the idea that "you can't fight City Hall (or the Board of Regents)."

Technolog is funded by student fees and advertising, and does the typesetting and printing off campus. We feel a responsibility to our readers and advertisers to print a quality magazine, since they pay for it. *Technolog* was granted *permission* to print Spring II (Spring I was unaffected as it was in print before spring quarter started), on a reduced scale, with a statement explaining that it is half the size it could be due to the budget cuts.

Will this help in the University's fight against the State budget cuts? As far as the image goes, it could. However, a legislator will read *Technolog* only if he/she has a paid subscription (currently, there are no Minnesota legislators on the mailing lists). As far as the budgetary end of it, this cut will save the University of Minnesota a total of: $0.00! With savings like that, it's easy to see that if we all tighten our belts, we'll be out of the red in no time.

Pete Marsnik is vacating his position as editor of *Technolog*. As soon as his bail is posted, he will begin looking for something new to do with his time. Perhaps graduate next quarter?

Peter G. Marsnik

Peter G. Marsnik
Editor

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Undergraduate Magazine of the Institute of Technology, University of Minnesota

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"We Do I.T. for YOU!!"
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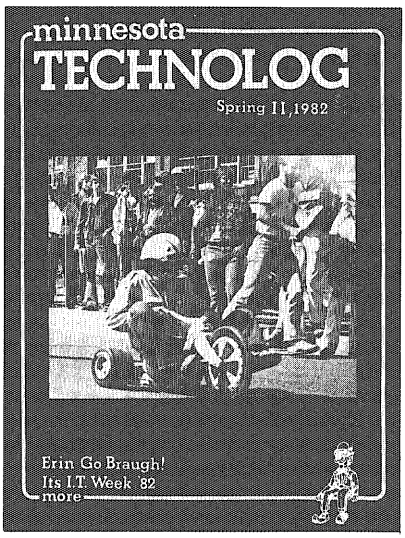

COVER: E-Day 1981

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Mapping the

by Ruth Schneiker

A geologist's life is an enviable one, for who but a geologist and a handful of other natural scientists could spend an entire summer in the Boundary Waters Canoe Area and get away with calling it work?

Last summer, Jim Miller, who is working on his Ph.D. in minerology and petrology, and Gene Mullenmeister, an undergraduate in geology, did exactly that, and Jim plans another trip up this September. But the pair did very little leisurely canoeing and camping. Most of their time was devoted to delineating the detailed geology of a portion of the Duluth Complex in the BWCA, specifically the Lake One through Four chain in the Forest Center Quadrangle. The Duluth Complex is a Precambrian igneous intrusion and part of a major rift system.

The purpose of the trip, which lasted from mid-June through the third week in September, was to collect field data for Jim's Ph.D. thesis. The results were varied. "The whole idea of the purpose of the trip changed in mid-stream," Jim explained. "At first we wanted to find a structure, faulting for example, and basic geological relationships, such as the variety of rock types. But when we say the complexity and how difficult it was to recognize structure, we realized detailing would be better," he said. So they mapped a smaller area, cutting back from their original goal of covering tens of miles, to that of studying only sixteen square miles, focusing on the relationships between two major rock types encountered: anothosite and troctolite.

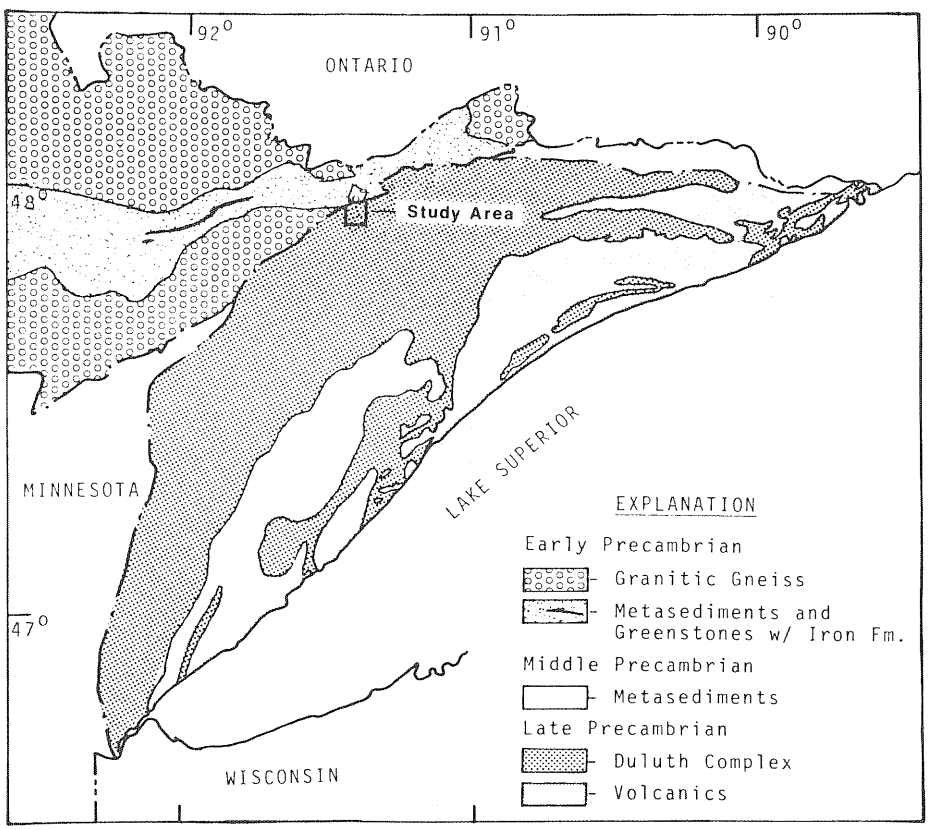
"One of Jim's goals," Gene said, "is to determine whether these two rock types were separate events, i.e., separate intrusions of molten magma, or whether they differentiated from a single magmatic impulse." Currently, explained Jim, the former interpretation is favored. The Anorthosite Series, the older of the two, "is characterized by plagioclase cumulates which form a semi-continuous, but internally disrupted cap to the Duluth Complex," Jim wrote in his Doctoral Dissertation Research Proposal. Intruding this anorthosite cap is the Troctolite Series, composed of plagioclase-olivene-pyroxene cumulates.

Most of the previous geological work done in the area Jim and Gene studied was done for economic reasons. From Jim's proposal:

> "Detailed petrologic investigations of the Duluth complex, to date, have dealt almost exclusively with rocks of the Troctolite Series. This is due, largely, to their economic potential and to the preservation of their primary internal features. The anorthositic rocks, which are thought to cover over 69% of the total exposure area of the Complex, have received only a cursory investigation of their field occurrence and general petrology. No economic mineralization has yet been identified in the Anorthosite Series rocks. Present mapping indicates that the anorthosites are extremely complex in mineralogy, texture, and structure, which is due, in part, to the intrusion of the Troctolite Series magma.

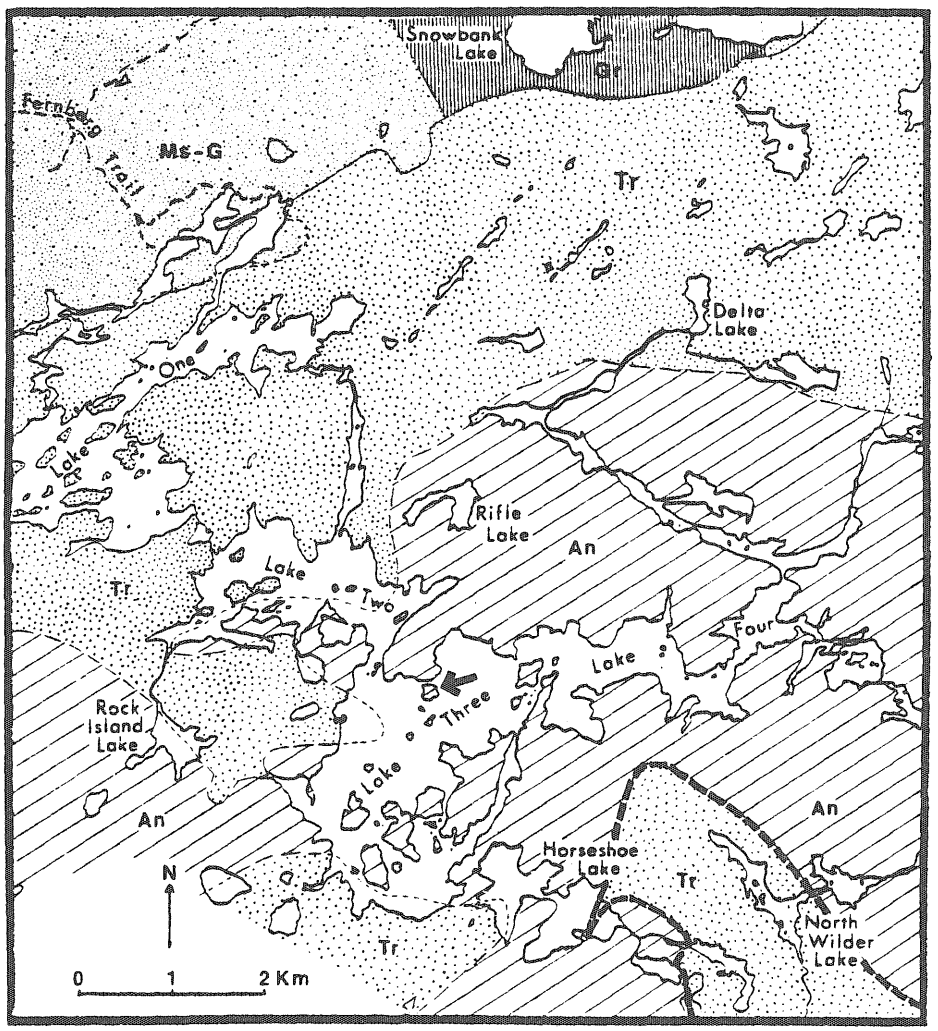
Jim called the work he and Gene did last summer a "second look," which was purely academic in purpose.

From this academic viewpoint, one interesting aspect of the anorthosites is that they are a unique component of the early history of the earth. Because they have been found to constitute a major portion of the lunar crust, and because earth and moon origins are believed to be closely



Location of area under study.

B W C A



The newly discovered western extent of the troctolites is located in the southeast corner of Jim and Gene's study area shown here. Base camp, on an island on Lake Three (see arrow), was four portages away.

linked, anorthosites enable scientists to better understand early earth history.

Another interesting feature in the study of the Duluth Complex is related to the theory of plate tectonics.

Only within the last ten years had a major tectonic feature in the U.S., the Midcontinent Rift system, been recognized, of which the Duluth Complex is a part. Two definitions, provided by Jim in his proposal, are useful here:

Plate Tectonics: The theory that the earth's crust is comprised of numerous torsionally rigid plates in horizontally divergent, convergent or static motion relative to one another.

Rift: A linear depression formed within a previously stable continental mass as a result of divergent (tensional) tectonics.

Rocks of the Duluth Complex provide a record of the forces that created this particular rift system, and are also valuable in the study of rifting in general.

"The Duluth Complex," explains Jim, "offers a rare opportunity to study the anatomy of an intercontinental rift system which is a tectonic feature common to many areas worldwide," Another such rift system is the African Rift Valley in Eastern Africa.

Jim and Gene's academic approach included the study of mineralization in the Duluth Complex.

The Troctolite Series rocks contain over a billion tons of copper and nickel ore, "making the Duluth Complex one of the largest potential Cu-Ni resources in the world," according to Jim, but the anorthosites may have economic value as well. A rock body similar to the Duluth Complex, the Stillwater Complex in Montana, contains anorthosites which are capable of providing significant amounts of platinum group metals. Due to the similarities of the two rock bodies and the possibility of similar origins, there seems to be a likelihood of similar mineralization in Duluth Complex anorthosites.

What's an average day in the life of a field geologist like?

According to Jim, he and Gene got up between 6:30 and 7:00 each morning. Sounds terribly early, but, Jim explained, there are fewer bugs in the morning and it's cooler, too. Since canned goods are prohibited in the the BWCA, and eggs are hard to carry, the team usually had pancakes for breakfast. In July, blueberries ripened, so for a change Jim and Gene made blueberry pancakes, which Jim remembers as "a real taste treat."

After breakfast, they got their gear together, and canoed, sometimes up to an hour, to that day's study area—outcrops surrounding the lakes. Once at an outcrop, tasks were split according to individual goals and information needed to complete those goals. Jim did the basic geology, including measuring the layering on rocks (an indicator of igneous intrusion shapes) and marked the findings on maps. Gene recorded joint patterns, information to be used in his senior thesis.

Ten to twenty exposures were completed each day, depending on complexity, and eventually "we did almost every

outcrop along the lake shores," Jim said.

Because of a natural tendency to get lazy after eating, Jim and Gene ate their lunch of peanut butter and jelly sandwiches late, and by four or five p.m., they were ready to canoe back home. After dinner (typically including freeze-dried foods, Rice-a-Roni, Jello), they labeled the rock samples collected that day, went over the geology completed, and finally, planned the next day's work. Then each pulled out a novel and read. With sunset, the west side of Jim and Gene's tent was host to thousands of mosquitos which kept up a constant buzz all night," Jim recalled.

Work went on at this pace for ten to fourteen days, after which the pair went to Ely to resupply. "We came back to Minneapolis twice during the summer to regain our sanity," Jim said. These return trips, made in Jim's '67 Rambler, include the transport of approximately 500 to 1000 pounds of rock samples, to be used in petrology graphic work. Once in the lab, the rocks are cut into "thin sections," slices of rock, 30 microns thick, and about 4 square centimeters in area. Each thin section, mounted on a glass slide, is studied under a polarizing light microscope. Over the winter Jim studied the mineralogic and textural characteristics of the anorthosite in over 70 thin sections.

A geologist's life isn't all hard work. Jim and Gene managed a few unusual adventures over the course of the summer.

In spite of these exciting adventures, the work "got boring at times," Jim said, especially "because the area had been mapped before; nothing much was new." In 1968 William Phinney, a former U of M professor, did a reconnaissance map of the area. A reconnaissance map, described Gene, is a "quick and dirty geologic inspection of an area." The pair used maps and aerial photographs provided by Phinney and topographic maps from the U.S. Geologic Survey as aids in their work.

In the last four days they spent at the BWCA in late September, the two made an interesting discovery. A new, more remote area exhibited an unexpected geologic relationship. The area was out of the way, "we went through four portages to get there," said Jim. (See map)

In his earlier map, Phinney had found troctolites similar to those found in this new area, but this area was five miles to the east. "We expected to find anorthosites," Jim said. What Jim and Gene found was the western extent of the troctolites. Due to the crunch for time, "we just cruised through the geology," Jim said. This September Jim will return to the BWCA to finish up the work on these troctolites.

Both Jim and Gene will give talks during the first week of May at the "Twenty-eighth Annual Institute on Lake Superior Geology" in International Falls. Jim's talk, entitled "Mineralogical and Textural Variations of Anorthosites on the Duluth Complex," and Gene's "Structural Analysis of the Duluth Complex NW, Forest Center Quadrangle, MN," describe the work and findings of the summer.

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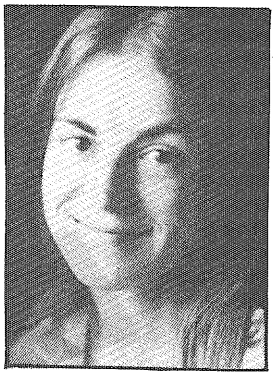
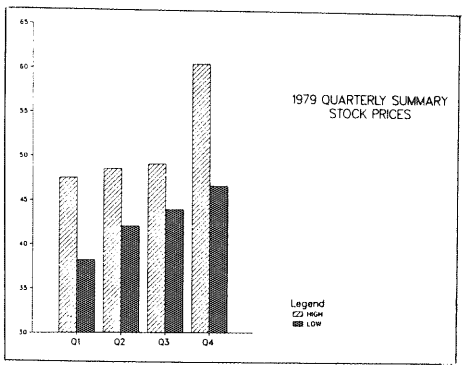


Ruth Schneiker has a degree in journalism and German, and is now taking a course in Geology.

Say it with Pictures



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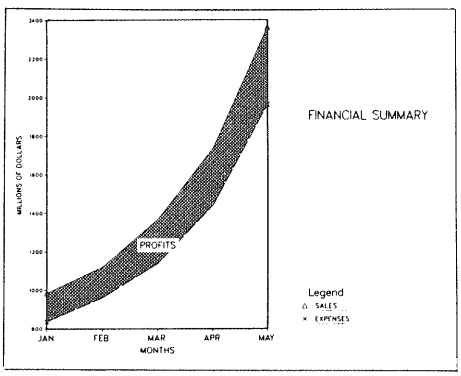

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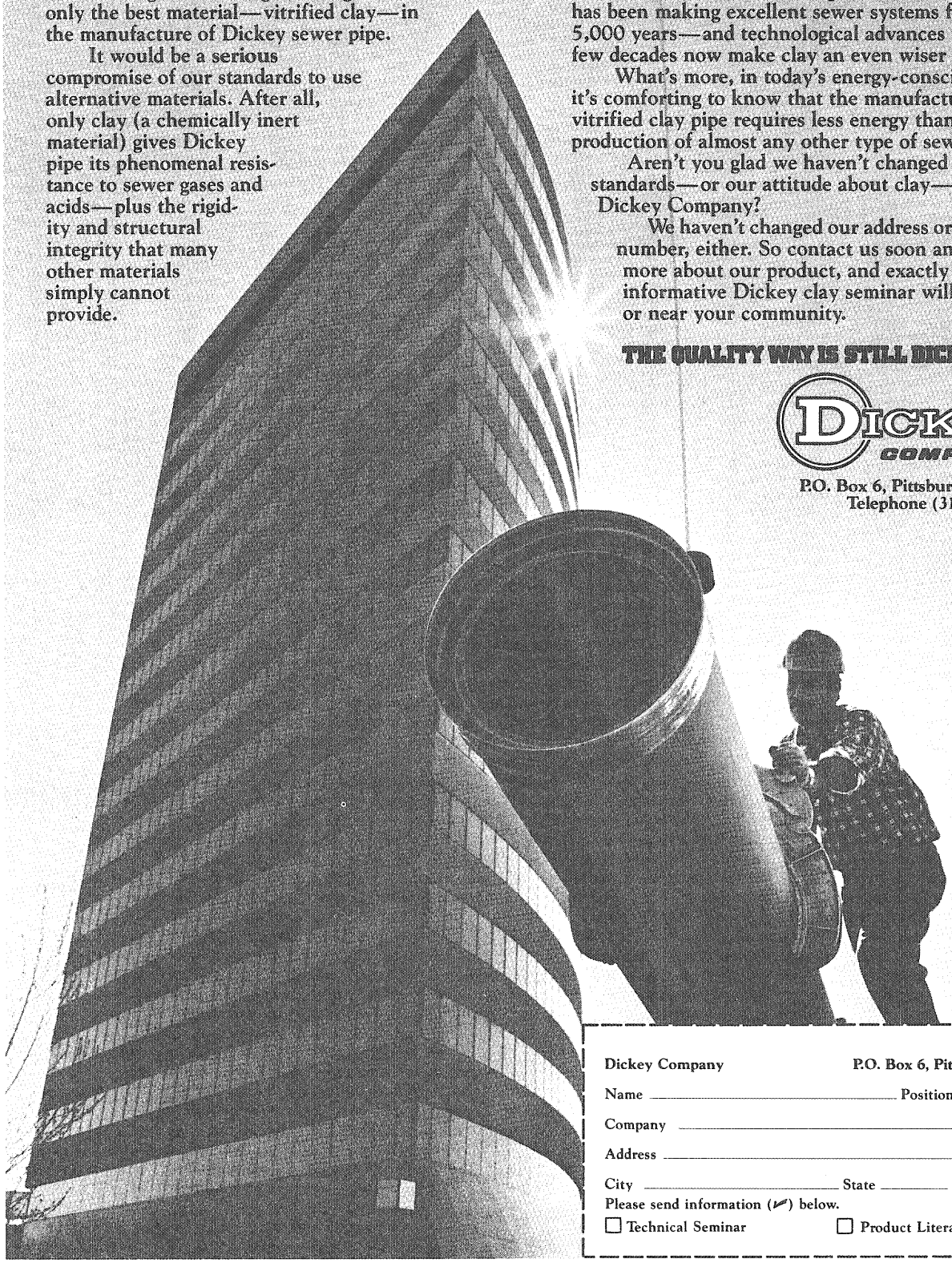

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I.T. WEEK: A HISTORY

Engineer's Week is no more. But the spirit lives on in the new all-encompassing I.T. Week 1982, with more fun and entertainment than ever. This week, which starts Monday, May 3, is when all I.T. students get involved in five days of fun, entertainment, information, and just plain craziness. Plan to become involved. You won't be sorry!

I.T.-Week 1982 runs from May 3 through May 7. Schedules of events can be found in *Blarney's Castle* and the IT newsletter, *The I.T. Connection,* distributed throughout the IT campus in *Technolog* magazine racks.

I.T.-Week is sponsored by the IT Student Board, the Minnesota Student Association, and the IT Alumni Society and is directed, as it has been throughout its history by IT's senior honorary fraternity, Plumb Bob.

Sixty-eight years ago, when the spring celebration officially came to the University of Minnesota as E-Day, the engineering laboratories were open for all to see just what it was engineers did. Soon after, national and local industrial groups joined in the diplays and brought examples of flourescent lighting, controversial transport aircraft, and demonstrations of mining equipment to the campus.

Early accounts cite both Minnesota and Missouri as the birthplace of this student engineers' celebration. Minnesota's began with an excavation for the foundation of an engineering annex, dug in 1903. It was there that the legendary Blarney Stone was uncovered. This was not an ordinary stone, but the one carrying a mysterious inscription in ancient script, "Erin Go Braugh," and glowing green.

On the evening of March 16, 1903, University of Minnesota engineering seniors who had discovered the stone revealed the meaning of its hieroglyphics: "St. Patrick was an engineer." And it was said that St. Pat's mainstays were his Blarney Stone and slide rule, though the worm gear was also close to his heart since the day he had driven the worms or snakes out of Ireland.

Thus St. Patrick's Day, March 17, was made a holiday celebrating engineering's Irish ancestry. And a large group of students dedicated themselves to the service of their patron saint, then followed a band about the city, singing Irish songs and reveling.

While those of Irish or near-Irish ancestry were extolling St. Patrick at Minnesota, students at the University of Missouri were looking for a similar excuse to enjoy spring weather. Their elaborate celebrations soon spread to other schools, particularly to Iowa State University where they were enjoyed by a student named George C. Priester who came to Minnesota in 1910 as a postgraduate.

Priester passed on the tradition to engineering students here who initiated a major event in 1914 and established E-Day at the University of Minnesota.

On March 17 that year, an all-green *Minnesota Daily* proclaimed that "St. Patrick was an Engineer!" and that thereafter engineers would monopolize the Irish celebration and entertain the entire University.

That day's jubilant events, sanctioned by University President George Vincent, included a noon parade with the University Band leading a procession of engineering students through the campus, a knighting ceremony at which Professor Priester, as "St. Patrick," conferred the title of Knight of St. Patrick's on the dean of the College of Engineering and its faculty, graduate students and seniors who then kissed the magical Blarney Stone and thereafter possessed the gift of golden tongues.

There was also a Green Tea held for all on campus in the electrical engineering laboratories and attended by William Howard Taft, who was lecturing at Minnesota. An evening Engineers' Ball, preceded by a vaudeville show held in the Armory, drew the largest crowd of any

If you remember what a big success the **Technology Fair** was last spring, get set for a show, because 1981 can't hold a candle to what's in store for you in '82! The Tech Fair will get under way on Wednesday morning, and continue throughout Wednesday and Thursday on the mall.

The KS-95 hot air balloon will be on hand Wednesday morning between Kolthoff and Ford Hall. Its liftoff will officially open Tech Fair. Be sure to catch the Air Force's T-38, the same plane the Thunderbirds use. The 45 foot bird with 26 foot wingspan will be on display throughout the week.

And of course, be sure to take in all the exhibits. This year, there will be a lot more to 'play with', in addition to the many visual displays.

dance at that date. A spirit of promoting closer relations between engineers and the rest of the University's students prevailed.

This spirit has been nurtured by Plumb Bob Society members who have been responsible for E-Week celebrations through the years as they enlarged to include more events and more than a day's time. The event soon reached into the community sector and the leaders invited high school and junior college students as well as the public on special tours of campus engineering facilities.

The fun increased, too. There were chariot races through campus, tugs of war with a fire hose awaiting the loser, greased pig contests, and other sporting events. The parade became a major extravaganza—with numerous floats, bands, and marchers.

The honor of becoming "St. Patrick" passed from faculty members to prestigious students, and prizes were given to outstanding scholars and teachers as well.

The evening ball became the Engineer's Brawl and a Queen Colleen was crowned. The Green Tea died of its own popularity—not enough cups were available for those who attended. It was replaced with a special convocation, featuring internationally known speakers. And late afternoons were enlivened with satirical revues, starring engineering students.

The Blarney Stone was often the center of attention. Numerous times during early celebrations the mining students, who for unknown or unpublished reasons, were not allowed in the E-Day festivities, managed to steal the stone—once to roll it into the river and later to drop it down a manhole, stopping traffic on Washington Avenue. The first time they made off with it in a wheelbarrow a general alarm was sounded throughout the engineering buildings which rapidly emptied of students racing to rescue their magical stone.

In 1918 the mining students again stole the Blarney Stone and took it to a local rock crushing company where it was transformed into a sack of pebbles. Legend has it that the stone the mining students took was a fake, and purposely had been left unguarded while the real one was carefully hidden.

However, the May 1972 issue of *Minnesota Technolog* claimed that the real stone had indeed been demolished and that the Foresters had perpetuated the myth that the real Blarney Stone had survived.

By the late 1960s and the coming of the Vietnam crisis, college students' appetites for E-Day celebrations diminished, though it was marked in quiet revelry, void of its St. Pats and Queen Colleens, Brawls, and the like. The games and contests prevailed and now are part of a week's schedule of similar events and career seminars for IT students.

minnesota TECHNOLOG

I.T. WEEK May 3-7

I.T. Week is bigger and better than ever. To make sure you don't miss out on anything, here's a schedule of the entertainment available:

Monday	3:30 pm	5-Km Forester chase footrace	Superblock Dorm
	6-11 pm	Chess Tournament Prelims	Architecture Court
	6-11 pm	Backgammon Tournament Prelims	Architecture Court
	See Blarney Board in Mechanical Engineering lobby for info on:		
		Foosball Tournament	
		*Video Games Contest	
		Ping-Pong Tournament	
		Pool Tournament	
		Softball Tournament	
		*3-man Basketball Tournament	
Tuesday	11:00 am	Paper Airplane and Toobie Contest*	Architecture Court
	1:00 pm	Egg Drop Contest	Architecture Court
	2:00 pm	*Airplane Contest (Students vs. Faculty)	Architecture Court
	3:00 pm	Car Rally	Mechanical Loading Dock
	4:00 pm	Tug-of-War registration ends	see Blarney Board
	6-11 pm	Chess Tournament Finals	Architecture Court
	6-11 pm	Backgammon Tournament Finals	Architecture Court
	See Blarney Board for info on:		
		*Roller Skating at Northrop Mall (Tuesday, Wednesday, and Thursday)	
		Video Games Contest	
Wednesday	9 am-4 pm	Solar Flat Plate Collectors Contest	Northrop Plaza
	9 am-4 pm	Technology Fair	Northrop Mall
	10 am-3 pm	*Orienteering	see Blarney Board
	12 noon	ASCE Toothpick Truss Contest	Architecture Court
	1-3 pm	*Equation Bee	Architecture Court
	6-9 pm	Technology Fair	Northrop Mall
	6 pm	*Minnesota Exposition	Architecture Court
	See Blarney Board for info on:		
		Video Games Contest	
Thursday	9 am-4 pm	Technology Fair	Northrop Mall
	9 am-4 pm	*Dunk Tank	Northrop Mall
	12:30 pm	Calculator Race	Architecture Court
	1:00 pm	*I.T. Connnection Contest	see Blarney Board
	3:30 pm	I.T. Tug-of-War	Northrop Field
	7-11 pm	Volleyball Tournament	see Blarney Board
	7 pm	*I.T. Spaghetti Dinner	Shevlin Hall
	See Blarney Board for info on:		
		Video Games Contest	
Friday	10 am-noon	Tricycle Race	Union Street
		Trike Pull	Union Street
		Trike Tug-of-War	Union Street
		Bed Race	Union Street
		Wheelbarrow Race	Union Street
		Tug-of-War Finals	Union Street
		Non-Combustion Car Race	Union Street
		Three-Legged Race	Union Street
	noon-1 pm	I.T. Day PICNIC	Northrop Mall
	1:15 pm	Calculator Toss	Architecture Court
	1:30 pm	Balloon Toss	Architecture Court
	1:45 pm	Equation Bee Finals	Architecture Court
	2:00 pm	Textbook Stacking	Architecture Court
	2:30 pm	Awards Ceremony	Northrop Mall

*denotes new event this year.

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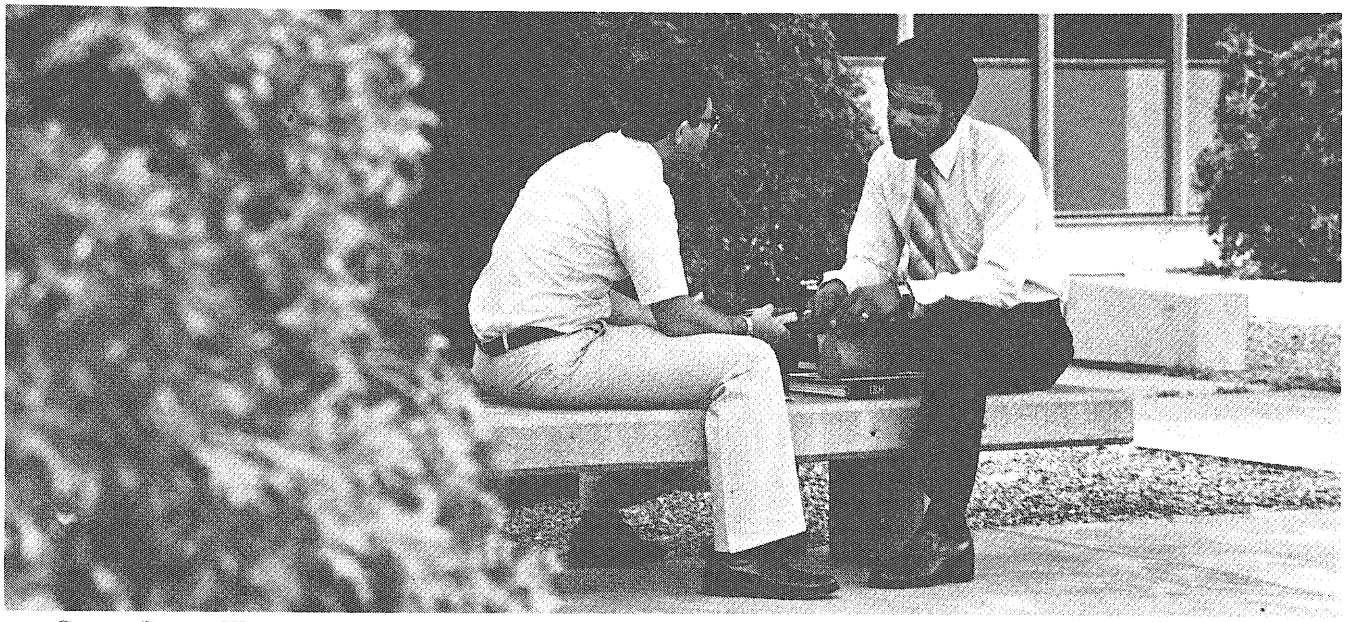

—Grant Green III. (right). BS. Mechanical Engineering. U. of Minnesota: IBM. magnetic head development. Boulder. Colorado.

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"Another thing that makes coming up with new ideas a lot easier is the equipment IBM provides. Vendors who know other companies too, look at what we have with awe. You can see why I figure the future is wide open for me, and my friends here at IBM feel the same way about their futures."

IBM will be coming to the Technology Fair (May 5-6)

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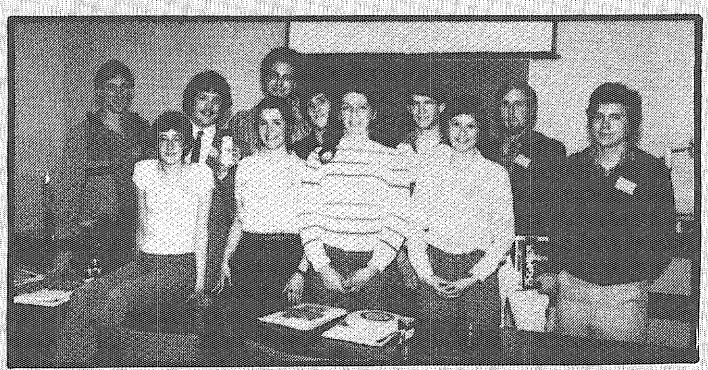
Log Ledger

The I.T. Board of Publications has selected **Terry Hansen** the editor for *Technolog* for the school year 1982-83. Hansen is a student in the Master of Arts in science writing in the journalism school. He graduated from the University in 1973 with a B.S. in biology. The St. Paul native (Alexander Ramsey High School—1969) has work experience in several technical and writing jobs. The board also selected **Meribeth Nordloef** as editor of the *I.T. Connection* and **Anne Larson** to edit the *I.T. Annual*, as well as **Steve Sigel** for the business manager position.



***Technolog* staff and board members attending ECMA in 1982 are (back row, l to r) Kent Christensen, Pete Marsnik, Steve Sigel, Roger Janczak, Bret Troyer, Terry Hansen and Scott Dacko and (front row l to r) Jane Friedman, Barb Gross, Julie Richardson, and Sonja Premack.**

Technolog won five awards at the National Engineering College Magazines Associated (ECMA) convention held at Purdue University in West Lafayette, Indiana April 1-3, 1982.

Among the awards were a second place for best recurring feature, the "Log Ledger," a third place for Kent Christensen and Barb Gross in the best non-technical article category for their story on the Cray I Computer in Fall I, a third place for the best layout (single issue) for Winter II, and honorable mention for best layout—all issues, and best single issue for Fall II.

Eleven members of the *Technolog's* staff and the Board of Publications attended the convention. As the weather was bad that week, they left the Lear jet at home and took a van for the eleven-hour trip. Attending were Editor Pete Marsnik, Business Manager Kent Christensen, Ad Manager Barb Gross, *I.T. Connection* Editor Scott Dacko, *I.T. Annual Editor* Jane Friedman, next year's Editor Terry Hansen, next year's Business Manager Steve Sigel, and Board members Roger Janczak, Sonja Premack, Bret Troyer and Julie Richardson.

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The conference will facilitate discussion between scientific users of large-scale computational and designers of new computer architecture, both from academia and industry.

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The program will include presentations from representatives of the computing industry in the immediate and future plans of their respective firms in the area of computer design and its effect on large-scale computation.

For further information please write to:

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Funding is expected from the National Science Foundation and the Center from Microelectronics and Information Sciences at the University of Minnesota.

Cray Research, Inc., announced it will install a CRAY-1S/1000 computer system at the new Digital Productions facility in Los Angeles, California in the second quarter of 1982. This system is valued at $6.5 million and will be leased by Digital Productions.

Cray Research Chairman, John A. Rollwagen said, "We are excited about this order because it will be the first CRAY system used exclusively for graphics applications."

Digital Productions will develop computer generated image simulation sevices, specializing in high resolution, high scene complexity, color raster graphics. Digital Productions' Computer Scene Simulation services will be marketed to the motion picture and television industries. Digital Productions also plans to license their software to organizations which require high quality, interactive computer visualization capabilities.

Cray Research, Inc. designs, manufactures, markets and supports large scale, high performance computers used by industry and government for engineering, research and technological processing purposes. Cray computers, introduced in 1976, have been installed and are operating productively in the United States, England, Germany, France and Japan.

How do nuclear plants reduce the cost of electricity to consumers? What fuels will utilities use in the 21st century to produce electricity? Is there a safe way to dispose of radioactive waste? What kind of reactor produced the first electricity?

If you'd like the answers to these and other questions dealing with nuclear energy and the breeder reactor, they're yours for the asking through Breeder Reactor Corporation (BRC). BRC is a non-profit corporation consisting of 753 electric systems from across the country. Together these utilities have pledged $257 million to build and operate the Clinch River Breeder Reactor Plant Project in Oak Ridge, Tennessee. The Clinch River Plant is the nation's first large-scale demonstration breeder reactor power plant. A breeder is a nuclear plant that produces more fuel than it consumes as it generates electricity.

BRC has just revised a catalog entitled *Public Information Resources* that lists free services, publications, and educational materials available to the public. The information resources include films, videotapes, slide presentations, exhibits and models, publications and educational aids.

BRC also sponsors a program called *Energy for the Future —The Breeder Reactor.* This educational project of Oak Ridge Associated Universities — a private, independent research and education consortium of 50 colleges and universities — is a live 25-to-40 minute demonstration by a nuclear information specialist who uses displays and action-oriented exhibits to explain energy issues. BRC also sponsors a Speaker's Bureau that provides specially trained speakers to discuss a broad range of energy issues for general or technical audiences. Presentations are designed for consumers groups, labor organizations, women's groups, professional societies, service clubs, and schools.

The *Public Information Resources* catalog lists all these services and others and includes an order form. For further information contact Breeder Reactor Corporation, P.O. Box U, Oak Ridge, TN 37830, (615) 576-6202.

As for the question above on electricity from a nuclear reactor, the answer is that a breeder reactor known as Experimental Breeder Reactor I produced the first electricity from a nuclear reactor. On December 20, 1951, EBR-I lit four light bulbs and nuclear power continued its advance toward commercialization.

minnesota TECHNOLOG

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plumb bob

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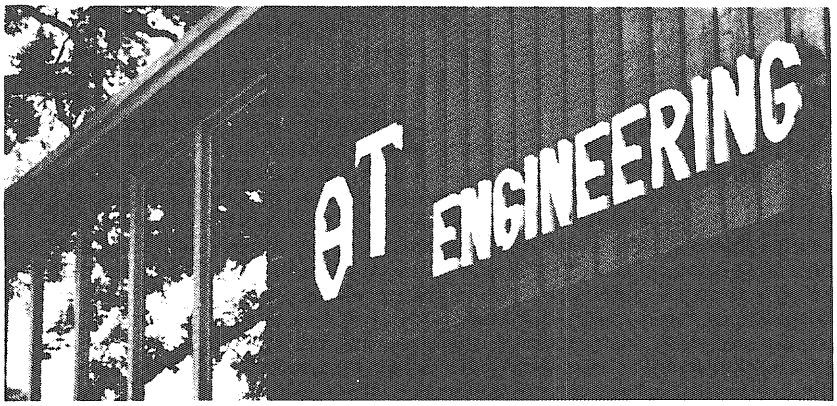

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▪▪EXTRATERRESTRIAL MATERIALS & LIMITS TO GROWTH
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- 12:15PM WEST BANK AUD.
- 7:00PM FIREPLACE RM. WEST BANK

MAY 13

▪▪SPACE SETTLEMENT & POPULATION
DR. BRUCE ROBERTS St. Olaf College
DR. HOWARD THORSHEIM St. Olaf College

- 12:15PM THEATER LECTURE HALL CMU
- 7:00PM FIREPLACE RM.

MAY 20

▪▪SATELLITE COMMUNICATIONS
BOB FRANSEN V.P. of KSTP

- 12:15PM THEATER LECTURE HALL CMU
- 7:00PM THEATER LECTURE HALL CMU

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MSP: ELECTRONICALLY CONTROLLED

Minneapolis — St. Paul International Airport is the first major U.S. air terminal to install a General Electric programmable energy management system.

The initial phase, covering lighting in the new north terminal extension ticketing and baggage handling areas, was completed during the summer of 1981. The second phase, covering lighting and 55 air handlers in the terminal, its three concourses and the balance of the airport baggage areas, is to be completed during 1982.

Based only on phase one, the Metropolitan Airports Commission expects a 1.8 year payback on its 1981 investment.

The Twin Cities airport — designated MSP by the airlines — serves the main business center of the Upper Midwest, a metropolitan area of two million people. MSP, the home base for Northwest Orient Airlines, is also one of a handful of major U.S. airports operating in the black.

The energy management project was planned and is being directed by Dunham Associates, a Minneapolis consulting engineering firm which has been responsible for a major portion of the electrical, mechanical and structural engineering at MSP for the last 15 years. Dunham's Dan Morseth estimates the energy controls will provide a cost-to-benefit ratio of 11.2 over a 20-year period.

MSP's system is built around a microprocessor-based Programmable Lighting Control supplied by General Electric's Wiring Device Department, Warwick, RI.

The GE system was recommended by Dunham during the design of the north terminal expansion as a way to "save energy, improve lighting control, provide long-term flexibility for future renovation projects, and eliminate the need for complicated, custom-design relay panels which had proven to be a maintenance headache," said Morseth.

The ease of installation of the GE system, due to its use of low-voltage "soft" wiring, also made it "almost the same price" as its non-programmable alternative, noted Morseth. The central controller and some of the transceivers used in phase one, however, also will apply to phase two, thereby providing a $30,000 equipment savings when the system is expanded throughout the rest of the terminal this year.

The system can control up to 8,000 loads — lighting, HVAC, or other equipment. It uses a single twisted pair Class 2 wire to connect the controller to local single-chip microcomputer-based transceivers which activate 24V latching relays On or Off to control loads.

The controller continually monitors an internal seven-day clock against the operating schedule in its memory and carries on an interactive conversion with the transceivers — sending out multiplexed commands to be decoded, checking relay status against its program instructions and accepting switch messages. It also can act on coded override signals received via a modem from touch-tone telephones and drive a CRT or printer to produce a complete record of automatic and manual program overrides. The program can be easily reloaded using a mini tape cassette should power failure exceed the limits of the unit's battery backup.

Airport maintenance expense also will be reduced, says Morseth, when the 55 air handlers are tied into the GE controller. These exhaust fans currently are controlled by time clocks located in the ceiling mechanical space in the concourses and must be reset twice annually when Daylight Savings Time comes and goes.

All of the benefits of the new system are not dollar benefits, either. Flexible lighting control is expected to play a significant role in helping the airport police reduce theft, vandalism and crime.

The north terminal expansion provides ticketing facilities for Republic, Eastern and American airlines. Vestibule lighting is controlled by photo cells, while the GE controller is programmed to reduce ceiling lighting in the upper level ticket area to 1/3 normal from midnight to 5 a.m., when the ticket counters are normally closed. A manual switch is provided to override the programmed setback should flights be delayed due to weather conditions. The controller hourly, between midnight and 5 a.m., checks the status of lights against the program, cancelling any manual overrides.

In the lower level passenger baggage claim and airline baggage handling areas, lighting is programmed to go to 1/3 normal in the passenger corridors and 1/4 normal in the three carousel loading areas from midnight to 6 a.m. Sensors in these areas provide override signals to bring lighting back to normal whenever they detect motion during this six-hour period. The minicomputer checks the sensors every 10 minutes and reinstitutes the lighting setback if no motion is detected.

Lighting in the north terminal expansion at Minneapolis-St. Paul airport is now controlled by a GE programmable lighting controller.

Science Fiction Contest 1st Place Winner

THE

by Alan Hauser

White. A luminous white permeated the classroom. The walls, the table, the ceiling, even the students' robes were white. Not the glowing, warm whiteness of the sun, but a cool, milky, almost sterile white which reminded the students of the fur of laboratory mice, those specimens used by the first psychoscientists at the dawn of time.

At the front of the room stood a tall, lean professor whose white hair only added to the room's atmosphere. His students listened intently to his lecture.

"One must always remember that the observer affects the observed. This is an unavoidable and, unfortunately, detrimental aspect of psychoscience. For if the specimen knows he is being studied, he will, either purposely or subconsciously, change his actions and reactions. This can be castastrophic to any experiment! Why? Listen carefully.

"Since the psychoscientist is unable to actually monitor thoughts, his only source of information about a specimen is the specimen's responses to various changes in the environment. The psychoscientist inflicts pain and records a change in heartbeat. He creates an atmosphere of anxiety, and monitors any change in the specimen's perspiration rate. In other words, the psychoscientist's sole source of data is the input-output relationship of the specimen. Also, even though he can measure all input and output variables, the ultimate accuracy of the measured input-output relationship depends upon the unbiased response of the specimen.

"The point I am trying to make is that an accurate and reliable experiment requires the normal behavior of the specimen, which can only be obtained if he does not know he is being watched. Do you understand?"

One student, whose wrinkled forehead indicated both confusion and disagreement, meekly addressed the professor.

"But sir, isn't it true that experiments can be designed so that unnatural reactions can be almost completely eliminated or else easily distinguished from spontaneous and natural responses?"

With annoyance on his face but patience on his tone, the professor responded.

"An Imperial general who knows every detail of each individual solar system in the Empire is of little use to the Emperor if he does not have a grasp of the galaxy as a whole. In the same way you will never be of much use to the Emperor as a psychoscientist if you know all the details of psychoscience but fail to master the major concepts! Yes, an experiment can be made to yield *almost* correct results, but *almost* is not good enough!

"Recall the basis of all psychoscience. Every response must be measured a large number of times so that exact probability tables can be tabulated and compared with the organic make-up of the subject's brain. If, however, one's results are *almost* correct and there remains a small deviation in the measurement of a specimen's input-output relationship due to the effect of the observer, this deviation will be multiplied as more and more measurements are taken. As a result, the final probability tables will be altered significantly, the precision which is required to make psychoscience an exact and predicting science will be lacking, and psychoscience will revert to its former condition of being more black magic and guessing than actual science."

The professor eyed the students in front of him as he paused to catch his breath. He met their expressions of confusion with a stern glare.

"Well, perhaps you will understand what I am saying after an example."

The smooth, white wall behind the professor slowly came alive with color and motion. People in brightly colored clothing were walking in different directions while others were seating themselves at a long table. The view of the screen narrowed until it was filled by a young man seated at the table. To the right of the screen a panel opened, revealing several meters and gauges. In the bottom left-hand corner of the screen a digital display was blinking slowly towards zero. 2556, 2555, 2554...

The professor's deep, clear voice filled the room once more.

"This is Specimen UOY88X5. He was taken from one of the recently conquered periphery planets at the time of his birth. As with all newly conquered species, the Emperor wished that tests be done on the inhabitants of the planet so that he may know how to best govern them and keep the general population in a state of submission, thus allowing greater consolidation of the Empire.

"The Emperor has learned from past rebellions that new conquests are impossible unless the existing Empire is under his complete and absolute control. He also has had the foresight to realize that complete submission and obedience can not be obtained by the use of physical force alone, but by the psychological conditioning of all subjects.

"This is why my work and the work of my fellow professors in the Department of Society Control is so important. Each new race conquered by the Emperor responds differently to various forms of authority. The inhabitants of Ceta-Y are meek by nature and thus are easily conditioned to respect and obey the all-powerful and authoritative image of the Emperor. The genes of the inhabitants of Attrena-2, on the other hand, pass a rebellious nature from one generation to the next. An Attrenite cannot be held in a state of submission for a long period of time by fear of and respect for authority, or by coercion, as the Emperor learned long ago."

A twinkle appeared in the professor's eye and a smile broke the stern expression on his face as he continued. Each student had heard this lecture many times before. It was obvious that the professor was quite proud of some of the advances he had helped make in this branch of psychoscience.

"Ahh, but note a subtlety here. Physical force has little effect, but psychological force is invaluable. The Attrenites have always been a close-knit race and their culture is based on loyalty. Therefore, we simply condition them to believe than an Attrenite is sitting on the throne, a fellow citizen ruling the Empire with wisdom and a spirit of goodwill. They are conditioned in this way from birth, and any contradictory idea appears to them as being quite absurd.

"The result? The last Attrenite rebellion was quelled long before any of you were born."

The professor walked to the side of the room and turned towards the screen. All attention was immediately focused on UOY88X5 as he sat in the middle of the room with his eyes fixed on an object in front of him. The digital display blinked on slowly. 2116, 2115, 2114....

"As I stated earlier, we wish to learn more about the inhabitants of UOY88X5's home planet by conducting tests on him. I want you to notice the extreme care that has been taken to insure that U-5, as we call him, does not realize that he is merely a subject in our tests, a specimen. I assure you all, if you do not learn the importance of this you will never work for the Department of Society Control. Your entire education will be for nothing and you will find yourselves wearing frontier guard uniforms within a year!"

A few of the students shifted uneasily at the thought of being stationed at a lonely outpost in the periphery.

"Since his birth, U-5 has been in a make-believe environment of our construction. Every building, every street, every tree is there because we put it there. All his friends, his parents, brothers and sisters, even his milkman and every person he passes on the sidewalk are are psychoscience professors or students. Soon you

SPECIMEN

will have an opportunity to take part in such a project.

"Everything in U-5's world has been put there by us and is controlled by us. We control when it rains, when U-5 is ill, even when the lead in his pencil breaks. And we can also monitor all his responses. We can record every word he says, every expression he makes, even how often he clips his fingernails.

"The gauges which you see to the right of the screen record U-5's heartbeat, pulse, respiration rate, and other body parameters. They are called the output monitors. The digital display in the bottom left-hand corner of the screen is the input monitor.

"In a typical experiment we will present a situation or a piece of information to U-5 through his 'friends,' or other parts of his environment, and watch his reactions. The input monitor measures the amount of information U-5 receives, and the output monitors measure his exact response. You can see, then, that even though we cannot measure or record what he is actually thinking, we can almost always predict it by accurately recording his every response to the slightest stimulus."

"Day after day, U-5 goes on living his life on a stage. We have made the set and formed the plot and cast him in the leading role. He goes through his life acting out each scene the way that is natural for him while we, the audience, record and record and record. If we are very attentive and work hard, by the end of the play we will know U-5 better than he knows himself."

The professor paused and eyed the screen. Although U-5 was seated in such a way that only his back could be seen by occupants of the classroom, the professor felt as if he could see every aspect of his white mouse. U-5 has been his special project since the captive's arrival at the Department for Society Control. He had watched U-5 grow and develop through the years. He had designed more testing situations for U-5 than most other professors had designed for all their specimens combined. That white mouse represented twenty years of the professor's life.

"Yes...," he whispered to himself. "I know you better than you know yourself. I know everything about you. Every goal, every motive, every value... I know every inch of every room behind every door in your mind...except for one small dark corner, and that will be dealt with soon."

The professor glanced at the input monitor for a second. It continued to bound down towards its final destination. 1504, 1503, 1502... His attention soon shifted from the display to a student whose hand was in the air.

"Yes," he said.

"What are the purposes of these experiments?" the student asked.

"The main objective, as I said before, is to find the form of authority which is most respected and obeyed by U-5 and therefore, will be most respected and obeyed by the inhabitants of his home planet. We have inserted different power figures into U-5's life and are monitoring his reactions to each of these. We have led him to believe in the existence of a mysterious, omnipotent, yet somewhat distant being. This image of the Emperor has worked well on the Celca and Orious systems and seems to be the power figure most respected, although not always obeyed, by U-5.

"We have also inserted power figures in his life who, he believes, are members of and who have been elected by his race to lead and govern. This is the image Emporor which has worked so well on Ceta-7 and many other planets scattered around the galaxy. These power figures are respected and obeyed by U-5 as long as they do not demand things which U-5 finds contrary to his own inner sense of morality. This image, therefore, is probably quite useless to us. Order in U-5's home planet would collapse as soon as the Emperor tried to enact the Imperial forced-labor laws.

"Finally, we have inserted the parent-image into U-5's life. Utilizing this image would require that the Emperor be portrayed as a wise, loving and caring individual who, although imperfect and mortal, usually knows best. This image was very successful in the early years of U-5's life, but we have recently encountered problems with it.

"We have also worked with other power images—the intellectual genius and the physically dominated member of society are two—and have encountered only limited success. The Emperor also plans to transfer a large number of people from some of the overcrowded inner planets to U-5's home planet. As a result we are examining U-5's acceptance of different races. We have exposed him to races with different languages, skin colors and facial features. His behavior has been somewhat promising.

"I cannot overemphasize the importance of this work. We are the weapons of the Emperor in his crusade to eliminate the plague of instability for the entire galaxy once and for all. In past years, rebellions against the Emperor continually surfaced like malignant sores on the galactic body. If one sore was healed, two more took its place.

"But now we have realized that the rebellion, the cancerous sore, is only a symptom of the real disease: all this nonsense about liberty and individual rights. We have finally learned that in order to rule a man's body, one must first rule his mind. And so, with the help of psychoscience, we are now able to remove these ridiculous ideas from a population, to condition each newly conquered race into submission before they have a chance to rebel.

"We are like antibodies injected throughout the galaxy before an infection has taken hold. Soon, after the completion of many experiments like this one, and after the mass conditioning of the remaining periphery planets, the entire galactic body will be immune to rebellion. At last the Emperor will have universal and absolute control!"

All eyes were again focused on the screen. U-5, oblivious to all the attention he was receiving, remained seated with his back to his audience, gazing at something on the table in front of him. The input monitor in the bottom left-hand corner of the screen blinked onward. The numbers flowed sporadically toward zero. 882, 881, 880.... A puzzled student unable to restrain his curiosity any longer burst into a question.

"But surely you cannot monitor and live with and be a 'friend' to a subject for a period of several years without making a mistake! Surely there must have been some times when the psychoscientists and students living in U-5's world said the wrong thing, or when U-5 noticed something contradictory in his little world, something that doesn't make sense, something that would suggest that things aren't what they seem to be!"

The professor smiled at his brightest student, but the smile soon

Alan Hauser is a junior in mechanical engineering from Sleepy Eye, Minnesota. This is his first piece of journalism, although he has always enjoyed science fiction.

gave way to a look of concern. When the professor spoke, it was as if his mind was far away and going through a problem it had been through many times before. His voice was softer and somewhat distant.

"Yes... yes, there is always a problem in these types of experiments. We have invented such concepts as superstition and ghosts and inserted them into U-5's notion of reality. Mostly, though, we rely on his ability to disbelieve his senses when they perceive something which contradicts what he expects to perceive. This has worked quite well in past experiments."

Instead of satisfying the student, this reply merely puzzled him more.

"But sir, your entire lecture today has dealt with the detrimental effect of the observer on the observed. You have warned us that this effect will change the behavior of a subject and make the results of any experiment useless. And yet, haven't you ignored this very lesson in your own experiment?

"True, you have been very careful and have hidden your tracks well, but you really aren't sure if U-5 knows or doesn't know if he is being observed! He could be aware of us watching him at this very minute! If he does suspect that he is merely a subject in an experiment, he certainly won't tell his friends because he realizes that they are probably all part of the conspiracy. In fact, he won't tell anyone! He won't alter his behavior in the slightest because he suspects that he is being watched. He will go on acting like he always has. You will notice no change in his behavior, and since you cannot read his mind, you will have no way of knowing whether the results of your experiments are accurate or biased. Already the certainty required for psychoscience has been lost and you have no way of regaining it!"

The professor broke into a laugh and looked approvingly at the student. "Ohhh, you are always thinking, Thor. I do believe that if I missed a day of work you would have my seat on the Grand Council. Your thoughts are, as usual, insightful and penetrating, but somewhat rash.

"True, all our work is useless unless we can ascertain the extent of U-5's suspicions. You were wrong in stating that this was impossible. U-5 will not purposely alter his behavior, but there are certain responses which he has no control over."

He glanced quickly at the input monitor, which was now at 354. A touch of anxiety was on his face.

"Consider the following ingenious experiment: We expose U-5 to a magazine story which he supposes to be a work of fiction. In actuality the story tells of what is happening to U-5. It describes how he is merely a subject in a grand experiment and that he is constantly being observed and studied. Now, if U-5 has never suspected this, he will regard the story as a good piece of fiction and not give it a second thought.

"If, however, he has suspected this situation in the past, this story will confirm his suspicions, for he will realize that the exact resemblance of the character in the story to himself is not coincidental and that we have purposely given this story to him. He will realize that his entire life has been an experiment and that he is constantly being studied and watched. Such a revelation would be quite traumatic, and will certainly cause a change in some of his body parameters. We will watch the entire episode carefully.

"The input monitor will tell us the exact number of words in the story which he has yet to read, and the output monitor will allow us to immediately notice any changes in the rate of his heartbeat and respiration. This experiment will tell us whether U-5 has suspected his true situation all along or if he has no idea that he is actually a subject in an experiment."

Thor smiled at this brilliant solution to his "unsolvable " problem.

"When will this experiment take place?" he asked eagerly.

The professor turned towards the screen and replied, "It's taking place right now."

The heads of the students snapped up in unison. The classroom was perfectly silent. All eyes focused on U-5 as he continued to read the magazine article in front of him. The input monitor, which displayed the number of words U-5 had not yet read, blinked down to 26, 25, 24.

The professor said softly, "As a matter of fact, he is just finishing the story this very second."

The input monitor stopped at 0.

minnesota TECHNOLOG

A touch of class.

Our Personnel Recruiters will be on campus May 5th and 6th. Check with your placement office to verify dates and sign up on our schedule.

Jan Olson and Mitzi Crawford handle engineering tests and test engineering with ease and confidence.

As student interns at Sperry Univac's Defense Systems Division (DSD) in suburban St. Paul, these women combine classroom theory with hands-on professional operations.

"I'm learning twice as much – twice as fast", said Jan. *"The experience has been invaluable so far, and the program was instrumental in my reaching a decision to accept DSD's offer for a permanent position upon graduation."*

"At that point, I'll be developing LSI test programs and utilizing a Macrodata test system to verify new components' reliability. The IC testing I'm conducting right now is great training for the challenges to come."

Like Jan, Mitzi is enthusiastic about the experience she's gaining at DSD. In fact, she highly recommends the company to her associates in the Society of Women Engineers.

"I'm thoroughly impressed with the organization's technical competence", stated Mitzi. *"And my internship is allowing me the chance to share and benefit from this knowledge firsthand."*

"I'm currently working on some complex failure analysis programs that have proved to be fascinating. It involves using state-of-the-art scanning electron equipment, and typifies the company's emphasis on reliability by creating a high technology environment."

Jan and Mitzi represent two of nearly 20 students who are simultaneously furthering their careers and college degrees through DSD's intern program.

If you'd like more information on combining your classwork with the working environment of a top class organization, contact *Jan Gacke, Employment Office, Sperry Univac Defense Systems Division, U1E20, (MNT), P.O. Box 3525, St. Paul, MN 55165.*

Send a resume or call ***TOLL FREE (800) 328-0117*** or *TTY handicapped: 612-456-3257.* In the Twin Cities, phone 456-2808. An Affirmative Action Employer M/F/H.

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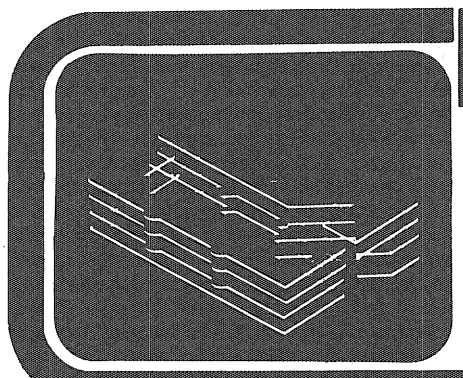


Brain Teasers and Belly laughs

"Professor," said the engineer in search of knowledge, "Will you try to explain to me the theory of limits?"
"Well, John," said the professor, "assume that you have called on your girlfriend. You are seated at one end of the divan and she is seated at the other. You move halfway toward her. Then you move half the remaining distance toward her. Again, you move half the remaining distance toward her. Continue to do this for some time. Theoretically, you will never reach her. On the other hand, you will soon be close enough for practical purposes."

● ● ● ● ● ● ● ● ●

Editor: Your articles should be written so that even the most ignorant may understand them.
Staff Member: Well, just what part seems to be giving you the trouble.

● ● ● ● ● ● ● ● ●

1st Drunk: I gotta go to the little boy's room.
2nd Drunk: Say! Howsh 'bout goin' fer me, too?
1st Drunk: Sure, you're m'besht pal; shure, I'll go fer ya.
When he came back, his inebriated friend asked, "Di'ja go fer me?"
1st Drunk: I forgot, n' you're m'besht pal.
With that, he wheeled around and made his way back to the washroom. Coming back, he planted himself in front of his chum, wagging his finger at him and said, "Shay, whash the big idea of foolin' me? You di'nt have to go!"

● ● ● ● ● ● ● ● ●

Two hunters in Africa were captured by cannibals and put in a huge cooking pot. One man laughed hysterically.
Annoyed, the other asked, "What's so funny?"
The first replied, "If only they knew what I'm doing in their soup."

● ● ● ● ● ● ● ● ●

"Halt, who goes there?"
"American."
"Advance and recite the second verse of the 'Star Spangled Banner!' "
"I don't know it."
"Proceed, American."

● ● ● ● ● ● ● ● ●

The reason for the Mona Lisa's sly smile has never been resolved, but the latest conjecture is that she just discovered that she's not pregnant.

● ● ● ● ● ● ● ● ●

Doctor: How's the engineering patient this morning?
Nurse: I think he's back to normal. He tried blowing the foam off his medicine this morning.

● ● ● ● ● ● ● ● ●

"O.K., Moses, take out your tablet and number from one to ten. We're going to have a little quiz."

Jim Homan is the winner of the Brain Teasers set in Spring I. Here are the answers Jim arrived at:

1. Make one measurement, taking one sphere from the first sack, two from the second, three from the third, and so on up to ten from the tenth. However much the weight differs from 55 grams will determine which sack has the light spheres.

2. The possible ages are:

1	1	36
1	2	18
1	3	12
1	4	9
1	6	6
2	2	9
2	3	6
3	3	4

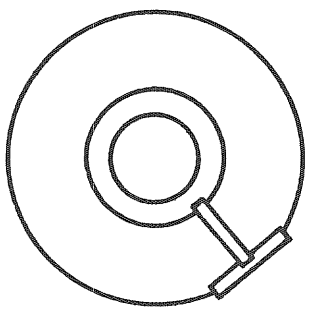
This is too many possibilities for the census taker to make a decision. The second clue gave numbers of 38, 21, 16, 14, 13, 13, 11, and 10. The census taker knew the house number across the street, so it must have been thirteen, or else he would not have needed the third clue. The two possibilities are:

1	6	6
2	2	9

Since the final clue revealed the man has an oldest daughter with blue eyes, the census taker knew the ages were 2, 2, 9.

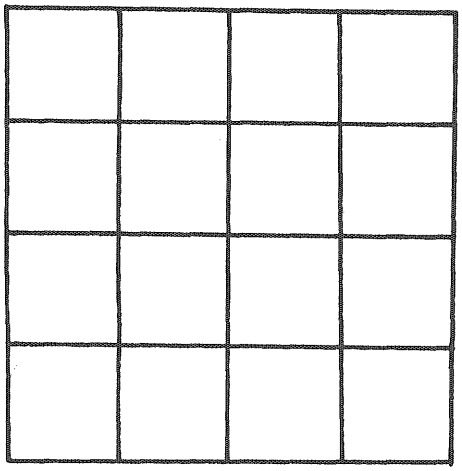
3. 0 = 4 + 4 - 4 -4
   1 = (4 + 4)/(4 + 4)
   2 = 4/4 + 4/4
   3 = (4 + 4 + 4)/4
   4 = 4 + (4-4)/4
   5 = (4 + 4x4)/4
   6 = (4 + 4)/4 + 4
   7 = 4 + 4-(4/4)
   8 = ((4 + 4)/4)x4
   9 = 4 + 4 + (4/4)
   10 = (44-4)/4

4



Here is the final set of Brain Teasers for this year. As always, you can win a T-shirt if you are the first with the correct answers. The solutions will be posted outside ME 2 as soon as there is a winner.

1. How many squares can you find?



*2. Given the following data, and the knowledge that Dwight has been killed, determine the murderer. You have three suspects, named Al, Bill and Charlie. Two of them are lawyers. They each make two statements, for a total of six statements. Only two statements are true. A lawyer killed Dwight.

Al: I am not a lawyer.
I did not kill Dwight.

Bill: I am a lawyer.
I did not kill Dwight.

Charlie: I am not a lawyer.
A lawyer killed Dwight.

*3. Who owns a zebra? The facts essential to solving the problem, which can be solved by combining deductions, analysis, and sheer persistence, are as follows:

a. There are five houses, each a different color and inhabited by men of different nationalities, with different pets, drinks, and cars.
b. The Englishman lives in the red house.
c. The Spaniard has a dog.
d. Cocoa is drunk in the green house.
e. The Ukranian drinks eggnog.
f. The green house is immediately to the right (your right) of the ivory house.
g. The Oldsmobile owner owns snails.
h. The owner of the Ford lives in the yellow house.
i. Milk is drunk in the middle house.
j. The Norwegian lives in the first house on the left.
k. The man who owns a Chevrolet lives in the house next to the house where the man owns a fox.
l. The Ford owner's house is next to the house where the horse is kept.
m. The Mercedes-Benz owner drinks orange juice.
n. The Japanese man drives a Volkswagen.
o. The Norwegian lives next to the blue house.

Now, who drinks water? And who owns the zebra?

4. An old man died and left 17 horses to be divided among his three sons, with the oldest getting one-half of the, the second one-third, and the third one-ninth of them. Since the sons couldn't decide how to split the horses, and didn't want to slaughter any, they called in a wise old mathematician who lived in town. The mathematician came over, with his own old horse. "Let me add my horse to the 17 your father left," he said, "and then proceed with the will." The sons, thinking they had one more horse, agreed. With 18 horses, the wise mathematician gave the oldest nine, the second six and the third two. This done, his old horse was left over, which he took and left. Explain how and why this turn of events came about.

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*W.I. Fletcher, "Digital Design"

INDEX

To *Minnesota Technolog*, Vol. 62 (1981-82)

ANNUAL FINANCIAL REPORT

by Kent S. Christensen

The *MINNESOTA TECHNOLOG* is operated by I.T. undergraduates and is published every so often by IT students who can't think of any other reason for a party. *TECHNOLOG* is a non-profit organization (unintentional) and exists for the sole purpose of Federal Enforcement Agencies, Beer Companies, and Campus Protesters amusement.

INCOME

Income from staff members winning Brain Teasers	$ 6.00
Paid on Blackmail Operations:	
From Faculty	104,721.05
From Students	72.00
Sale of Stolen Books	24.00
Advertising Revenue	12,644.00
Sale of Technolog to incoming Freshman	654.92
Sale of Beer and Cigarettes to Orientation Groups	11,321.77
Paid Subscriptions	14,690.00
Sale of Physics Building to CLA	12.18
Rental of Technolog Towers Office Space (Formerly Known as IDS)	124,312.00
Rental of Dean's Car During School Hours	710.00
Business Manager's Hobby (Printing $20 Bills)	420,000.00
Rental of Technolog Office as Contract Lot	15,427.35
Gift From 'Log Board for Getting April Issue Out in April	25.06
Bets on Louisville/Gophers NCAA Basketball Game	21,624.13
Found On Architecture Court	5.00
Sale of "Chew Purdue", "Hate State" and 1945 E-Week buttons	611.93
Offerings Collected by Ad Manager Posing As Deacon of Church	611.93
Membership Revenue, Technolog Yacht & Racquet Club (On 5th Floor of Lind Hall)	720.00
Deposit on Editor's Beer Bottles	4,231.27
Sale of Student Phone Directories To Foresters	183.71
Donations	.04
	$ 732,607.44

EXPENSES

Lear Jet Payments	$ 332,958.94
Printing/Typesetting	17,215.00
Tickets From Purdue	
Speeding	250.00
D.W.I.	150.00
Possession/Controlled Substances	550.00
Other National Convention Expenses	550.00
Staff Salaries	312,500.00
Supplies	
Office	1.12
School	385.75
Bail, Editor After Production (6 @ 100.00)	600.00
Bail, Business Manager After Audit	10,000.00
Payments of Staff Parking Tickets For Illegal Parking In Front Of M.E. Building	600.00
Engraving of Dean's Signature	9.50
Paid to Improper Fraction For Damage Caused At October Staff Meeting	1,721.94
Advertising Commissions	1,178.84
Telephone	
Business	2.85
Personal	947.93
Mark Hall	2,847.92
Vagrancy Charges Against Humor Editor	100.00
Bribes	
Dean's Office	5,950.00
Publication Freeze Comm.	10,000.00
Auditor	10,000.9 5
Staff Beer Expense	1,345.60
Unaccounted For	22,741.10
	$732,607.44

Kent Christensen, after two years of Business Manager has stepped aside, (with the help of the IRS), and will take on an advisory position from his new residence, San Quentin. He is also a disowned member of Delta Kappa Epsilon Fraternity and was to be a senior in Computer Science.

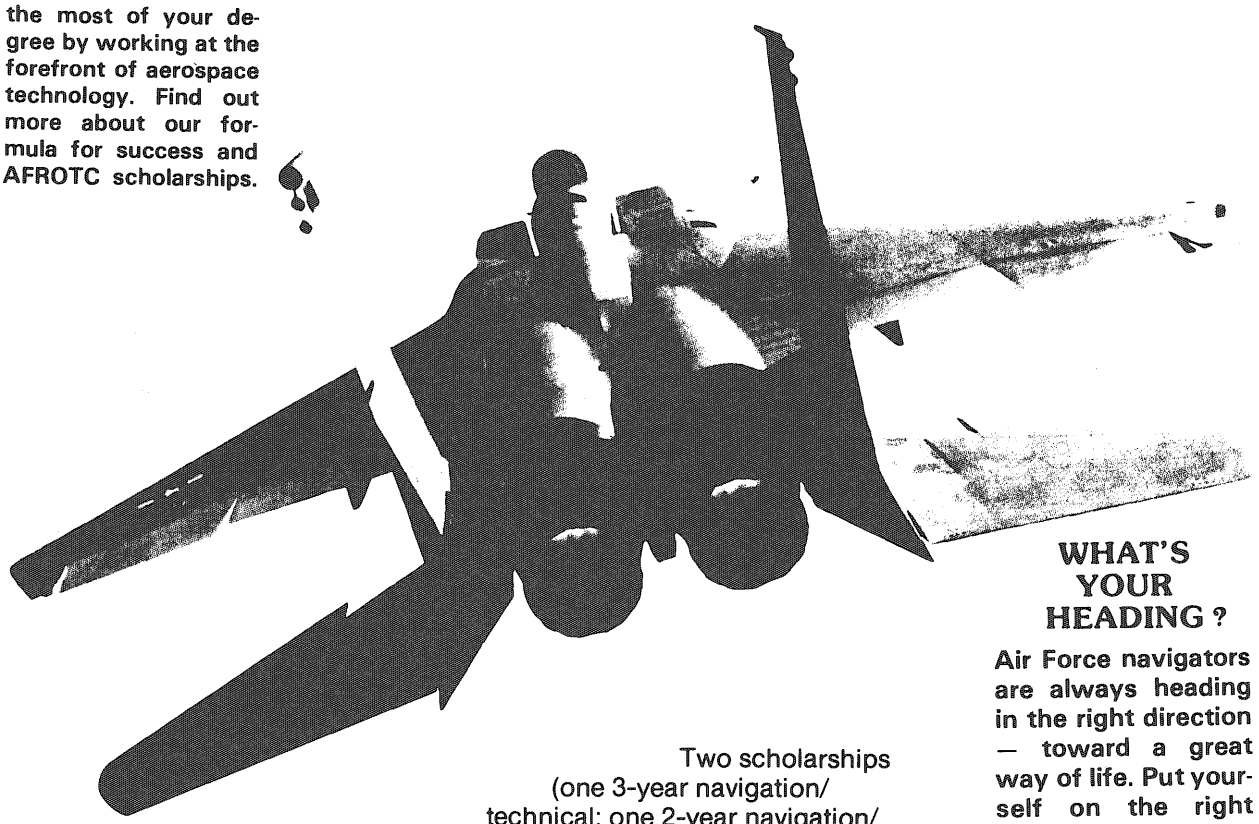
A FORMULA FOR YOUR FUTURE

Science and engineering students, the Air Force has a special future for you. Air Force ROTC plus a college degree can add up to an Air Force commission. You'll make the most of your degree by working at the forefront of aerospace technology. Find out more about our formula for success and AFROTC scholarships.

Two scholarships (one 3-year engineer; one 2-year engineer) are available now for qualifed students. Estimated starting salary after graduation is $16,400 and after 5 years would be $36,700.

Each scholarship provides:

- Full tuition
- Textbook reimbursement
- $100 a month allowance (tax-free) during the school year



Two scholarships (one 3-year navigation/ technical; one 2-year navigation/ technical) are available now for qualified students. Applicants must be in a technical academic specialty. Estimated salary after graduation is $17,900 and after 5 years would be $39,200.

WHAT'S YOUR HEADING?

Air Force navigators are always heading in the right direction — toward a great way of life. Put yourself on the right heading by enrolling in Air Force ROTC. You'll be eligible for a scholarship and get flying training while you're in college. It's the first step in earning your wings.

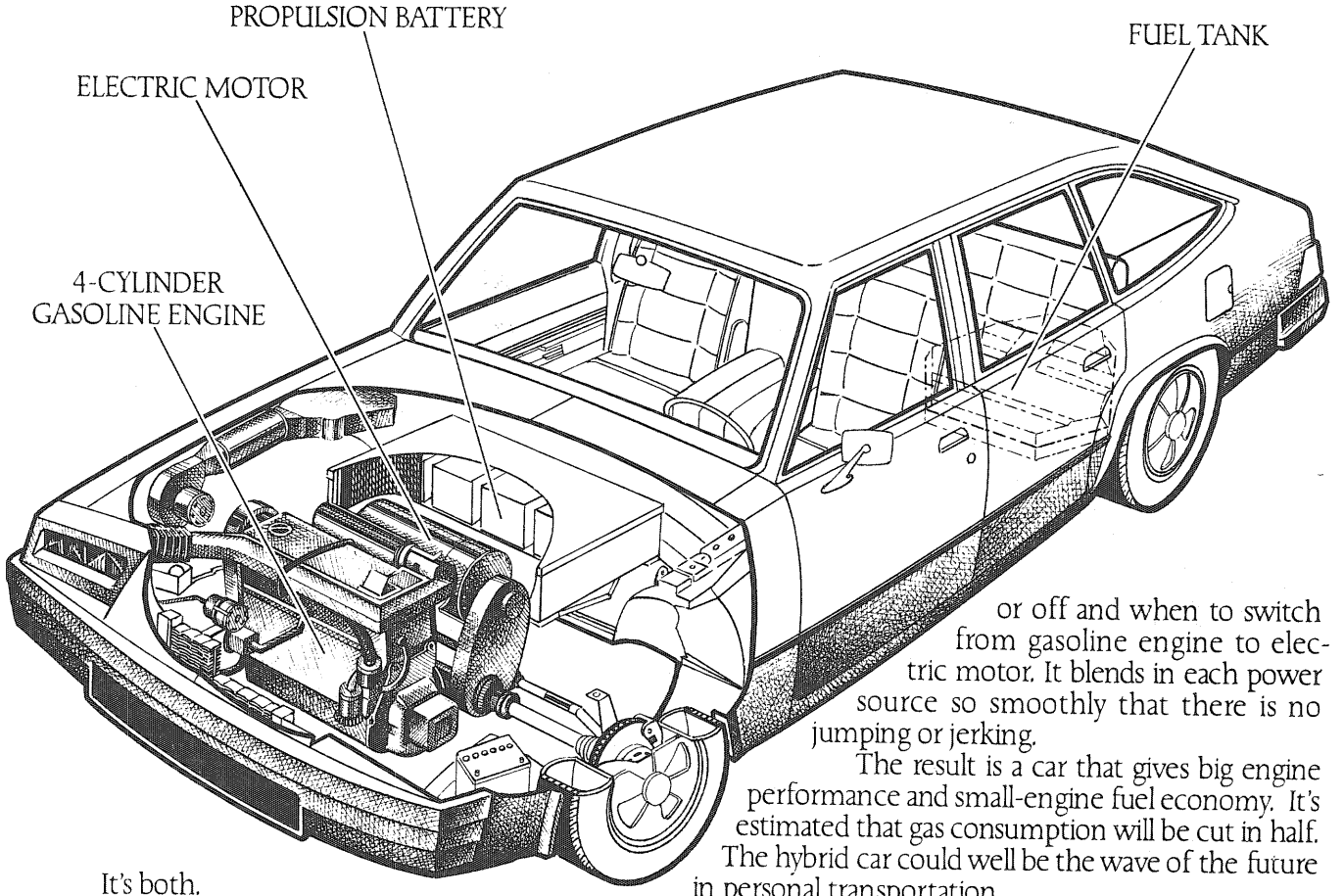
If you are interested in these opportunities please call (612) 373-2205 or write to:

Department of Aerospace Studies
Room 3 Armory
15 Church Street S.E.
University of Minnesota
Minneapolis, Minnesota 55455

AIR FORCE ROTC

Gateway to a great way of life.

Is it an electric car that runs on gasoline, or a gasoline car that runs on electricity?



It's both.

It's a hybrid car being developed by General Electric for the Department of Energy. It's powered by both a gasoline engine and an electric motor.

This car runs part of the time on gasoline, part of the time on batteries, and combines both power sources when needed.

The electric motor will be used primarily for speeds from zero to 30 mph, and the gasoline engine for most highway driving. When you need extra power for passing, the electric motor automatically kicks in to boost the power.

The key to the operation of this vehicle is a GE-designed microcomputer. This computer, about the size of a cigar box, continually receives signals from more than three dozen sensors, measuring all the functions of the vehicle.

The microcomputer takes this information and determines the amount of power needed to meet the driver's command when he presses on the accelerator or brake pedal. It then decides when to turn power on or off and when to switch from gasoline engine to electric motor. It blends in each power source so smoothly that there is no jumping or jerking.

The result is a car that gives big engine performance and small-engine fuel economy. It's estimated that gas consumption will be cut in half. The hybrid car could well be the wave of the future in personal transportation.

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

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

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